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Las Ciencias Sociales y las Humanidades en los estudios sobre el cambio climático: un análisis de las conferencias presentadas en *American Geophysical Union* (2010-2018)

The Social Sciences and Humanities in studies on climate change: an analysis of the conferences presented at the American Geophysical Union (2010-2018)

Resumen

Desde diferentes áreas del conocimiento se han abordado las causas, efectos, y posibles soluciones al cambio climático. Sin embargo, históricamente los estudios han sido realizados por disciplinas relacionadas con las STEM (ciencia, tecnología, ingeniería y matemáticas). Solo en los últimos años se ha presentado una visión más integral en donde se incluyen interdisciplinariamente las ciencias sociales (CS) y las humanidades (HH). Dicha interacción ha supuesto retos y dificultades, pero también ha abierto la posibilidad de nuevas investigaciones. Los resultados de estas interacciones se encuentran documentados en artículos de revistas científicas, congresos, e informes. El presente artículo busca comprender la relación colaborativa entre las STEM, las CS y las HH a través de una lectura crítica de una serie de resúmenes presentados entre 2010 y 2018 en el American Geophysical Union Fall Meeting (AGU-FM). Como primer paso, se extrajeron 13447 resúmenes que incluyen las expresiones “climate change” y “climate crisis”, de los cuales, posteriormente, se extrajeron 99 resúmenes en donde se encontraban las palabras “social science” y “humanities”. En un segundo paso, se analiza la formación académica de 230 autores de dichos resúmenes. A través de la lectura se pudo constatar que se da una incipiente integración colaborativa de elementos teóricos y metodológicos propios de las CS y las HH con las STEM para tratar el problema del cambio climático. También, que la participación de los profesionales de estas áreas continúa siendo muy baja en relación con los profesionales de STEM, que en muy pocos casos tienen una educación formal en CS y HH. Estas dos características imponen limitaciones importantes en el objetivo común de tener una integración adecuada entre los saberes que permitan abordar el cambio climático como un fenómeno complejo físico y social.

Palabras clave:

Cambio climático; American Geophysical Union AGU; Ciencias Sociales; Humanidades; mitigación; adaptación; educación.

Abstract

The causes, effects, and possible solutions to climate change have been addressed from different areas of knowledge. However, historically studies have been carried out by disciplines related to STEM (science, technology, engineering, and mathematics). Only in recent years has a more comprehensive vision been presented where the social sciences (CS) and the humanities (HH) are interdisciplinary. This interaction has posed challenges and difficulties but has also opened the possibility of new research. The results of these interactions are documented in articles in scientific journals, conferences, and reports. This article seeks to understand the collaborative relationship between STEM, CS, and HH through a critical reading of a series of summaries presented between 2010 and 2018 at the American Geophysical Union Fall Meeting (AGU-FM). As a first step, 13,447 abstracts were extracted that include the expressions “climate change” and “climate crisis,” of which, later, 99 abstracts were extracted where the words “social science” and “humanities” were found. In a second step, the academic training of 230 authors of these summaries is analyzed. Through the reading, it was found that there is an incipient collaborative integration of theoretical and methodological elements typical of CS and HH with STEM to address the climate change problems. Also, the participation of professionals in these areas continues to be very low regarding STEM professionals, who, in very few cases, have a formal education in Social Sciences and Humanities. These two characteristics impose important limitations on the common objective of having an adequate integration between knowledge that allows addressing climate change as a complex physical and social phenomenon.

Keywords:

Climate change; American Geophysical Union AGU; social sciences; humanities; environmental, mitigation; adaptation; education.

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1. Introducción

1.1. El cambio climático

Según el Grupo Intergubernamental de Expertos sobre el Cambio Climático (IPCC)¹, el cambio climático o crisis climática es: “Un cambio de clima atribuido directa o indirectamente a la actividad humana que altera la composición de la atmósfera mundial y que se suma a la variabilidad natural del clima observada durante períodos de tiempo comparables”² (*Glosary IPCC*, 2018). El fenómeno se debe principalmente al incremento de los niveles de CO₂ en la atmósfera. Según la cronología descrita por Scheinder (2009:10-12), antes de ser identificado, en 1824, Joseph Fourier sugirió que el CO₂ podría afectar el clima. Luego, en 1896, Svante Arrhenius publicó un trabajo explicando cómo el CO₂ y el vapor de agua atrapan el calor del sol en la tierra. En 1938, Arrhenius sugiere que este calentamiento puede ser beneficioso al incrementar las cosechas y hacer más agradables las zonas más frías del planeta. Esta idea de Arrhenius es replicada por la Unión Soviética que, en 1960, promociona potenciales beneficios asociados a un eventual derretimiento de los polos.

Sin embargo, en el mismo periodo científicos ya advertían sobre los peligros asociados al incremento del CO₂. En 1937 Glenn Trewartha comienza a emplear el término de “efecto invernadero” que hace referencia al “fenómeno por el cual determinados gases, que son componentes de la atmósfera planetaria, retienen parte de la energía que el suelo emite por haber sido calentado por la radiación solar” (ciifen, 2018). Y en 1957, Revelle y Hans publican

¹ El IPCC es un organismo multilateral adscrito a la ONU y a la Organización Meteorológica Mundial (WMO), que actúa como componente técnico para la Convención Marco de las Naciones Unidas sobre el Cambio Climático (CMNUCC). A pesar de que se sugiere el uso de la expresión “crisis climática” (Fundación BBVA, 2019), el IPCC no hace referencia en sus comunicados oficiales al “climate crisis”. En este artículo se usará la expresión “cambio climático” por su equivalencia a la expresión inglesa.

² “A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (*Glosary IPCC*, 2018).

un artículo en donde mencionan que, debido a sus emisiones de CO₂, la humanidad está haciendo un “experimento a escala geofísica” sin tener control de este. Por otra parte, el *President’s Science Advisory Committee Environmental Pollution Panel* de la presidencia de Estados Unidos (1965), advertía que para el año 2000 la concentración de CO₂ en la atmosfera se incrementaría un 25%. Dentro del mismo reporte se advertían de potenciales cambios en el clima que difícilmente podrían ser controlados³.

Sin embargo, el tema tardó hasta los años 70 para ganar relevancia, popularizándose en la agenda pública debido al libro *Los Límites del Crecimiento* escrito por el Club de Roma (Meadows, Randers, Meadows, Pawlowsky, 2006), una sociedad interdisciplinar de científicos de diversos países que se plantearon la pregunta sobre la sostenibilidad de la humanidad. El tema tuvo aún más eco en la década de los 80, gracias al artículo de Hansen, Johnson, Lacy, Lebedeff, Lee, Rind y Russell (1981) que describía, a partir de modelación climatológica, las tendencias de aumento de las temperaturas y planteaba posibles consecuencias. Treinta años después, Hansen (2012) mencionaba durante una conferencia lo siguiente:

Trabajé con otros científicos para analizar las observaciones del cambio climático. En 1981, publicamos un artículo en la revista *Science* que concluía que el calentamiento observado en el siglo anterior de 0,4 grados Celsius era consistente con el efecto invernadero del incremento de CO₂. Que posiblemente la Tierra se calentaría en los años 1980 y que ese calentamiento excedería el nivel de ruido aleatorio del clima para finales del siglo. También dijimos que el siglo XXI vería desplazamientos de zonas climáticas, regiones propensas a la sequía en América del Norte y Asia, erosión de las capas de hielo, aumento del nivel del mar y la apertura del legendario Paso del Noroeste. Todos estos impactos ya han ocurrido o están en marcha(2010, Minuto 2:21) ⁴.

³ Según las mediciones de la NOAA (2020), para el año 2000 el aumento del CO₂ en la atmosfera fue de un 13%, para finales del 2019 fue del 24%, experimentando un crecimiento exponencial cercano a lo que predijo el informe de 1965 realizado durante la administración del presidente Lyndon Johnson.

⁴ “I worked with other scientists to analyze Earth climate observations. In 1981, we published an article in *Science* magazine concluding that observed warming of 0.4 degrees Celsius in the prior century was consistent with the greenhouse effect of increasing CO₂. That Earth would likely warm in the 1980's, and warming would exceed the noise level of random weather by the end of the century. We also said that the 21st century would see shifting climate zones, creation of drought-prone regions in North America and Asia, erosion of ice sheets,

Según lo anterior, el cambio climático modifica de manera acelerada las dinámicas que conocemos como naturales, condicionando prácticas económicas, rituales, soberanía alimentaria y generando situaciones de riesgos de desastres que exigen un abordaje interdisciplinar. Según Adger et al, (2008 y 2012), el cambio climático se convierte, además de una dinámica geofísica, en un fenómeno socioambiental complejo mediado por valores culturales, la percepción del entorno y las dinámicas económicas, a su alrededor se entretajan las relaciones del territorio local y las afectaciones que pueden generar las prácticas de comunidades humanas a nivel local y global.

No obstante, este fenómeno ha sido objeto de fuertes polémicas, con desacuerdos en torno a los responsables del fenómeno. Según Cook, Van Der Linden, Maibach, & Lewandowsky (2018) el cambio climático ha sido un tema controvertido tanto en el campo científico como en la esfera pública. Si bien existe un predominante consenso científico de que el cambio climático tiene un origen antropogénico, este tardó alrededor de dos décadas para consolidarse. Sin embargo, persiste un enfrentamiento que está estrechamente relacionado con las orientaciones políticas e ideológicas y el manejo de la información por parte de los medios de comunicación. Así como de intereses económicos, comerciales y creencias religiosas.

Para diferenciar las dos posiciones se hace referencia al concepto de “variabilidad climática”, que corresponde a las dinámicas propias del planeta y se hace referencia al cambio climático como la aceleración de estos patrones por causas antropogénicas, teniendo como principal causa la emisión de gases en la quema de combustibles fósiles. Pero, a pesar del desacuerdo y del negacionismo usado con fines políticos, muchas comunidades científicas defienden la idea sobre la responsabilidad del ser humano como causante del cambio climático. Lo anterior se presenta en una síntesis de seis estudios de opinión de comunidades científicas, la cual muestra un consenso mayor al 90% con respecto al CC de origen antropogénico (Cook, Oreskes, Doran, Anderegg, Verheggen, Maibach,

rising sea levels and opening of the fabled Northwest Passage. All of these impacts have since either happened or are now well under way.” (Hansen, 2012, Minuto 2:21).

Carlton, Lewandowsky, Skuce, Green, Nuccitelli, Jacobs, Richardson, Winkler, Painting, Rice, 2016: 6). Reafirmando lo anterior, 217 asociaciones científicas y academias de ciencia de diversas partes del mundo y centros de investigación gubernamentales y multilaterales avalan, oficialmente, su posición acerca del cambio climático como fenómeno de origen antropogénico (NASA, 2019) .

Cabe anotar que recientemente surgió el concepto “antropoceno”, que describe una nueva era geológica en que la civilización ha modificado los ritmos del ambiente a escala planetaria (Crutzen, 2016). El concepto fue introducido formalmente en el año 2000 por el limnólogo Eugene F. Stoermer y el científico atmosférico Paul J. Crutzen (Trischler 2016: 309) y establece como momento de paso del Holoceno al Antropoceno la revolución industrial. El cambio climático es descrito como la punta del iceberg de la alteración antropogénica del planeta, la nueva era geológica es testigo de la alteración del ciclo del carbono, la modificación de otros ciclos bioquímicos, el cambio en el ciclo natural del agua y una extinción masiva de la biodiversidad. Si bien la historia de la relación humanos-ambiente data de millones de años atrás y se ha caracterizado por la modificación del entorno, sólo hasta esta época tuvimos la capacidad de modificar la composición química de la atmósfera (Steffen, Grinevald, Crutzen, McNeill, 2011: 842, 846).

1.2. Los estudios sobre el cambio climático y su relación con las Ciencias Sociales y las Humanidades

El cambio climático o crisis climática nos pone como civilización ante un reto de gran magnitud y, en este marco, se hace necesario que la academia se involucre con mayor responsabilidad social en la comprensión del fenómeno, sus efectos, así como sus soluciones, y enfrentarse así al reto de romper barreras entre campos del conocimiento propios de las Ciencias Naturales o “ciencias duras” y las Ciencias Sociales (en adelante CS) y las Humanidades (en adelante HH) tradicionalmente divididos. Esto hace recordar lo que C.P Snow describía en la *Conferencia de Rede* de 1959 como el problema de las “dos culturas”, es decir, la separación abismal entre científicos (entre los que se encontraban los

físicos como los más representativos) e intelectuales literarios, que lo único que compartían eran malentendidos:

Entre ambos un abismo de incompreensión mutua, a veces (particularmente entre los jóvenes) hostilidad y desagrado, pero sobre todo falta de entendimiento. Cada grupo tiene una curiosa imagen distorsionada del otro. Sus actitudes son tan diferentes que, aun en el plano de la emoción, no pueden encontrar mucho terreno en común (Snow, 1988:76).

Ambas "culturas" evidenciaban la existencia de diferentes miradas, pero cuya polarización representa más bien una pérdida para la comunidad académica y para la sociedad (Snow, 1988:82). Aunque, posteriormente, en su "segunda mirada" de 1963, Snow reconoció que no advirtió la existencia de una emergente "tercera cultura", que ya tendía puentes entre científicos y humanistas (Snow, 1988:132), muchas reacciones se generaron luego de esta apreciación en autores como Brockman (1995) y Collini (1995) por nombrar solo algunos⁵. Esta alusión apunta a que con respecto al cambio climático, su discusión en las comunidades científicas, fragmentadas en muchos casos, se ponen en evidencia, como veremos más adelante, tensiones que subsisten entre esos dos mundos pero, también, la necesidad por tender puentes hacia una colaboración interdisciplinaria que, al parecer, se da más frecuentemente en disciplinas como la biología y las ciencias médicas (Qin, Lancaster, Allen, 1997), pero no tanto entre las STEM con las CS y las HH.

El IPCC publicó en el año 2014 el quinto informe que agrupa una evaluación sobre el fenómeno dividido en tres secciones: bases físicas; impactos, adaptación y vulnerabilidad; y mitigación del cambio climático (IPCC, 2014)⁶. A pesar de que dicho informe aborda las dimensiones sociales y humanas, diversos grupos de expertos cuestionaron la inclusión interdisciplinaria de las CS y las HH en la discusión y la lucha para enfrentar el cambio

⁵ A propósito, puede consultarse el artículo de Millán de Benavides y Malagón (2004) que resume esta controversia.

⁶ El IPCC genera informes o reportes, que son el producto de la deliberación y evaluación de la literatura académica disponible sobre los últimos avances de investigación en torno al cambio climático. Y las recomendaciones para la toma de medidas a los gobiernos, tanto para seguir ahondando en la comprensión como en el diseño de acciones de mitigación y adaptación. Estos informes son realizados por expertos voluntarios de todo el mundo y constituyen el componente técnico para la toma de decisiones.

climático, argumentando que la participación de los expertos en estas áreas continuaba limitada a las ciencias económicas y otras que comparten los mismos parámetros que las ciencias dominantes en el campo (Veltrone, De Andrade, Andrade, 2016). Posterior a la publicación del reporte del IPCC del 2015, Denis y Moser (2015) y Stern y Dietz (2015) publicaron en la sección correspondencia de la revista *Nature*, dos notas invitando al IPCC a promover la participación de expertos de estas áreas del conocimiento, insistiendo sobre su valor y potencialidades para responder las preguntas que aún están abiertas en torno a los comportamientos humanos, las percepciones y las dinámicas sociales. Según los autores, para que esto sea viable es necesario incluir diferentes disciplinas y tradiciones para enriquecer los métodos y los abordajes del fenómeno, consideran que su inclusión es aún insuficiente, y aunque recalcan que se han realizado avances para abordar el fenómeno desde todas las disciplinas, aún no se han integrado lo suficiente las áreas en cuestión. Así mismo, autores como (2015:156)^[9] han llamado la atención sobre concepciones limitadas de las ciencias sociales y la escasa inclusión de las humanidades. El informe del IPCC de 2018 tampoco mostró cambios sustanciales sobre esta situación. Dicho informe es criticado fuertemente por Allison y Miller (2019) por hacer un excesivo énfasis en las ciencias, lo que puede obstaculizar el diseño de soluciones climáticas efectivas. Para estos autores, la solución a los problemas climáticos del mundo requerirá aprovechar una mayor capacidad intelectual que vaya más allá de las STEM:

Los humanistas también pueden ayudar a los tomadores de decisiones al ver cómo la historia y la cultura afectan las opciones de políticas públicas. Los planes para mejorar la economía basada en la quema de combustibles fósiles deberán abordar el vínculo histórico entre el petróleo y la libertad personal. Alternativamente, la humanidad podría seguir quemando combustibles fósiles mientras intenta capturar las emisiones. Sin embargo, algunas sociedades pueden oponerse a los altos costos de las tecnologías de captura de carbono relativamente no probadas.⁷

⁷ *Humanists can also help decision makers see how history and culture affect policy options. Plans to improve fuel economy will need to address the historical bond between petroleum and personal freedom.*

Esta es una posición que también comparte Oskamp (2000) cuando afirma que: "pensando en problemas ambientales como los descritos anteriormente, es esencial darse cuenta de que no son solo problemas técnicos que requieren simplemente ingeniería, física y química para su solución. Hay un papel crucial de las ciencias sociales en estos problemas, porque todos son causados por el comportamiento humano, y potencialmente todos pueden ser revertidos por el comportamiento humano" (p. 501)⁸.

Lowe, Whitman y Phillipson (2009) describen cómo la colaboración interdisciplinar de las CS y las HH en el abordaje de temas ambientales, cómo el cambio climático, ha contado con diferentes modos de acercamiento. Uno instrumental, que centra su rol en la comunicación de resultados, la participación en políticas públicas y la mediación de la gestión ambiental; y otro no instrumental, que centra su rol en la comprensión de la valoración de los impactos ambientales, los valores e intereses individuales y sociales. Describe también que el profesional y el investigador social y humanista ha tenido roles como portavoz, puente entre la sociedad y los investigadores de las ciencias exactas, productor social responsable de involucrar a las comunidades de base en los procesos y analista crítico comprometido. Este último rol es la base para que las CS y las HH puedan aportar desde una visión amplia y con una sensibilidad crítica propia de su formación.

Quienes evalúan la interdisciplinariedad como Hansen (2012), plantean como imperativo la inclusión de las CS y las HH en los procesos como parte fundamental para la comprensión de los fenómenos y la proposición de soluciones y medidas de adaptación al cambio climático, de manera efectiva y no subsidiaria. Argumento que la *Organización para la Investigación del Cambio Global* (GCR), enfatiza, al mismo tiempo que promueve la fundamentación de un nuevo marco epistemológico integrativo que traspase los retos que

Alternatively, humanity could keep burning fossil fuels while trying to capture the emissions. Yet some societies might balk at the high costs of relatively unproven carbon capture technologies (Allison & Miller, 2019)

⁸ *"thinking about environmental problems such as the ones described above, it is essential to realize that they are not solely technical problems, requiring simply engineering, physics, and chemistry for their solution. There is a crucial role for the social sciences in these problems, because they are all caused by human behavior, and potentially they can all be reversed by human behavior" (Oskamp, 2000)*

presenta la investigación interdisciplinar y transdisciplinar: un nuevo marco de trabajo epistemológico que permita reformas no sólo simbólicas, sino también institucionales (Holm, Winiwarter, 2017:7).

Según Pittman, Tiessen y Montaña (2016), la búsqueda de la interdisciplinariedad en estudios relacionados con el cambio climático ha aumentado en popularidad tanto en investigación como en el diseño de medidas de adaptación en las últimas dos décadas. Sin embargo, de acuerdo a Haarstard et al. (2018), la mayor parte de los proyectos asociados a la investigación del cambio climático son principalmente dirigidos por las facultades de ingenierías y ciencias biológicas. Dicha situación, refleja un orden jerárquico y un abordaje subsidiario del papel de las CS y las HH. Por su parte, Grunfest (2017:181), considera que en los estudios interdisciplinarios las CS y las HH han sido consideradas un tema accesorio, usado solo para garantizar convenios y financiación, siguiendo las exigencias de tratados internacionales que suponen la sujeción de los proyectos de investigación e intervención en esta área a la sociedad.

En esta búsqueda de la interdisciplinariedad se registran diferentes retos y dificultades, entre los que se encuentran: diferencias en las valoraciones del objeto de estudio, presencia de prejuicios entre investigadores de áreas diferentes y dificultades de aproximación entre teorías y modelos (Bennett, Roth, Klain, Chan, Christie, Clark, Cullman, Curran, Durbin, Epstein, Greenberg, Nelson, Sandlos, Stedman, Teel, Thomas, Veríssimo, Wyborn, 2017; Lélé, Norgaard, 2005). También dificultad para marcar el objeto del problema de investigación de manera adecuada, encontrar métodos compatibles de investigación y la coordinación logística por los tiempos, las distancias y las diversas dinámicas de los actores involucrados (Pittman, Tiessen, Montaña, 2016). Estas situaciones suelen presentarse junto a la falta de incentivos institucionales, la dificultad en la medición y los roles dominantes de las ciencias exactas y las ingenierías (Kliskey, Alessa, Wandersee, Williams, Trammell, Powell, Grunblatt, Wipfli, 2017) .

Sin embargo, la literatura en este asunto es dinámica y crece constantemente. Las agremiaciones científicas han empezado a tomar una posición pública y activa frente a lo

que ya se describe como una compleja crisis climática con efectos negativos para todo el planeta. Callaghan, Minx y Forster (2020) describen un aumento en la participación de las CS y las HH en la última década, en relación con el volumen de trabajos publicados en las bases de datos académicas y en los informes del IPCC.

En las conferencias abiertas al público y en reuniones de asociaciones científicas tales como la *Fall Meeting* del American Geophysical Union (AGU), se percibe un llamado a implementar acciones concretas que pongan la ciencia al servicio de la sociedad ante fenómenos que ya comprendemos y ante los que no se está actuando.

1.3. La American Geophysical Union (AGU)

La American Geophysical Union (AGU) es una asociación internacional sin ánimo de lucro creada en 1919, que agrupa más de 60.000 científicos de Ciencias de la Tierra y el Espacio, originarios de 137 países⁹. Su visión es impulsar una comunidad de científicos para trabajar de forma colaborativa favoreciendo los avances en la investigación y la comunicación de la ciencia para un futuro sostenible. Su misión es promover el conocimiento de la Tierra y el Espacio para el beneficio de la humanidad¹⁰.

Sus reuniones de otoño comenzaron en el año 1920 y han ocurrido casi de manera ininterrumpida desde aquel año, que contó con 25 miembros. Para el año 2018 reunió 25.000 participantes. La conferencia cuenta con charlas magistrales de expertos reconocidos en el campo, presentaciones orales de 10 minutos en mesas de trabajo, presentaciones de poster y el formato interactivo *e-lightning*¹¹. Las secciones se agrupan temáticamente de acuerdo con los asuntos de interés y tienen la misma división que las secciones de la

⁹ Sin desconocer que existen diferentes agremiaciones científicas que abordan el tema del cambio climático, entre las que podemos destacar la American Meteorological Society (AMS), creada en 1919 con alrededor de 13.000 miembros activos o la European Geosciences Union (EGU), creada en 2002 y con alrededor 15.000 miembros, se ha escogido como objeto de estudio las conferencias de la American Geophysical Union (AGU) porque es una de las más antiguas, tiene el mayor número de científicos asociados, de mayor prestigio y con mayor representatividad de nacionalidades.

¹⁰ Información oficial institucional de la AGU puede consultarse en: <https://www.agu.org/>

¹¹ *E-lightning* es un formato incorporado en el 2018 que permite presentar los resultados en archivos hipertextuales, además de la presentación oral de 3 minutos con un formato inspirado en las charlas TED.

Asociación, estas son: Global Environmental Change (Cambio Ambiental Global, Public Affairs (Asuntos públicos), Natural Hazards, (Desastres naturales), Education and Human Resources, (Educación y Recursos Humanos), Union (Unión), Hydrology (Hidrología), Volcanology (Volcanología), Geochemistry (Geoquímica), Petrology (Petrología), Ocean Sciences (Ciencias oceánicas), Earth and Planetary Surface Processes (Tierra y procesos planetarios superficiales), Earth and Space Science Informatics (Ciencias informáticas de la Tierra y el Espacio), Atmospheric Sciences (Ciencias atmosféricas), Cryosphere (Criosfera).

Previamente se presentan las propuestas para la reunión y se enmarcan en una sección específica de acuerdo con los proponentes y con la validación de los comités de evaluación. La participación de los investigadores está condicionada a la presentación de resúmenes de los resultados y avances significativos de sus proyectos y a la indicación de la sesión en la que desean participar. dentro de las fechas definidas por el Comité del Programa. El procedimiento de organización de las sesiones se resume de la siguiente manera:

Después de la fecha límite de presentación, el Comité del Programa determina el número disponible de sesiones y de pósteres para cada Sección en función de la disponibilidad de tiempo y espacio en el centro de convenciones. Posteriormente, el secretario de la Sección asigna cada sesión. Si solo se envían unos pocos resúmenes a una sesión propuesta, las sesiones se fusionan. Como solo se permite una sesión de hasta cuatro convocantes - coordinadores, algunas personas renunciarán a su función. Una vez que las sesiones orales y de pósteres han sido delegadas dentro de una sección, el coordinador principal y el o los coordinadores moderarán las presentaciones orales y de pósteres. (Ford et al, 2018:4).

Estas reuniones científicas son espacios que sirven para la consolidación de diferentes campos científicos. En ellas se pueden identificar las tendencias en la investigación, la generación de oportunidades para la divulgación científica y la conexión con otros campos y con los diferentes actores involucrados. Las discusiones y encuentros que se dan en estos certámenes favorecen los avances y promueven las conexiones entre investigadores para abordar fenómenos como el cambio climático, que se ha establecido como prioritario para la asociación (Addor, Ewen, Johnson, Çöltekin, Derungs, Muccione, 2015). Estas reuniones

han sido claves para la discusión del cambio climático desde el surgimiento de las advertencias en torno a la aparición del fenómeno.

Si bien las Ciencias de la Tierra han jugado un rol fundamental en el entendimiento del problema, hay un llamado por involucrar de manera interdisciplinaria las CS y las HH. La AGU ha sido crucial en los estudios del cambio climático y ha establecido dentro de sus principios un llamado a estudiar este fenómeno, sus impactos, las oportunidades de adaptación y a educar al público sobre sus hallazgos (AGU, 2019). En este sentido se ha dado la necesidad de integrar investigadores que aborden las dinámicas desde una perspectiva humana y social. Es nuestro objetivo, entonces, analizar cómo algunos estudios expuestos entre 2010 y 2018 en este evento aluden o mencionan la necesidad de que exista una relación cooperativa entre las ciencias exactas y las CS y HH.

2. Metodología

Para el presente estudio se realizó una búsqueda de los resúmenes de los años 2010 a 2018 de las conferencias de otoño de la AGU. El rastreo se hizo a través de su buscador, que clasifica todos los textos publicados bajo 48 palabras clave (*Keywords*) como: *atmospheric composition and structure, biogeosciences, computational geophysics, electromagnetics, cryosphere, education, exploration geophysics, geochemistry, geochronology, geodesy y gravity*, entre otras¹². Si bien el problema del cambio climático cuenta en las últimas versiones del evento con sus propias sesiones, por las características tan complejas del fenómeno, este puede ser mencionado en casi todas las conferencias presentadas. Por eso mediante el uso de *web Scraping*¹³ se extrajeron 13.447 resúmenes en los que específicamente se mencionaba el problema del cambio climático a través de la identificación de la expresión “climate change” y “climate crisis”.

¹² Pueden consultarse el resto de palabras clave en: <https://abstractsearch.agu.org/keywords>

¹³ El *web scraping* es una técnica de extracción de datos de uno o varios sitios web que accede directamente al protocolo de transferencia de la información. Es útil para acceder a grandes volúmenes de datos.

Entre los temas abordados en esos resúmenes se encuentran: modelación del cambio climático, eras geológicas, gestión del riesgo, características físicas del fenómeno, entre otras. Estos resúmenes hacen parte de un volumen aún mayor de trabajos que abordaban los temas de interés de AGU.

Luego, se realizó un segundo filtro utilizando los términos “humanities” y “social science”. Allí se obtuvieron solo 99 resúmenes a partir de los cuales se realizó una lectura crítica con el objetivo de comprender la relación colaborativa descrita por los participantes de la AGU con las CS y las HH, en los estudios sobre el cambio climático. Dicha lectura fue apoyada con la herramienta Atlas.Ti en su versión en línea. La lectura crítica consistió, en primer lugar, en una revisión sistemática del contenido de todos los resúmenes seleccionados. En segundo lugar, en una lectura que permitiera llegar a una comprensión global del contenido, intención y puntos de vista expresados por los investigadores. Gracias a esta lectura se establecieron cuatro categorías de clasificación temáticas de los resúmenes, a saber: Las CS y las HH como instrumento para la comprensión del cambio climático; Las CS y las HH en la mitigación, adaptación y solución del cambio climático; Las CS y las HH para la comunicación y educación; y la inclusión integral de las CS y las HH en el abordaje del cambio climático. Cada una de estas categorías será tratada en el apartado 3.2.

De manera paralela, se realizó la búsqueda de información relacionada con la trayectoria de la formación académica de los 230 autores de los 99 resúmenes. Solo a partir del 2013 la AGU ha solicitado a sus miembros que declaren por sí mismos datos personales como género, año y último título académico obtenido. Sin embargo, muchos perfiles están incompletos, por lo que fue necesario realizar pesquisas a través del motor de búsqueda de Google, utilizando el nombre, el apellido del autor y la afiliación registrada durante la conferencia de AGU. Se identificó que, de acuerdo con la afiliación los autores en la fecha de la búsqueda, se podían encontrar perfiles o currículos completos en las páginas de las universidades donde se desempeñan, en Google Scholar, ResearchGate y en LinkedIn, que son redes sociales autogestionadas. Se complementa la información sobre formación de autores con un análisis del orden en el que aparecen como coautores, para dar cuenta de

cómo podría percibirse la contribución de cada uno dentro de la investigación de acuerdo con su formación académica.

La información recolectada fue clasificada bajo las siguientes categorías: CS para los estudios de pregrado y posgrado¹⁴ en alguna disciplina tradicionalmente enmarcada en las Ciencias Sociales, HH para los estudios en humanidades y STEM para agrupar las disciplinas que se desenvuelven en estas áreas: Ciencia, Tecnología, Ingeniería, Matemáticas y Ciencias de la computación¹⁵. La reconstrucción de estos perfiles académicos ha permitido la creación de un directorio de expertos en ciencias de la tierra, humanistas y científicos sociales que están abordando el cambio climático interdisciplinariamente y que quedará disponible como insumo para otros estudios.

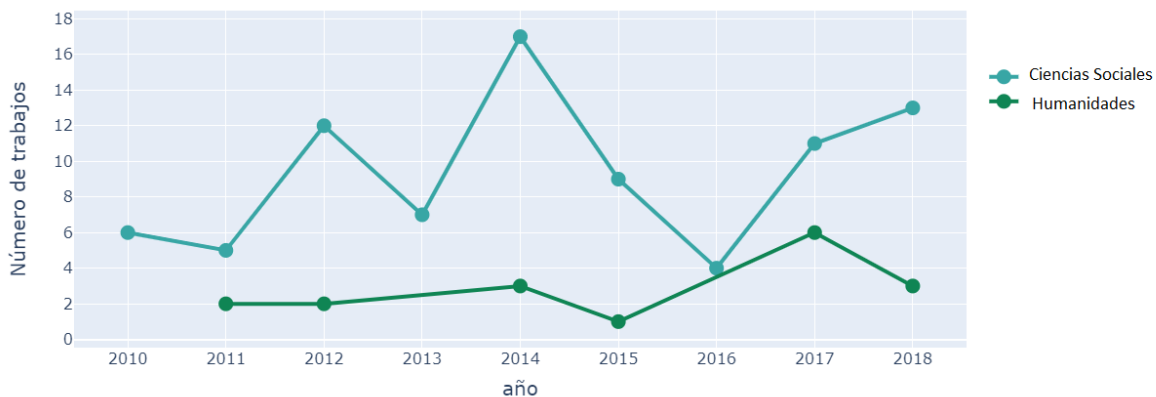
3. Resultados y discusión

Desde una perspectiva temporal, los resúmenes en los que aparece el término “*social science*” presentan una tendencia creciente leve con una alta variabilidad (Ver Gráfica 1). Para el año 2010 hubo 6 presentaciones en los que aparece dicho término. En los años 2017 y 2018 la cantidad de resúmenes ascendió a 11 y 13 respectivamente. En el año 2014 se presentó un pico importante con 16 trabajos, y en el año 2016 se identificó un mínimo de 4 presentaciones. El pico del año 2014 coincide con el vigésimo aniversario de la implementación de la Convención Marco para el Cambio Climático de las Naciones Unidas (UNFCCC por sus siglas en inglés). Este acuerdo es el principal instrumento jurídico de las Naciones Unidas para afrontar esta crisis global y es la base de todos los documentos, acuerdos y protocolos para lo relacionado con el cambio climático. La convención contiene la base jurídica, los acuerdos, y protocolos relacionados con el cambio climático. Es posible que en el 2014 se diera un incremento en los temas relacionados debido a su aniversario.

¹⁴ Para los estudios de Posgrado sólo se tuvieron en cuenta Maestría y Doctorado.

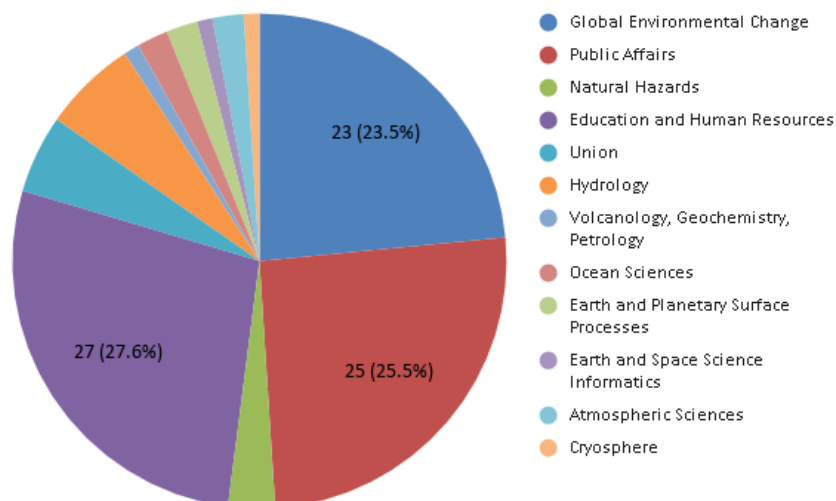
¹⁵ STEM pertenece a una categorización realizada por la National Science Foundation (FNS) de Estados Unidos para agrupar campos disciplinares (U.S. Department of Education, 2018). También se puede encontrar en la literatura el concepto STEAM, que incluye la A de Arts. Esta adición hace parte de un movimiento liderado por la escuela de diseño de Rodhe Island, también en Estados Unidos, con el argumento de la necesidad de incluir las artes para poder promover la creatividad y el pensamiento científico (Maeda, 2013).

Desde su comienzo en el año 2011, los resúmenes en los que se menciona el término “*humanities*” mantienen una tendencia estable hasta el año 2017. Dentro de este período de tiempo la cantidad de trabajos se incrementa de 2 a 6. En el año 2018 la categoría presenta un descenso en la cantidad total de trabajos (Ver Gráfica 1). En consecuencia, al menos en el contexto de la conferencia de AGU, a nuestro modo ver no parece haber un significativo avance de la participación de las Humanidades en la investigación del CC como lo afirman Callaghan, Minx, & Forster (2020), tendría más bien razón Klenk & Meehan, (2015b) quienes afirman que la inclusión es limitada.



Gráfica 1 Aparición de los términos Ciencias Sociales y Humanidades.

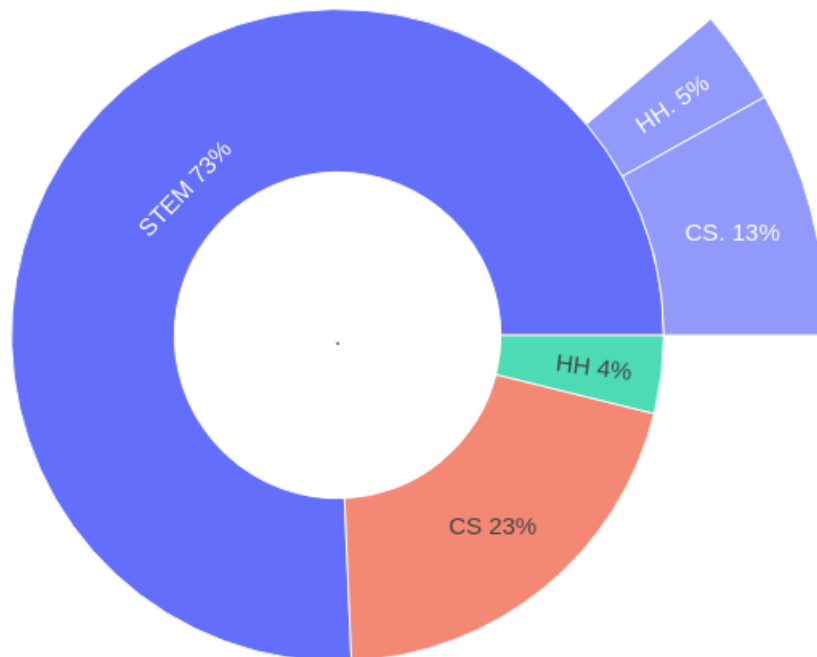
Como se mencionó anteriormente, las conferencias se encuentran divididas en secciones temáticas que, a su vez, tienen sesiones de trabajo más específicas. En la Gráfica 2 se puede observar cómo alrededor del 75% de los trabajos que contienen los términos “*social science*” y “*humanities*” se encuentran en las secciones: *Education and Human Resources* (Educación y recursos Humanos) y *Public Affairs* (Asuntos Públicos). Sin embargo, es interesante la mención de las HH en otras secciones, especialmente en *Global Environmental Change* (Cambio Ambiental Global), porque refleja una necesidad de ampliar las posibilidades con otras miradas en campos de acción que tradicionalmente eran dominados por las STEM.



Gráfica 2 Distribución por sección de los trabajos que incluyen específicamente los términos Humanidades y Ciencias Sociales.

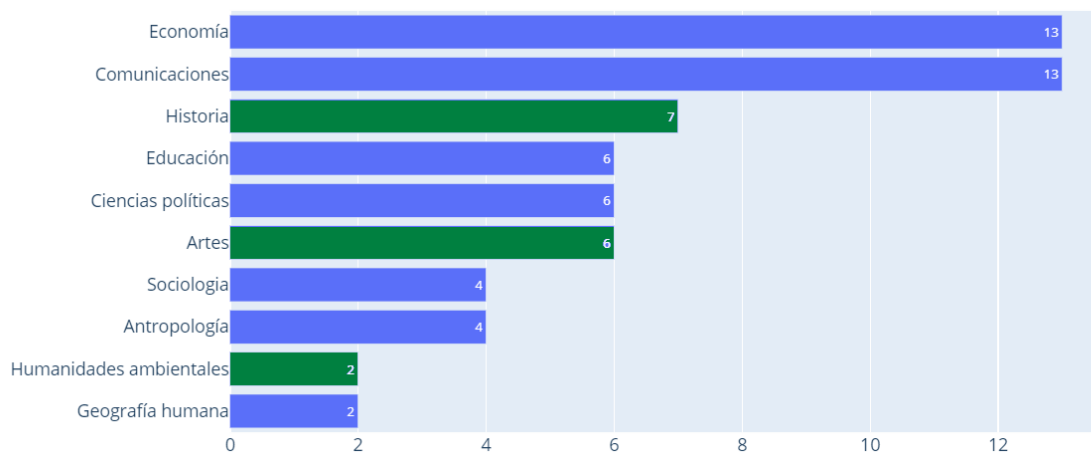
3.1. Las disciplinas de los autores

Los 99 resúmenes analizados pertenecen a 241 autores, de los que se pudieron identificar 230 perfiles. Del total, 53 autores tenían formación inicial (pregrado) en una disciplina que podríamos enmarcar dentro de las CS y 10 autores en HH (23% y 4% respectivamente). Los 167 autores restantes (73%) tienen una formación inicial en disciplinas STEM. De estos, 21 (13%) realizaron estudios de posgrado relacionados con las CS y tan solo 8 autores (5%) en HH. En este grupo se incluyen 10 autores que describen en sus perfiles su experticia en Comunicaciones, pero no cuentan con títulos oficiales de educación superior. En total, 92 de los 230 autores tienen educación formal en CC y HH (40%), 63 en su formación inicial y 29 provenientes de STEM (21 de CC y 8 de HH) y 138 con educación formal solo en STEM (Ver Gráfica 3). Para los estudios de posgrado sólo se consideró Maestría y Doctorado.

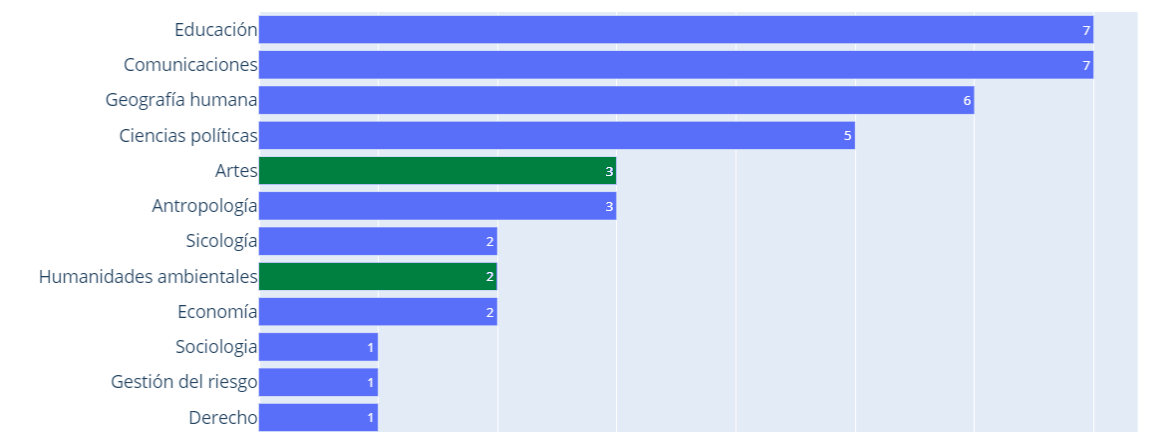


Gráfica 3. Áreas de formación de los autores durante el pregrado (primer nivel) y durante el postgrado considerando que provienen de STEM en el pregrado (segundo nivel).

En las Gráficas 4 y 5 se muestran las disciplinas específicas de formación, azul para las CS y en verde para las HH.



Gráfica 4. Distribución por área de Ciencias Sociales y Humanidades en autores con formación en Ciencias Sociales y Humanidades



Gráfica 5. Distribución por área de posgrado en Ciencias Sociales y Humanidades en autores con formación de pregrado en STEM

Como se puede observar, una de las disciplinas con mayor participación es la Economía, la cual, según Veltrone, De Andrade y Andrade (2016), es tradicionalmente predominante en estos estudios para la medición y valoración de impactos, junto con Comunicaciones, lo cual puede estar relacionado con la misión de AGU que busca la divulgación de la ciencia y la función instrumental de las CS y las HH en los estudios de cambio climático (Gráfica 4).

Llama la atención que para este período aún se mantiene una ausencia de ciertas disciplinas de las CS como Psicología, que podría cumplir roles tan importantes como el de promover comportamientos tendientes hacia la sostenibilidad ambiental (Oskamp, 2000 y Spence, Poortinga y Pidgeon, 2011) y de las HH como Filosofía que, por ejemplo, puede acompañar la educación ambiental en escuelas y universidades (Cole y Malone, 2019), proponer estudios metodológicos (Petersen, 2000) o contribuir al desarrollo de una ecología humana (Valera, 2019). Sin embargo, tanto en la Gráfica 4 como en la 5 aparece una nueva disciplina, las Humanidades Ambientales, un campo emergente de carácter transdisciplinario que surgió como respuesta para abordar la crisis ecológica. Según Robin:

Las Humanidades Ambientales no son tanto una nueva disciplina o método, sino una nueva combinación de perspectivas humanísticas y alianzas. Las humanidades ambientales incluyen historia, filosofía, estética, geografía, estudios religiosos

comparativos, literatura, teatro, cine y estudios de medios; relacionados con las investigaciones más recientes en las ciencias de la naturaleza y la sostenibilidad. (2018:2)

Para comprender mejor la participación de los expertos en CS y HH observamos el orden de aparición de los autores. Este orden, generalmente, denota el nivel de participación y de liderazgo dentro de la investigación realizada. Si bien existen múltiples criterios para definir el orden de los autores de acuerdo con dicho nivel, definidos por las editoriales o las agremiaciones científicas, no se encontró ningún parámetro establecido para determinar el orden de las autorías en la AGU. Sin embargo, se sigue aquí lo señalado en el estudio *The write position. A survey of perceived contributions to papers based on byline position and number of authors*¹⁶:

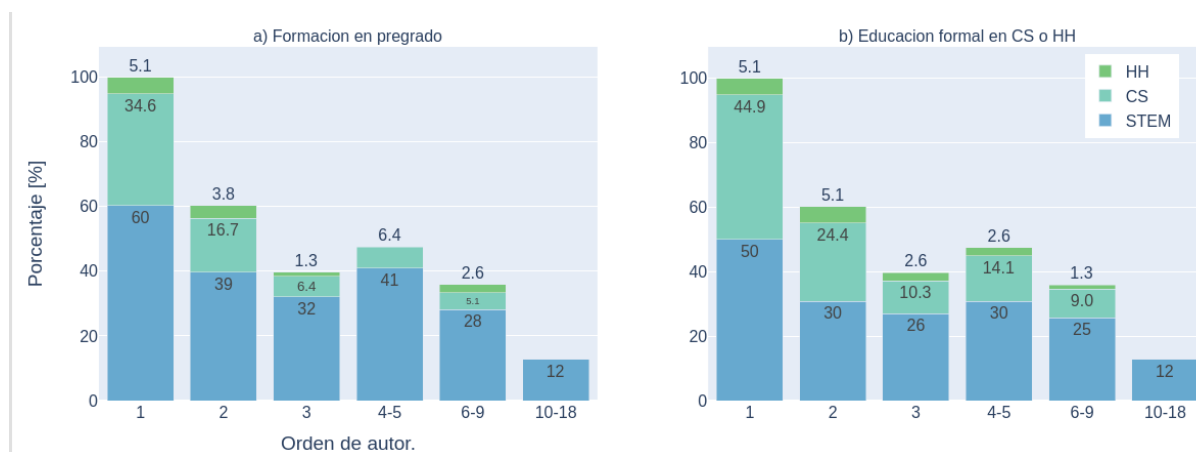
“Agregar autores a una publicación aparentemente no afecta el crédito general relativo otorgado al último autor, pero las contribuciones percibidas de todos los otros autores sufren una caída en el valor. Aunque los primeros y últimos autores recibieron la mayor cantidad de crédito en comparación con los autores medios en las tres categorías encuestadas, la contribución percibida de los autores primero y medio disminuyó en una de cinco personas en comparación con uno de tres personas”. (Wren, Kozak, Johnson, Deakyne, Schilling, Dellavalle, 2007)¹⁷

En la Gráfica 6 se presenta el porcentaje de orden de aparición de los autores de acuerdo con las categorías STEM, CS, y HH, en los 45 trabajos que tienen dos autores o más. La Gráfica 6a, corresponde a su formación de pregrado, y la 6b, si cuentan con una formación en CS o

¹⁶ En su versión en inglés *The Write position*, es un juego de palabras con la homófona *The right position*, que haría referencia a la posición correcta. Se trata de una encuesta de la percepción sobre las contribuciones de los autores según el orden de aparición.

¹⁷ “Adding authors to a publication apparently does not affect the relative overall credit afforded to the last author, but the perceived contributions of all other authors suffer a drop in value. Although first and last authors received the largest amount of credit compared with middle authors in all three categories surveyed, the perceived contribution of the first and middle authors decreased in a five-person byline compared with a three-person one (Wren, Kozak, Johnson, Deakyne, Schilling, Dellavalle, 2007).”. (Wren, Kozak, Johnson, Deakyne, Schilling, Dellavalle, 2007)

HH, considerando también los estudios de posgrado. Independiente de las categorías, cabe resaltar que alrededor de un 40% de los trabajos han sido realizados por un solo autor y alrededor del 60% han sido realizado por dos autores. Por otro lado, los autores provenientes de STEM tienden a dominar los diferentes órdenes de autoría. Sin embargo, en el primer y segundo orden de autoría se da una participación importante de las CS. Caso contrario sucede con las HH, las cuales mantienen un porcentaje de participación bajo en todos los niveles de autoría.



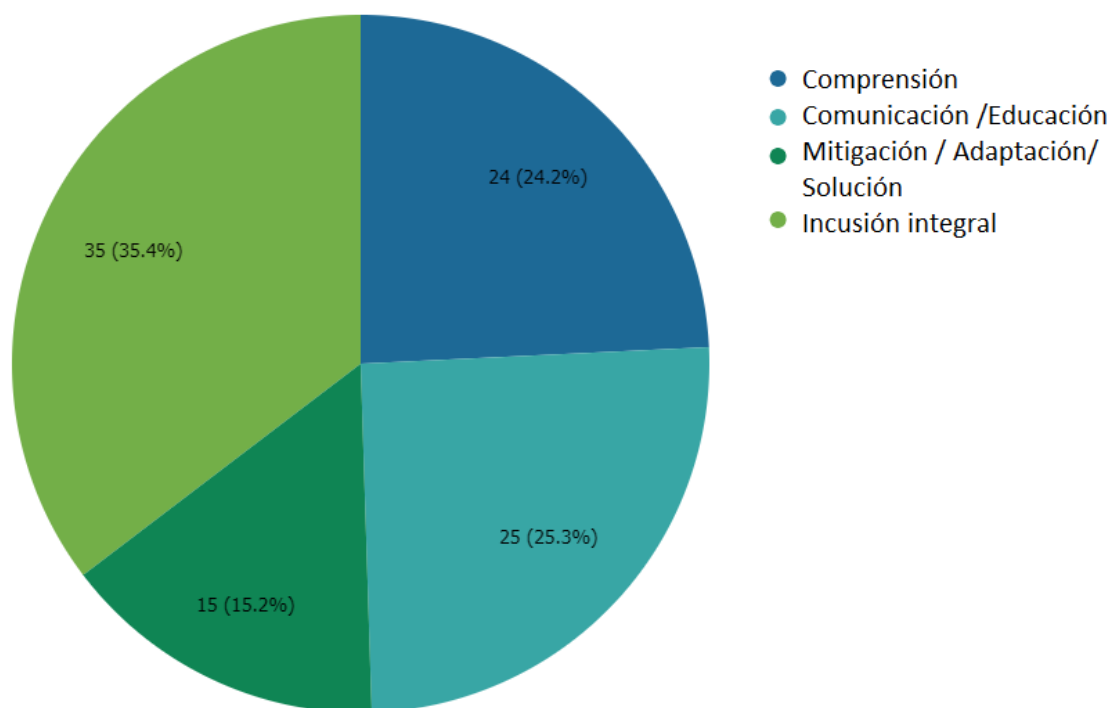
Gráfica 6. Orden de autoría según área del conocimiento.

Se identifica que, en esos 45 trabajos con más de dos autores, 25 están conformados por equipos interdisciplinarios (55%), considerando como parte de CS y HH autores con estudios de posgrado en CS y HH con formación inicial en STEAM. Los otros 20 trabajos son integrados por personas de la misma área de conocimiento.

3.2. Presentación y clasificación de los resúmenes seleccionados

A continuación, se exponen los resúmenes identificados, algunos serán citados textualmente, otros solo serán mencionado por sus autores cuyos trabajos apoyan la

exposición organizada a partir de puntos en común. En la sección de anexos se podrán consultar la totalidad de estos resúmenes. Dado que se pudo constatar que las CS y las HH son mencionadas en los resúmenes de los estudios descritos por los investigadores, en diferentes etapas (para la prevención o mitigación de los efectos del cambio climático) y con diferentes objetivos y alcances (educación, comprensión, comunicación, etc.), se clasificaron dichos resúmenes en cuatro grupos temáticos: Las CS y las HH como instrumento para la comprensión del cambio climático (que cuenta con 24 trabajos, correspondientes al 24.2%); Las CS y las HH en la mitigación, adaptación y solución del cambio climático (con 15 trabajos, correspondientes al 14.2%); Las CS y las HH para la comunicación y educación (con 25 trabajos, correspondientes al 25.3%); y la inclusión integral de las CS y las HH en el abordaje del cambio climático (con 35 trabajos, correspondientes al 35.5%). Esta categorización se puede observar con mayor detalle en los siguientes apartados. La siguiente gráfica muestra la distribución de los resúmenes de acuerdo con la categoría, en los que fueron clasificados en la sistematización de la lectura, la categoría con menor representación cuantitativa es la descrita como las CS y las HH para la comprensión, mitigación y solución del CC.



Gráfica 3 Distribución de los trabajos según la categoría de análisis.

3.2.1. *Las Ciencias Sociales y Humanidades como instrumento para la comprensión del cambio climático*

Varios expositores señalan que uno de los objetivos de la inclusión de las CS y las HH es identificar el cambio climático como un fenómeno complejo físico y social. Según lo anterior, el papel de las CS y las HH sería aportar a la medición de los impactos que se han generado y los posibles impactos futuros a partir de sus metodologías propias, las cuales permiten describir las dinámicas humanas y sociales, ahondando en las causas, estableciendo conexiones con las realidades físicas observables y el cómo son vividas por las personas y las comunidades (Even, Zhang, Yao, Andersson, Landelius, Melton, Yan 2018; Field 2012; Hsiang 2013; Klein, Gordon, 2010). En esta misma línea, Klein y Gordon, afirman en el trabajo *The Colorado Climate Preparedness Project: A Systematic Approach to Assessing Efforts Supporting State-Level Adaptation*¹⁸, que: “para generar planes estratégicos de adaptación al clima es necesario identificar todo el conjunto de actividades que están implícitamente relacionadas con el clima y que podría afectar la capacidad adaptativa dentro del sistema” (2010)¹⁹. De esta manera exponen que es imprescindible ampliar la mirada y romper los límites de un abordaje meramente físico para generar una línea de base clara y contextualizada para el diseño de medidas de adaptación y mitigación al CC.

En otros resúmenes, los expositores enfatizan que las CS y las HH se convierten en claves para ir más allá de las características físicas del fenómeno que son cuantificables, ahondado en las dimensiones humanas y sociales, fortaleciendo las capacidades de los grupos de investigación. Duffin et. al. (2013), Klein & Gordon (2010) y Kopp (2012) consideran que las CS y las HH facilitan el enlace entre distintas disciplinas y la conexión con otras problemáticas

¹⁸ El Proyecto de Colorado para la preparación climática: un enfoque sistemático para evaluar los esfuerzos de apoyo a la adaptación a nivel estatal.

¹⁹ “to generate a strategic climate adaptation plan requires identifying the entire suite of activities that are implicitly linked to climate and may affect adaptive capacity within the system” (Klein & Gordon, 2010).

ambientales en diferentes escalas y magnitudes, como la deforestación, la contaminación, la soberanía alimentaria y la gobernanza del agua.

En el rol que las CS y las HH asumen para la comprensión del CC se identifican también los estudios para ahondar en las percepciones del fenómeno y sus riesgos asociados. Prokopy, Carlton & Dunn (2014) en *Communicating Climate Change in the Agricultural Sector: Insights from Surveys and Interviews with Agricultural Advisors in the Midwestern United States*²⁰ implementan encuestas y entrevistas para, a partir de los hallazgos, fundamentar estrategias de comunicación sobre los efectos del CC y las medidas de adaptación. Por otra parte, Hsiang en *The Social Impact of Climate*, afirma que: “al enlazar datos y métodos entre las ciencias físicas y las sociales, estamos empezando a entender cuándo, dónde y cómo, las condiciones climáticas pueden causar impacto en el bienestar humano”²¹.

En esta misma línea, un equipo interdisciplinar de profesionales en STEM, liderado por Niepold²², afirmaba en *Increasing Communities Capacity to Effectively Address Climate Change Through Education, Civic Engagement and Workforce Development*²³ que: “Entender las causas, los efectos, riesgos y desarrollar las capacidades sociales para responder al cambio global, es el mayor reto del siglo XXI que requiere contribuciones coordinadas de las ciencias, las ciencias sociales, las humanidades y las artes” (Niepold, Ledley, Stanton, Fraser, Scowcroft, 2017)²⁴. Desde una perspectiva interdisciplinaria estos investigadores describen

²⁰ Comunicación del cambio climático en el sector agrícola: percepciones de encuestas y entrevistas con asesores agrícolas en el medio oeste de los Estados Unidos (Prokopy, Carlton, Dunn, 2014).

²¹ “By linking data and methods across physical and social sciences, we are beginning to understand when, where, and how climatic conditions have a causal impact on human wellbeing” (Hsiang, 2013)

²² Frank Niepold es un artista visual con posterior formación en ecología, líder actual de Climate Literacy and Energy Awareness Network (una red de educación ambiental con base en EUA, con presencia en 18 países) y director del programa NOAA Climate.gov (estrategia de divulgación de información científica sobre el clima, con énfasis en Cambio Climático). Su perfil se destaca al ser un personaje clave en la implementación de una estrategia interdisciplinaria, intersectorial e internacional. Su formación está dada en los Dos Mundos, como se mencionaba en la introducción.

²³ Aumento de la capacidad de las comunidades para abordar eficazmente el cambio climático a través de la educación, la participación cívica y el desarrollo de la fuerza laboral.

²⁴ “Understanding the causes, effects, risks, and developing the social will and skills for responses to global change is a major challenge of the 21st century that requires coordinated contributions from the sciences, social sciences, humanities, arts, and beyond” (Niepold, Ledley, Stanton, Fraser, Scowcroft, 2017).

cómo comprender y enfrentar las realidades alrededor del CC que constituyen el mayor reto al que nos enfrentamos como sociedad en este siglo.

Las ideas encontradas en esta categoría concuerdan con las planteadas por Denis & Moser, 2015; Hansen, 2012; Klenk & Meehan, 2015; Meehan, Klenk, & Mendez, 2018 y Veltrone et al., 2016, autores mencionados en el apartado *1.2. Los estudios sobre el cambio climático y su relación con las Ciencias Sociales y las Humanidades*. Algunos investigadores que participaron en AGU, entre 2010 y 2018, proponen que las CS y las HH pueden aportar a la comprensión tanto del fenómeno físico del CC, como facilitar el abordaje de las dimensiones sociales y humanas. Se encuentra en esta categoría, aunque de manera incipiente, el CC como un fenómeno complejo que requiere bases más sólidas e integrales para el diseño e implementación de acciones viables para la mitigación y adaptación. Esta última tendencia sobre el rol de las CS y las HH hacia la mitigación y adaptación, está más ampliamente desarrollada en la categoría que se expone en el siguiente apartado.

3.2.2. Las Ciencias Sociales y Humanidades en la mitigación, adaptación y solución del cambio climático

En otro grupo de resúmenes las CS y las HH son mencionadas como parte de acciones de mitigación, adaptación y solución al cambio climático. Esto refleja a nuestro juicio una ruptura de los límites de los campos científicos, para abrirse a los diferentes sectores de la sociedad (Brasseur, 2012; Eise J, 2018; Niyogi & Andresen, 2011). Su participación es considerada esencial para diseñar medidas eficaces y reales, ya que posibilitan la conversión de los datos y el conocimiento en la base para la acción (Brasseur, 2012; Moss, 2013). En el trabajo: *Climate Services in Support Adaptation Strategies*²⁵, el Ingeniero Brasseur señala que: “Equipos interdisciplinarios se han empezado a formar para trabajar con todos los sectores sociales interesados para coproducir conocimiento que resuelva las complejas

²⁵ Servicios climáticos como soporte a las estrategias de adaptación.

cuestiones que enfrentan los tomadores de decisión” (2012)²⁶. Es así como la conformación de equipos interdisciplinarios permite establecer relaciones entre diferentes sectores sociales, como son: el sector público y privado, la sociedad civil, la academia y los organismos multilaterales. Facilitando así la transversalización de la problemática, su comprensión, así como la apropiación de los conocimientos para diseñar medidas efectivas de adaptación y mitigación.

También las CS y las HH son, la posibilidad de moverse hacia la sostenibilidad y la promoción de comunidades que aumenten su resiliencia al generar conocimientos profundos a escalas que permiten crear soluciones contextuales y adaptadas y que tienen en cuenta las características particulares de cada grupo social para afrontar un fenómeno que, si bien es global, presenta diferentes afectaciones en la escala local (Franco, Cayan, Moser, Hanemann, Pittiglio, 2010; Gleick, 2010; Klein & Gordon, 2010; Kopp, 2012; Plag H, 2013). Además, facilitan el aprendizaje a partir de experiencias anteriores, favoreciendo la consideración de líneas de base (diagnóstico del estado de la situación), que incluyen perspectivas históricas y de análisis documental, que enriquecen el conocimiento de cómo una comunidad ha afrontado diferentes problemáticas específicas. También apoyan la homogenización y estandarización de medidas, promoviendo la implementación acertada de las mismas a escala local. Para autores como Franco, Cayan, Moser, Hanemann, Pittiglio (2010) y de Leon Barido, Nelson, Thatikonda, Smith, Roe, Foufoula (2012), las CS tienen la capacidad de aportar a la creación y medición de indicadores que permitan identificar de una manera eficiente qué dimensiones merecen ser priorizadas, sin descartar la particularidad de cada asunto.

En la conferencia de Plag, Earnest y Jules-Plag, S (2013), geofísico, politólogo y geógrafa, respectivamente, titulada *Deterministic or Probabilistic - Robustness or Resilience: How to Respond to Climate Change?*²⁷, se describe la evaluación de una región con riesgo de inundación y con infraestructura de mitigación, afirmando: “Las ciencias naturales tienen

²⁶ “Interdisciplinary teams of physical and social scientists are being formed to work with stakeholders to co-produce knowledge that address complex questions posed by decision-makers” (Brasseur, 2012).

²⁷ Determinismo o probabilidad – solidez o resiliencia: ¿Cómo responder al cambio climático?

que enfocarse en analizar las probabilidades de ocurrencia del fenómeno, mientras que las ciencias sociales y la ingeniería tienen que trabajar juntas para entender cómo la interacción de la infraestructura y los entornos sociales impactan la solidez social y la resiliencia” (2013)²⁸. En este trabajo los autores defienden la idea de que es necesario integrar conocimientos sociales que permitan concebir un sentido crítico, la experiencia, la empatía y la información necesaria para concebir y construir obras de infraestructura ajustadas de manera correcta a las medidas de adaptación y mitigación que las comunidades necesitan y requieran. A nuestro juicio, este punto es importante, en la medida en que expone la necesidad de incluir elementos de análisis que proveen las CS y las HH para identificar adecuadamente las particularidades de cada territorio. En el siguiente apartado veremos como las CS y las HH contribuyen a la comunicación y educación de las causas y efectos del CC.

3.2.3. *Las Ciencias Sociales y Humanidades para la comunicación y educación*

En otros trabajos expuestos en AGU se reconoce el potencial que tienen las CS y las HH en la comunicación y educación para el CC. Su experticia aporta a la divulgación y a favorecer la comprensión y la apropiación del CC y las medidas de adaptación y mitigación. A su vez, facilitan conectar la sociedad civil (ciudadanos y organizaciones sociales), los tomadores de decisión (funcionarios del sector público y empleados o administradores del sector privado con poder suficiente para influir o ejecutar decisiones) y el mundo científico (investigadores y académicos) (A, Trtanj, & Collier, 2012; Byrne J, McDaniel, Graham, Little, & Hoggan J, 2012; Franco et al., 2010; Gleick, 2010; Leigh M, 2011; Molino G, Kenney M, Sutton-Grier, & Penn K, 2017; Prokopy et al., 2014).

En el mismo sentido, Leigh, artista con formación doctoral en Microbiología; Golux, director de teatro y desarrollador de software y Franzen, PhD en Biología; afirman en su exposición *In a Time of Change: Integrating the Arts and Humanities with Climate Change*

²⁸ “natural sciences have to focus on hazard probabilities, while engineering and social sciences have to work together to understand how interactions of the built and social environments impact robustness and resilience” (Plag, H, Earnest. D, Jules-Plag,S 2013).

*Science in Alaska*²⁹ que: “Las Artes y las Humanidades tienen la poderosa capacidad de crear líneas de comunicación entre el público y las esferas políticas y científicas” (2011)³⁰. Describen como a través del arte y de diversas manifestaciones estéticas se pueden crear y fortalecer lazos de empatía y puntos comunes de comprensión y vivencia del fenómeno del CC en una red de profesores, científicos, escritores, artistas visuales y comunidades nativas. A nuestro modo de ver, es importante destacar un avance interdisciplinar como este en una región como Alaska, que, debido a su sensibilidad ecosistémica ante el CC, lo convierte en uno de los primeros territorios para observar y evaluar los impactos del fenómeno en la vida de las comunidades. Este proyecto es una muestra de las potencialidades de los roles asumidos por las CS y las HH en cuanto a comunicación y educación para el CC, identificados en algunos de los trabajos presentados en AGU.

En cuanto a educación se reconocen dos estrategias principales, la primera a corto plazo y la segunda a mediano y largo plazo. La primera es la formación de los expertos de cambio climático para abordar estas tareas y la formación de científicos sociales y humanistas en temas ambientales (Byrne, McDaniel, Graham, & Hoggan, 2011; Byrne, Rasch, & Andronova, 2013; Byrne J et al., 2012; Dahlberg, Hoffman, & Maurakis, 2017). A mediano y largo plazo se describen estrategias de creación y/o fortalecimiento de cursos y contenidos transversales sobre temas ambientales, abordados interdisciplinariamente en todas las áreas del saber, tanto en la educación básica como en la educación superior (Byrne et al., 2013; Keener & Staal, 2011; Teranes, 2017).

Cabe destacar también, que se encontraron trabajos como los de Holzer (2011); Storcksdieck (2012); Bedford 2015; Byrne J, McDaniel, Graham, Little, Hoggan J 2012; Teranes, (2017); que defienden la necesidad de implementar estrategias de educación interdisciplinarias y transversales en todos los niveles educativos y en la sociedad civil, manteniéndose en línea con los principios de la educación ambiental definidos en la cumbre de la Tierra en 1992, cumbre donde se creó el convenio Marco para el cambio climático de

²⁹ Tiempo de cambio: Integrando las artes y las humanidades en la ciencia del cambio climático en Alaska.

³⁰ “The arts and humanities have a powerful capacity to create lines of communication between the public, policy and scientific spheres” (Leigh; Golux; Franzen, 2011).

la ONU. En este sentido, Sortksdieck afirma: “los principios que han guiado varios esfuerzos exitosos para implementar la educación climática trans e interdisciplinariamente incluyen: la orientación hacia la acción local y comunitaria; relevancia para los alumnos; compromiso de liderazgo y personal; libertad institucional y organizativa para experimentar y cooperar; oportunidades para explorar los fenómenos subyacentes de las ciencias naturales y sociales a través del aprendizaje práctico y activo; y compromiso con la excelencia y la "verdad científica"” (2012)³¹.

La comunicación y la educación componen dos áreas distintas que trabajan en sinergia en cuanto a temas ambientales se refieren, así como lo presentan Byrne, McDaniel, Graham y Hoggan en la descripción de su trabajo: “Estamos desarrollando un programa de educación y comunicación del Cambio Climático, para aplicar en los bachilleratos, las universidades y en la educación pública. El objetivo de este trabajo es congrega el conocimiento sobre el CC de los mejores científicos y científicos sociales usando una serie de nuevos formatos multimediales” (2011)³².

Por otra parte, se identifican trabajos que abordan la comunicación desde el punto de vista de los medios de comunicación. Algunos de los resúmenes afirman que en ocasiones, los medios de comunicación promueven una discusión social frente al fenómeno del CC, basada en creencias e intereses y no en datos o información científica (Roser-Renouf, Maibach, Lewandowsky, Cook 2016; Walker, 2017). Sin embargo, se identificó en otras conferencias, que ocasiones los medios ayudan a generar y liderar acciones de divulgación y

³¹ *“Principles that have guided various successful efforts to implement trans-and interdisciplinary climate education include orientation towards local and community action; relevance to learners; commitment by leadership and staff; institutional and organizational freedom to experiment and cooperate; opportunities to explore underlying natural and social science phenomena through hands-on and active learning; and commitment to excellence and scientific “truth””* (Storksdieck, 2012)

³² *“We are developing a climate change education and communication program (ECP) for application in high schools, colleges and in public education. The objective of this work is to convey climate change knowledge from the best scientists and social scientists using a series of new media format”* (Byrne, McDaniel, Graham, Hoggan, 2011).

comunicación con mensajes acertados y concretos basados en evidencia científica (Byrne, Rasch, Andronova, 2013).

En algunos trabajos como los de Dahlberg, Hoffman, Maurakis, 2017; Ledley, Carley, Niepold, Duggan-Haas, Hollweg, McCaffrey 2012; Niepold, Ledley, Stanton, Fraser, Scowcroft 2017; Sadri, 2015, se identifica, a nuestro modo de ver, cierto rol no instrumental pero limitado de las CS y las HH. En efecto, estos autores reconocen que las CS y las HH tienen la capacidad para ayudar a expresar, divulgar, establecer conexiones simbólicas y reflexiones éticas, pero no son incluidas de manera integral en los procesos para la comprensión y el diseño de las estrategias de mitigación y adaptación. Esto tiene una relación muy cercana con las características descritas por Lowe, Whitman y Phillipson (2009) quienes clasifican la interdisciplinariedad para el CC en dos vías, instrumental o no instrumental. Una vía interdisciplinaria no instrumental se da cuando las CS y las HH sirven de mediadoras para la comprensión e interpretación del CC, así como la diseminación de información clara, completa, confiable y abordable. Esta misma línea es compartida en los trabajos de Even et al., 2018; Jensen, 2015 y Kenney, 2014. Este último afirma que “Las decisiones climáticas y ambientales requieren una ciencia que combine los sistemas humanos y naturales para cuantificar o articular los cambios físicos, naturales y sociales observados o las posibles consecuencias de las diferentes opciones de decisión. A pesar de la necesidad de tal investigación relevante para las políticas, las colaboraciones multidisciplinarias pueden forjarse con desafíos de integración de datos, interoperabilidad de modelos y comunicación a través de divisiones disciplinarias. En esta charla, presentaré varios ejemplos en los que he colaborado con colegas de las ciencias físicas, naturales y sociales para desarrollar ciencia novedosa y accionable para informar la toma de decisiones.”, mostrando diversas experiencias exitosas, que incluyen el establecimiento de un red global de comunicación para la el programa de investigación del cambio global, liderado por el gobierno de Estados Unidos.

En esta categoría emerge también el asunto de la controversia del CC como un fenómeno de origen antropogénico, en el que se puede destacar un trabajo de revisión llamado

“Building Public Will for Climate Change Solutions: Which Beliefs Are Most Helpful?, presentado por Roser-Renouf en el 2016 que afirma:

“Durante la última década, ha habido una considerable cantidad de investigación empírica en ciencias sociales sobre la participación pública frente al cambio climático. En esta presentación, revisaremos brevemente los hallazgos de algunas de estas investigaciones para sugerir que cinco supuestos clave constituyen en gran medida la base de la voluntad pública para abordar el cambio climático. Específicamente, las personas que sostienen los siguientes supuestos tienen más probabilidades de apoyar acciones para limitar el cambio climático y personalmente tomar acciones útiles por sí mismas: (1) el cambio climático es real; (2) el cambio climático es causado por el hombre; (3) existe un consenso de expertos sobre el cambio climático causado por el hombre; (4) el cambio climático es perjudicial para las personas; (5) se pueden tomar medidas para limitar el cambio climático”³³

Estos cinco supuestos son los que efectivamente contribuyen a que la ciudadanía, no sólo comprenda el fenómeno, sino que se movilice a la búsqueda de soluciones intersectoriales (academia, gobiernos, sociedad civil) para enfrentar el CC, que, desde algunos contextos políticos y sociales, es puesto aún en duda. Al respecto, cabe resaltar lo expuesto por Siperstein en su conferencia *Developing Climate Change Literacy With the Humanities: A Narrative Approach*, en la que afirma que “en el contexto multidisciplinario de la educación en cambio climático, uno de los roles más importantes de las humanidades es empoderar a los estudiantes dándoles herramientas críticas y creativas para contar sus propias historias climáticas” (2015)³⁴. Para este autor ciertas herramientas de los estudios literarios y culturales, como los ejercicios narrativos (*narratives of speculation* y *narratives of conversion*), ayudarían a los estudiantes a ser conscientes y dar cuenta de los cambios en el

³³ “Over the past decade, there has been a considerable amount of empirical social science research on public engagement with climate change. In this presentation, we will briefly review the findings of some of this research to suggest that five key beliefs largely form the basis for public will to address climate change. Specifically, people who hold the following beliefs are more likely to support actions to limit climate change, and to personally be taking helpful actions themselves: (1) climate change is real; (2) climate change is human-caused; (3) there is expert consensus about human-caused climate change; (4) climate change is harmful to people; (5) actions can be taken to limit climate change” (Roser-Renouf C, 2016)

³⁴ “In the context of multidisciplinary climate change education, one of the most important roles of the humanities is to empower students by giving them the critical and creative tools to tell their own climate stories.” (Siperstein, 2015)

clima, vencer los prejuicios sobre el CC, imaginar y proponer futuros más justos y sostenibles basados en sus comunidades y ecologías locales.

El rol de la CS y las HH en el abordaje del CC, así como lo describen los trabajos de AGU clasificados en esta categoría de comunicación y educación, amplían nuestra perspectiva para enfrentar el CC desde una posición analítica, ética, propositiva y rigurosa. Veamos ahora como en otros trabajos podemos identificar la relación integral de las CS y las HH con otras ciencias.

3.2.4. Inclusión integral de las Ciencias Sociales y las Humanidades

Al identificar el cambio climático (CC) como un problema para la humanidad, las CS y las HH se han integrado a la búsqueda de soluciones, como es descrito en los trabajos presentados en AGU por Pearthree, Allison, Patten 2013; Rummel, Griffith, Kimmel, Landry, Montz 2012; Givens, Padowski, Guzman, Malek, Witinok-Huber, Cosens, Briscoe, Boll, Adam 2018; Adamson, 2018. Este último afirmaba en su exposición: “Los humanistas han estudiado durante mucho tiempo los deseos, motivaciones y comportamientos humanos, en literatura, historia, filosofía, psicología y comunicación. Durante los últimos quince años, también se han estado organizando internacionalmente entre ellos y con sus colegas en las ciencias naturales y sociales, y también en las comunidades locales. Este trabajo tiene como objetivo contribuir a conversaciones cada vez más urgentes sobre el diseño o la gestión de futuros sostenibles y socialmente justos.”³⁵ .

En los trabajos clasificados en esta categoría, hay un reconocimiento de la importancia de las CS y las HH. En algunos de ellos, además de esto, se describe como su integración permite aumentar el espectro para la comprensión del fenómeno del CC y favorecen el

³⁵ *“Humanists have long studied human desires, motivations and behaviors, in literature, history, philosophy, psychology and communication. For the last fifteen years, they have also been organizing internationally among themselves and with their colleagues in the natural and social sciences--and in local communities as well. This work aims to contribute to increasingly urgent conversations about designing or managing sustainable and socially-just futures.” (Adamson, 2018)*

diseño de medidas más acertadas y aceptadas socialmente (Rummel, Griffith, Kimmel, Landry, Montz 2012; Brown 2013; Clifford, Travis, Rangwala, Rondeau, Young 2016; Niyogi, Andresen, 2011). Al respecto, en el trabajo *Adopting an Engaged, Holistic Approach to Identifying Climate Change Adaptation Needs in Localized Environments: A Blueprint for Interdisciplinary Success Between the Sciences and Social Sciences*³⁶, dos investigadoras en comunicación y cambio climático describieron lo siguiente: “un equipo integrado por científicos, científicos sociales y miembros de la comunidad puede diseñar técnicas de adaptación adecuadas, con una mayor probabilidad de éxito” (Eise, 2018)³⁷.

No obstante, a pesar de reconocer avances en la integración de las CS y las HH para abordar el CC, desde las etapas iniciales de investigación hasta la implementación de medidas de adaptación y mitigación, algunos autores afirman que es necesario un mayor reconocimiento de sus logros y de su importancia en el tratamiento del fenómeno (Pearthree, Allison, Patten 2013; Liverman 2015;; Larson E K 2017; Hassol, 2014). Por su parte, Xu, Gober, Wheeler y Kajikawa, científicos provenientes de las áreas de STEM, afirman en *Quantitative and qualitative synthesis of socio-hydrological research*³⁸ que: “La participación de los científicos sociales es inadecuada, y una mayor integración transdisciplinar es deseable” (2017)³⁹. Estos investigadores enfatizan en su trabajo que las habilidades y métodos propios de los científicos sociales y humanistas difieren de las STEM, pero es esto lo que en efecto enriquece el conocimiento de las dinámicas humanas y sociales, de ahí que sea necesaria su integración.

Considerando también la diferencia y la diversidad entre las áreas del saber, otros autores participantes en las reuniones de AGU estudiadas, afirman que es dicha diferencia la clave para poder mejorar la comprensión del fenómeno, su divulgación y el diseño de las medidas de adaptación y mitigación (Bartley J et al., 2014; Gergel, 2014; Keener & Staal,

³⁶ Adopción de un abordaje holístico e integrador para identificar las necesidades de adaptación al cambio climático ambientes regionales: un plan para el éxito de la interdisciplinariedad entre las ciencias y las ciencias sociales.

³⁷ “*This integrated team of scientists, social scientists and community members can design customized adaptation techniques with much higher chances of success*” (Eise J, 2018).

³⁸ Síntesis cuantitativa y cualitativa de la investigación en socio hidrología

³⁹ “*The participation of social scientists is inadequate and greater cross-disciplinary integration is desirable*” (Xu et al., 2017)

2011; May et al., 2018). Dentro de las posibilidades se reconoce que las CS y las HH ayudan a ahondar en las causas, efectos y riesgos del cambio climático; además ayudan a desarrollar las capacidades sociales y habilidades necesarias para afrontarlos (DeLorme, 2011; McNutt, 2018; Kontar, 2013; Baule, Briley, Brown, Gibbons, 2014; Teranes 2017; Niepold, Ledley, Stanton, Fraser, Scowcroft, 2017). Así como lo afirma Gergel, graduada de historia con Ph. D. en Climatología, en su exposición: *From Environmental History to Environmental Engineering: Learning the Tools of the New Trade*, afirma que: “las ciencias sociales y las humanidades se enmarcan típicamente en términos de ser completamente dispares de las "ciencias duras", y aunque esta bipolaridad está lejos de ser precisa, las habilidades requeridas en cada área son bastante diferentes ... Conceptualizar el impacto del clima en los cambios en los recursos hídricos en términos de medios de vida humanos, por ejemplo, es necesario y productivo para comprender los impactos de las políticas a largo plazo. Este marco más amplio de preguntas de investigación es, por lo tanto, significativo para ir más allá de las conversaciones a veces estrechas que se mantienen a puerta cerrada de cada disciplina académica” (2014) ⁴⁰.

Otra de las características que emerge en la lectura, es que la inclusión de las CS y las HH favorecen el abordaje del problema desde perspectivas locales, comunitarias y personales, gracias a las posibilidades de comprensión y análisis de los deseos, valores, motivaciones y comportamientos tanto sociales como individuales (Adamson, 2018; Baule et al., 2014; Eise J, 2018; Kassam, Samimi, & Trabucco, 2017). Haciendo referencia a estrategias que involucran las humanidades ambientales, Adamson⁴¹ afirma lo siguiente:

Las emergentes colaboraciones interdisciplinarias basadas en las humanidades y orientadas a los valores entre comunidades indígenas y académicos que se enfrentan

⁴⁰ *“The social sciences and humanities are typically framed in terms of being completely disparate from the "hard sciences", and although this bipolarity is far from accurate, the skills required in each area are indeed quite different.... Conceptualizing the impact of climate change on water resources in terms of human livelihoods, for example, is both necessary and productive to understanding long-term policy impacts. This broader framing of research questions is thus significant in moving beyond the sometimes narrow conversations that are had behind the closed doors of each academic discipline”* (Gergel, 2014)

⁴¹ Es importante anotar que AGU invitó a Adamson a ser miembro honorario debido a su trayectoria en la consolidación del campo de las humanidades ambientales y su abordaje interdisciplinar del cambio climático. Con formación en el campo de las humanidades, Adamson, actualmente ejerce como directora del Environmental Humanities Initiative (EHI).

al cambio ambiental global. Por ejemplo, la respuesta indígena al cambio climático, ofrece ideas poderosas sobre cómo aprender de soluciones a escala local, basadas en la construcción de relaciones a medida que enfrentamos los desafíos de la respuesta a escala global a los desafíos ambientales (2018)⁴².

Esto que anota Adamson, nos muestra una integración mucho más amplia, pues no sólo reivindica las CS y las HH, sino que también incluye los saberes ancestrales y populares, que deben ser escuchados para el establecimiento de relaciones y la implementación de medidas que estén acorde con las realidades comunitarias y territoriales.

En línea con lo encontrado en la revisión de la literatura, la integración disciplinar de las CS y las HH se ha dado de manera lenta, pero con una relevancia contundente a pesar de los obstáculos asociados y a la deslegitimación a la que en ocasiones sus saberes y metodologías propias se enfrentan. El reconocimiento de la complejidad del fenómeno es un asunto común en quienes las reconocen como parte fundamental para su abordaje, quienes adicionalmente, reconocen la importancia de involucrar diferentes sectores y comunidades. En el trabajo *Developing A Transdisciplinary Process and Community Partnerships to Anticipate Climate Change at the Local Level: The Role of Biophysical and Sociocultural Calendars*⁴³, Kassam, sociólogo en compañía de dos geógrafos físicos señalan:

La diferencia es esencial para solventar los más complejos problemas que enfrenta la humanidad. El cambio climático de origen antropogénico es uno de esos problemas que demandan diversidad cognitiva. Científicos biofísicos y sociales tienen que colaborar con los académicos de las humanidades para enfrentar los asuntos prácticos que enfrentan las comunidades locales, que son quienes hacen frente a las variaciones que conlleva dicho cambio. Como tal, las comunidades de investigadores (por ejemplo; ciencias biofísicas y sociales, humanidades) deben trabajar en conjunto con las comunidades de práctica (por ejemplo, agricultores, pescadores, recolectores, pastores, cazadores). Esto conduce a un conocimiento cogenerado, donde una estrategia de adaptación a la variación climática se basa en una

⁴² "Emerging humanities-based, values-oriented, interdisciplinary collaborations with indigenous communities and scholars who are dealing with global environmental change. Indigenous response to climate change, for example, is offering powerful insights about how we might take lessons from local-scale solutions based on building relationship as we face the challenges of global-scale response to environmental challenges" (Adamson, 2018).

⁴³ Desarrollo de un proceso transdisciplinar y alianzas comunitarias para la adaptación al cambio climático a nivel local, el rol de los calendarios biofísicos y socioculturales.

perspectiva local del contexto biofísico y sociocultural de las comunidades donde los impactos de la variación climática son más percibidos. (Kassam, Samimi, Trabucco, 2017)⁴⁴.

Es así como los trabajos agrupados en esta categoría promueven la necesidad de un abordaje colaborativo desde todas las áreas del conocimiento, partiendo de la urgencia que manifiestan los desastres naturales incrementados por el cambio climático, obligando a ingenieros, científicos sociales y científicos naturales a abordar el asunto (García A A, Fischer H, Semken, Wentz E, Gober, 2018). Además de dicha urgencia, los procesos de investigación son influenciados por los acuerdos globales para trabajar por el bienestar de la humanidad, como es el caso de los 13 objetivos del desarrollo sostenible (ODS) que buscan luchar contra las inequidades sociales que derivan de las afectaciones del cambio climático (Liverman, 2015). Por su parte Hsiang (2013), haciendo referencia a formas que permitan comprender mejor el estado de las condiciones del CC que afectan el bienestar perseguido por los ODS afirma que: “al enlazar datos y métodos entre las ciencias físicas y las ciencias sociales, estamos empezando a entender cuándo, dónde y cómo las condiciones climáticas están causando impactos en el bienestar humano”⁴⁵.

Sin embargo, se debe continuar un trabajo necesario para mantener la credibilidad y reputación de los científicos sociales y los humanistas, tanto a nivel individual como institucional, que ha sido parte de la disputa histórica entre los saberes de los dos mundos que se referenciaba al inicio de este trabajo . Situación que, si bien es retadora, ha ganado espacio como es descrito en este apartado (Victor, 2018; Liverman, 2015) . En el trabajo

⁴⁴ *“Difference is essential to solving the most complex problems faced by humanity. Anthropogenic climate change is one such wicked problem that demands cognitive diversity. Biophysical and social scientists must collaborate with scholars from the humanities to address practical issues of concern to local communities, which are at the forefront of impacts of climatic variation. As such, communities of inquirers (e.g. biophysical and social sciences, humanities) must work in tandem with communities of practice (e.g. farmers, fishers, gatherers, herders, hunters). This leads to co-generated knowledge where an adaptation strategy to climatic variation is locally grounded in the biophysical and sociocultural context of the communities where the impacts of climatic variation are most felt (Kassam, Samimi, Trabucco, 2017)” (Kassam et al., 2017).*

⁴⁵ *“By linking data and methods across physical and social sciences, we are beginning to understand when, where, and how climatic conditions have a causal impact on human wellbeing” (Hsiang, 2013).*

Maintaining Credibility of The Social Sciences In The Highly Politicized Debate Over Climate Change, Victor describe como es necesario hacer este ejercicio que enfrenta grandes retos: “Estos desafíos son quizás aún más severos en las ciencias sociales porque los académicos en este campo tratan directamente con temas, como el papel del liderazgo y el ejemplo moral, que implican intrínsecamente a los individuos y a las instituciones creadas por los humanos”(2018)⁴⁶. Esto se da en entornos que siguen entrelazados en las disputas de los dos mundos y, en un fenómeno que ha sido liderado inicialmente por las STEM, las CS y las HH han asumido su papel para abordar la complejidad de los problemas ocasionados por el CC y en el que aún hay mucho camino por recorrer.

4. Conclusiones

En estas conferencias seleccionadas de la AGU entre 2010 y 2018 se confirma que en la integración disciplinar de las Ciencias Sociales y las Humanidades es dominante la orientación para la solución de problemas generados por el CC. Como se pudo constatar, las investigaciones giran en torno, en primer lugar, a la comprensión, la percepción de los riesgos del fenómenos físico; en segundo lugar, al papel de las CS y las HH en la mitigación de las afectaciones del CC que consisten básicamente en el diseño de medidas eficaces e integrales, esto es, que no se proponen solo desde conocimientos puramente técnicos, sino en los que se incluye conceptos y un sentido crítico que contribuyen a tener medidas ajustadas a las comunidades involucradas. En tercer lugar, las CS y HH ayudan en la solución de los problemas a través de estrategias de comunicación y educación para formar estudiantes en todos los niveles y ciudadanos en general capaces de participar en la discusión adecuada de los problemas y el diseño de soluciones. Por último, se reitera en

⁴⁶ “*These challenges are perhaps even more severe in the social sciences because scholars in this domain deal directly with topics, such as the role of leadership and moral example, that intrinsically implicate the of individuals and human-created institutions.*” (Victor, 2018)

estas conferencias la importancia de una inclusión colaborativa de las CS y las HH en todas las etapas de investigación sobre el CC.

Si bien en la sistematización realizada se puede observar que, desde un punto de vista cuantitativo, la distribución del número de resúmenes en cada categoría es relativamente equitativa y, por ello, no es posible afirmar que una categoría sea más importante o influyente que las otras. A través del análisis de los contenidos se pudo constatar que, en general, estos resúmenes muestran una integración de las CS y HH que ayuda al reconocimiento del cambio climático como un fenómeno no solo físico, sino también social y humano complejo.

No obstante, la alusión a las CS y las HH sigue siendo en su mayoría instrumental. Esta característica no es negativa en sí misma, pero sí limitante. El conocimiento y las estrategias que pueden aportar las CS y las HH para la solución, se puede ver limitado e insuficiente cuando se parte de la base de un conocimiento ajeno a su área y que no se ha integrado desde las primeras etapas. Una inclusión no instrumental incluye, necesariamente, las perspectivas propias y el sentido crítico que los investigadores de las CS y las HH pueden aportar. En este mismo sentido, los resultados obtenidos en el análisis de autorías de los trabajos analizados evidencian una superioridad en número por parte de los autores pertenecientes a STEM y en los trabajos con coautoría, sólo un poco más de la mitad son de equipos interdisciplinarios.

Se evidencia en los trabajos que mencionan las CS y las HH una búsqueda por ampliar la interdisciplinariedad y la integración para abordar el cambio climático, aunque el crecimiento es aún incipiente, la integración ha aportado en la ampliación de las perspectivas para la comprensión de las dinámicas sociales, las percepciones, los conflictos, su vulnerabilidad y resiliencia. Su acercamiento ha enriquecido un sentido crítico para diseñar e implementar medidas de adaptación que buscan ser más contextualizadas y eficientes. No obstante, a pesar de esta disrupción, es deseable seguir rompiendo brechas e integrar de mejor manera las STEM, las CS y las HH para abordar el cambio climático. Para que esto pueda darse plenamente es necesario romper los límites de los malentendidos y enfrentamientos entre las áreas del conocimiento, de tal manera que se haga un

reconocimiento de sus métodos, valor e importancia y la mirada válida del fenómeno desde otra perspectiva. Esta transformación es necesaria desde el plano individualidad e institucional, de lo contrario, esta es temporal e insostenible.

La participación de los expertos en ciencias sociales y humanidades tiene un lento crecimiento. Sin embargo, para alcanzar una participación integral, es deseable que las investigaciones y programas en torno al cambio climático, tanto interdisciplinarias como propias de cada área, aumenten su participación en espacios de socialización e intercambio de las comunidades científicas como es el caso de AGU. Abrirse camino en estos espacios es una posibilidad para continuar el posicionamiento y legitimización de los saberes y las formas de las CS y las HH. Además, es necesario ahondar en la formación interdisciplinar buscando legitimidad y que se establezca una integración de los saberes, o al menos una conversación, es necesario tener un marco común de conceptos, alcances y limitaciones. Este marco común es indispensable para alcanzar un nivel básico de la interdisciplinariedad, en dónde se puede tener un diálogo con conceptos comunes sobre un mismo fenómeno. Sin embargo, para seguir avanzando en la integración disciplinar, es necesario establecer límites y enlaces según los alcances de cada área y establecer un marco epistemológico común.

Este y otros trabajos elaborados sobre el asunto ponen sobre la mesa una pregunta, ¿de qué manera nos estamos involucrando los investigadores sociales y los humanistas ante una crisis global que reclama acciones individuales y colectivas para la transformación en la forma en que vivimos? El hecho de que nos encontremos ante un cambio de época, y no precisamente en una época de cambio, pone en evidencia la necesidad de repensar las formas en que abordamos las realidades humanas y sociales.

Esto nos implica generar interrupciones en estructuras aparentemente sólidas o a las que estamos aferrados. Como seres humanos estamos abocados a escuchar y comprender al otro y lo otro, reconocer aquello en nuestro entorno que no es humano. Enfrentarnos a esto, nos confronta también a temas éticos, religiosos, espirituales, políticos, poniéndonos en una encrucijada como ciudadanos e investigadores. Las nuevas realidades ya no solo piden, nos

obligan a pensar la sociedad y la humanidad de una manera en que se pongan todos los conocimientos adquiridos, todas las capacidades sociales y de la academia para afrontar un fenómeno que es inminente y nos pone en una situación de crisis. La humanidad hoy está interconectada y se debe mirar desde el espacio en tiempo real, para intercambiar información más allá de cualquier frontera. Pero esta aparente universalidad se contrasta con la necesidad de transformaciones individuales y colectivas de diferentes escalas.

Las acciones que emprendamos frente al cambio climático y la crisis ambiental deben emprenderse sin dar espera, sin caer en un círculo de desesperación y apocalipsis, pero sin ignorar la gravedad de la situación. Las CS y las HH tienen el deber de aportar desde el sentido crítico y reflexivo a la contextualización y creación de conexiones para que como humanidad nos veamos realmente implicados en una situación que hemos creado y que tenemos que afrontar.

El hecho de que las CS y las HH hayan tenido un acercamiento aparentemente tímido no desestima la profundidad de sus conocimientos y capacidad crítica de quienes son sus abanderados y la fuerza de sus acciones en los tres roles descritos. Para esto es necesario reconocernos al interior de nuestro campo científico y responder a lo que ya no es un problema de conocimiento técnico, sino un problema ético y un problema de cómo reconocemos la vida y qué valor le damos a las cosas.

Esta investigación describe una circunstancia en una asociación científica bastante reconocida a nivel mundial, pero más que plantear respuestas, plantea preguntas, por ejemplo ¿cómo organizarnos para poder influir en lo que es la responsabilidad social de la academia y enfrentar lo que nos pasa como humanidad? ¿cuál es la acción que se deriva de la reflexión propia de las humanidades?

Cómo se señaló en la introducción, el Antropoceno es considerada la entrante época geológica del planeta y en esta transición el cambio climático es sólo la punta del iceberg de diversas problemáticas ambientales y sociales. Invocando entonces la necesidad de seguir profundizando en los caminos que otros ya empezaron a caminar: la justicia ambiental, la

historia ambiental, la ecocrítica, los derechos ambientales. Reconocer esa realidad implica movilización individual y social, implica repensar nuestras instituciones, nuestros sistemas económicos e incluso nuestra alimentación. Citando a Taylor “Mi principal tesis es que sólo podemos abordar el fenómeno de derrumbe de una civilización si tratamos de entender con mayor claridad y profundidad las significaciones comunes e intersubjetivas de la sociedad que hemos vivido hasta ahora” (Taylor, 1985:196).

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7. Anexos

Anexo 1, Resúmenes analizados. La tabla contiene el título, la sesión y sección, autores, año, y resumen completo. Clasificados según las categorías,

Las Ciencias Sociales y Humanidades como instrumento para la comprensión del cambio climático

	title	session	section	index_ter	authors	country	year	university	abstract
1	New institutional mechanisms to bridge the information gap between climate	Institutional Support for Science and Scientists in an Age of Public Scrutiny I	Public Affairs	['Decision making under uncertainty', 'Institutions', 'Science policy', 'General or	['Rogers, W*', 'Gulledge, J M']	USA	2010	Center for a New American Security	<p>Many decision makers lack actionable scientific information needed to prepare for future challenges associated with climate change. Although the scope and quality of available scientific information has increased dramatically in recent years, this information does not always reach - or is not presented in a form that is useful to - decision makers who need it. The producer (i.e. scientists) community tends to be stovepiped, even though consumers (i.e. decision makers) often need interdisciplinary science and analysis. Consumers, who may also be stovepiped in various agencies or subject areas, may lack familiarity with or access to these separate communities, as well as the tools or time to navigate scientific information and disciplines. Closing the communication gap between these communities could be facilitated by institutionalizing processes designed for this purpose. We recommend a variety of mainstreaming policies within the consumer community, as well as mechanisms to generate a strong demand signal that will resonate more strongly with the producer community. We also recommend institutional reforms and methods of incentivizing policy-oriented scientific analysis within the producer community. Our recommendations focus on improving information flow to national security and foreign policy decision makers, but many are relevant to public policy writ large. Recommendations for Producers 1. The scientific community should formally encourage collaborations between natural and social scientists and reward publications in interdisciplinary outlets Incentives could include research funding and honorary awards recognizing service to public policy. 2. Academic merit review should reward research grants and publications targeted at interdisciplinary and/or policy-oriented audiences. Reforms of merit review may require new policies and engaged institutional leadership. Recommendations for Consumers 1. Congress should amend Title VI of the National Defense Education Act to encourage the development of multidisciplinary educational programs on the national security implications of climate change. 2. Federal agencies should establish funding programs to encourage producers to provide scientific information tailored to consumer needs. 3. The Department of State should appoint climate advisors to serve within the regional bureaus and on the policy and planning staff. 4. Federal agencies, the Department of Education, and the National Science Foundation should develop programs to stimulate new interdisciplinary research partnerships and training of a new generation of interdisciplinary climate change risk thinkers, assessors and managers. 5. Federal agencies should encourage Senior Executive Service decision makers to participate in science policy certification workshops and include science and technology policy as a core curriculum component of the SES Federal Candidate Development Program. These recommendations are described in detail in a report published by the Center for a New American Security: Rogers, W. and J. Gulledge (2010) Lost in Translation: Closing the Gap Between Climate Science and National Security Policy (available online: http://cnas.org/node/4391)</p>

2	The Demonstration Test Catchment Approach to Land and Water	Applying River and Watershed Research to Facilitate Management and Guide	Hydrology	['Catchment', 'Surface water quality', 'Water management', 'Science policy']	['Jonczyk, J*', 'Quinn, P F', 'Haygarth, P', 'Reaney, S', 'Wilkinson, M', 'Burke, S',	United Kingdom	2010	Dept. of Civil Engineering	<p>The Demonstration Test Catchment (DTC) initiative is a five year project to address pollution issues in catchments. The initiative will study the wider environmental problems suffered by catchments which are under intense farming pressures and potential climate change impacts. The UK Department for Food, Agriculture and Rural Affairs (Defra) in partnership with the Environment Agency for England and Wales (EA) have funded this initiative to answer key policy concerns in catchments. The first key step has been the establishment of a 'research platform' at three catchments in the UK (The Eden, Wensum and Hampshire Avon) whereby funding of 9.3 million dollars has gone into funding new equipment and pollution sampling regimes have been established. Within each catchment between three and four, 8-10km² sub-catchments have been established. The experimental design and thinking for DTCs will be explained fully in this paper. The next phase of the project will install an extensive suite of land management and pollution mitigation interventions. In parallel to this monitoring work, a full knowledge exchange package will seek to engage with farmers, the rural community and understand the governance regime at the broader catchment scale. There is also a need for a modelling component to upscale the findings to the whole of the UK. Whilst this is an ambitious goal, there is a very basic commitment of working with rural communities to come up with real solutions that will help underpin effective policy making for the future. The research platform covers a multi-scale approach to the monitoring strategy that will allow local grouping of mitigation measures to be studied local in terms of impact and propagated to the catchment scale. Even with high level of funding, the DTC can only fully instrument a catchment of 8-10km². Beyond this scale, the EA and the standard catchment monitoring will continue as normal. The focus here is to prove that mitigation can be achieved within smaller land units that have a clear catchment scale benefit. This will provide the evidence base for future policy which is of use to all location in the UK. Hence, the need to have suite of parameters that can be evaluated has given rise to specific experimental design. Fundamental to this is to use continuous telemetered sampling at as many location as possible, including field laboratories capable of measuring, Nitrate, Ammonia, Total Phosphorus, dissolved phosphorus, suspended sediment and chlorophyll a. Standard hydro-metrological equipment is also fully telemetered. The goal is to allow all the data to be freely available to all end users via an internet data portal. The long term goal is to invite experts from many environmental and social sciences to work at the established research platform and ultimately give a better understanding of what a healthy catchment should be like. Being able to communicate this point to both local and national audiences will also be made and will link closely to the UK Virtual Observatory project funded by the NERC.</p>
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3	Developing Curriculum to Help Students Explore the Geosciences' Cultural	Climate Literacy: Engaging and Evaluating Public and K-12 Audiences Around	Education and Human Resources	['Post-secondary education ', 'Teaching methods ', 'Instructional tools ', 'Diversity	['Miller, G*', 'Schoof, J T', 'Therrell, M D']	USA	2011	Curriculum & Instruction	<p>Even though climate change and an unhealthy environment have a disproportionate affect on persons of color, there is a poor record of diversity in geoscience-related fields where researchers are investigating ways to improve the quality of the environment and human health. This low percentage of representation in the geosciences is equally troubling at the university where we are beginning the third and final year of a project funded through the National Science Foundation's (NSF) Opportunities to Enhance Diversity in the Geosciences (OEDG). The purpose of this project is to explore a novel approach to using the social sciences to help students, specifically underrepresented minorities, discover the geosciences' cultural relevance and consider a career in the earth, atmospheric, and ocean sciences. To date, over 800 college freshmen have participated in a design study to evaluate the curriculum efficacy of a geoscience reader. Over half of these participants are students of color. The reader we designed allows students to analyze multiple, and sometimes conflicting, sources such as peer-reviewed journal articles, political cartoons, and newspaper articles. The topic for investigation in the reader is the 1995 Chicago Heat Wave, a tragic event that killed over 700 residents. Students use this reader in a core university course required for entering freshmen with low reading comprehension scores on standardized tests. To support students' comprehension, evaluation, and corroboration of these sources, we incorporated instructional supports aligned with the principles of Universal Design for Learning (UDL), reciprocal teaching, historical reasoning, media literacy, and quantitative reasoning. Using a digital format allows students to access multiple versions of the sources they are analyzing and definitions of challenging vocabulary and scientific concepts. Qualitative and quantitative data collected from participating students and their instructors included focus groups, a content test, an epistemology survey (with think-aloud interviews that also served for cognitive testing purposes), classroom observations, student work, and tracking of student navigation through the digital reader. Overall, the impact this curriculum had on students' affective and academic learning varied; however, the instructional supports we developed to temper challenge with instructional support appear to have had a positive impact on student learning. Analysis of data illustrates how these supports improved their comprehension of multiple, and sometimes conflicting sources. Student feedback from focus groups and interviews also indicate that using a social science lens to learn about concepts such as urban heat island was engaging. In terms of students' understanding of the nature of knowledge in the sciences, the epistemology survey and interview seem to indicate that students lack a complex understanding of continuity and change in scientific knowledge. Further, participants appeared to have many misconceptions about scientific inquiry. As a result, we are currently developing a similar curriculum for a lab-based geography course, GEOG104: Weather, Climate, and Society.</p>
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4	Energy Literacy: A	Climate Literacy:	Education and Human	[Elementary and	[Inman, M M*]	USA	2011	Department of Energy	As with climate science topics, many Americans have misconceptions or gaps in understanding related to energy topics. Recent literacy efforts are geared to address these gaps in understanding. The U.S. Global Change Research Program’s recently published “Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education” offers a welcome complement to the Climate Literacy Essential Principles released in 2008. Research and experience suggest that education, communication and outreach about global climate change and related topics is best done using a solutions-based approach. Energy is a natural and effective topic to frame these solutions around. Used as a framework for designing curricula, Energy Literacy naturally leads to solutions-based approaches to Climate Change education. An inherently interdisciplinary topic, energy education must happen in the context of both the natural and social sciences. The Energy Literacy Essential Principles reflect this and open the door to curriculum that integrates the two.
5	Tipping Points and Balancing Acts: Grand Challenges and Synergistic	Climate Literacy: Integrating Research and Education, Science and	Education and Human Resources	[EDUCATION , Geoscience education research , GLOBAL CHANGE ,	[McCaffrey, M S* , Stroeve, J C]	USA	2011	CIRES	The “Grand Challenges” to address Global Change identified by the International Council for Science (ICSU) and its partners through the Earth System Sustainability Initiative—improving forecasting, enhancing and integrating observation systems, confining and minimizing global environmental change, responding effectively to change, as well as innovating and evaluating these efforts—require an integrative approach that engages and inspires society in general and young people in particular. What are some of the effective strategies—and stumbling blocks—in being able to make Earth System science and related sustainability efforts relevant and practical to non-technical audiences? Recent climate education projects have pioneered new strategies toward linking and infusing research with education, science with solutions. For example, the Climate Literacy and Energy Awareness Network (CLEAN), a National Science Digital Library Pathway funded by NSF, has approached this integral approach by “closing the loop” between climate and energy topics, identifying and annotating high quality online resources relating to the carbon cycle and related topics. The Inspiring Climate Education Excellence (ICEE) project, funded by NASA, offers professional development for teachers that infuses climate science with solutions as an emerging “best practice” while being sensitive to the emotional, psychological and political aspects of avoiding “gloom and doom” on one hand or advocating for particular policy solutions on another. Other examples includes NASA’s climate website (http://climate.nasa.gov), which serves as a robust, engaging portal for climate research and data, especially for educators. The recent PBS series Earth: The Operators’ Manual and related book and website are other recent example of how climate science research, education and solutions can be incorporated in a way that is appealing and informative. The Alliance for Climate Education (ACE) has given assemblies in thousands of US high schools that integrate climate science and solutions in a way that inspires and informs youth, and similar programs exist internationally. Other approaches to prepare vulnerable communities, especially young people, for natural hazards and human-induced environmental change include programs such as Plan International’s “Child Centered Disaster Risk Reduction- Building Resilience Through Participation,” and their “Weathering the Storm” project, focusing on integrating the needs of teenage girls with climate change adaptation and risk reduction. While minimizing global environmental and climate change is crucial, these and related programs that weave research with education, science with solutions offer the potential for addressing the “Grand Challenges” by better preparing for societal and environmental tipping points through a more balanced and integrated approach to addressing change.”

6	A Scientist's Guide to PA13B.* Countering Denial Public Affairs ['EDUCATION ' , 'POLICY ['Rosenau, J*'] USA 2012 National Center for	Why are so many scientifically uncontroversial topics, from evolution and the age of the earth to climate change and vaccines, so contentious in society? The American public respects science and scientists, yet seems remarkably unaware of - or resistant to accepting - what scientists have learned about the world around us. This resistance holds back science education and undermines public policy discussions. Scientists and science communicators often react to science denial as if it were a question of scientific knowledge, and respond by trying to correct false scientific claims. Many independent lines of evidence show that science denial is not primarily about science. People reject scientific claims which seem to conflict with their personal identity - often because they believe that accepting those claims would threaten some deeply-valued cultural, political, or religious affiliation. Only by identifying, addressing, and defusing the underlying political and cultural concerns can educators, scientists, and science communicators undo the harm done by science denial.
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7	Oceans and Human Health: Linking Ocean, Organism, and Human Health for Sustainable Oceans I (Video On-Demand)	Ocean Sciences	[Monitoring, forecasting, prediction, 'Health impact', 'Ecological prediction	[Sandifer, P A*, 'Trtanj, J', 'Collier, T K']	USA	2012	NOAA	<p>Scientists and policy-makers are increasingly recognizing that sustainable coastal communities depend on healthy and resilient economies, ecosystems, and people, and that the condition or “health” of the coastal ocean and humans are intimately and inextricably connected. A wealth of ecosystem services provided by ocean and coastal environments are crucial for human survival and well being. Nonetheless, the health of coastal communities, their economies, connected ecosystems and ecosystem services, and people are under increasing threats from health risks associated with environmental degradation, climate change, and unwise land use practices, all of which contribute to growing burdens of naturally-occurring and introduced pathogens, noxious algae, and chemical contaminants. The occurrence, frequency, intensity, geographic range, and number and kinds of ocean health threats are increasing, with concomitant health and economic effects and eroding public confidence in the safety and wholesomeness of coastal environments and resources. Concerns in the research and public health communities, many summarized in the seminal 1999 NRC Report, From Monsoons to Microbes and the 2004 final report of the US Commission on Ocean Policy, resulted in establishment of a new “meta-discipline” known as Oceans and Human Health (OHH). OHH brings together practitioners in oceanography, marine biology, ecology, biomedical science, medicine, economics and other social sciences, epidemiology, environmental management, and public health to focus on water- and food-borne causes of human and animal illnesses associated with ocean and coastal systems and on health benefits of seafood and other marine products. It integrates information across multiple disciplines to increase knowledge of ocean health risks and benefits and communicate such information to enhance public safety. Recognizing the need for a comprehensive approach to ocean health threats and benefits, Congress passed the Oceans and Human Health Act of 2004. Major outcomes of the OHH Act of 2004 include: --A national focus on ocean health and its relation to human health and well-being; --Enhanced interagency coordination and cooperation in research, development, and education; --Emphasis on development of a new, interdisciplinary community of practice; --Increased understanding of linkages between marine animal health and human health and the dangers of transmission of zoonotic diseases from the marine environment; --A richer understanding of factors affecting the occurrence and impacts of ocean health threats; --An enhanced ability of the ocean science and public health communities to respond to health-related emergencies; --A strong focus on development of ecological forecasts that are providing early warning of ocean health threats and impacts, thus improving the effectiveness of protection and mitigation actions. Taken together, these outcomes contribute significantly to more sustainable management of coastal resources and communities.</p>
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8	Shaping the global landscape in the Anthropocene	The Future of Human-Landscape Systems II (Video On-Demand)	Earth and Planetary Surface Processes	['GLOBAL CHANGE ', 'Earth system modeling ', 'System operation and	['Lotze-Campen, H*']	Germany	2012	Climate Impacts and Vulnerabilities	<p>In the emerging era of the Anthropocene (Crutzen and Stoermer 2000) most ecosystems are either directly or indirectly influenced by human activities, and neither socio-economic processes nor environmental changes can be understood without taking their interactions into account. Social transitions towards more sustainable development paths will only be achieved through a co-evolution process of society and nature. Both are parts of one integrated "Earth system", where land and water use are key linking elements. In the industrialised countries the transition task will have to focus on maintaining current standards of living while reducing the demand for ecosystem services. In the developing countries the major challenge will be to raise income levels substantially and find more sustainable development paths that try to minimise the negative side-effects of economic growth. Due to technological changes and a globally integrated economy, human society is now in a position where it has to ask itself: "What kind of landscapes and ecosystems do we really want in the future?" Shaping environmental conditions in the course of economic growth and climate change becomes a social management task. While many environmental and social problems have to be dealt with at the regional and national scale, in some areas, like climate change and international trade, the level of analysis and political action extends to the global scale. The allocation of land and water resources for different human uses has to be consciously managed. The potential and limitations of different options and the trade-offs between land expansion, increased land use intensity and re-allocation between different uses have to be carefully assessed. While agricultural productivity has continuously grown in the past, a slowing pace has to be expected in many regions in the future. Water may pose the most serious limitation to future global food and bioenergy supplies. Rising crop outputs per unit of land and water are essential to feed growing demands. The technological and organisational changes required to increase productivity will only be achieved through continuous investments and appropriate institutional settings and incentives. Strategies for a "sustainable land management" will only emerge from truly integrated methods of analysis. These have to combine theories, models and data from various social sciences (e.g. economics, sociology, psychology) and natural sciences (e.g. ecology, hydrology, biogeochemistry). We provide an integrated assessment approach for modeling global landscape change and related management options, including changes in lifestyles and global consumption patterns. The global biogeochemistry model LPJmL (Bondeau et al. 2007) is linked to the economic land and water use model MAgPIE (Lotze-Campen et al. 2008) and the economy-climate model REMIND-R (Leimbach et al. 2010). We illustrate the trade-offs between different societal goals with regard to land use and landscape diversity. Finally, we provide a research design for multi-scale analysis of landscape change through a combination of regional case studies with our global models of the economy, biosphere, and climate.</p>
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9	The Importance of Change: Integrating Natural and Social Global Environmental Change	Global Environmental Change	['Climate variability ', 'Impacts of ['Ponce de Leon Barido, D*', USA 2012	Institute on the Environment	Freshwater availability and human prosperity are intricately connected. In many parts of the world however, water demands exceed the renewable water supply and groundwater resources are depleted at an alarming rate. Such is the case in India, especially in its agriculturally intensive regions of Punjab and Telangana where most of the country's rice and wheat is produced. Punjab (Northwest India; deep alluvial aquifers), and Telangana (Central India; shallow bedrock aquifers), with vastly different natural resource endowments (water and hydrogeology) and economic structures, present an exemplary case study for depicting the linkages that exist between hydrological variability, climate change adaptation, and regional sectorial economies. We focus our study on precipitation variability and key parameters that can explain how the Indian monsoon has been evolving over time: total and monthly monsoon rainfall, the frequency and length of dry spells, the spatial distribution of rainfall, and the frequency and intensity of extreme events. Using a social accounting matrix (SAM) to describe the sector composition and structure of the Punjab, Telangana and the rest of India, we evaluate the economic implications of variability, adaptation, and policy changes, via a general equilibrium framework. Hydrologic variability and change is given context as "water shocks" are translated to economic consequences allowing to study scenarios and trade-offs.
10	The Role of Uncertainty in Climate GC33F.* Construing Uncertainty in Global Environmental Change	Global Environmental Change	['GLOBAL CHANGE ', 'HISTORY OF ['Oreskes, N*'] USA 2012	History	Scientific discussions of climate change place considerable weight on uncertainty. The research frontier, by definition, rests at the interface between the known and the unknown and our scientific investigations necessarily track this interface. Yet, other areas of active scientific research are not necessarily characterized by a similar focus on uncertainty; previous assessments of science for policy, for example, do not reveal such extensive efforts at uncertainty quantification. Why has uncertainty loomed so large in climate science? This paper argues that the extensive discussions of uncertainty surrounding climate change are at least in part a response to the social and political context of climate change. Skeptics and contrarians focus on uncertainty as a political strategy, emphasizing or exaggerating uncertainties as a means to undermine public concern about climate change and delay policy action. The strategy works in part because it appeals to a certain logic: if our knowledge is uncertain, then it makes sense to do more research. Change, as the tobacco industry famously realized, requires justification; doubt favors the status quo. However, the strategy also works by pulling scientists into an "uncertainty framework," inspiring them to respond to the challenge by addressing and quantifying the uncertainties. The problem is that all science is uncertain—nothing in science is ever proven absolutely, positively—so as soon as one uncertainty is addressed, another can be raised, which is precisely what contrarians have done over the past twenty years.

11	The Social Impact of Climate	Union Science for Solutions	Union	['GLOBAL CHANGE',	['Hsiang, S M*']	USA	2013	Goldman School of Public	Managing climate change requires that we understand the social value of climate-related decisions. Rational decision-making demands that we weigh the potential benefits of climate-related investments against their costs. To date, it has been challenging to quantify the relative social benefit of living under different climatic conditions, so policy debates tend to focus on investment costs without considering their benefits. Here I will discuss challenges and advances in the measurement of climate's impact on society. By linking data and methods across physical and social sciences, we are beginning to understand when, where, and how climatic conditions have a causal impact on human wellbeing. I will present examples from this burgeoning interdisciplinary field that quantify the effect of temperature on macroeconomic performance, the effects of climate on human conflict, and the long-term health and economic impact of tropical cyclones. Each of these examples provide new insight into previously unknown benefits of various climate management strategies. I conclude by describing new efforts to systematically gather and compare findings from across the research community to support informed and rational climate management decisions.
12	Bridging the Science/Policy Gap	Climate Literacy: Effective	Education and Human Resources	['Elementary and secondary	['Kalafatis, S*']	USA	2014	University of Michigan Ann Arbor	Generating the capacity to facilitate the informed usage of climate change science by decision makers on a large scale is fast becoming an area of great concern. While research demonstrates that sustained interactions between producers of such information and potential users can overcome barriers to information usage, it also demonstrates the high resource demand of these efforts. Our social science work at Great Lakes Integrated Sciences and Assessments (GLISA) sheds light on scaling up the usability of climate science through two research areas. The first focuses on partnerships with other boundary organizations that GLISA has leveraged \u2013 the \u201cboundary chains\u201d approach. These partnerships reduce the transaction costs involved with outreach and have enhanced the scope of GLISA\u2019s climate service efforts to encompass new users such as First Nations groups in Wisconsin and Michigan and underserved neighborhoods in St. Paul, Minnesota. The second research area looks at the development of information usability across the regional scale of the eight Great Lakes states. It has identified the critical role that communities of practice are playing in making information usable to large groups of users who work in similar contexts and have similar information needs. Both these research areas demonstrate the emerging potential of flexible knowledge networks to enhance society\u2019s ability to prepare for the impacts of climate change.

13	Communicating Climate Change in the	Key Challenges in Climate Adaptation:	Global Environmental Change	[Earth system modeling', 'Impacts of	[Prokopy, L S*', 'Carlton, S', 'Dunn, M']	USA	2014	Purdue University	<p>Understanding U.S. agricultural stakeholder views about the existence of climate change and what influences these views is central to developing communication in support of adaptation and mitigation. It has been postulated in the literature that extreme weather events can shape people's climate change beliefs and adaptation attitudes. In this presentation, we use data from pre- and post-extreme event surveys and interviews to examine the effects of the 2012 Midwestern US drought on agricultural advisors' climate change beliefs, adaptation attitudes, and risk perceptions. We found that neither climate change beliefs nor attitudes toward adaptation changed significantly as a result of the drought. Risk perceptions did change, however, with advisors becoming more concerned about risks from drought and pests and less concerned about risks related to flooding and ponding. Qualitative interviews revealed that while advisors readily accept the occurrence of extreme weather as a risk, the irregularity and unpredictability of extreme events for specific localities limits day-to-day consideration in respect to prescribed management advice. Instead, advisors' attention is directed towards planning for short-term changes encompassing weather, pests, and the market, as well as planning for long-term trends related to water availability. These findings provide important insights for communicating climate change in this critical sector while illustrating the importance of social science research in planning and executing communication campaigns.</p>
14	From Researchers to Teachers to	Key Challenges in Climate Adaptation:	Global Environmental Change	[Earth system modeling', 'Impacts of	[Bartholow, S*', 'Warburton, J', 'Larson,	USA	2014	ARCUS	<p>PolarTREC (Teachers and Researchers Exploring and Collaborating) is a National Science Foundation funded program in which K-12 teachers spend 3-6 weeks participating in hands-on, transformative field research experiences in the polar regions which focus heavily on climate change and climate science. Administrated by the Arctic Research Consortium of the United States, the goal of PolarTREC is to invigorate polar science education and understanding by bringing K-12 educators and polar researchers together.</p> <p>Since 2007, the PolarTREC program evaluation has been collecting deep and diverse sets of data from all audiences engaged in the project. Nearly all expeditions focus on at least one aspect of climate change science. Teacher and researcher participants are queried pre- and post- expedition on their knowledge and interested in polar science, K-12 education, and a critique of the PolarTREC program. A specific highlight is the thousands of students surveyed in regards to their knowledge gain, attitudes, and interest in science learning. Additionally, longitudinal studies expose the myriad of ways that the PolarTREC program influences teachers and their practice many years after program completion. The findings influence and shape the program every year, nearly perfecting the strategy for communicating climate change science to audiences around the world.</p> <p>This presentation will present the social science research findings in our extensive evaluation and provide best practices for program structure as well as evaluation methods to best capture the impact on audiences beyond participants.</p>

15	Opportunities and Examples for	Key Challenges in Climate Adaptation:	Global Environmental Change	['Earth system modeling ', 'Impacts of	['Kenney, M A *']	USA	2014	University of Maryland College Park	Climate and environmental decisions require science that couples human and natural systems to quantify or articulate the observed physical, natural, and societal changes or likely consequences of different decision options. Despite the need for such policy-relevant research, multidisciplinary collaborations can be wrought with challenges of data integration, model interoperability, and communication across disciplinary divides. In this talk, I will present several examples where I have collaborated with colleagues from the physical, natural, and social sciences to develop novel, actionable science to inform decision-making. Specifically, I will discuss a cost analysis of water and sediment diversions to optimize land building in the Mississippi River delta (winner of American Geophysical Union Water Resources Research Editor's Choice Award 2014) and the development of a National Climate Indicator System that uses knowledge across the physical, natural, and social sciences to establish an end-to-end indicator system of climate changes, impacts, vulnerabilities, and responses. The latter project is in the process of moving from research to operations, an additional challenge and opportunity, as we work with the U.S. Global Change Research Program and their affiliated Federal agencies to establish it beyond the research prototype. Using these examples, I will provide some lessons learned that would have general applicability to socio-environmental research collaborations and integration of data, models, and information systems to support climate and environmental decision-making.
16	Completed	Exploring the Role	Public Affairs	['Impacts of	['Jensen, A M *']	USA	2015	UMIAQ	The Arctic contains many sites with exquisite organic preservation, which can be used to inform policy decisions in two very different ways. Archaeological sites can be considered at the result of completed experiments in human adaptation. With proper analysis of the multiple types of data they contain, one can see how climate change affected arctic ecosystems (including the human components) and how successful human responses were. Secondly, archaeological finds can provide vivid illustrations of the effects of climate change effects and extreme climatic events at a particular place. These illustrations appear to be far easier for members of the public to relate to than other means of transmitting scientific information, and can be good means of motivating people to be proactive.

17	Arctic System Science: Meeting Earth System and Social Impact <i>The arts and humanities have a powerful capacity to create</i>	Cryosphere	['Cryospheric change ', 'Impacts of global change ', 'Decision	['Vorosmarty, C J*', 'Hinzman, L D', 'Rawlins, M A', 'Serreze, M	USA	2017	CUNY City College of New York	<p>The Arctic is an integral part of the Earth system where multiple interactions unite its natural and human elements. Recent observations show the Arctic to be experiencing rapid and amplified signatures of global climate change. At the same time, the Arctic systems response to this broader forcing has itself become a central research topic, given its potential role as a critical throttle on future planetary dynamics. Changes are already impacting life systems and economic prosperity and continued change is expected to bear major implications far outside the region. We also have entered an era when environmental management, traditionally local in scope, must confront regional, whole biome, and pan-Arctic biogeophysical challenges. While challenges may appear to operate in isolation, they emerge within the context of an evolving, integrated Arctic system defined by interactions among natural and social sub-systems. Clearly, new efforts aimed at community planning, industrial development, and infrastructure construction must consider this multiplicity of interacting processes.</p> <p>We recently organized an Arctic System Synthesis Workshop Series supported by the Arctic Systems Science Program of NSF and devoted to exploring approaches capable of uncovering the systems-level behavior in both the natural and social sciences domains. The series featured two topical meetings. The first identified the sources responsible for extreme climate events in the Arctic. The second focused on multiple currencies within the system (i.e., water, energy, carbon, nutrients) and how they interact to produce systems-level behaviors. More than 40 experts participated, drawn from the ranks of Arctic natural and social sciences.</p> <p>We report here on the workshop series consensus report, which identifies a broad array of topics. Principal among these are a consideration of why study the Arctic as a system, as well as an articulation of the major systems-level approaches to support basic as well as policy-relevant research on the Arctic. Two examples of these approaches are given with respect to extremes (exposure, impacts and reverberations within and outside of the Arctic) and currencies (their role in uniting the Arctic as an interacting system). We will also review some proposed programmatic elements to support this new science.</p>
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18	Global Water Cycle Diagrams Minimize	Water and Society: Water Resources	Hydrology	['Water management', 'Institutions',	['Abbott, B W*', 'Bishop, K', 'Zarnetske, J P',	USA	2017	Plant and Wildlife Sciences	<p>The diagram of the global water cycle is the central icon of hydrology, and for many people, the point of entry to thinking about key scientific concepts such as conservation of mass, teleconnections, and human dependence on ecological systems. Because humans now dominate critical components of the hydrosphere, improving our understanding of the global water cycle has graduated from an academic exercise to an urgent priority. To assess how the water cycle is conceptualized by researchers and the general public, we analyzed 455 water cycle diagrams from textbooks, scientific articles, and online image searches performed in different languages. Only 15% of diagrams integrated human activity into the water cycle and 77% showed no sign of humans whatsoever, although representation of humans varied substantially by region (lowest in China, N. America, and Australia; highest in Western Europe). The abundance and accessibility of freshwater resources were overrepresented, with 98% of diagrams omitting water pollution and climate change, and over 90% of diagrams making no distinction for saline groundwater and lakes. Oceanic aspects of the water cycle (i.e. ocean size, circulation, and precipitation) and related teleconnections were nearly always underrepresented. These patterns held across disciplinary boundaries and through time. We explore the historical and contemporary reasons for some of these biases and present a revised version of the global water cycle based on research from natural and social sciences. We conclude that current depictions of the global water cycle convey a false sense of water security and that reintegrating humans into water cycle diagrams is an important first step towards understanding and sustaining the hydrosocial cycle.</p>
19	Grassland Aboveground Biomass in Inner Mongolia:	Sustainable Development Under Environmental,	Global Environmental Change	['Permafrost, cryosphere, and high-latitude processes',	['Li, F*', 'Zeng, Y', 'Chen, J', 'Wu, B']	USA	2017	Michigan State University	<p>Plant biomass is the most critical measure of carbon stored in an ecosystem, yet it remains imprecisely modeled for many terrestrial biomes. This lack of modeling capacity for biomass and its change through time and space has impeded scientists from making headway concerning issues in the geographic and social sciences. Satellite remote sensing techniques excel at detecting changes in the Earth's surface; however, accurate estimates of biomass for the heterogeneous biome landscapes based on remote sensing techniques are few and far between, which has led to many repetitive studies. Here, we argued that our ability to assess biomass in a heterogeneous landscape using satellite remote sensing techniques would be effectively enhanced through a stratification of landscapes, i.e. homogenizing landscapes. Specifically, above-ground biomass (AGB) for an extended heterogeneous grassland biome over the entirety of Inner Mongolia during the past 16 years (2001-2016) was explored using remote sensing time series data from the Moderate Resolution Imaging Spectroradiometer (MODIS). Massive and extensive in-situ measurement AGB data and pure vegetation index (PVI) models, developed from normal remote sensing vegetation indices such as the normalized difference vegetation index (NDVI) and the enhanced vegetation index (EVI), were highlighted in the accomplishment of this study. Taking into full consideration the landscape heterogeneity for the grassland biome over Inner Mongolia, we achieved a series of AGB models with high R^2 (>0.85) and low RMSE (~ 20.85 g/m²). The total average amount of fresh AGB for the entirety of Inner Mongolia grasslands over the past 16 years was estimated as ~ 87 Tg with an inter-annual standard deviation of ~ 9 Tg. Overall, the grassland AGB for Inner Mongolia increased sporadically. We found that the dynamics of AGB in the grassland biome of Inner Mongolia were substantially dominated by variation in precipitation despite the accommodation of a huge population of livestock in this area over the past few decades. Concerning the production of grassland AGB for the future, we emphasized that the impacts of the frequently warming-drying climate associated with climate change across the Mongolia Plateau should be paid more attention.</p>

20	Wicked Problems in Natural Hazard Assessment and	Wicked Problems and Deep Uncertainties: Tough	Natural Hazards	['Extreme events ', 'Monitoring, forecasting, prediction ',	['Stein, S*', 'Steckler, M S', 'Rundle, J B', 'Dixon, T H']	USA	2017	Northwestern University	<p>Social scientists have defined "wicked" problems that are "messy, ill-defined, more complex than we fully grasp, and open to multiple interpretations based on ones point of view... No solution to a wicked problem is permanent or wholly satisfying, which leaves every solution open to easy polemical attack." These contrast with "tame" problems in which necessary information is available and solutions - even if difficult and expensive - are straightforward to identify and execute. Updating the U.S.'s aging infrastructure is a tame problem, because what is wrong and how to fix it are clear. In contrast, addressing climate change is a wicked problem because its effects are uncertain and the best strategies to address them are unclear. An analogous approach can be taken to natural hazard problems. In tame problems, we have a good model of the process, good information about past events, and data implying that the model should predict future events. In such cases, we can make a reasonable assessment of the hazard that can be used to develop mitigation strategies. Earthquake hazard mitigation for San Francisco is a relatively tame problem. We understand how the earthquakes result from known plate motions, have information about past earthquakes, and have geodetic data implying that future similar earthquakes will occur. As a result, it is straightforward to develop and implement mitigation strategies. However, in many cases, hazard assessment and mitigation is a wicked problem. How should we prepare for a great earthquake on plate boundaries where tectonics favor such events but we have no evidence that they have occurred and hence how large they may be or how often to expect them? How should we assess the hazard within plates, for example in the New Madrid seismic zone, where large earthquakes have occurred but we do not understand their causes and geodetic data show no strain accumulating? How can we assess the hazard and make sensible policy when the recurrence of earthquakes, floods, or hurricanes seems to be changing with time or is expected to do so due to human activity? A starting approach might be to assess what we know, what we don't know, what we think, and what can be done that might improve this situation. We should draw on what is known in other areas of risk assessment including social science, meteorology, engineering, and economics.</p>
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21	Bringing Indicators Down into the Muck: Toward Interdisciplinary Perspectives on Drought and	Public Affairs	['Impacts of global change ', 'Drought ', 'Human	['Even, T*', 'Zhang, J', 'Yao, T', 'Andersson, S M',	USA	2018	KTH Royal Institute of Technology	Indicators in the form of biophysical statistics, climate records, census information, or otherwise quantifiable data have proven themselves to be a critical tool in the climate change vulnerability, disaster risk, and environmental justice analysis fields, both for their ability to provide broad, synoptic views of complex systems and in their capacity to allow for inter-comparison between diverse regions. At the same time, however, social scientists, socio-ecological systems researchers, and other interdisciplinary scholars have long noted that while indicator-based approaches (and the maps and visualization they are often used to create) are powerful tools for analysis and communication, they often fall short when it comes to capturing local level cultural, political, and environmental response dynamics, particularly in systems wherein inequalities of power and resource access go beyond readily observable system characteristics like annual average precipitation and the median income of residents. In this presentation, I detail my on-going efforts to address these shortcomings within the context of assessing the socio-hydrological vulnerability of a particularly complex (and to some, arcane) resource management system, namely, the water management systems of the South Platte Basin, located in northern Colorado, southern Wyoming, and the southwest corner of Nebraska. Shaped by an intensely variable climate, a complicated mosaic of federal, state, and private land management entities, 150 years of prior appropriation-based water law, sharp ideological divisions, and dramatic ecological diversity, this area presents a particularly acute challenge to the over-generalizing tendencies of traditional indicator-based approaches. As a result, I argue, new approaches supported in part by novel data harvesting approaches, and in part by on-the-ground ethnographic fieldwork must be utilized in order to understand past and future risks to water security and overall socio-ecological sustainability.
22	Loyalty across Scales: How Utilizing Indigenous and Local	Public Affairs	['Extreme events ', 'Risk ',	['Weyiouanna, A*', 'Marino,	USA	2018	Native Village of Shishmaref	Non-Indigenous social scientists, Indigenous scientists, and Indigenous local leaders are often balancing the different avenues and different scales at which adaptation and response to climate change outcomes are possible. In Shishmaref, Alaska, Annie Weyiouanna and her family, friends, and colleagues work with their own Inupiat cultural traditions to respond to changes to sea ice, animal migration routes, berry seasons, and weather. She and colleagues in Alaska also work with the Denali Commission and other state agencies on immediate infrastructure needs and to prepare the island community for flooding and evacuation needs. At the federal level, anthropologist Elizabeth Marino is working to show how federal disaster policy is biased against Indigenous communities and ill prepared to handle a quickly changing climate and to point out possible solutions to these large scale adaptation issues. All of this work is influenced by her relationships with Annie and other friends and colleagues in Shishmaref. This paper discusses how loyalty to solutions and relationship can structure and lead Indigenous and non-Indigenous science collaborations; and point to solutions that may be unique and innovative because they were borne out of joint effort.

23	Population displacement and flood	Comparative Sociohydrology:	Hydrology	['Floods ', 'Human impacts ', 'Water	['Kakinuma, K*', 'Puma, M J',	Japan	2018	Tohoku University	<p>Estimation of potential population displacements that associate with climate changes are one of the most important topics in the world. Population displacement has been studied well by social sciences, and conducted mainly at regional scales. However, there are few knowledge how natural factors affect human migration and which country has high potential of that. Thus, we examine the relationship among human internal migration and flooded areas and economic condition in the world.</p> <p>We used data of flooded areas that were calculated by using a global river and inundation model, human internal migration data that are provided by Internal Displacement Monitoring Center, and GDP as an economic indicator of each country. We conducted a Generalized Linear Mixed Model (GLMM) to examine how flooded intensity and economic condition affect the human internal migration.</p> <p>The number of internal displacement that caused by flood had been high in African, South/South-eastern countries during 2008-2016. The result of GLMM showed that the flood intensity and the interaction of the flood intensity (anomaly of flooded areas) and the economic condition would affect the human migration. We suggest that the impact of floods on human migration is high especially in lower economic countries.</p>
24	Responses to Rapidly Shifting Waterscapes in the High Mountains as Sentinels of Change: Transdisciplinary	Global Environmental Change	['Climate variability ', 'Impacts of global change ', 'Regional	['Reider, K*', 'Caine, A', 'Price, R', 'Seimon, T A', 'Donnelly, M	USA	2018	Florida International University	<p>Research in tropical alpine areas provides a window into some of the most rapidly changing, yet least-studied, ecosystems on Earth. The Cordillera Vilcanota in the central Andes of southern Peru has been the focus of more than decade of research dedicated to understanding the biological and societal impacts of rapid climate change. Our multi-disciplinary approach bridging natural and social sciences highlights the parallel and interacting socio-environmental impacts of climate-driven shifts in high-elevation waterscapes.</p> <p>High-elevation waterscapes face uncertainty surrounding the future timing of onset and duration of the wet season. We synthesized participatory observation of daily pastoral practices in a high-elevation herding community with reproductive phenology surveys of a high-elevation amphibian community to examine parallel responses to the strong 2015/2016 El Niño event, which caused a significant delay in wet season onset. We identify key strategies (i.e., flexible mobility for humans; reproductive plasticity in amphibians) for confronting unpredictable, extreme conditions in rapidly changing high-mountain environments.</p> <p>Concurrently, rapid deglaciation and a surplus of glacial meltwater are substantially altering alpine wetlands. We assessed past, current, and future water availability by analyzing stable isotope signatures in synoptic water samples to identify habitats fed by glaciers, in conjunction with long-term observations of wetland vegetation cover change, and interviews with local herders. Our results suggest future reductions to connectivity between aquatic habitat and glacial meltwater may decrease the availability of suitable habitat for aquatic organisms and grazing areas for alpaca herds, the principal economic resource in this pastoralist community.</p> <p>Taken together, our results suggest future precipitation and meltwater reductions could increase human-human and human-wildlife conflicts over diminishing water resources. As a living climate change laboratory, the Cordillera Vilcanota highlights the urgent need to create collaborative research approaches and adaptation strategies to make informed responses to changes that affect high-mountain areas worldwide in coupled human-natural systems.</p>	

Las Ciencias Sociales y Humanidades en la mitigación, adaptación y solución del cambio climático

	title	session	section	index_ter	authors	country	year	university	abstract
1	Bridging the Gap: The 'Soft Path'	Detecting and Predicting Change	Hydrology	['Water cycles',	['Gleick, P H*']	USA	2010	Pacific Institute	The failure of traditional water management systems in the 20th century -- what I call the "hard path for water" -- is evident in several ways, including the persistent inability to meet basic human needs for safe water and adequate sanitation for vast populations, ongoing and accelerating aquatic ecosystem collapses, and growing political disputes over water allocation, management, and use, even in regions where substantial investment in water has been made. Progress in resolving these problems, especially in the face of unavoidable climate changes, growing populations, and constrained financial systems, will require bridging hydrologic and social sciences in new ways. Integrating social and cultural knowledge with new economic and technological tools and classical hydrologic and climatological sciences can produce a new "soft path for water" that offers the opportunity to move toward sustainable water systems. This talk will define the soft path for water and offer examples of innovative steps already being taken along that path in the western United States, South Africa, India, and elsewhere.

2	Recent Advances in Climate Impacts, Vulnerability, Using Downscaled Climate Data in Impact and Global Environmental Change	['Impacts of global change ', 'Regional climate change	['Franco, G*', 'Cayan, D R', 'Moser, S C', 'Hanemann,	USA	2010	California Energy Commission	<p>The State of California is committed to preparing periodic climate change impacts and adaptation assessments to inform and develop policy in the State. The most recent assessment was released late in 2009 and a new vulnerability and adaptation assessment is underway for release in late 2011. Both assessments use IPCC climate simulations that were statistically downscaled to a horizontal resolution of about 12 Km. The 2009 California assessment attempted to translate some impacts and adaptation options into monetary terms which introduced additional uncertainties. The 2011 California assessment combines a set of coordinated statewide and regional/local studies because many adaptation options, though informed by state and national policies, will be implemented at regional and local levels. The 2011 assessment expands the number of climate simulations that are employed in order to form a fuller estimate of the potential envelope of climate change and its impacts in the state. It also introduces a subset of dynamically downscaled scenarios to understand how well statistical relationships, developed using historical data, hold up in future climate regimes. Investigations are on-going to translate the ensemble of climate simulations and to begin to attach probabilities to the scenarios using subjective and objective techniques. In addition to advances in climate simulations and downscaling techniques, the new vulnerability and adaptation assessment also increasingly integrates social science approaches to assessing vulnerabilities and adaptation options. This presentation will illustrate results from the 2009 assessment and describe the design and initial implementation of the 2011 assessment.</p>
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3	The Colorado Climate Preparedness Project: A Systematic Approach	Climate Change Adaptation: Education and Communication II Posters	Education and Human Resources	['Decision making under uncertainty ', 'Regional planning ', 'General	['Klein, R', 'Gordon, E*']	USA	2010	Center for Science and Technology Policy Research	<p>Scholars and policy analysts often contend that an effective climate adaptation strategy must entail "mainstreaming," or incorporating responses to possible climate impacts into existing planning and management decision frameworks. Such an approach, however, makes it difficult to assess the degree to which decisionmaking entities are engaging in adaptive activities that may or may not be explicitly framed around a changing climate. For example, a drought management plan may not explicitly address climate change, but the activities and strategies outlined in it may reduce vulnerabilities posed by a variable and changing climate. Consequently, to generate a strategic climate adaptation plan requires identifying the entire suite of activities that are implicitly linked to climate and may affect adaptive capacity within the system. Here we outline a novel, two-pronged approach, leveraging social science methods, to understanding adaptation throughout state government in Colorado. First, we conducted a series of interviews with key actors in state and federal government agencies, non-governmental organizations, universities, and other entities engaged in state issues. The purpose of these interviews was to elicit information about current activities that may affect the state's adaptive capacity and to identify future climate-related needs across the state. Second, we have developed an interactive database cataloging organizations, products, projects, and people actively engaged in adaptive planning and policymaking that are relevant to the state of Colorado. The database includes a wiki interface, helping create a dynamic component that will enable frequent updating as climate-relevant information emerges. The results of this project are intended to paint a clear picture of sectors and agencies with higher and lower levels of adaptation awareness and to provide a roadmap for the next gubernatorial administration to pursue a more sophisticated climate adaptation agenda. Project results can also inform numerous other ongoing database efforts connected to the U.S. National Assessment of Climate Change.</p>
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4	Communicating Uncertainty about Climate Change for Application to Security Risk Management	Scientific Uncertainty: A Multidisciplinary Assessment I Posters	Public Affairs	['GLOBAL CHANGE ', 'Risk ', 'Decision making under uncertainty ', 'PUBLIC ISSUES ']	['Gulledge, JM*']	USA	2011	<p data-bbox="594 938 625 1404">Pew Center on Global Climate Change</p> <p data-bbox="625 228 1764 1404">The science of climate change has convincingly demonstrated that human activities, including the release of greenhouse gases, land-surface changes, particle emissions, and redistribution of water, are changing global and regional climates. Consequently, key institutions are now concerned about the potential social impacts of climate change. For example, the 2010 Quadrennial Defense Review Report from the U.S. Department of Defense states that “climate change, energy security, and economic stability are inextricably linked.” Meanwhile, insured losses from climate and weather-related natural disasters have risen dramatically over the past thirty years. Although these losses stem largely from socioeconomic trends, insurers are concerned that climate change could exacerbate this trend and render certain types of climate risk non-diversifiable. Meanwhile, the climate science community—broadly defined as physical, biological, and social scientists focused on some aspect of climate change—remains largely focused scholarly activities that are valued in the academy but not especially useful to decision makers. On the other hand, climate scientists who engage in policy discussions have generally permitted vested interests who support or oppose climate policies to frame the discussion of climate science within the policy arena. Such discussions focus on whether scientific uncertainties are sufficiently resolved to justify policy and the vested interests overstate or understate key uncertainties to support their own agendas. Consequently, the scientific community has become absorbed defending scientific findings to the near exclusion of developing novel tools to aid in risk-based decision-making. For example, the Intergovernmental Panel on Climate Change (IPCC), established expressly for the purpose of informing governments, has largely been engaged in attempts to reduce unavoidable uncertainties rather than helping the world’s governments define a science-based risk-management framework for climate security. The IPCC’s Fourth Assessment Report concluded that “Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes to risk.” In risk management, key uncertainties guide action aimed at reducing risk and cannot be ignored or used to justify inaction. Security policies such as arms control and counter-terrorism demonstrate that high-impact outcomes matter to decision makers even if they are likely to be rare events. In spite of this fact, the long tail on the probability distribution of climate sensitivity was largely ignored by the climate science community until recently and its implications for decision making are still not receiving adequate attention. Informing risk management requires scientists to shift from a singular aversion to type I statistical error (i.e. false positive) to a balanced presentation of both type I</p>
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5	Useful to Usable (U2U): Transforming Climate Variability and Change Information for	Climate Change, Food, and Water: III Posters	Global Environmental Change	['Agricultural systems ', 'Climate variability ', 'Impacts of global change ']	['Niyogi, D', 'Andresen, J*']	USA	2011	Agronomy	<p>Corn and soybean production contributes over \$100 billion annually to the U.S. economy, most of which comes from the intensely cultivated corn-belt region of the Midwest. Successful crop production in this region is highly dependent on favorable temperatures and appropriate precipitation patterns, making this industry vulnerable to changes in climate patterns. Though predictive models are constantly improving, there are gaps in our understanding of how different management practices can be used to help farmers adapt to changes in climate while maintaining economic viability. Furthermore, currently available tools and models are not meeting producers' needs, and little is known about the types of information they would like to access. Useful to Usable (U2U): Transforming Climate Variability and Change Information for Cereal Crop Producers is an integrated research and extension project that seeks to improve the resilience and profitability of farms in the North Central Region amid variable climate change through the development and dissemination of improved decision support tools, resource materials, and training. The goal is to work closely with producers to help them make better long-term plans on what, when and where to plant, and also how to manage crops for maximum yields and minimum environmental damage. The U2U team is composed of a uniquely qualified group of climatologists, crop modelers, agronomists, economists, and social scientists from 10 partner universities across the Midwest. Over the span of 5 years, collaborators will complete tasks associated with 5 objectives that will enhance the usability of climate information for the agricultural community and lead to more sustainable farming operations. First the team will produce research on the biophysical and economic impacts of different climate scenarios on corn and soybean yields in the North Central Region (objective 1) and conduct complementary research to understand how producers and advisors are likely to use this information (objective 2). Based on these findings, decision support tools (DSTs) and training materials will be developed to effectively deliver climate information to stakeholders (objective 3). Next, DSTs will be piloted in a four-state region (Indiana, Iowa, Nebraska, and Michigan) to help improve tools and evaluate effectiveness (objective 4). After several iterations with stakeholders to ensure the usability and utility of the tools, the program will be extended to all twelve states in the region (objective 5). Decision support tools, along with training products, surveys, feedback mechanisms and collaborative social tools, will be supported using the NSF-funded and Purdue University developed HUBzero™ web-based technology.</p>
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6	Balancing benefits and costs in a 4°C world: the need for and challenges of natural-social	The Anthropocene: Confronting the Prospects of a +4°C World I (Video On-Demand)	Global Environmental Change	['GLOBAL CHANGE', 'Benefit-cost analysis', 'Decision making under uncertainty']	['Kopp, R E*']	USA	2012	Dept. of Earth & Planet. Sci.	<p>Making wise policy decisions regarding mitigation, adaptation and geoengineering requires fair assessments of the risks of both action and inaction. Such assessments necessitate dialogue between natural and social scientists. Recent attempts by the U.S. government to estimate the social cost of carbon (SCC) for use in balancing the benefits and costs of proposed mitigatory regulations highlight some of the challenges involved. Among them: (1) Scale: The costs and benefits of adaptation decisions generally take place locally, while the benefits of mitigation accrue globally. Most studies to inform adaptation decision have, quite reasonably, taken place at the local scale, but this has left globally aggregate estimates of climate risk in a fairly tenuous state, engaging only a handful of economists. More accurate assessments, needed for making critical policy decisions as we approach a 4°C world, will require both better top-down analyses and a better framework for integrating bottom-up analyses. (2) Historical validation: Integrated assessment models have not been subject to validation studies, such as the historical runs used to test physical climate models. Conducting such studies for impact analyses will require the integration and further development of statistical analyses of the human impact of past and ongoing climate change. If models don't work for a 0.8°C world, there's no reason to think they'll work for a 4°C world. (3) Looking beyond a 4°C world: A world that reaches 4°C in this century may exceed it in the next century; and even if temperature is stabilized, understanding the economic impacts of 4°C warming will require more than the current approach of extrapolating from 2°C impacts. Natural scientists and social scientists need to work together to estimate damage calibration points for considerably warmer conditions. Recent work on the loss of physiologically habitable regions in a >8°C warmer world is a rare step in this direction (Sherwood and Huber, 2010). (4) Characterizing the economic impacts of climate surprises and other hard-to-model climatic events: Complex climate models are tuned to perform well against historical observations, but such tuning leads to undersampling of the tails of probability distribution. Characterizing these tails is critical for risk assessment. Non-model-based approaches (e.g., paleoclimatic studies) can help in assessing the likelihoods of physical climate events that are either hard to model or vary greatly between models (e.g., ice sheet melt, ENSO strengthening, AMOC slowdown, Amazon die-off, etc.) With the exception of sea level change associated with ice sheet melt, the social science literature on the impacts of these events is limited or non-existent. Sherwood, S.C., Huber, M., 2010. Proc. Natl. Acad. Sci. 107, 9552 -9555.</p>
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7	Climate Services	Sustainable	Global	['GLOBAL CHANGE	['Brasseur, G P*']	Germany	2012	Climate Service With expected climate change and its impacts on society, adaptation practices will have to be implemented by public and private institutions. Climate Services are being developed to help society cope with climate risks and opportunities. Interdisciplinary teams of physical and social scientists are being formed to work with stakeholders to co-produce knowledge that address complex questions posed by decision-makers. Lessons learned during the development of the Climate Service Center in Germany and of the International Climate Service Partnership will be discussed.
8	Decision support: Applying	Climate Literacy: The Role of	Union	['Impacts of global change ',	['Moss, R H*']	USA	2013	Pacific Northwest National A wide range of decision-makers - including policy makers and many categories of professionals - should be considering climate information in their decisions and plans. AGU members may increasingly be called on to provide this information. This presentation will explore the importance of a broad approach to developing information of use in decision making. Traditional climate research must be supplemented with climate change decision science that incorporates climate information and includes decision analysis and qualitative research on institutions, perceptions, and other socioeconomic processes essential to implementing adaptation and mitigation decisions. Adoption of this broader paradigm and development of partnerships with decision and social scientists is essential to render climate data into actionable insights. The talk will draw on recent experience with applying modeling in decision support and introduce some practical suggestions.

9	Deterministic or Probabilistic - Robustness or Resilience: How to Respond to Climate Change?	Why Should We Talk About What We Don't Know? Implications of Communicating Scientific	Public Affairs	['Sea level change ', 'Extreme events ', 'Resilience ', 'Disaster mitigation ']	['Plag, H*', 'Earnest, D', 'Jules-Plag, S']	USA	2013	Climate Change and Sea Level Rise Initiative	<p>Our response to climate change is dominated by a deterministic approach that emphasizes the interaction between only the natural and the built environment. But in the non-ergodic world of unprecedented climate change, social factors drive recovery from unforeseen Black Swans much more than natural or built ones. Particularly the sea level rise discussion focuses on deterministic predictions, accounting for uncertainties in major driving processes with a set of forcing scenarios and public deliberations on which of the plausible trajectories is most likely. Science focuses on the prediction of future climate change, and policies focus on mitigation of both climate change itself and its impacts. The deterministic approach is based on two basic assumptions: 1) Climate change is an ergodic process; 2) The urban coast is a robust system. Evidence suggests that these assumptions may not hold. Anthropogenic changes are pushing key parameters of the climate system outside of the natural range of variability from the last 1 Million years, creating the potential for environmental Black Swans. A probabilistic approach allows for non-ergodic processes and focuses more on resilience, hence does not depend on the two assumptions. Recent experience with hurricanes revealed threshold limitations of the built environment of the urban coast, which, once exceeded, brought to the forefront the importance of the social fabric and social networking in evaluating resilience. Resilience strongly depends on social capital, and building social capital that can create resilience must be a key element in our response to climate change. Although social capital cannot mitigate hazards, social scientists have found that communities rich in strong norms of cooperation recover more quickly than communities without social capital. There is growing evidence that the built environment can affect the social capital of a community, for example public health and perceptions of public safety. This suggests an intriguing hypothesis: disaster risk reduction programs need to account for whether they also facilitate the public trust, cooperation, and communication needed to recover from a disaster. Our work in the Hampton Roads area, where the probability of hazardous flooding and inundation events exceeding the thresholds of the infrastructure is high, suggests that to facilitate the paradigm shift from the deterministic to a probabilistic approach, natural sciences have to focus on hazard probabilities, while engineering and social sciences have to work together to understand how interactions of the built and social environments impact robustness and resilience. The current science-policy relationship needs to be augmented by social structures that can learn from previous unexpected events. In this response to climate change, science does not have the primary goal to reduce uncertainties and prediction errors, but rather to develop processes that can utilize</p>
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									uncertainties and surprises to increase robustness, strengthen resilience, and reduce fragility of the social systems during times when infrastructure fails.
10	Modern Approaches to Wildfire Mitigation by Air and by Ground: An	Uncertainty in Natural Hazard Assessment: Volcanoes, Earthquakes,	Volcanology, Geochemistry, Petrology	['Disaster risk analysis and assessment']	['Duffin, J*', 'Lindquist, E', 'Pierce, J L', 'Wuerzer, T', 'Lawless, B',	USA	2013	Geosciences	In 2012, 1.7 million acres of land burned in Idaho—more than any other state. Boise, Idaho, is situated at the base of the Boise Foothills; this physiographic setting places the area at risk of not only fires along on the Wildland-Urban Interface (WUI), but also at risk for post-fire floods and debris flows in the lower lying neighborhoods adjacent to steep hillslopes. In 1959 and 1994, fires and post-fire debris flows devastated areas of the foothills, and inundated residences with water and mud. Anthropogenically-induced climate change is projected to increased summer temperatures and decrease summer precipitation; the associated increase in fire risk necessitates enhanced wildfire planning in Boise's WUI. Temporal uncertainty with varying weather and vegetation conditions poses problems in defining wildfire risk and requires new methods to address the WUI challenges. Unmanned aerial systems (UAS) could identify and characterize fire hazards to be mapped and used as a management tool. This technology would allow for repeat flights to update risk analysis as the hazards change both annually and multiple times within each fire season. With aerial photography obtained from flights, Structure from Motion software can be used to compile the images and render a 3D model to help quantify biomass. Aerial photographs would also allow for the ability to track seasonal changes in fire risk from vegetation height and inferred moisture content. Boise State University's departments of Geoscience, Community and Regional Planning, and the Public Policy Center are examining the risks and impacts of fire along the Boise WUI. The research integrates the perspectives of the geosciences and social sciences by combining physically-based fire hazards, effective fire management policies, and urban/regional planning in the WUI to provide better spatially-appropriate data and resources to the community and a common reference to assist in unifying the local efforts for fire mitigation. This presentation will introduce findings from a homeowner's survey of potentially at-risk residents regarding their perceptions of risk and uncertainty and their receptiveness to local mitigation, adaptation policies, and alternatives.

11	Study on the Information to Enlighten the Climate Literacy: Barriers, Education and Human Resources ['EDUCATION', 'General or miscellaneous ['Homma, M*', 'Suzuki, Y', 'Sato, Y'] Japan 2013 Disaster Prevention Research Institute	We performed Internet questionnaire survey subject to residents in Toyama prefecture which is snowy region and locates in middle-Japan, and grasped the image for the climate change and examined a reporting policy to recognize the need of climate change measures. The persons who feel a climate change at the present tend to feel the additional changes in the future. It is important to show the monitoring results of climate change for a citizen and promote the understanding for the climate change that had already occurred. Many people in Toyama are concerned about the increase of the health damage such as heatstroke, the flood damage by the increase in heavy rain and the change of farm products as concrete influences of climate changes in the future (Fig.1). The multiple regression analysis using the general image of climate change and the concrete influence to occur in Toyama as explanation variables, and the understanding of need for the mitigation measures as an objective variable has been made (Fig. 2). As a result, it has been shown that general images for the climate change promote to understand the need of the mitigation, and that it is important to explain about the climate change that might occur in the future even if it did not occur at the present in order to have people recognize widely the need of the adaptation.
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12	New trends in communicating risk and cultivating resilience: a multi-	Public Affairs General Contributions Posters	Public Affairs	['General or miscellaneous']	['Kontar, Y Y*', 'Eichelberger, J C', 'Rupp, S T', 'Taylor, K']	USA	2014	University of Alaska Fairbanks	<p>The increasing extent and vulnerability of technologically advanced society together with aspects of global climate change intensifies the frequency and severity of natural disasters. Every year, communities around the world face the devastating consequences of hazardous events, including loss of life, property and infrastructure damage, and environmental decline. In this session, we will introduce a new book, entitled <i>New Trends in Communicating Risk and Cultivating Resilience</i>, which is dedicated to those who have directly or indirectly suffered the effects of climate change extreme events with the hope that the advance of knowledge, implementation of sound science and appropriate policies, and use of effective communication will help in reducing their vulnerability while also improving resilience in the face of often devastating natural hazards. This book comprises manuscripts from those whose research, advocacy, work, teaching, or service in the natural or social sciences deals with risk communication and/or management surrounding natural disasters, with a particular focus on climate change-related phenomena.</p> <p>This book is arranged into five sections:</p> <p>The Role of Communication in Fostering Resilient Communities (Reframing the conversation about natural hazards and climate change with a new focus on resilience)</p> <p>Before the Disaster: Prediction, Preparation, and Crisis Communication (The role of communication in predicting and preparing for the unpredictable regarding natural disasters)</p> <p>Mitigating Circumstances: Living Through Change, Uncertainty, and Disaster (Mitigation and the role of communication in minimizing the damage during natural disasters and during an era of climate change)</p> <p>After the Disaster: Response and Recovery Communication (The role of communication after natural disasters)</p> <p>Looking Back and Learning Forward: Best and Worst Practices Exposed (Considering risk and resilience communication of natural disasters with one eye on best practices and one eye on a critical perspective. Case studies of resilience both supported and undermined by communication)</p> <p>During our presentation, we will introduce a case study from every section.</p>
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13	Adopting an Engaged, Holistic Approach to Identifying Climate Change	Climate Services Research and Development: Adapting to Climate Today I	Public Affairs	['Climate variability ', 'Regional climate change ', 'Decision making under	['Eise, J*', 'White, N']	USA	2018	Brian Lamb School of Communication	<p>For many communities, climate change adaptation is a reality they already face. With United Nations estimates ranging from \$60 to \$182 billion needed for adaptation annually by 2030, efforts and resources must be carefully applied to ensure programs work effectively in local environments. Solutions for localized environments can prove difficult as they must be tailored to a community's social, political and economic needs and constraints. Blanket solutions or prescribed solutions without contextual understanding often backfire, wasting resources and, in some cases, even harming local communities. To approach climate change adaptation in localized environments successfully, interdisciplinary collaborations between the sciences and social sciences are necessary. Integrated efforts must start at the beginning of a research process. A team of social scientists should first conduct an exploratory study of the localized environment, paying particular attention to gaps in climate information, community needs, existing communication systems, organizational limitations and resources, social, cultural and economic norms and potential barriers to behavior change. While doing so, team members can build the groundwork for local cooperation and engagement by working with local stakeholders to create an information feedback loop. After this, the social science team should present findings to the science partners, relying on their expertise to provide and deliver tailored, appropriate solutions to the community. This integrated team of scientists, social scientists and community members can design customized adaptation techniques with much higher chances of success. An example of the potential in and importance of following this blueprint for interdisciplinary success is demonstrated through the yearlong research program Climate Change Adaptation in Colombia's Coffee Axis: Assessing Communicative Needs of Agricultural Producers. This interdisciplinary project spanned biology, agro-industry and communication. The findings of the project, running at a budget of only \$25,000 and lasting one year, highlighted a critical array of social, cultural and economic factors that, if not taken into consideration in a climate change adaptation program, would likely lead to poor or nonexistent outcomes.</p>
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14	Recent progress of Japans regional downscaling project (SI-CAT) and Regional Climate Modeling III Posters	Atmospheric Sciences	['Earth system modeling', 'Regional climate change', 'Climate change and ['Dairaku, K*']	Japan	2018	<p>NIED National Research Institute for Earth Science and Disaster Prevention</p> <p>Climate information and services for risk assessments are of great concern. Fundamental regional climate information is indispensable for understanding changing climate and making decisions on when and how to act. To meet with the needs of stakeholders such as National/local governments, spatio-temporal comprehensive and consistent information is necessary and useful for decision making.</p> <p>As a Japans national project, SI-CAT develops reliable technologies to find climate change adaptation measures in collaboration with researchers of geoscience, social science and humanities, and officials of local governments from the beginning of the project to avoid and reduce various threats of climate change.</p> <p>We conducted dynamical downscaling experiments with horizontal grid spacing of 5km and 2km to reproduce regional climate information. We examine the performance of the regional climate model (NHRCM) to represent severe precipitation events occurred around Gifu and Nagano region. To examine the performance in ungauged mountainous regions, the runoff analysis was conducted. It indicates the overestimation of precipitation. We conduct the ensemble downscaling experiments using database for Policy Decision making for Future climate change (d4PDF) to detect the climate change impact in this region.</p> <p>Multi-model large ensemble regional climate scenarios with 1km horizontal grid-spacing over Japan are developed by using CMIP5 GCMs (RCP2.6 and RCP8.5) and a statistical downscaling (Bias Corrected Spatial Disaggregation (BCSD)) to investigate uncertainty of projected change associated with structural differences of the GCMs for the periods of historical climate (1950-2005) and near future climate (2026-2050). The most of CMIP5 models show qualitatively consistent increase of average and extreme temperature and precipitation in Japan.</p> <p>Uncertainty range information of the regional climate scenarios support various regional adaptation measures and informed decision making. Based on the SI-CAT experiences, the CORDEX Asia ESD group enhances and integrates the science and application of downscaling activities in Asia by sharing and exchanging data, knowledge, and techniques.</p>
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15	Translating Climate and Health Research into Policies to Increase Science to Action: Building Novel and Transformative Partnerships	Public Affairs	['Geoscience education research ', 'Impacts of global change ', ['Madrigano, J*']	USA	2018	RAND Corporation Arlington	On average, extreme heat results in more deaths than any other weather-related event in the U.S. According to the National Oceanic and Atmospheric Administration, 2017 ranks as one of the hottest years on record and May of 2018 was the warmest May for the contiguous U.S. on record. As the climate continues to change, there will be increased social consequences of more frequent and severe heat waves. To allocate resources efficiently, policymakers need to understand what populations are most at risk for the effects of extreme heat, how the public perceives risk to such events, and barriers to protective behaviors. Although metropolitan areas across the country are bracing to deal with the effects of climate change, many lack the empirical evidence to answer these key questions. At the same time, there is a growing research interest in the interdisciplinary field of climate change and health, but researchers may lack both knowledge of specific community priorities and access to adequate data to answer locally-relevant questions. Therefore, it is critical that a variety of stakeholders from a wide range of disciplinary perspectives work together to inform and develop policies to improve community resilience. This presentation will describe a successful research-practitioner collaboration which examined vulnerability, risk perception, and protective behaviors for extreme heat in New York City (NYC). Lessons learned on barriers and facilitators to developing actionable, policy-oriented research will be addressed. Specific points of discussion will include how to scope a research question with policy goals in mind, key stakeholders to facilitate implementation and dissemination of the research, and the timeline from research to practice. Our case study will demonstrate how a collaboration between researchers in the health, geographic, and social sciences, and practitioners in the fields of public health and disaster recovery contributed to a multimillion-dollar policy initiative to mitigate the health effects of extreme heat in NYC.
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	title	session	section	index_ter	authors	country	year	university	abstract
1	Climate Research: a Model for Holistic & Contextual Thinking	Climate Change,	Natural Hazards	['Impacts of global	['Sprigg, W A*']	USA	2010	Center of Excellence	Public support of climate research is motivated by a desire to identify hazards and anticipate risks. Society\u2019s future security and safety depend on predicting often unknown hazards. Laser-like focus on less than the total of Earth\u2019s system of systems increases our vulnerability to change. Thus, El-Nino, the oceans and biosphere become essential elements for strategic planning under climate change. So, too, are seemingly impossible to predict elements of tectonics, global energy policy and technology, and public action. A grand challenge for climate research is to include holistic and contextual thinking while satisfying a public need to understand future risks attributable to climate.
2	How Shall We Tell Our People? The Art and Science of Communicating Sea-Level Rise to Coastal Audiences (	The Uncertainty of Future Sea Level Rise:	Natural Hazards	['Sea level change ', 'PUBLIC ISSUES ']	['Moser, S C*']	USA	2010	S. Moser Research & Consulting	Improved sea-level rise projections and translation into decision-relevant information (e.g., changed flood frequencies and elevations, increased rates in coastal erosion, salinity changes in coastal aquifers) are critical for coastal managers, planners, and local elected officials to feel more confident in bringing climate change and its related coastal impacts to the attention of their communities. Those who have done so or are considering doing so, however, are not just concerned with “getting the science right” or getting the most credible and relevant information. They immediately, and sometimes primarily, are concerned with the reactions of coastal residents, developers, and business interests to the prospects of potentially difficult and substantial changes in coastal land use, their property rights, and the potential loss of their homes and establishments. How to engage the public constructively in developing adaptation strategies is a largely unmet challenge for most coastal managers. Similarly, they have not been trained in how to effectively communicate an issue that is ripe with the potential for loss, danger, and social and legal conflict - more so than they already face. Better physical science on sea-level rise alone will not meet these needs. Meanwhile, the social sciences have only begun to study public attitudes toward local impacts and adaptation responses. This paper will summarize key insights available at this time and point to important research and education/training needs to better assist practitioners faced with developing and implementing coastal adaptation strategies.

3	The Psychology of Climate Change Communication - Insights from the Center for Research on Environmental Decisions (CRED) (Climate Change Adaptation: Education and Communication I	Education and Human Resources	['Informal education ', 'Decision making under uncertainty ', 'General or	['Marx, S*']	USA	2010	Center for Research on Environmental Decisions	<p>Natural scientists have made great strides in recent years to improve their understanding of the complex issue of global climate change. Despite the progress made, there continues to be a persistent gap between the knowledge and concern among members of the climate science community and translation of such scientific expertise into effective climate change policies and the general public's behavioral choices. Communication is breaking down at the intersection of climate science, policy, and behavior change. Part of the reason is that, to date, social science research has not been sufficiently exploited to help individuals and groups incorporate information about climate change and environmental risk into decision making. The presentation will highlight research conducted at the Center for Research on Environmental Decisions (CRED). This presentation will discuss barriers to behavioral change and provide suggestions for improving communication about climate change: Typical science communication requires analytic processing, some level of expertise, at a minimum interest. For most people abstract information does not translate into powerful vivid images that would trigger action. Furthermore, we have found that people's interpretation of scientific uncertainty can get in the way of using forecasts and projections. Other barriers include public risk perceptions and attitudes, cultural values, and myopia, as well as the importance that people place on self-interest/economic goals vs. collective interest/social goals. Many of these obstacles can be overcome and communication of climate change information can be improved by presenting a combination of affective information (vicarious experience, scenarios, narratives, and analogies) and scientific data; yet there are also downsides to the overuse of emotional appeals (such as the finite pool of worry and the single action bias); tapping into social affiliations and group identities can motivate the activation of social goals in favor or self interest; early involvement of stakeholders through participatory processes can help identify key concerns and information needs which can then be addressed in a tailored approach; taking advantage of default effects can make it easier for people to choose environmentally and socially beneficial options. Using research into the reactions of groups as disparate as African farmers and conservative U.S. voters, we offer insights on how scientists, educators, journalists and others can effectively connect with wider audiences. The communication principles presented in this talk can be applied beyond climate change and to science communication in general.</p>
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4	Conveying researcher knowledge of climate change on multiple new media platforms	Scientist Participation in Science Communication II	Education and Human Resources	['Geoscience education research ' , 'GLOBAL	['Byrne, J M*' , 'McDaniel, S' , 'Graham, J' , 'Hoggan, J	Canada	2011	Department of Geography	<p>We are developing a climate change education and communication program (ECP) for application in high schools, colleges and in public education. The objective of this work is to convey climate change knowledge from the best scientists and social scientists using a series of new media formats. The ECP utilizes high quality video and television production built on interviews and field visits with outstanding colleagues from around the globe. The deliverables will include a high definition documentary production and an interactive website that includes the documentary, a series of single concept/topic teaching webisodes (short videos) and teaching and study plans for application with each webisodes. The presentations will feature three levels of discussion: (i) what is the state of climate change knowledge, impacts, mitigation and adaptation? (ii) What international locales exist where climate change is creating immediate critical challenges and risks? (iii) How can we mitigate, adapt and other wise address current and pending climate change challenges? The ECP will be distribution FREE via the WWW to educational users anywhere on the planet. We have discussions ongoing for collaborations with international colleagues that may lead to translations of the work into other languages. The intent herein is to share research outcomes from the best global scientists and social scientists with the public and numerous stakeholders, and for use in education at all levels. The work will be publicised through film festivals and possibly through television broadcast licenses, over the WWW and through the many connections of the academics and through our industry partner, an internationally regarded Public Relations and Communication Firm.</p>
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5	In a Time of Change: Integrating the Arts and Humanities with Climate Change Science in Alaska	Science Data Reuse: Art and Literacy Programs for	Education and Human Resources	['Elementary and secondary education ', 'Informal	['Leigh, M*', 'Golux, S', 'Franzen, K']	USA	2011	Institute of Arctic Biology	<p>The arts and humanities have a powerful capacity to create lines of communication between the public, policy and scientific spheres. A growing network of visual and performing artists, writers and scientists has been actively working together since 2007 to integrate scientific and artistic perspectives on climate change in interior Alaska. These efforts have involved field workshops and collaborative creative processes culminating in public performances and a visual art exhibit. The most recent multimedia event was entitled In a Time of Change: Envisioning the Future, and challenged artists and scientists to consider future scenarios of climate change. This event included a public performance featuring original theatre, modern dance, Alaska Native Dance, poetry and music that was presented concurrently with an art exhibit featuring original works by 24 Alaskan visual artists. A related effort targeted K12 students, through an early college course entitled Climate Change and Creative Expression, which was offered to high school students at a predominantly Alaska Native charter school and integrated climate change science, creative writing, theatre and dance. Our program at Bonanza Creek Long Term Ecological Research (LTER) site is just one of many successful efforts to integrate arts and humanities with science within and beyond the NSF LTER Program. The efforts of various LTER sites to engage the arts and humanities with science, the public and policymakers have successfully generated excitement, facilitated mutual understanding, and promoted meaningful dialogue on issues facing science and society. The future outlook for integration of arts and humanities with science appears promising, with increasing interest from artists, scientists and scientific funding agencies.</p>
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6	Innovative Interactive Visitor Experiences Focused on Climate Change	Climate Literacy: Engaging and Evaluating Public and K-12 Audiences Around Complex and	Education and Human Resources	['Informal education ', 'Instructional tools ', 'Impacts of global change ', 'General or	['Lettvin, E E*']	USA	2011	Science & Education	<p>Pacific Science Center has adopted a multi-pronged approach to introduce visitors to the concepts of climate change and linkages to human behavior in an informal science education setting. We leverage key fixed exhibit assets derived from collaborations with NOAA: Science on a Sphere and an exhibit kiosk showcasing local CO2 measurements that are adjacent on our exhibit floor. NOAA PMEL Scientists deployed a sensor at the top of the Space Needle that measures variability in atmospheric CO2 over Seattle; the kiosk showcases these near-real-time, daily, weekly and monthly measurements as well as similar observations from a NOAA buoy near Aberdeen, Washington. Displays of these data enable visitors to see first-hand varying CO2 levels in urban and remote marine environments as well as seasonal cycling. It also reveals quantifiable increases in CO2 levels over a relatively short time (~5 years). Trained interpreters help visitors understand linkages between personal behavior and corresponding CO2 footprints. Interpreters discuss connections between local and regional CO2 measurements displayed on the kiosk, and global Sphere datasets including NOAA Carbon Tracker, changing arctic sea ice coverage and sea level rise projections. Portable Discovery Carts, consisting of props and interactive, hands-on activities provide a platform for facilitated interpretation on a series of topics. We have developed two climate focused carts: \u2018Sinks and Sources\u2019 that examines materials and activities that produce and absorb carbon, and \u2018Ocean Acidification\u2019 that shows how absorption of atmospheric CO2 is changing ocean composition and its habitability for marine life. These carts can be deployed anywhere on the exhibit floor but are primarily used adjacent to the Sphere and the kiosk, making it possible to have a range of conversations about global and local CO2 levels, linkages to individual and collective behaviour and associated implications. Additional collaborations with members of the regional climate research community are showcased during regularly scheduled \u2018scientist spotlights\u2019 and \u2018research weekends\u2019. Additional climate programs were developed targeting high school students. During the summer of 2010, 10 participants in a teen development program had summer internships with climate researchers working in horticulture, policy, arctic science and geology. The following fall, the teens hosted 4 \u2018Family Climate Workshops\u2019 at community centers around Seattle. For these events, the teens developed hands-on activities and posters showcasing the climate research focus of their internships. These events were held in collaboration with the \u2018Cool School Challenge\u2019, a program that teaches how to conduct a greenhouse gas inventory and develop a corresponding action plan. The program culminated in the convening of the first \u2018High School Climate Change Symposium\u2019, held at Pacific Science Center. Nearly 200 teens attended on-site, and hundreds more live-streamed the event. The Symposium consisted of two panels: one focused on the scientific underpinnings of climate change</p>
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7	An Interdisciplinary Network Making Progress on Climate Change Communication	Communicating Climate Science—Seeking the Best of Old and New Paradigms II	Global Environmental Change	['Informal education ', 'Oceans ']	['Spitzer, W*', 'Anderson, J C', 'Bales, S', 'Fraser, J', 'Yoder, J A']	USA	2012	<p data-bbox="659 1068 693 1359">New England Aquarium</p> <p data-bbox="701 228 1906 1365">Public understanding of climate change continues to lag far behind the scientific consensus not merely because the public lacks information, but because there is in fact too much complex and contradictory information available. Fortunately, we can now (1) build on careful empirical cognitive and social science research to understand what people already value, believe, and understand; and then (2) design and test strategies for translating complex science so that people can examine evidence, make well-informed inferences, and embrace science-based solutions. Informal science education institutions can help bridge the gap between climate scientists and the public. In the US, more than 1,500 informal science venues (science centers, museums, aquariums, zoos, nature centers, national parks, etc.) are visited annually by 61% of the population. Extensive research shows that these visitors are receptive to learning about climate change and trust these institutions as reliable sources. Ultimately, we need to take a strategic approach to the way climate change is communicated. An interdisciplinary approach is needed to bring together three key areas of expertise (as recommended by Pidgeon and Fischhoff, 2011): 1. Climate and decision science experts - who can summarize and explain what is known, characterize risks, and describe appropriate mitigation and adaptation strategies; 2. Social scientists - who can bring to bear research, theory, and best practices from cognitive, communication, knowledge acquisition, and social learning theory; and 3. Informal educators and program designers - who bring a practitioner perspective and can exponentially facilitate a learning process for additional interpreters. With support from an NSF CCEP Phase I grant, we have tested this approach, bringing together Interdisciplinary teams of colleagues for a five month "study circles" to develop skills to communicate climate change based on research in the social and cognitive sciences. In 2011, social scientists, Ph.D. students studying oceanography, and staff from more than 20 institutions that teach science to the public came together in these learning groups. Most participants were motivated to create new or revised training or public programs based on lessons learned together. The success of this program rests on a twofold approach that combines collaborative learning with a cognitive and social sciences research based approach to communications. The learning process facilitated trust and experimentation among co-learners to practice applications for communications that has continued beyond the study circle experience through the networks established during the process. Examples drawn from the study circle outputs suggest that this approach could have a transformative impact on informal science education on a broad scale. Ultimately, we envision informal science interpreters as "vectors" for effective science communication, ocean and climate scientists with enhanced communication skills, and increased public demand for explanation and dialogue about global issues.</p>
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8	Effective Engagement of Hostile Audiences on Climate Change	PA21A. * Countering Denial	Public Affairs	['EDUCATION', 'PUBLIC	['Denning, S*']	USA	2012	Colorado State University	Communicating effectively about climate change can be very frustrating because hostility to climate science is rooted in deeply held beliefs rather than facts. Opposition can be more effectively countered by respecting ideological objections than by aggressive insistence on acceptance of consensus evidence. When presented with a stark choice between sacred beliefs and factual evidence, social science research shows that nearly everyone will choose the latter. Rational argument from authority is often the weakest approach in such situations. Climate change is Simple, Serious, and Solvable. Effective communication of these three key ideas can succeed when the science argument is carefully framed to avoid attack of the audience's ethical identity. Simple arguments from common sense and everyday experience are more successful than data. Serious consequences to values that resonate with the audience can be avoided by solutions that don't threaten those values.
9	Saving Grace - A Climate Change Documentary Education Program	Communicating Climate	Global Environmental Change	['GLOBAL CHANGE']	['Byrne, JM*', 'McDaniel, S',	Canada	2012	Geography and Prentice Affiliate	Saving Grace conveys climate change knowledge from the best international scientists and social scientists using a series of new media formats. An Education and Communication Plan (ECP) has been developed to disseminate climate change knowledge on impacts, mitigation and adaptation for individuals, and for all sectors of society. The research team is seeking contacts with science and social science colleagues around the world to provide the knowledge base for the ECP. Poverty enslaves...and climate change has, and will, spread and deepen poverty to hundreds of millions of people, primarily in the developing world. And make no mistake; we are enslaving hundreds of millions of people in a depressing and debilitating poverty that in numbers will far surpass the horrors of the slave trade of past centuries. Saving Grace is the story of that poverty - and minimizing that poverty. Saving Grace stars the best of the world's climate researchers. Saving Grace presents the science; who, where and why of greenhouse gases that drive climate change; current and projected impacts of a changing climate around the world; and most important, solutions to the climate change challenges we face.

10	The Climate Literacy Network: Leveraging a Diverse Community to Broaden the Reach of Your Climate Literacy Efforts	Climate Literacy: Reaching Diverse Audiences Through Education and Human Resources	['EDUCATION ', 'GLOBAL CHANGE ', 'PUBLIC ISSUES ']	['Ledley, T S*', 'Carley, S', 'Niepold, F', 'Duggan-Haas, D	USA	2012	Center for Science Teaching and Learning	<p>There are a wide range of programs, activities, and projects focused on improving the understanding of climate science by citizens in a multitude of contexts. While most of these are necessarily customized for the particular audiences, communities, or regions they address, they can learn a lot from each other by sharing their experiences, expertise, and materials. The Climate Literacy Network (CLN, http://cleanet.org/cln), established in 2008 to facilitate the implementation of the Climate Literacy Essential Principles of Climate Science, is a diverse group of over 370 stakeholders with a wide range of expertise in, for example, science, policy, media, arts, economics, psychology, education, and social sciences. The CLN meets virtually weekly to share information about ongoing activities and new resources, discuss controversial public issues and ways to address them, get input from this diverse community on directions individual efforts might take, organize climate literacy sessions at professional meetings, provide input on documents relevant to climate literacy, and address common needs of the individual members. The weekly CLN teleconferences are also a venue for presentations from climate change education efforts to extend their reach and potential impact. The teleconferences are supported by an active listserv that is archived on the CLN website along with recordings of past teleconference and the schedule of upcoming teleconferences (http://cleanet.org/clean/community/cln/telecon_schedule.html). In this presentation we will describe the details of these various activities, give examples of how discussions within the CLN has led to funded efforts and expanded partnerships, and identify ways you can participate in and leverage this very active community.</p>
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11	Trusted Sources: The Role Scientific Societies Can Play in Improving Public Opinions on Climate Change	PA13B. * Countering Denial and Manufactured Doubt of 21st	Public Affairs	['GLOBAL CHANGE ', 'Decision making under uncertainty ',	['McEntee, C*', 'Cairns, A', 'Buhrman, J']	USA	2012	American Geophysical Union	<p>Public acceptance of the scientific consensus regarding climate change has eroded and misinformation designed to confuse the public is rapidly proliferating. Those issues, combined with an increase of politically motivated attacks on climate scientists and their research, have led to a place where ideology can trump scientific consensus as the foundation for developing policy solutions. The scientific community has been, thus far, unprepared to respond effectively to these developments. However, as a scientific society whose members engage in climate science research, and one whose organizational mission and vision are centered on the concepts of science for the benefit of humanity and ensuring a sustainable future, the American Geophysical Union can, and should, play an important role in reversing this trend. To that end, in 2011, AGU convened a Leadership Summit on Climate Science Communication, in which presidents, executive directors, and senior public policy staff from 17 scientific organizations engaged with experts in the social sciences regarding effective communication of climate science and with practitioners from agriculture, energy, and the military. The discussions focused on three key issues: the environment of climate science communication; public understanding of climate change; and the perspectives of consumers of climate science-based information who work with specific audiences. Participants diagnosed previous challenges and failings, enumerated the key constituencies that need to be effectively engaged, and identified the critical role played by cultural cognition—the influence of group values, particularly around equality and authority, individualism, and community; and the perceptions of risk. Since that meeting, AGU has consistently worked to identify and explore ways that it, and its members, and improve the effectiveness of their communication with the public about climate change. This presentation will focus on the insights AGU has gathered, as well as make the case for why this is an important role for scientific societies, such as AGU, to play.</p>
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12	Exploring Water Resources as a Study Abroad Experience in Northern India	Education General Contributions III Posters	Education and Human Resources	['Water quality', 'Impacts of global change', 'Human impacts', 'Watershed']	['Vulava, V M*', 'Callahan, T J']	USA	2013	Department of Geology	<p>Water and environmental resources are of high interest for students at the College of Charleston. These issues are covered in varying levels of detail in the Geology Department in introductory to advanced courses, some of which include field and laboratory components. While courses stress the importance of understanding global water resource issues, students are rarely given hands-on exposure beyond local problems. To address this, we designed a course that explored water resource issues along the entire length of the Ganges River from headwaters to the mouth, a region in which water is seen as a critical economic, environmental, and cultural resource. The 2500-km long Ganges River in northern India is stressed due to large demand and cyclical, yet unpredictable, supply. This region has a population of over 700 million who speak different languages, have diverse cultures, and varied states of development, economic access, and planning, and diverse geologic and ecological settings. Poor river management, inconsistent precipitation during monsoons likely affected by climate change and pollution from insufficient waste management practices and a burgeoning population has resulted in additional stress on the river and its ecosystems. A three-week travel-intensive study abroad course covered three important reaches of the river in the headwaters (Himalayan glaciers, steep mountain landscapes, and large hydroelectric dams in Uttarakhand state), the plains (industrial heartland and large population centers in Uttar Pradesh state), and the mouth (coastal development, Sunderbans mangrove forest, and coastal hazards near Bay of Bengal in West Bengal state). The course was timed to coincide with the pre-monsoon summer season to show students the importance of the monsoon season to this region. The course had two modules: (1) water resource and hydrology principles that delve into specific issues, including impacts of river management for economic development and associated land use change effects on water resource availability and (2) water quality principles that focused on natural and anthropogenic changes to the chemical character of the river water, and linkages between human and environmental health. The target audience was students who have completed a sequence of introductory geology courses, but expectations and learning goals were calibrated to match students' interests and background. Readings were organized for students allowing for lectures and discussions at several locations. Hands-on activities included basic stream hydrology (estimating discharge and runoff), water quality monitoring, and informal social science surveys of residents. Water quality parameters measured included bulk parameters (pH, conductivity, turbidity, temperature, etc.) and chemical analytes (dissolved oxygen, NO₃, PO₄, SO₄, Cu and Cr). Surveys were informally designed to gain local perspective on water issues such as sources of their drinking water, wastewater disposal practices, and perceived needs and vulnerabilities. Students collected the data, allowing them to reflect on the changing physical, chemical, and human character of the river from headwaters to the mouth.</p>
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									Students also gained more nuanced perspectives on the role of water on society, culture, and religion in this region.
13	Public understanding of climate change continues to lag far behind the scientific consensus not merely	Climate Literacy: Beyond Climate	Education and Human Resources	'EDUCATION ' ; 'GLOBAL CHANGE ' ;	'Byrne, J M*', 'Rasch, P J' ; 'Andronova,	Canada	2013	University of Lethbridge	The American Geophysical Union hosted a Chapman Conference on Communicating Climate Science at Snow Mountain Ranch, Granby, Colorado, June 8-13, 2013. The goal of the Chapman Conference was to bring together scholars, social scientists and journalists to discuss the history, and more importantly, the present and future of climate change communication. We met to evaluate our current and needed communication capacity, and to develop ways and means to convey advances in the understanding of climate science. Delegates discussed and presented methods and capacity to communicate to policymakers, the media, and society. Our focus was on the efficacy of scientific communication, on improving communication practices, and on building collaborations spawned at the conference, and beyond. The Chapman was a success. Close to 150 of us gathered high in the Colorado Rockies to share almost 100 presentations and nearly 10 hours of group discussions focused on ways and means to better bring the climate change message to society, to educators and policymakers in North America and around the world. This presentation will focus on the outcomes of the Chapman Climate Change Communication Conference; the conclusions of the delegate community; and directions forward.

14	Artistic: An Art and Science Integration Project to Enquire into Community Level Adaptation to Climate Change	Connecting Geoscience with the Arts II	Public Affairs	['Informal education ', 'Instructional tools ', 'General or	['Vanderlinden, J P*', 'Baztan, J']	France	2014	CEARC-OVSQ	<p>The purpose of this paper is to present the "Adaptation Research a Transdisciplinary community and policy centered approach" (ARTisticc) project. ARTisticc's goal is to apply innovative standardized transdisciplinary art and science integrative approaches to foster robust, socially, culturally and scientifically, community centred adaptation to climate change. The approach used in the project is based on the strong understanding that adaptation is:</p> <p>(a) still "a concept of uncertain form"; (b) a concept dealing with uncertainty; (c) a concept that calls for an analysis that goes beyond the traditional disciplinary organization of science, and; (d) an unconventional process in the realm of science and policy integration.</p> <p>The project is centered on case studies in France, Greenland, Russia, India, Canada, Alaska, and Senegal. In every site we jointly develop artwork while we analyzing how natural science, essentially geosciences can be used in order to better adapt in the future, how society adapt to current changes and how memories of past adaptations frames current and future processes. Artforms are mobilized in order to share scientific results with local communities and policy makers, this in a way that respects cultural specificities while empowering stakeholders, ARTISTICC translates these "real life experiments" into stories and artwork that are meaningful to those affected by climate change. The scientific results and the culturally mediated productions will thereafter be used in order to co-construct, with NGOs and policy makers, policy briefs, i.e. robust and scientifically legitimate policy recommendations regarding coastal adaptation. This co-construction process will be in itself analysed with the goal of increasing arts and science's performative functions in the universe of evidence-based policy making.</p> <p>The project involves scientists from natural sciences, the social sciences and the humanities, as well as artists from the performing arts (playwriters, film directors) as well as the visual arts (photographs, designers, sculptor) working in France, Senegal, India, Russia, Greenland, Alaska, and Canada</p>
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15	<p>Infusing Sustainability Across Disciplines to Build Student Engagement</p>	<p>Climate Literacy: Approaches to Multidisciplinary Climate Education</p>	<p>Education and Human Resources</p>	<p>['Post-secondary education ' , 'General or miscellaneous ']</p>	<p>['Bruckner, M Z*' , 'O'Connell, K' , 'McDarris, J R' , 'Kirk, K B' , 'Larsen, K' ,</p>	<p>USA</p>	<p>2014</p>	<p>Science Education Resource Center at Carleton College</p> <p>Establishing relevance and effective communication are key mechanisms for building student and community engagement in a topic and can be used to promote the importance of working across disciplines to solve problems. Sustainability, including the impacts of and responses to climate change, is an inherently interdisciplinary issue and can be infused across courses and curricula in a variety of ways. Key topics such as climate change, hazards, and food, water, and energy production and sustainability are relevant to a wide audience and can be used to build student engagement. Using real-world examples, service learning, and focusing on the local environment may further boost engagement by establishing relevance between sustainability issues and students' lives. Communication plays a key role in the exchange of information across disciplines and allows for a more holistic approach to tackling the complex climate and sustainability issues our society faces. It has the power to bridge gaps, break down disciplinary silos, and build connections among diverse audiences with a wide range of expertise, including scientists, policy-makers, stakeholders, and the general public. It also aids in planning and preparation for, response to, and mitigation of issues related to sustainability, including the impacts of climate change, to lessen the detrimental effects of unavoidable events such as sea level rise and extreme weather events. Several workshops from the InTeGrate and On the Cutting Edge projects brought together educators and practitioners from a range of disciplines including geoscience, engineering, social science, and more to encourage communication and collaboration across disciplines. They supported networking, community-building, and sharing of best practices for preparing our students for a sustainable future, both in and out of the workplace, and across disciplines. Interdisciplinary teams are also working together to author curricular materials that highlight societal issues. The InTeGrate Teaching Materials web pages highlight major outcomes from the workshops and feature community-contributed resources and pedagogic guidance designed to enhance teaching about sustainability across disciplines. Explore these materials at: serc.carleton.edu/integrate/teaching_materials/</p>
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16	Integrating Communication Best Practices in the Third National Climate Assessment	Climate Literacy: Effective Responses and Solutions	Education and Human Resources	['Elementary and secondary education ', 'Post-secondary	['Hassol, S J*']	USA	2014	Climate Communication	<p>Modern climate science assessments now have a history of nearly a quarter-century. This experience, together with important advances in relevant social sciences, has greatly improved our ability to communicate climate science effectively. As a result, the Third National Climate Assessment (NCA) was designed to be truly accessible and useful to all its intended audiences, while still being comprehensive and scientifically accurate. At a time when meeting the challenge of climate change is increasingly recognized as an urgent national and global priority, the NCA is proving to be valuable to decision-makers, the media, and the public.</p> <p>In producing this latest NCA, a communication perspective was an important part of the process from the beginning, rather than an afterthought as has often been the case with scientific reports. Lessons learned from past projects and science communications research fed into developing the communication strategy for the Third NCA. A team of editors and graphic designers worked closely with the authors on language, graphics, and photographs throughout the development of the report, Highlights document, and other products. A web design team helped bring the report to life online. There were also innovations in outreach, including a network of organizations intended to extend the reach of the assessment by engaging stakeholders throughout the process. Professional slide set development and media training were part of the preparation for the report's release. The launch of the NCA in May 2014 saw widespread and ongoing media coverage, continued references to the NCA by decision-makers, and praise from many quarters for its excellence in making complex science clear and accessible. This NCA is a professionally crafted report that exemplifies best practices in 21st century communications.</p>
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17	It's Not Just About More Data: Translation of Science and Decision Support Evaluation for Climate Impact Indicators	Assessing the Socioeconomic Impacts of Big Geospatial Data	Public Affairs	['Benefit-cost analysis', 'Decision making under uncertainty',	['Kenney, M A*']	USA	2014	University of Maryland College Park	<p>The U.S. Global Change Research Program is currently considering establishing a National Climate Indicators System, which would be a set of physical, ecological, and societal indicators that would communicate key aspects of climate changes, impacts, vulnerabilities, and preparedness to inform mitigation and adaptation decisions. Thus, over the past several years 150 scientists and practitioners representing a range of expertise from the climate system to natural systems to human sectors have developed a set of indicator recommendations that could be used as a first step to establishing such an indicator system. These recommendations have been implemented into a pilot system, with the goal of working with stakeholder communities to evaluate the understandability of individual indicators and learn how users are combining indicators for their own understanding or decision needs through this multiple Federal agency decision support platform.</p> <p>This prototype system provides the perfect test bed for evaluating the translation of scientific data – observations, remote sensing, and citizen science data -- and data products, such as indicators, for decision-making audiences. Often translation of scientific information into decision support products is developed and improved given intuition and feedback. Though this can be useful in many cases, more rigorous testing using social science methodologies would provide greater assurance that the data products are useful for the intended audiences. I will present some initial research using surveys to assess the understandability of indicators and whether that understanding is influenced by one's attitude toward climate change. Such information is critical to assess whether products developed for scientists by scientists have been appropriately translated for non-scientists, thus assuring that the data will have some value for the intended audience. Such survey information will provide a data driven approach to further develop and improve the National Climate Indicators System and could be applied to improve other decision support systems.</p>
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18	A Prototype Indicators System for U.S. Climate Changes, Impacts, Vulnerabilities, and Responses	Communication as a Driver of Landscape Change Posters	Global Environmental Change	['Land cover change ', 'Disaster risk communication ', 'Decision	['Kenney, M A*', 'Janetos, A']	USA	2015	University of Maryland College Park	<p>Indicators are observations or calculations that are used to systematically report or forecast social and biophysical conditions over time. When the purpose of indicators is to, in part, provide complex scientific information that is understood by non-scientists and included in decision processes, the choice of indicators requires a structured process that includes co-production among a range of actors, including scientists, decision-makers, and a range of stakeholders. Here we describe recommendations on a vision and a prototype created for an indicators system, we term the National Climate Indicators System (NCIS). The goal of the NCIS is to create a system of physical, natural, and societal indicators to communicate and inform decisions about climate changes, impacts, vulnerabilities, and responses. The process of generating the indicator system involved input from over 200 subject-matter experts. Organized into 13 teams, experts created conceptual models of their respective sectors to generate an initial recommended set of indicators. A subset of indicators, which could be immediately implemented, were prototyped for the U.S. Global Change Research Program (USGCRP) a Federal program that coordinates and supports integration of global change research across the government. USGCRP reviewed the recommendations (Kenney et al., 2014) and prototypes provided by the scientific experts, and recently launched 14 indicators as proof-of-concept in support of a sustained National Climate Assessment and to solicit feedback from the users. Social science research is currently being undertaken in order to evaluate how well the prototype indicators communicate science to non-scientists, the usability of indicator system portal by scientists and decision-makers, and the development of information visualization guidelines to improve visual communication effectiveness. The goal of such efforts would be to provide input into the development of a more comprehensive USGCRP indicator set, building on recommendations from Kenney et al. (2014), and improve our understanding of the comprehension and use of indicators by non-scientists.</p>
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19	Effective Climate Communication with Difficult Audiences	Breaking through the Noise:	Public Affairs	['Informal education ', 'Decision	['Schumacher, R S*']	USA	2015	Colorado State University	<p>Climate communication is often fraught with ideological baggage (noise) that makes it very difficult to connect to audiences. In these cases, it is helpful to use best practices known from other fields of communication. Engaging audiences with authenticity, using plain language, respecting cultural and political differences, and a sprinkling of humor can go a long way toward establishing a connection. Its important to avoid common but polarizing tropes from popular media, and often quite helpful to frame climate issues in novel or unexpected ways that cut across entrenched political discourse.</p> <p>Emerging social science research</p> <p>Beyond ideology, climate change is Simple, Serious, and Solvable. Effective communication of these three key ideas can succeed when the science argument is carefully framed to avoid attack of the audiences ethical identity. Simple arguments from common sense and everyday experience are more successful than data. Serious consequences to values that resonate with the audience can be avoided by solutions that dont threaten those values.</p>
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20	The Fate of the World is in your hands: computer gaming for multi-faceted climate change education	Climate Literacy in Multidisciplinary Higher Education III Posters	Education and Human Resources	['Post-secondary education', 'Impacts of global change', 'General or	['Bedford, D P*']	USA	2015	Geography	<p>Climate change is a multi-faceted (or wicked) problem. True climate literacy therefore requires understanding not only the workings of the climate system, but also the current and potential future impacts of climate change and sea level rise on individuals, communities and countries around the world, as noted in the US Global Change Research Programs (2009) Climate Literacy: The Essential Principles of Climate Sciences. The asymmetric nature of climate change impacts, whereby the worlds poorest countries have done the least to cause the problem but will suffer disproportionate consequences, has also been widely noted. Education in climate literacy therefore requires an element of ethics in addition to physical and social sciences. As if addressing these multiple aspects of climate change were not challenging enough, polling data has repeatedly shown that many members of the public tend to see climate change as a far away problem affecting people remote from them at a point in the future, but not themselves. This perspective is likely shared by many students.</p> <p>Computer gaming provides a possible solution to the combined problems of, on the one hand, addressing the multi-faceted nature of climate change, and, on the other hand, making the issue real to students. Fate of the World, a game produced by the company Red Redemption, has been used on several occasions in a small (20-30 students) introductory level general education course on global warming at Weber State University. Players are required to balance difficult decisions about energy investment while managing regional political disputes and attempting to maintain minimum levels of development in the worlds poorer countries. By providing a realistic total immersion experience, the game has the potential to make climate change issues more immediate to players, and presents them with the ethical dilemmas inherent in climate change. This presentation reports on the use of Fate of the World in an educational setting, highlighting student experiences and lessons learned from two attempts to use the game as a tool for teaching the multi-faceted nature of climate change.</p>
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21	The Need for More Scientific Approaches to Science Communication	Climate Literacy: Research and Evaluation at the	Education and Human Resources	['Geoscience education research', 'General or	['Sadri, S*']	USA	2015	Princeton University	<p>Two possible goals for public science communication are: a) improving the public's in-depth understanding of the scientific subject; and b) fostering the public's belief that scientific efforts make a better world. Although (a) is often a natural target when scientists try to communicate their subject, the importance of (b) is underscored by the NSF, who investigated the cultural authority of science to understand science's role in policymaking. Surveys consistently find that there is a huge divergence between knowledge and admiration of science in society because science literacy has very little to do with public perception of science.</p> <p>However, even if both goals could be achieved, it doesn't necessarily mean that the general public will act on scientific advice. Different parts of society have different criteria for reaching judgments about how to act in their best interests. This makes the study of science communication important when controversies arise requiring public engagement. Climate change, sustainability, and water crises are only a few examples of such controversial subjects. Science communication can be designed carefully to sponsor dialogue and participation, to overcome perceptual obstacles, and to engage with stakeholders and the wider public.</p> <p>This study reviews work in social science that tries to answer: When is science communication necessary? What is involved in science communication? What is the role of media in effective science communication? It also reviews common recommendations for improved public engagement by scientists and science organizations.</p> <p>As part of this effort, I will present some portions of my science films. I will conclude with suggestions on what scientific institutions can focus on to build trust, relationships, and participation across segments of the public.</p> <p>Keywords: informal learning, popular science, climate change, water crisis, science communication, science films, science policy.</p>
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22	Building Public Will for Climate Change Solutions: Which Beliefs Are Most Helpful?	Climate Literacy: Science and Solutions in Education and Human Resources	['Post-secondary education ', 'Diversity ',	['Roser-Renouf, C*', 'Maibach, E',	USA	2016	George Mason University Fairfax	<p>At the COP21 meeting in December 2015, the nations of the world set an ambitious climate change goal to limit warming to no more than 2 degrees (C), ideally limiting the warming to 1.5 degrees. Achieving this ambitious goal will require building and/or sustaining a high degree of political will in dozens or hundreds of nations, especially highly industrialized nations. One important means of building/sustaining political will is to build public will (i.e., public demand) in support of this goal. Over the past decade, there has been a considerable amount of empirical social science research on public engagement with climate change. In this presentation, we will briefly review the findings of some of this research to suggest that five key beliefs largely form the basis for public will to address climate change. Specifically, people who hold the following beliefs are more likely to support actions to limit climate change, and to personally be taking helpful actions themselves: (1) climate change is real; (2) climate change is human-caused; (3) there is expert consensus about human-caused climate change; (4) climate change is harmful to people; (5) actions can be taken to limit climate change. We will also briefly review what is known about how to successfully communicate these ideas in ways that minimize the societal polarization about climate change (what we call the acceptance gap) that has developed between liberals and conservatives in several primarily English-speaking nations.</p>
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23	Analysis of Stakeholder-Defined Needs in Northeast U.S. Coastal Communities to Determine Gaps in Research Informing Coastal Resilience Planning	Science to Action: Building Novel and Transformative	Public Affairs	'Impacts of global change ', 'Regional climate change	['Molino, G D*', 'Kenney, M A', 'Sutton-Grier, A',	USA	2017	Brown University	<p>The impacts of climate change on our coastlines are increasing pressure on communities, ecosystems, infrastructure, and state-to-local economies in the northeastern United States (U.S.). As a result of current or imminent risk of acute and chronic hazards, local, state and regional entities have taken steps to identify and address vulnerabilities to climate change. Decisions to increase coastal infrastructure resilience and grey, green, and cultural infrastructure solutions requires physical, natural, and social science that is useful for decision-making and effective science translation mechanisms. Despite the desire to conduct or fund science that meets the needs of communities, there has been no comprehensive analysis to determine stakeholder-defined research needs. To address this gap, this study conducts a stakeholder needs analysis in northeast U.S. coastal communities to determine gaps in information and translation processes supporting coastal resilience planning. Documents were sourced from local, state, and regional organizations in both the public and private sectors, using the northeast region defined by the third National Climate Assessment. Modeled after Dilling et al. (2015), a deductive coding schema was developed that categorized documents using specific search terms such as Location and condition of infrastructure and Proactive planning. A qualitative document analysis was then executed using NVivo to formally identify patterns and themes present in stakeholder surveys, workshop proceedings, and reports. Initial stakeholder priorities centered around incorporation of climate science into planning and decision making regarding vulnerabilities of infrastructure, enhanced emergency planning and response, and communication of key information.</p>
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24	Creative Change: Art, Music, and Climate Science	Climate Literacy: The Arts as an Ally in	Public Affairs	['Informal education', 'Climate variability',	['Dahlberg, R A*', 'Hoffman, J S', 'Maurakis, E G']	USA	2017	Experience Development	<p>As part of ongoing climate science education initiatives, the Science Museum of Virginia hosted Creative Change in March 2017. The event featured multidisciplinary programming created by scientists, artists, and students reacting to and interpreting climate change and resiliency through a variety of artistic mediums and informal science education. Creative Change was developed in consideration of studies conducted at Columbia University that indicate traditional educational approaches, which rely heavily on scientific information and data literacy, fail to engage and inspire action in a majority of people. Our informal science education programming developed for Creative Change, by contrast, is inclusive to all ages and backgrounds, integrating scientific data and an artistic human touch. Our goal was to increase public awareness of climate change and resiliency through the humanities in support of the Museums mission to inspire Virginians to enrich their lives through science. Visitors were invited to attend Coral Reef Fever, a dance performance of coral bleaching; high school and university art exhibitions; climate data performed by a string quartet; poetry, rap, and theater performances; and a panel discussion by artists and scientists on communicating science through the arts and humanities. Based on 26 post- event survey results, we found as a result that visitors enjoyed the event (mean of 9.58 out of 10), learned new information (9.07), and strongly agreed that the arts and humanities should be used more in communicating science concepts (9.77). Funded in part by Bond Bradley Endowment and NOAA ELG Award #NA15SEC0080009.</p>
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25	Locally-sourced: How climate science can collaborate with arts & humanities museums to achieve widespread public trust and communication	Climate Literacy: The Arts as an Ally in Understanding Earth and	Public Affairs	['Informal education ', 'Climate variability ', 'Impacts of global	['Walker, C G*']	USA	2017	Brick Store Museum	<p>Local history, art and culture museums have a large role to play in climate science communication. Unfortunately, in our current society, scientific evidence and logic is not universally accepted as truth. These messages can be dispersed through trusted institutional allies like humanities and arts museums. There are many reasons for scientific institutions to work with humanities and arts museums of all sizes, especially local museums that have personal, trusted relationships with their communities. First, museums (by definition) are public educators; the work that they do is to disperse challenging information in an understandable way to a wide array of audiences. Museums are located in every state, with over 35,000 museums in the nation; 26% of those are located in rural areas. These museums serve every demographic and age range, inspiring even those with difficulty accepting climate change information to act. Second, in a recent public opinion survey commissioned by the American Alliance of Museums, museums especially history museums are considered the most trustworthy source of information in America, rated higher than newspapers, nonprofit researchers, the U.S. government, or academic researchers. Scientific institutions must collaborate with local museums to improve science communication going forward. Not only will important climate and sustainability research be dispersed via trusted sources, but the public will engage with this information in large numbers. In 2012 alone, over 850 million people visited museums more than the attendance for all major league sports and theme parks combined. A recent impact study shows that history and art museums, especially, are not seen as having a political agenda, with over 78% of the public seeing these museums as trusted institutions. There are many ways in which the scientific community can collaborate with the arts. This presentation will speak to the larger benefit of working with sister arts & humanities institutions for widespread public education, with examples and actionable ideas.</p>
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26	Math: A Critical, Treacherous Bridge Between Scientific Disciplines	Geoscience Impact in a Complex Union	['Urban systems ', 'Impacts of ['Fefferman, N H*']	USA	2018	University of Tennessee	I will briefly present my experiences working to bridge the interdisciplinary divide as one member of a team that brought geophysical and social scientists together to understand how social perceptions of, and behavioral responses to, climate change should be incorporated into climate projection models. Rather than translating between geosciences and social sciences directly, we turned to mathematical modeling to provide the integration of perspectives, tools, and research activities required to succeed. This was not itself without difficulty, but ultimately provided what I believe to be a rigorous and reproducible path forwards for interdisciplinary collaboration between physical and social scientists. I will attempt to distill this experience to make a few concrete recommendations for how the language and perspectives of mathematical modeling can be exploited to facilitate future collaborations while trying to avoid the pitfalls of adding yet a third discipline into the mix. I will also make a few short observations on what I perceived to be the greatest sources of difficulty in melding geophysical and social science perspectives.
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Inclusión integral de las Ciencias Sociales y las Humanidades

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1	Climate Change Education Today in K-12: What's Happening	Climate Literacy: Precollege Activities That Support Climate	Education and Human Resources	['Elementary and secondary education ']		USA	2011	<p>Climate change is a highly interdisciplinary topic, involving not only multiple fields of science, but also social science and the humanities. There are many aspects of climate change science that make it particularly well-suited for exploration in the K-12 setting, including opportunities to explore the unifying processes of science such as complex systems, models, observations, change and evolution. Furthermore, this field of science offers the opportunity to observe the nature of science in action - including how scientists develop and improve their understanding through research and debate. Finally, climate change is inherently highly relevant to students - indeed, students today will need to deal with the consequences of the climate change. The science of climate change is clearly present in current science education standards, both at the National level as well as in the majority of states. Nonetheless, a significant number of teachers across the country report difficulties addressing climate change in the classroom. The National Earth Science Teachers Association has conducted several surveys of Earth and space science educators across the country over the past several years on a number of issues, including their needs and concerns, including their experience of external influences on what they teach. While the number of teachers that report external pressures to not teach climate change science are in the minority (and less than the pressure to not teach evolution and related topics), our results suggest that this pressure against climate change science in the K-12 classroom has grown over the past several years. Some teachers report being threatened by parents, being encouraged by administrators to not teach the subject, and a belief that the “two sides” of climate change should be taught. Survey results indicate that teachers in religious or politically-conservative districts are more likely to report difficulties in teaching about climate change than in other areas of the country. This presentation will provide an overview of our most recent survey results on climate change education in the K-12 Earth and space science classroom, including highlighting some of the strategies that teachers are using to bring this critically important area of science to their students.</p>
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2	Increasing Vulnerability to Drought and Climate Change on the Navajo Nation,	Global Environmental Change General Contributions II Posters	Global Environmental Change	['Biodiversity', 'Ecosystems, structure and dynamics', 'Impacts of global change', 'General	['Hiza, M M*', 'Kelley, K B', 'Francis, H']	USA	2011	US Geological Survey	<p>The Navajo Nation of Arizona, New Mexico, and Utah, is an ecologically sensitive semi-arid to arid area where rapid growth of one of the largest population of Native Americans is outstripping the capacity of the land to sustain them. Recent drought conditions, combined with increasing temperatures, are significantly altering the habitability of a region already characterized by harsh living conditions. In addition to altered landscape conditions due to climatic change, drought, and varying land use practices over the last 200 years, the Navajo people have been affected by land use policies and harsh economic conditions that weaken their cultural fabric. Increasing aridity combined with drought threaten the very existence of Navajo culture and the survival of traditional Navajo communities. People presently living on these Native lands are unique in American society as their traditional lifestyle requires intimate knowledge of the ecosystem, knowledge that has been passed on for generations through oral traditions. We present data from the lifelong observations of 73 Native American elders that provide a record of the changes in plants and animals, water availability, weather, and sand or dust storms. This information is used to complement the scant long-term meteorological records and historical documentation for the region to further refine our understanding of the historical trends and local impacts of climate change and drought. Among the most cited changes is a long-term decrease in the amount of annual snowfall over the past century, a transition from wet conditions to dry conditions in the 1940s, and a decline in surface water features. The lack of available water, in addition to changing socioeconomic conditions, was mentioned as a leading cause for the decline in the ability to grow corn and other crops. Other noted changes include the disappearance of springs, and of plant and animal populations (particularly medicinal plants, cottonwood trees, beavers, and eagles). Changes in the frequency of wind, sand and dust storms (more frequent in the 1950s and increasing in the 1990s) were also observed. Important information that cannot be easily gleaned from meteorological and stream flow records are also recorded in our consultations. For example, they include observations of soil moisture and the description of disappearing migratory birds that rely on water sources. Local monitoring of soil moisture conditions today indicates that a rapid decline occurs in the Springtime. The fact that soil moisture was noted in the past to persist through the spring dry season, until the late summer monsoon season has profound implications for impacts to ecosystem viability that may have already occurred with climate change and drought. In addition, these changes in soil moisture also help us understand the mechanisms contributing to current drought severity. We conclude that a long-term drying trend and decreasing snowpack, superimposed on regional drought cycles, will magnify the cultural and literal erosion and desertification of the Navajo Nation and leave its people increasingly vulnerable to climate extremes.</p>
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3	Two-Sides of the Same Coin: Communicating	Scientist Participation in Science	Education and Human Resources	['EDUCATION', 'Climate impacts']	['Keener, V W*', 'Staal, L']	USA	2011	<p>Environment/Research</p> <p>The NOAA-funded Regional Integrated Sciences and Assessment (RISA) programs act as boundary organizations that both conduct and translate academic climate research in the physical and social sciences for a variety of stakeholder applications, including for local and state governments, natural resource managers, non-climate scientists, and community members. For the past six years, I have worked with two RISAs—one in the southeast United States, and recently in the Pacific region. In confronting the most immediate impacts of climate change, Florida and Hawai'i are both currently dealing with saltwater intrusion effects on infrastructure and water supply, sea level rise impacts on vulnerable coastlines, and expect the problems to worsen in the future. Both RISAs have focused on water resource sustainability as a topic of interest, and held workshops on climate variability and change impacts for water utilities and a wider range of relevant stakeholders. Methods that have been used to communicate climate science, projected impacts, and risk have included: working groups/collaborative learning, scientific presentations and presentations of relevant case studies, beach management planning, in-depth interviews, and educational radio spots. Despite the similarities in the types of issues being confronted, stakeholders in each location have responded with differing levels of acceptance, which has resulted in the usage of different methods of communication of the same types of climate science information. This talk will focus on the success of a variety of different methods in communicating similar information on comparable risks to different audiences.</p>
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4	Using and Applying Focus Groups in Climate Change Impact Assessment	Climate Change Challenge in Social-Ecological Systems: From Science to	Global Environmental Change	['Impacts of global change ', 'General or miscellaneous ', 'Interaction	['DeLorme, D*', 'Hagen, S']	USA	2011	School of Communication	<p>The focus group social science research method is an efficient and flexible data collection tool with broad applicability across disciplines and contexts. Through group dynamics, this interviewing approach offers strengths in gathering candid, spontaneous comments and detailed firsthand descriptions from stakeholders\u2019 perspectives. The method, which can stand alone or be integrated with other research frameworks, has much potential for helping to manage complex issues of global change. For optimal outcomes, however, careful planning and procedures are paramount. This presentation offers guidance in this regard via examples, tips, and lessons learned from a multidisciplinary NOAA-funded project: Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico (EESLR-NGOM). Focus groups are a key component of the EESLR-NGOM project as they are being used to better understand coastal resource managers\u2019 operational and information behaviors and needs regarding sea level rise (SLR), erosion, and hurricane storm surge impact; to learn how to best develop and translate the project\u2019s expected scientific results into straightforward, useful, and readily-disseminated products; and to gather outreach recommendations. As part of an EESLR-NGOM project kickoff workshop, 12 coastal resource managers participated voluntarily in a focus group. A summary of findings and illustrative participant quotations will be included in the presentation. The initial focus group was productive in gaining insights into challenges and opportunities associated with a climate change project such as the EESLR-NGOM. It highlighted the importance of considering the interrelationships of natural and built environments and new avenues for resilience and sustainability. The coastal resource managers are not only end-users but also opinion leaders in their local communities who will diffuse this information widely through their networks of other potential end-users. Engaging coastal resource managers in this manner will result in successful communication and tailoring of the scientific products so that they are most appropriate and beneficial in helping to determine the viability of future management actions relative to predicted conditions and will put resource managers in a more knowledgeable position to inform policy makers as to the likely results of their decisions. Further, by addressing the gap in the interdisciplinary literature on regionally-based climate change issues as studied using qualitative social science research approaches such as focus groups, our work makes theoretical and methodological scholarly contributions.</p>
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5	Climate Change and Migration along the Albemarle and Pamlico Sounds,	Living on the Edge: Societies on the Front Line of Coastal Change II	Ocean Sciences	[Impacts of global change', 'Sea level: variations and mean', 'North	[Rummel, J D*', 'Griffith, D C', 'Kimmel, D G', 'Landry, C E', 'Montz, B E']	USA	2012	Inst for Coastal Sci & Policy	<p>Climactic events that have stimulated or enhanced human migrations have been documented historically. For example, the U.S. granted Temporary Protective Status to Honduran migrants following Hurricane Mitch in 1998, and many of those migrated to North Carolina and other parts of the U.S. South. In North Carolina and elsewhere, changing environmental conditions have led to shifting migration patterns among fish, birds, marine mammals, and other species—with a concomitant change in fishing practices and other forms of marine resource exploitation. Now, significant landscape changes are taking place as a result of global climate change, including sea level rise, changing ice cover at the poles, an increasing frequency and duration of drought, forest fires, and storms. Anthropocentric responses to the occasional disasters that will punctuate these changes suggest that the relationship between climate/environmental change and migration is likely to become central to the future of the geosciences along with the environmental and social sciences, as well as an essential focus to policies influencing population movements, environmental health, and risk management. Over the last two decades, the Albemarle-Pamlico region of North Carolina has harbored one of the nation’s fastest growing populations, with immigrants to the region primarily consisting of two distinct, yet interconnected, groups: 1) relatively affluent U.S. citizens (including many retirees seeking proximity to coastal amenities); and, 2) relatively poor workers (many from Mexico and Central America) attracted to the region for work in agriculture, fisheries, food processing, construction/landscaping, tourism, and forestry. By settling near the coast, these immigrants can be particularly susceptible to storm surge and other damage from the combination of sea level rise, hurricanes, and related processes that are reshaping coastal environments. This paper considers the past, present, and future of climate change along the Albemarle and Pamlico Sounds in the context of past, present, and future migrations—and other human dimensions—that are affected by the pervasive changes we now face along the coast.</p> <p>The Albemarle-Pamlico Peninsula. East and North of the City of Washington (black dot), much of the peninsula is nearly at sea-level. The major west-east elevation change between green and yellow occurs at the Suffolk Scarp, a 120 kya paleo-shoreline.</p>
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6	IPCC and other assessments as vehicles for integrating natural and	Integrating Natural and Social Science Research to Address Human	Global Environmental Change	['Earth system modeling' , 'Coupled models of the climate system ']	['Field, C B*']	USA	2012	Global Ecology	<p>IPCC and other assessments address both natural and social science aspects of climate change, but this approach has historically involved relatively little integration across the two sets of disciplines. In a framing that is only slightly oversimplified, past relationships were mostly sequential. From a physical climate perspective, human behavior was a boundary condition setting the trajectory of atmospheric forcing. And from an impacts perspective, changes in the physical climate set the stage upon which humans experienced impacts and made decisions about adaptation and mitigation. Integrated assessment models have been the main locus of research on questions about bi-directional coupling, where the trajectory of the physical climate influences GHG balance related to the need for agricultural land as well as GHG emissions from other activities. In the IPCC AR4 (2007), feedbacks from the natural carbon cycle to climate were a focus, but with little discussion of the potentially important feedbacks from climate-carbon interactions in the human domain. Detailed research and modeling in this area are still in the relatively early stages. For the future, IPCC and other assessments potentially provide a vehicle for new insights about the interaction of natural and social science dimensions of climate change. Several aspects could be interesting. Some of these relate to the decisions that modulate GHG emissions. For example, how does scientific understanding of climate change influence people's interest in mitigation and adaptation? How does it influence their willingness to pay? How are these modulated by regional and global geopolitics? Other potentially interesting aspects relate to interactions between mitigation and adaptation. For example, how does local experience of climate change alter the balance of focus on adaptation and mitigation? Still others relate to the nature of impacts and the role of sustainable development. With an aggressive sustainable development agenda aimed at building resilience, would societies be more or less focused on impacts? Finding ways to address these questions in the context of an assessment presents a range of challenges, beginning with the challenge that the assessments are generally not designed to conduct new research. But on the other hand, the juxtaposition of disciplines, perspectives, and tools creates a fertile ground for new insights.</p>
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7	Trans- and Interdisciplinarity in K-14 Climate Change Education: Trends Emerging from	Climate Literacy: Evidence From Research and Evaluation on Effectiveness of Interdisciplinary	Education and Human Resources	['Elementary and secondary education ', 'Informal education ', 'Curriculum and laboratory	['Storksdieck, M*']	USA	2012	Board on Science Education	<p>A recent report by the National Research Council placed climate change or climate science education deeply into the curriculum of K-12 science education in the US (A Framework for K-12 Science Education). The NRC Framework is currently being translated into the Next Generation Science Standards (NGSS), an effort by 26 states, representing 57% of the US school-aged population, under the leadership of the educational nonprofit Achieve. A first draft version of the NGSS was made available to public audiences in June of 2012, and a revised draft will be available for a second round of reviews in later November of 2012; the final version of the NGSS which will likely feature climate change and climate science as part of Earth Systems Science, but also embedded in other areas of the science curriculum, is expected to be released in the spring of 2013. It has already become apparent, though, that successful implementation of the new standards down into effective classroom-based instruction will require a deep analysis of current and likely future barriers and opportunities for engaging K-14 students in climate change education. A recently released report on an NRC workshop conducted in 2011 summarizes these discussions (Climate Change Education in Formal Settings, K-14: A Workshop Summary). The proceedings of the workshop highlight the need to think in trans- or interdisciplinary ways about educating children in primary, secondary and early post-secondary education. This report builds on a 2010 workshop that addressed how to best reach general audiences on the issue of climate change education, particularly if the desired outcome is seen as building adaptive capacity in children and adults alike. This workshop was summarized in a report entitled Climate Change Education: Goals, Audiences, and Strategies. Opportunities for engaging students in trans- or interdisciplinary exploration of climate science or climate change-related topics, while available to K-12 students, abound in undergraduate education and informal learning. This presentation will feature a variety of cases in which climate is being addressed this way, and discuss principles that one can extract from such diverse examples as an integrated undergraduate minor; a youth-oriented show and related activities for schools provided by an educational non-profit; Green Schools and other specialty initiatives at the K-12 level that integrate education around climate and energy challenges, or programs in nature and science centers that address climate issues from a stewardship perspective, addressing actions children can take as part of the educational activities themselves. Principles that have guided various successful efforts to implement trans-and interdisciplinary climate education include orientation towards local and community action; relevance to learners; commitment by leadership and staff; institutional and organizational freedom to experiment and cooperate; opportunities to explore underlying natural and social science phenomena through hands-on and active learning; and commitment to excellence and scientific “truth”. The session will close with a reflection on the merits of infusing climate change throughout the learning trajectory of a child, adolescent or young adult.</p>
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8	Development of EarthCube Governance: An Agile Approach	Emerging Concepts for Cyberinfrastructure in the Geosciences II (Virtual	Earth and Space Science Informatics	[Community standards', 'Cyberinfrastructure', 'Data and information	[Pearthree, G*, 'Allison, M L', 'Patten, K']	USA	2013	Arizona Geological Survey	<p>Governance of geosciences cyberinfrastructure is a complex and essential undertaking, critical in enabling distributed knowledge communities to collaborate and communicate across disciplines, distances, and cultures. Advancing science with respect to "grand challenges," such as global climate change, weather prediction, and core fundamental science, depends not just on technical cyber systems, but also on social systems for strategic planning, decision-making, project management, learning, teaching, and building a community of practice. Simply put, a robust, agile technical system depends on an equally robust and agile social system. Cyberinfrastructure development is wrapped in social, organizational and governance challenges, which may significantly impede progress. An agile development process is underway for governance of transformative investments in geosciences cyberinfrastructure through the NSF EarthCube initiative. Agile development is iterative and incremental, and promotes adaptive planning and rapid and flexible response. Such iterative deployment across a variety of EarthCube stakeholders encourages transparency, consensus, accountability, and inclusiveness. A project Secretariat acts as the coordinating body, carrying out duties for planning, organizing, communicating, and reporting. A broad coalition of stakeholder groups comprises an Assembly (Mainstream Scientists, Cyberinfrastructure Institutions, Information Technology/Computer Sciences, NSF EarthCube Investigators, Science Communities, EarthCube End-User Workshop Organizers, Professional Societies) to serve as a preliminary venue for identifying, evaluating, and testing potential governance models. To offer opportunity for broader end-user input, a crowd-source approach will engage stakeholders not involved otherwise. An Advisory Committee from the Earth, ocean, atmosphere, social, computer and library sciences is guiding the process from a high-level policy point of view. Developmental evaluators from the social sciences embedded in the project provide real-time review and adjustments. While a large number of agencies and organizations have agreed to participate, in order to ensure an open and inclusive process, community selected leaders yet to be identified will play key roles through an Assembly Advisory Council. Once consensus is reached on a governing framework, a community-selected demonstration governance pilot will help facilitate community convergence on system design.</p>
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9	Integrating Social Science, Environmental Science, and Engineering to Understand	Deltas: A Multi-trillion Dollar Global Problem III	Earth and Planetary Surface Processes	['Impacts of global change ', 'Sea level change ', 'Resilience ', 'Vulnerability ']	['Gilligan, J M*', 'Ackerly, B', 'Goodbred, S L']	USA	2013	Earth & Environmental Sciences	<p>In populated delta environments, it is impossible to separate human and natural systems. Human activities change the landscape by altering the dynamics of water and sediment and in return, humans themselves are affected by the natural and anthropogenic changes to the landscape. Such interactions can also have significant impacts on the ecology and natural resources of a delta system, affecting local and regional food supply, livelihoods, and economies, particularly in developing nations. Successful adaptation to environmental change in a strongly coupled human-natural system, such as the Bengal delta, requires understanding how the physical environment and the changing social, political, and economic conditions of people's lives interact. Research on human-delta interactions has largely focused on macro-scale effects from major dams, water diversions, and catchment-scale land use; but at the smaller scale of households and communities, decisions, actions, and outcomes may occur abruptly and have significant local impacts (positive or negative). Southwest Bangladesh experiences profound environmental problems at the local human-landscape interface, including groundwater salinity, soil fertility, conflicting land-use practices, management of engineering structures, and declining land-surface elevations. The impacts of climate-induced sea-level rise, especially with respect to population migration, receive great attention and concern, but neither sea level rise nor migration occurs against a background of static physical or human environments. For example, changing land use (e.g., building embankments, which affect drainage, sediment transport, and the evolution of tidal channels; and the transformation of rice fields to shrimp aquaculture, which affects soil chemistry, labor markets, river ecology, and possibly the integrity of embankments) can significantly change the impact that sea level rise will have on flood hazards and the resulting effect on people living on the delta. Assessing the impacts of climate change and other environmental stresses on delta populations and designing effective responses will require understanding interactions between the physical and human environments at multiple scales. As part of a multidisciplinary research project drawing on sedimentology, hydrology, remote-sensing, engineering, political science, sociology, psychology, and anthropology we are studying the interactions of human and natural systems in coastal Bangladesh to understand conditions that contribute to vulnerability and resilience at both the household and the community level. Building on Elinor Ostrom's socioecological systems approach, we have developed a theoretical framework for studying vulnerability and resilience when coupled human-natural systems are subject to significant changes and exogenous forcings. We will report on this framework using examples of successful and unsuccessful interventions to manage or mitigate exposure to environmental hazards, and we will also report on progress toward using our framework to identify and understand factors that contribute to the success or failure of such projects.</p>
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10	The Nature of Natural Hazards Communication	Interdisciplinary Approaches to Natural Hazards: Environmental, Natural Hazards	['EDUCATION ', 'GLOBAL CHANGE ', 'NATURAL HAZARDS ', 'PUBLIC	['Kontar, Y Y*']	USA	2013	Geology & Geophysics	Some of the many issues of interest to natural hazards professionals include the analysis of proactive approaches to the governance of risk from natural hazards and approaches to broaden the scope of public policies related to the management of risks from natural hazards, as well as including emergency and environmental management, community development and spatial planning related to natural hazards. During the talk we will present results of scientific review, analysis and synthesis, which emphasize same new trends in communication of the natural hazards theories and practices within an up-to-the-minute context of new environmental and climate change issues, new technologies, and a new focus on resiliency. The presentation is divided into five sections that focus on natural hazards communication in terms of education, risk management, public discourse, engaging the public, theoretical perspectives, and new media. It includes results of case studies and best practices. It delves into natural hazards communication theories, including diffusion, argumentation, and constructivism, to name a few. The presentation will provide information about: (1) A manual of natural hazards communication for scientists, policymakers, and media; (2) An up-to-the-minute context of environmental hazards, new technologies & political landscape; (3) A work by natural hazards scientists for geoscientists working with social scientists and communication principles; (4) A work underpinned by key natural hazards communication theories and interspersed with pragmatic solutions; (5) A work that crosses traditional natural hazards boundaries: international, interdisciplinary, theoretical/applied. We will further explore how spatial planning can contribute to risk governance by influencing the occupation of natural hazard-prone areas, and review the central role of emergency management in risk policy. The goal of this presentation is to contribute to the augmentation of the conceptual framework of risk governance and increase the awareness of practitioners and decision-makers to the need to adopt proactive policies, leading to a more integrated, participative, and adaptive governance that can respond more efficiently to the increasing uncertainty resulting from escalating natural hazards risk exposure.
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11	Water, Society and the future of water	Water Resources Management and Policy	Hydrology	['Water management ']	['Brown, C M*']	USA	2013	Univ of Massachusetts Amherst	<p>The subject of water and society is broad, but at heart is the study of water as a resource, essential to human activities, a vital input to food and energy production, the sustaining medium for ecosystems and yet also a destructive hazard. Society demands, withdraws, competes, uses and wastes the resource in dynamic counterpart. The science of water management emerges from this interface, a field at the nexus of engineering and geoscience, with substantial influence from economics and other social sciences. Within this purview are some of the most pressing environmental questions of our time, such as adaptation to climate change, direct and indirect connections between water and energy policy, the continuing dependence of agriculture on depletion of the world's aquifers, the conservation or preservation of ecosystems within increasingly human-influenced river systems, and food security and poverty reduction for the earth's poorest inhabitants. This presentation will present and support the hypothesis that water resources research is a scientific enterprise separate from, yet closely interrelated to, hydrologic science. We will explore the scientific basis of water resources research, review pressing research questions and opportunities, and propose an action plan for the advancement of the science of water management. Finally, the presentation will propose a Chapman Conference on Water and Society: The Future of Water Resources Research in the spring of 2015.</p>
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12	Climate Science across the Liberal Arts Curriculum at Gustavus	Climate Literacy: Approaches to Multidisciplinary Climate	Education and Human Resources	['Post-secondary education', 'General or miscellaneous']	['Bartley, J K*', 'Triplett, L', 'Dontje, J', 'Huber, T', 'Koomen, M',	USA	2014	Gustavus Adolphus College	<p>The human and social dimensions of climate change are addressed in courses in humanities, social sciences, and arts disciplines. However, faculty members in these disciplines are not climate science experts and thus may feel uncomfortable discussing the science that underpins our understanding of climate change. In addition, many students are interested in the connections between climate change and their program of study, but not all students take courses that address climate science as a principal goal. At Gustavus Adolphus College, the Climate Science Project aims to help non-geoscience faculty introduce climate science content in their courses in order to increase climate science literacy among students and inform discussions of the implications of climate change.</p> <p>We assembled an interdisciplinary team of faculty with climate science expertise to develop climate science modules for use in non-geoscience courses. Faculty from the social sciences, humanities, arts, education, and natural sciences attended workshops in which they developed plans to include climate science in their courses. Based on these workshops, members of the development team created short modules for use by participating faculty that introduce climate science concepts to a non-specialist audience. Each module was tested and modified prior to classroom implementation by a team of faculty and geoscience students. Faculty and student learning are assessed throughout the process, and participating faculty members are interviewed to improve the module development process.</p> <p>The Climate Science Project at Gustavus Adolphus College aims to increase climate science literacy in both faculty members and students by creating accessible climate science content and supporting non-specialist faculty in learning key climate science concepts. In this way, climate science becomes embedded in current course offerings, including non-science courses, reaching many more students than new courses or enhanced content in the geosciences can reach. In addition, this model can be adopted by institutions with limited geoscience course offerings to increase geoscience literacy among a broad cross-section of students.</p>
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13	From Environmental History	Teaching and Career	Education and Human	['Informal education ' ,	['Gergel, D R*']	USA	2014	University of Washington The social sciences and humanities are typically framed in terms of being completely disparate from the "hard sciences", and although this bipolarity is far from accurate, the skills required in each area are indeed quite different. In this short talk, the author discusses her experience in shifting from a doctoral program in environmental history to a doctoral program in hydrology. The experience of having to learn a radically new skill set is both frightening and hugely rewarding and requires a confidence in one's ability to master new and ostensibly insurmountable concepts and a dedication to pushing beyond the initial endless frustrations. But after overcoming these initial hurdles, it became extremely useful to have a broad background in the geosciences. Conceptualizing the impact of climate change on water resources in terms of human livelihoods, for example, is both necessary and productive to understanding long-term policy impacts. This broader framing of research questions is thus significant in moving beyond the sometimes narrow conversations that are had behind the closed doors of each academic discipline.
14	Great Lakes Integrated Sciences Assessments:	New Opportunities in Global Change Collaboration:	Public Affairs	['Decision making under uncertainty ' , 'Institutions ' ,	['Baule, W J* ' , 'Briley, L ' , 'Brown, D ' , 'Gibbons, E']	USA	2014	Great Lakes Integrated Sciences Assessments The Great Lakes Integrated Sciences Assessments (GLISA) is one of eleven NOAA Regional Integrated Sciences and Assessments (RISAs) and is co-hosted by the University of Michigan and Michigan State University. The Great Lakes region falls between areas that are typically defined as the Midwest and Northeast in the United States and also includes portions of Ontario in Canada. This unique and complex region holds approximately 21% of global surface fresh water and is home to 23 million people on the United States side of the basin alone. GLISA functions as a bridge between climate science researchers and boundary organizations in the Great Lakes region, with the goals of contributing to the long-term sustainability of the region in face of a changing climate and to facilitate smart decision-making backed by sound scientific knowledge. Faculty and staff associated with GLISA implement physical and social science practices in daily operations, which includes but is not limited to: activating the boundary chain model to facilitate the transfer of knowledge through the community, integrating local and historical climate data into decision-making processes, addressing uncertainty and the downscaling of climate information, and implementing network analyses to find key access points to information networks across the Great Lakes region. GLISA also provides funding for projects related to climate and climate change adaptation in the Great Lakes region, as well as expertise to partner organizations through collaborations. Information from boundary organizations, stakeholders, and collaborators also flows back to GLISA to aid in the determination of the physical and social science needs of the region. Recent findings point to GLISA playing a crucial role in the scaling information across scales of government and ensuring that federal agencies and local stakeholders are able to learn from one another and share experiences and knowledge to continue building climate ready sectors and communities across the Great Lakes region.

15	Developing Climate Change Literacy With the Humanities: A	Climate Literacy in Multidisciplinary Higher Education I	Education and Human Resources	[Post-secondary education , 'Impacts of global change' ,	[Siperstein, S*]	USA	2015	University of Oregon	<p>Teaching the science and policy of climate change is necessary but insufficient for helping students to develop a robust climate literacy. Climate change educators must also teach students how to evaluate historical trends, to unpack the assumptions in shared cultural narratives, to grapple with ethical dilemmas, and more generally to traverse the turbulence of feeling that is a hallmark of living in a time of global climate chaos. In short, climate literacy must include the skills and strategies of the humanities, and specifically literary and cultural studies. After providing an overview of how literary and cultural studies scholars from around the world are developing innovative pedagogical methods for addressing climate change (drawing on the presenters experience editing the forthcoming volume Teaching Climate Change in the Humanities), the presentation will then report on a specific Literary Genres course taught at the University of Oregon. The course, offered to undergraduate non-majors who entered the class with little or no knowledge of climate change, constituted a case study of action research into the transdisciplinary teaching of climate change. The presentation will thus draw on quantitative course assessments, student coursework, and the instructors own experiences in arguing that three key narratives underpin the work we do as multidisciplinary climate change educators: narratives of observation, narratives of speculation, and narratives of conversion. That is, we guide students through the processes of witnessing climate change, imagining more just and sustainable futures, and by so doing, transforming themselves and their communities. In the particular Literary Genres course under consideration, students used the tools of literary and cultural studies first to analyze existing versions of these narratives and then to compose their own versions of these narratives based on their local communities and ecologies. In the context of multidisciplinary climate change education, one of the most important roles of the humanities is to empower students by giving them the critical and creative tools to tell their own climate stories.</p>
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16	Social Science, Equity and the Sustainable	Science and the Sustainable Development	Public Affairs	['Impacts of global change ', 'General or	['Liverman, D*']	USA	2015	University of Arizona	<p>The Sustainable Development Goals are underpinned by a commitment to a world that is just, equitable, inclusive and environmentally sustainable and include goals of ending poverty and hunger; universal access to health, education, water, sanitation, energy and decent work; and reducing the risks and impacts of climate change, biodiversity loss, and marine, forest and land degradation. They seek to reduce inequality between and within countries and achieve gender equality. The SDGs build on the apparent success in meeting many of the Millennium Development Goals, including those of reducing poverty, hunger and debt and providing access to water. The science needed to achieve and monitor most of these goals is social science - an area of scholarship that is traditionally undervalued, underfunded, underrepresented misunderstood and lacking in detailed data.</p> <p>This paper will provide an overview of the social science that is needed to support the Sustainable Development Goals, with a particular focus on the challenges of monitoring social data over time and within countries, the importance of research design, and of building capacity and credibility in the social sciences. As an example, the paper will discuss the social science that will be needed to achieve Goal 13: Take urgent actions to combat climate change and its impacts, and measuring targets such as strengthening resilience and adaptive capacity, and raising capacities of women, youth, and marginalized communities to manage and respond climate change.</p>
17	Uncertainty in Driftless Area Cold-Water Fishery	Toward Effective Decision Maker-Scientist	Public Affairs	['Climate impacts ', 'Preparedness and planning	['Schuster, Z*']	USA	2015	University of Wisconsin Madison	<p>The paradigm of stakeholder-based science is becoming more popular as organizations such as the U.S. Department of the Interior Climate Science Centers adopt it as a way of providing practicable climate change information to practitioners. One of the key issues stakeholders face in adopting climate change information into their decision processes is how uncertainty is addressed and communicated. In this study, we conducted a series of semi-structured interviews with managers and scientists working on stream habitat restoration of cold-water fisheries in the Driftless Area of Wisconsin that were focused on how they interpret and manage uncertainty and what types of information they need to make better decisions. One of the important lessons we learned from the interviews is that if researchers are going to provide useful climate change information to stakeholders, they need to understand where and how decisions are made and what adaptation measures are actually available in a given decision arena. This method of incorporating social science methods into climate science production can provide a framework for researchers from the Climate Science Centers and others who are interested in pursuing stakeholder-based science. By identifying a specific ecological system and conducting interviews with actors who work on that system, researchers will be able to gain a better understanding of how their climate change science can fit into existing or shape new decision processes. We also interpreted lessons learned from our interviews via existing literature in areas such as stakeholder-based modeling and the decision sciences to provide guidance specific to the stakeholder-based science process.</p>

18	Useful and Usable Climate Science: Frameworks for Bridging	Useful and Usable Data: What Makes Climate Science	Atmospheric Sciences	['Model verification and validation ', 'Climate impacts ', 'Global	['Buja, L*']	USA	2016	National Center for Atmospheric Research	<p>Society is transforming the Earth's system in unprecedented ways, often with significant variations across space and time. In turn, the impacts of climate change on the human system vary dramatically due to differences in cultural, socioeconomic, institutional, and physical processes at the local level. The Climate Science and Applications Program (CSAP) at the National Center for Atmospheric Research in Boulder Colorado addresses societal vulnerability, impacts and adaptation to climate change through the development of frameworks and methods for analyzing current and future vulnerability, and integrated analyses of climate impacts and adaptation at local, regional and global scales. CSAP relies heavily on GIS-based scientific data and knowledge systems to bridge social and physical science approaches in its five focus areas:</p> <ul style="list-style-type: none"> Governance of inter-linked natural and managed resource systems. The role of urban areas in driving emissions of climate change Weather, climate and global human health, GIS-based science data & knowledge systems. Regional Climate Science and Services for Adaptation <p>Advanced methodologies and frameworks for assessing current and future risks to environmental hazards through the integration of physical and social science models, research results, and remote sensing data are presented in the context of recent national and international projects on climate change and food/water security, urban carbon emissions, metropolitan extreme heat and global health. In addition, innovative CSAP international capacity building programs teaching interdisciplinary approaches for using geospatial technologies to integrate multi-scale spatial information of weather, climate change into important sectors such as disaster reduction, agriculture, tourism and society for decision-making are discussed.</p>
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19	Using interviews and focus groups with resource managers to	Toward More Effective Decision Maker-Scientist Engagement III	Public Affairs	['Impacts of global change ', 'Climate impacts ', 'Decision making	['Clifford, K R*', 'Travis, W', 'Rangwala, I', 'Rondeau, R', 'Young, L']	USA	2016	Western Water Assessment/CIRES	<p>Resource managers in the western U.S. are increasingly tasked to incorporate climate change into management decisions and long-term planning, but this task is complicated by multiple challenges, among them the need to bridge between the differing perspectives and prerogatives of scientists and resource managers. As part of a larger, iterative, interdisciplinary, multi-landscape research project that built on a prior climate vulnerability research, we conducted more than 50 semi-structured interviews and four focus groups with resource managers in the Gunnison Basin in western Colorado. The interviews addressed the managers risk perceptions and knowledge about the resources and landscapes, while the focus groups asked resource managers to reflect on their own resource decision-making in light of three narrative future climate scenarios created by scientists on the research team.</p> <p>While time-intensive, the interviews and focus groups produced important insights into the managers understanding of both the resources in question and the future climate scenarios. We found that the managers mental models of their systems, and their conceptions of landscape changes and future threats, were diverse and sometimes in conflict with those held by the research team. The managers responses to the climate scenarios reflected divergent and nuanced perceptions of risk, adaptation and uncertainty, heavily shaped by personal experience which could be a constraint under rapidly changing future conditions.</p> <p>Our deployment of social science methodologies facilitated the co-production of climate adaptation strategies and a bridge between and among scientists and managers. The participants found the focus groups helpful since they (1) provided space to focus on decision-making under climate change, rather than fixate on details of the science, and (2) facilitated interaction with colleagues from other agencies. Climate scientists used participant feedback to inform future scenario development. The use of small focus groups to engage with climate scenarios could add value to other ongoing efforts to promote landscape-scale adaptation.</p>
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20	A Faculty Workshop Model to Integrate Climate	Climate Literacy in Higher Education: Challenges and	Education and Human Resources	['Post-secondary education ', 'Curriculum and	['Teranes, J L*']	USA	2017	University of California San Diego	<p>Much of the growing scientific certainty of human impacts on the climate system, and the implications of these impacts on current and future generations, have been discovered and documented in research labs in colleges and universities across the country. Often these institutions also take decisive action towards combatting climate change, by making significant reductions in greenhouse emissions and pledging to greater future reductions. Yet, there are still far too many students that graduate from these campuses without an adequate understanding of how climate change will impact them within their lifetimes and without adequate workforce preparation to implement solutions. It may be that where college and universities still have the largest influence on climate change adaption and mitigation is in the way that we educate students.</p> <p>Here I present a curriculum workshop model at UC San Diego that leverages faculty expertise to infuse climate change education across disciplines to enhance UC San Diego students climate literacy, particularly for those students whose major focus is not in the geosciences. In this model, twenty faculty from a breadth of disciplines, including social sciences, humanities, arts, education, and natural sciences participated in workshops and developed curricula to infuse aspects of climate change into their existing undergraduate courses. We particularly encouraged development of climate change modules in courses in the humanities, social sciences and arts that are best positioned to address the important human and social dimensions of climate change. In this way, climate change content becomes embedded in current course offerings, including non-science courses, to increase climate literacy among a greater number and a broader cross-section of students.</p>
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21	Challenges and Opportunities for Integrating Social Science	Sustained Scientific Assessment: Tools and Approaches to Help	Global Environmental Change	['Evaluation and assessment', 'Impacts of global change',	['Larson, E K*', 'Li, J', 'Zycherman, A']	USA	2017	NASA Goddard Space Flight Center	<p>Integration of social science into climate and global change assessments is fundamental for improving understanding of the drivers, impacts and vulnerability of climate change, and the social, cultural and behavioral challenges related to climate change responses. This requires disciplinary and interdisciplinary knowledge as well as integrational and translational tools for linking this knowledge with the natural and physical sciences. The USGCRPs Social Science Coordinating Committee (SSCC) is tasked with this challenge and is working to integrate relevant social, economic and behavioral knowledge into processes like sustained assessments. This presentation will discuss outcomes from a recent SSCC workshop, Social Science Perspectives on Climate Change and their applications to sustained assessments.</p> <p>The workshop brought academic social scientists from four disciplines anthropology, sociology, geography and archaeology - together with federal scientists and program managers to discuss three major research areas relevant to the USGCRP and climate assessments: (1) innovative tools, methods, and analyses to clarify the interactions of human and natural systems under climate change, (2) understanding of factors contributing to differences in social vulnerability between and within communities under climate change, and (3) social science perspectives on drivers of global climate change. These disciplines, collectively, emphasize the need to consider socio-cultural, political, economic, geographic, and historic factors, and their dynamic interactions, to understand climate change drivers, social vulnerability, and mitigation and adaptation responses. They also highlight the importance of mixed quantitative and qualitative methods to explain impacts, vulnerability, and responses at different time and spatial scales.</p> <p>This presentation will focus on major contributions of the social sciences to climate and global change research. We will discuss future directions for sustained assessments that integrate and reflect the social science understanding of the complex relationships between social and natural worlds in a changing climate, and factors that impact effective mitigation and adaptation strategies that address risks and vulnerabilities of climate change.</p>
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22	Developing A Transdisciplinary	Science to Action: Communities	Union	['Teaching methods ', 'General or	['Kassam, K A*', 'Samimi, C',	USA	2017	Cornell University	<p>Difference is essential to solving the most complex problems faced by humanity. Anthropogenic climate change is one such wicked problem that demands cognitive diversity. Biophysical and social scientists must collaborate with scholars from the humanities to address practical issues of concern to local communities, which are at the forefront of impacts of climatic variation. As such, communities of inquirers (e.g. biophysical and social sciences, humanities) must work in tandem with communities of practice (e.g. farmers, fishers, gatherers, herders, hunters). This leads to co-generated knowledge where an adaptation strategy to climatic variation is locally grounded in the biophysical and sociocultural context of the communities where the impacts of climatic variation are most felt.</p> <p>We will present an innovative and real time example participatory and transdisciplinary research from an international project where we are developing integrated biophysical and sociocultural calendars, in short, ecological calendars, which are ecologically and culturally grounded in the local context to develop anticipatory capacity to anthropogenic climate change.</p>
23	Incorporating Social System Dynamics into the Food-Energy-	Achieving Water-Energy-Food Nexus Sustainability: A	Global Environmental Change	['Land cover change ', 'Remote sensing ', 'Water cycles ',	['Givens, J*', 'Padowski, J', 'Malek, K', 'Guzman, C', 'Boll, J',	USA	2017	Dept. of Sociology	<p>In the face of climate change and multi-scalar governance objectives, achieving resilience of food-energy-water (FEW) systems requires interdisciplinary approaches. Through coordinated modeling and management efforts, we study Innovations in the Food-Energy-Water Nexus (INFEWS) through a case-study in the Columbia River Basin. Previous research on FEW system management and resilience includes some attention to social dynamics (e.g., economic, governance); however, more research is needed to better address social science perspectives. Decisions ultimately taken in this river basin would occur among stakeholders encompassing various institutional power structures including multiple U.S. states, tribal lands, and sovereign nations. The social science lens draws attention to the incompatibility between the engineering definition of resilience (i.e., return to equilibrium or a singular stable state) and the ecological and social system realities, more explicit in the ecological interpretation of resilience (i.e., the ability of a system to move into a different, possibly more resilient state). Social science perspectives include but are not limited to differing views on resilience as normative, system persistence versus transformation, and system boundary issues. To expand understanding of resilience and objectives for complex and dynamic systems, concepts related to inequality, heterogeneity, power, agency, trust, values, culture, history, conflict, and system feedbacks must be more tightly integrated into FEW research. We identify gaps in knowledge and data, and the value and complexity of incorporating social components and processes into systems models. We posit that socio-biophysical system resilience modeling would address important complex, dynamic social relationships, including non-linear dynamics of social interactions, to offer an improved understanding of sustainable management in FEW systems. Conceptual modeling that is presented in our study, represents a starting point for a continued research agenda that incorporates social dynamics into FEW system resilience and management.</p>

24	Increasing Communities Capacity to Effectively Teaching Systems Thinking: Integrating Earth and Education and Human Resources ['Elementary and secondary education ', 'Informal ['Niepold, F III*', 'Ledley, T S', 'Stanton, C', 'Fraser, J', USA 2017 NOAA Washington DC	Understanding the causes, effects, risks, and developing the social will and skills for responses to global change is a major challenge of the 21st century that requires coordinated contributions from the sciences, social sciences, humanities, arts, and beyond. There have been many effective efforts to implement climate change education, civic engagement and related workforce development programs focused on a multitude of audiences, topics and in multiple regions. This talk will focus on how comprehensive educational efforts across our communities are needed to support cities and their primary industries as they prepare for, and embrace, a low-carbon economy and develop the related workforce. While challenges still exist in identifying and coordinating all stakeholders, managing and leveraging resources, and resourcing and scaling effective programs to increase impact and reach, climate and energy literacy leaders have developed initiatives with broad input to identify the understandings and structures for climate literacy collective impact and to develop regional/metropolitan strategy that focuses its collective impact efforts on local climate issues, impacts and opportunities. This Climate Literacy initiative envisions education as a central strategy for community civic actions in the coming decades by key leaders who have the potential to foster the effective and innovative strategies that will enable their communities to seize opportunity and prosperity in a post-carbon and resilient future. This talk discusses the advances and collaborations in the Climate Change Education community over the last decade by U.S. federal and non-profit organization that have been made possible through the partnerships of the Climate Literacy & Energy Awareness Network (CLEAN), U.S. National Science Foundation funded Climate Change Education Partnership (CCEP) Alliance, and the Tri-Agency Climate Change Education Collaborative.
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25	MOBI: a marine and earth science interpretation and	Enhancing Earth Science Education by Expanding the	Education and Human Resources	['Post-secondary education ', 'Teaching methods ',	['Schneider, S*', 'Elger, C']	Germany	2017	University of Potsdam	<p>As a contribution to Germany's Science Year 2016*17 Seas and Oceans, a large science outreach program organized and financed by the National Ministry for Education and Research, GeoUnion, the umbrella organization of Earth science associations and institutions in Germany, has conducted a series of advance level workshops for out-of-school educators and interpreters in Germany. The workshops were organized in co-operation with geoparks, biosphere reserve areas and other environmental management institutions all over Germany. The goal was to convey various perspectives of modern marine sciences to inland venues, linking important present-day marine themes with the presentation of marine phases in the geological history of the host region. The workshops were designed for park rangers, museum educationalists and other science communicators, initiating a broader impact on target groups such as school classes, (geo-)tourists and stakeholder groups.</p> <p>Our approach has been to combine lectures by top-level scientists (on both ocean literacy aspects and regional geology) with discussions and an on-the-spot learning-and-presenting module based on prepared text and visual material. Beyond earth science issues we have integrated economy, ecology, social sciences as well as arts and humanities aspects. One central topic was the role of the world ocean in climate change; other themes highlighted sea level rise, the thermohaline circulation, sea-floor spreading, coral reefs, over-fishing, various marine species and the problem of plastic waste in the ocean.</p> <p>We had anticipated that marine issues are actually very rarely discussed in inland Germany. A structured presentation of ocean literacy elements has proved to be a new range of topical issues from earth and environmental sciences highly appreciated by the participants.</p>
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26	Quantitative and qualitative synthesis of socio- Evolution of Catchment Hydrology-Society-Ecology	Global Environmental Change	['Impacts of global change ', 'Water cycles ', 'Human	['Xu, L*', 'Gober, P', 'Wheater, H S', 'Kajikawa, Y']	Canada	2017	University of Saskatchewan	<p>The challenge of climate change adaptation has raised awareness of the feedbacks and interconnections in complex human-natural coupled water systems. This has reinforced the call for a socio-hydrological approach to better understand, and represent in models, the associated system dynamics. Such models can potentially provide the tools to link knowledge about complex water systems to decision-making and policy frameworks. Socio-hydrology, as the subfield of human-natural coupled systems analysis, has been dramatically developed in the past few years. The purpose of this study is to empirically examine work that has been framed under the umbrella of socio-hydrology, to provide insights into the participants and their disciplinary perspectives, and to draw conclusions about where the field is headed. In doing so, we used a combined quantitative and qualitative approach to synthesise current knowledge of socio-hydrology and to propose some promising future directions in this subfield of water sciences. The general statistics of the existing literature showed that socio-hydrological research has become an emerging topic and is drawing more concern and engagement of hydrologists. However, the participation of social scientists is inadequate and greater cross-disciplinary integration is desirable. Current concerns in this subfield of water research centre on two basic challenges: (1) the need to embrace the social dimensions of water-related risks, and (2) the importance of interactions and feedbacks in dynamic socio-hydrological systems. A third challenge identified here relates to the large-scale implications of 1) and 2) above, i.e. virtual water flows as a mechanism to track the human use of water at the global scale. Accordingly, we propose five potential directions with regard to socio-hydrological models, interdisciplinary collaboration and transdisciplinary studies, the science-policy interface, resilience in socio-hydrological systems, and data sharing for human-water system studies.</p>
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27	Challenges and approaches to vulnerability and adaptation to	Evaluation Stands for Evidence-Based Claims About Education,	Education and Human Resources	['Elementary and secondary education ', 'Post-secondary	['Swami, D*', 'Parthasarathy, D']	India	2018	Indian Institute of Technology Bombay	<p>In India, the semi-arid regions are particularly facing a major challenge for agriculture sustainability owing to over-exploited water resources and climate variability. Implications of vulnerability and government policies are rarely assessed at regional level which can help in devising a structured adaptation approach by providing solutions at micro level. Present work focuses on the key factors leading to agriculture and socio-economic vulnerability to climate change for districts of Maharashtra state, India</p> <p>District level vulnerability index (DLVI) is being formed by using principal component analysis and experts survey which are further compared and evaluated to determine the highly agriculturally, and socio-economically sensitive regions in Maharashtra. Household level survey (HHS) of 185 farmers along with focused group discussion in eight villages of Akola district was carried out to know about the implementation and awareness of various government plans, schemes, role of formal institutions and the deriving factors for their adaptation.</p> <p>DLVI indicated that districts under Vidarbha and Marathwada regions are at highest risk and need immediate attention from decision-makers and scientists. Farmers informed that non-availability of irrigation and drinking water, lowering of ground water levels, drying of nearby lake, high water salinity, lack of support from government, and corruption in availing the basic facilities such as toilet, drinking water are the major barriers of their adaptation in these villages.</p> <p>Results strongly bring out the gaps in planning where entire Maharashtra has been considered as a single unit for analysis and policies have been formulated for the entire State. It necessitates separate policy formulation related to climate variability and agriculture for each district to bring out the solution for regional issues (socio-political, farmers, agriculturalists, economical) more clearly. Study proposes formulation of District action plan on Climate change so that the situation of each district can be monitored by the experts and amount of funding can be released accordingly.</p>
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28	Collaborative Workforce Training in Geoscience and Social	Building Community Resilience Through Education and Public	Education and Human Resources	['Elementary and secondary education ', 'Informal education ',	['Garcia, A A Jr*', 'Fischer, H A', 'Semken, S', 'Wentz, E A',	USA	2018	School of Earth and Space Exploration	<p>Natural hazards pose risks to humanity, institutions, and infrastructure. These risks are rendered more extreme, more complex, and more difficult to manage by a global climate change. Recent extreme events such as Hurricanes Irma and Maria, and massive western wildfires reveal a need for a more robust system of preparation for and mitigation of natural hazards at the state and national level. This is a problem for natural scientists, engineers, and social scientists alike, as hazards originate and occur in the interfaces between natural systems and societies. Research shows that better-educated societies with better-educated decision-makers are best equipped to prepare for, mitigate, and recover from natural disasters. The NSF-funded HazPM project has the goal of designing and implementing an undergraduate workforce-training program that integrates the natural and social sciences from start to finish. We seek to fully characterize the knowledge, skills, and dispositions required of graduates and professionals who will enter the natural-hazards workforce, and foster these in students by means of a certificate program accessible and professionally useful to hazards-minded students majoring in geoscience and other natural sciences, social sciences, engineering, planning, sustainability, as well professionals.</p> <p>We are conducting field ethnographic studies (focus groups, structured surveys, and formal interviews) with collaborators in a study population comprising professionals from a broad range of local, state, and tribal agencies and private organizations engaged in natural-hazards preparation and mitigation in Arizona and the Southwest US, as well as a textual analysis of published job advertisements relating to natural hazards in the same region. Our preliminary results indicate a strong expectation that new workers have knowledge of specific hazards (e.g., floods, mass wasting, wildfires), expertise in coding and GIS, communication skills, and the capacity to function in highly regulated and bureaucratic systems. We will discuss these results and outline the follow-on plan to work with faculty at regional two-year and four-year colleges to formulate a certificate program that serves both.</p>
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29	Fifth-stage of water reforms	Water and Society: Modeling Tools,	Hydrology	['Water management', 'Legislation and regulations	['Adamson, D*', 'Dumbrell, N', 'Loch, A J']	Australia	2018	University of Adelaide	<p>The effective management of water resources is a critical policy issue for governments globally. Both natural and social science are required to develop evidence-based water policy. Evidence-based policy decisions must also consider the inherent risk and uncertainty in water supply/demand, which existing natural and social scientists often struggle to model. Modelling water as both a risk-increasing and risk-decreasing input of production (social, economic and natural), informs how and why water managers may seek to prevent irreversible capital loss. In this context, the threat of irreversible loss has motivated (to date) four different water reform stages. This paper describes and defines the four existing water reform stages, and posits (for advanced reform contexts) a fifth stage of required reforms with uncertain properties by design. Possible drivers of fifth-stage water policy or program reforms may include: improved science or data outcomes (e.g. reassessments of climate change impact), new water use entrants or requirements (e.g. cultural water uses), pressure to deregulate existing water redistribution mechanisms (e.g. markets), and/or increased compliance requirements (e.g. in the face of rising water theft or conflict). This paper also contributes to a discussion about how greater awareness and representation of both fixed and variable water input requirements across all production systems (social, economic and natural) could develop resilient future water reform and management arrangements. We therefore argue that capturing these drivers within water reform modelling allows superior policy development in the face of irreversible loss, and how natural and social sciences can frame the challenges and stages of water reform on a global scale.</p>
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30	Integrating the Social Sciences at the Institutional Level:	Geoscience Impact in a Complex World: Successful	Union	['Urban systems ', 'Impacts of global change ', 'Decision	['McNutt, M K*']	USA	2018	National Academy of Sciences	<p>Geoscientists seek solutions for some of society's most profound challenges: providing abundance in the resources that fuel society such as energy, water, and minerals in a sustainable manner, and helping to build safe and resilient communities in the face of natural (and human, e.g. climate change) hazards. The incorporation of the the social sciences into the geosciences is critical to devising solutions that people will accept, use, and find maximally beneficial. The organization of institutions can facilitate working with civil society to find those solutions. The USGS has a number of organizational structures both at the macro level and at the ground level that facilitate such interactions. For example, several years ago, the USGS abandoned its disciplinary structure in favor of a focus on its mission areas that cross disciplinary lines. This organizational structure breaks down disciplinary silos and integrates expertise to solve problems. As another example, the Shake Out program works directly with communities on educating on earthquake preparedness. At Science Magazine, editors early on recognized the importance of including the social sciences into a predominately natural sciences journal. However, the true integration of the social sciences with the natural sciences occurs in the many special issues each year, when the journal's editors work across fields to include social science authors with natural science authors to explore the multiple dimensions of a topic, for example, the impact of the urbanization of our planet. Finally, most recently we have been examining barriers at the National Academies to better integration of the social sciences, and in fact all disciplines, across the Academies, as we perform our mission to advise the nation. We are taking steps to remove administrative, structural, training, financial, and other barriers that have siloed our divisions at the National Academies of Sciences, Engineering, and Medicine. With a more nimble structure, we should be able to more freely integrate the expertise from our social sciences division into the many reports and other products that can benefit from these professionals.</p>
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31	Maintaining Credibility of The Social Sciences In The Highly	Engaged Scientists: Personal and Professional Climate Action by	Public Affairs	['General or miscellaneous ']	['Victor, D G*']	USA	2018	University of California San Diego	<p>As public and political attention have focused on climate change, scholars in the natural sciences have understandably struggled with how to square their personal actions affect their credibility as scientists. These challenges are perhaps even more severe in the social sciences because scholars in this domain deal directly with topics, such as the role of leadership and moral example, that intrinsically implicate the of individuals and human-created institutions. This talk will at this question from two major perspectives--the first rooted in how individual scientists behave and the second focused on the organization of the scientific disciplines themselves.</p> <p>First, it will examine a few areas where individual human actions could have potentially large effects on climate outcomes. Particular attention will be given to the emerging social science around the role of leadership in creating new norms of acceptable action as well as the role of leaders in creating policy "experiments." The essence of these leader-focused theories is that broad-scale political change often originates in small groups where it can be much easier to coordinate actions, implement new policies, and deploy novel technologies. The paper where explore where and how scientists' personal actions affect the credibility of their social scientific claims about the importance and impact of leadership.</p> <p>Second, the paper examine how the social scientific community can organize itself more effectively. Few of the social sciences have much presence in the IPCC or other scientific institutions engaged with the assessment of climate science. Fixing this problem will require that social scientists learn more about the rest of the climate sciences and treat, within their disciplines, research on climate topics as a legitimate contribution to social science. (Examples will be drawn from political science and sociology.) It will also require reforms at IPCC and other assessment institutions so that the key insights from the social sciences--which are often qualitative and shrouded in high level of uncertainty--can be organized and discussed systematically. At present, most scientific insights of this type are hard to convey through the review and formalized uncertainty language process at IPCC.</p>
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32	MANAGING OR 'BUILDING	Can We Manage Earth's Future?	Union	['Biogeochemical cycles,	['Adamson, J L*']	USA	2018	Arizona State University	Humanists have long studied human desires, motivations and behaviors, in literature, history, philosophy, psychology and communication (Holm, Adamson et al 2015). For the last fifteen years, they have also been organizing internationally among themselves and with their colleagues in the natural and social sciences-- and in local communities as well. This work aims to contribute to increasingly urgent conversations about designing or managing sustainable and socially-just futures. Ill briefly discuss the outcomes of these international conversations and collaborations, narrowing my focus to emerging concepts of building relationship (rather than concepts of management), as I argue that management requires goals and that goals are shaped by values--which is the domain of the humanities. I'll focus on emerging humanities-based, values-oriented, interdisciplinary collaborations with indigenous communities and scholars who are dealing with global environmental change. Indigenous response to climate change, for example, is offering powerful insights about how we might take lessons from local-scale solutions based on building relationship as we face the challenges of global-scale response to environmental challenges.
33	Robust Adaptation to Cyclical Climate Risk	Toward Better Water Planning and	Hydrology	['Uncertainty assessment ', 'Water	['Doss-Gollin, J*', 'Farnham, D J', 'Lall, U',	USA	2018	Department of Earth and Environmental	Evaluating and optimizing investments in climate adaptation requires projecting future climate risk over the operational life of each proposed investment. While many studies have considered that different climate change scenarios may emerge over the course of this M-year future period, adaptation policies remain vulnerable to the temporal and spatial clustering of climate risk which dominates much of the observational record. Large-scale, low-frequency climate variability can induce spatial shocks by favoring simultaneous extremes around the world, and can also cause a historical record to be a misleading indicator of future risk. In this work we consider whether the limited information in an N-year observational record permits the identification and projection of quasi-periodic climate variability and secular change, and what the resulting bias and uncertainty portends for risk mitigation instruments with a service life ranging from a few years to several decades. We present a set of stylized experiments to assess how well one can learn and predict the two kinds of risk for the design life (M years) and the probability of over- or under-design of a climate adaptation strategy based on these projections. We consider different temporal structures for the underlying risk which encompass quasi-periodic, regime-like, and secular variability, as well as statistical models for estimating this risk from an N-year historical record. Cite as: Author(s) (2018), Title, Abstract H52F-05 presented at 2018 Fall Meeting, AGU, Washington, D.C., 10-14 Dec.

34	The Northwest Chapter of the Fourth National Climate	The Fourth National Climate Assessment: Highlighting Impacts,	Public Affairs	['Impacts of global change ', 'Regional climate change ',	['May, K*', 'Luce, C H', 'Casola, J', 'Dalton, M M', 'Lowe, S E',	USA	2018	Silvestrum Climate Associates	<p>Residents of the Northwest list the inherent qualities of the natural environment among the top reasons to live in the region. The region is known for clean air, abundant water, vast forests, extensive farmlands, and ample outdoor recreation. Climate change, including gradual changes and extreme events, is already affecting these valued aspects of the region, and the communities on the frontlines of climate change, those dependent on natural resources for their livelihoods, and the economically disadvantaged are experiencing the first, and often the worst, effects.</p> <p>The Fourth National Climate Assessment fulfills a Congressional mandate to assess and inform the Nation about the impacts of climate change on the U.S., as well as adaptation efforts that can minimize impacts and risks. This poster focuses on the findings from the Northwest Chapter, which includes Washington, Oregon, and Idaho. This chapter builds on the Third National Climate Assessment, and focuses not only on how the climate will change, but on how those changes can impact the health, livelihoods, and quality of life of residents of the Northwest. The chapter also includes case studies that illustrate how multi-stakeholder efforts and co-production between communities, decision makers, and the science community can lead to successful adaptation.</p> <p>This author team includes a depth and breadth of expertise that goes beyond climate change science, and includes experts in social science, economics, health, tribes and Indigenous people, frontline communities, climate adaptation, agriculture, forestry, hydrology, coastal and ocean dynamics, and ecology. The chapter development process included extensive stakeholder engagement, including breakout groups during stakeholder meetings that provided invaluable feedback on Northwest values and the intersection between humans, the natural environment, and climate change. The chapter went through multiple rounds of review, and considered comments submitted by the public, interested stakeholders, the National Academies of Sciences, and federal agencies.</p>
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title	session	section	authors	year	abstract
New institutional mechanisms to bridge the information gap between climate science and public policy decisions	Institutional Support for Science and Scientists in an Age of Public Scrutiny I Posters	Public Affairs	[Rogers, W*, Gullede, J M]	2010	<p>Many decision makers lack actionable scientific information needed to prepare for future challenges associated with climate change. Although the scope and quality of available scientific information has increased dramatically in recent years, this information does not always reach - or is not presented in a form that is useful to - decision makers who need it. The producer (i.e. scientists) community tends to be stovepiped, even though consumers (i.e. decision makers) often need interdisciplinary science and analysis. Consumers, who may also be stovepiped in various agencies or subject areas, may lack familiarity with or access to these separate communities, as well as the tools or time to navigate scientific information and disciplines. Closing the communication gap between these communities could be facilitated by institutionalizing processes designed for this purpose. We recommend a variety of mainstreaming policies within the consumer community, as well as mechanisms to generate a strong demand signal that will resonate more strongly with the producer community. We also recommend institutional reforms and methods of incentivizing policy-oriented scientific analysis within the producer community. Our recommendations focus on improving information flow to national security and foreign policy decision makers, but many are relevant to public policy writ large. Recommendations for Producers</p> <ol style="list-style-type: none"> 1. The scientific community should formally encourage collaborations between natural and social scientists and reward publications in interdisciplinary outlets 2. Academic merit review should reward research grants and publications targeted at interdisciplinary and/or policy-oriented audiences. Reforms of merit review may require new policies and engaged institutional leadership. <p>Recommendations for Consumers</p> <ol style="list-style-type: none"> 1. Congress should amend Title VI of the National Defense Education Act to encourage the development of multidisciplinary educational programs on the national security implications of climate change. 2. Federal agencies should establish funding programs to encourage producers to provide scientific information tailored to consumer needs. 3. The Department of State should appoint climate advisors to serve within the regional bureaus and on the policy and planning staff. 4. Federal agencies, the Department of Education, and the National Science Foundation should develop programs to stimulate new interdisciplinary research partnerships and training of a new generation of interdisciplinary climate change risk thinkers, assessors and managers. 5. Federal agencies should encourage Senior Executive Service decision makers to participate in science policy certification workshops and include science and technology policy as a core curriculum

					component of the SES Federal Candidate Development Program. These recommendations are described in detail in a report published by the Center for a New American Security: Rogers, W. and J. Gullledge (2010) Lost in Translation: Closing the Gap Between Climate Science and National Security Policy (available online: http://cnas.org/node/4391)
How Shall We Tell Our People? The Art and Science of Communicating Sea-Level Rise to Coastal Audiences (	The Uncertainty of Future Sea Level Rise: Bridging Science and End Users I	Natural Hazards	['Moser, S C*']	2010	Improved sea-level rise projections and translation into decision-relevant information (e.g., changed flood frequencies and elevations, increased rates in coastal erosion, salinity changes in coastal aquifers) are critical for coastal managers, planners, and local elected officials to feel more confident in bringing climate change and its related coastal impacts to the attention of their communities. Those who have done so or are considering doing so, however, are not just concerned with “getting the science right” or getting the most credible and relevant information. They immediately, and sometimes primarily, are concerned with the reactions of coastal residents, developers, and business interests to the prospects of potentially difficult and substantial changes in coastal land use, their property rights, and the potential loss of their homes and establishments. How to engage the public constructively in developing adaptation strategies is a largely unmet challenge for most coastal managers. Similarly, they have not been trained in how to effectively communicate an issue that is ripe with the potential for loss, danger, and social and legal conflict - more so than they already face. Better physical science on sea-level rise alone will not meet these needs. Meanwhile, the social sciences have only begun to study public attitudes toward local impacts and adaptation responses. This paper will summarize key insights available at this time and point to important research and education/training needs to better assist practitioners faced with developing and implementing coastal adaptation strategies.
The Psychology of Climate Change Communication - Insights from the Center	Climate Change Adaptation: Education and Communication I	Education and Human Resources	['Marx, S*']	2010	Natural scientists have made great strides in recent years to improve their understanding of the complex issue of global climate change. Despite the progress made, there continues to be a persistent gap between the knowledge and concern among members of the climate science community and translation of such scientific expertise into effective climate change policies and the general public’s behavioral choices. Communication is breaking down at the intersection of climate science, policy, and behavior change. Part of the reason is that, to date, social science research has not been sufficiently exploited to help individuals and groups incorporate information about climate change and environmental risk into decision making. The presentation will highlight research conducted at the Center for Research on Environmental Decisions (CRED). This presentation will discuss barriers to behavioral change and provide suggestions for

					<p>improving communication about climate change: Typical science communication requires analytic processing, some level of expertise, at a minimum interest. For most people abstract information does not translate into powerful vivid images that would trigger action. Furthermore, we have found that people's interpretation of scientific uncertainty can get in the way of using forecasts and projections. Other barriers include public risk perceptions and attitudes, cultural values, and myopia, as well as the importance that people place on self-interest/economic goals vs. collective interest/social goals. Many of these obstacles can be overcome and communication of climate change information can be improved by presenting a combination of affective information (vicarious experience, scenarios, narratives, and analogies) and scientific data; yet there are also downsides to the overuse of emotional appeals (such as the finite pool of worry and the single action bias); tapping into social affiliations and group identities can motivate the activation of social goals in favor or self interest; early involvement of stakeholders through participatory processes can help identify key concerns and information needs which can then be addressed in a tailored approach; taking advantage of default effects can make it easier for people to choose environmentally and socially beneficial options. Using research into the reactions of groups as disparate as African farmers and conservative U.S. voters, we offer insights on how scientists, educators, journalists and others can effectively connect with wider audiences. The communication principles presented in this talk can be applied beyond climate change and to science communication in general.</p>
The Demonstration Test Catchment Approach to Land and Water Management in the river Eden	Applying River and Watershed Research to Facilitate Management and Guide Policy I	Hydrology	['Jonczyk, J*', 'Quinn, P F', 'Haygarth, P', 'Reaney, S', 'Wilkinson, M', 'Burke, S', 'McGonigle, D', 'Harris, B']	2010	<p>The Demonstration Test Catchment (DTC) initiative is a five year project to address pollution issues in catchments. The initiative will study the wider environmental problems suffered by catchments which are under intense farming pressures and potential climate change impacts. The UK Department for Food, Agriculture and Rural Affairs (Defra) in partnership with the Environment Agency for England and Wales (EA) have funded this initiative to answer key policy concerns in catchments. The first key step has been the establishment of a 'research platform' at three catchments in the UK (The Eden, Wensum and Hampshire Avon) whereby funding of 9.3 million dollars has gone into funding new equipment and pollution sampling regimes have been established. Within each catchment between three and four, 8-10km² sub-catchments have been established. The experimental design and thinking for DTCs will be explained fully in this paper. The next phase of the project will install an extensive suite of land management and pollution mitigation interventions. In parallel to this monitoring work, a full knowledge exchange package will seek to engage with farmers, the rural community and understand the governance regime at the broader catchment scale. There is also a need for a modelling component to</p>

				<p>upscale the findings to the whole of the UK. Whilst this is an ambitious goal, there is a very basic commitment of working with rural communities to come up with real solutions that will help underpin effective policy making for the future. The research platform covers a multi-scale approach to the monitoring strategy that will allow local grouping of mitigation measures to be studied local in terms of impact and propagated to the catchment scale. Even with high level of funding, the DTC can only fully instrument a catchment of 8-10km². Beyond this scale, the EA and the standard catchment monitoring will continue as normal. The focus here is to prove that mitigation can be achieved within smaller land units that have a clear catchment scale benefit. This will provide the evidence base for future policy which is of use to all location in the UK. Hence, the need to have suite of parameters that can be evaluated has given rise to specific experimental design. Fundamental to this is to use continuous telemetered sampling at as many location as possible, including field laboratories capable of measuring, Nitrate, Ammonia, Total Phosphorus, dissolved phosphorus, suspended sediment and chlorophyll a. Standard hydro-metrological equipment is also fully telemetered. The goal is to allow all the data to be freely available to all end users via an internet data portal. The long term goal is to invite experts from many environmental and social sciences to work at the established research platform and ultimately give a better understanding of what a healthy catchment should be like. Being able to communicate this point to both local and national audiences will also be made and will link closely to the UK Virtual Observatory project funded by the NERC.</p>
<p>The Colorado Climate Preparedness Project: A Systematic Approach to Assessing Efforts Supporting State-</p>	<p>Climate Change Adaptation: Education and Communication II Posters</p>	<p>Education and Human Resources</p>	<p>['Klein, R', 'Gordon, E*']</p>	<p>2010</p> <p>Scholars and policy analysts often contend that an effective climate adaptation strategy must entail "mainstreaming," or incorporating responses to possible climate impacts into existing planning and management decision frameworks. Such an approach, however, makes it difficult to assess the degree to which decisionmaking entities are engaging in adaptive activities that may or may not be explicitly framed around a changing climate. For example, a drought management plan may not explicitly address climate change, but the activities and strategies outlined in it may reduce vulnerabilities posed by a variable and changing climate. Consequently, to generate a strategic climate adaptation plan requires identifying the entire suite of activities that are implicitly linked to climate and may affect adaptive capacity within the system. Here we outline a novel, two-pronged approach, leveraging social science methods, to understanding adaptation throughout state government in Colorado. First, we conducted a series of interviews with key actors in state and federal government agencies, non-governmental organizations, universities, and other entities engaged in state issues. The purpose of these interviews was to elicit information about current activities that may affect the state's adaptive capacity and to</p>

				<p>identify future climate-related needs across the state. Second, we have developed an interactive database cataloging organizations, products, projects, and people actively engaged in adaptive planning and policymaking that are relevant to the state of Colorado. The database includes a wiki interface, helping create a dynamic component that will enable frequent updating as climate-relevant information emerges. The results of this project are intended to paint a clear picture of sectors and agencies with higher and lower levels of adaptation awareness and to provide a roadmap for the next gubernatorial administration to pursue a more sophisticated climate adaptation agenda. Project results can also inform numerous other ongoing database efforts connected to the U.S. National Assessment of Climate Change.</p>
<p>Bridging the Gap: The 'Soft Path' for Improving Resilience and Adaptability of Water Systems (</p>	<p>Detecting and Predicting Change in Coupled Human-Water Systems III</p>	<p>Hydrology</p>	<p>['Gleick, P H*']</p>	<p>2010</p> <p>The failure of traditional water management systems in the 20th century -- what I call the "hard path for water" -- is evident in several ways, including the persistent inability to meet basic human needs for safe water and adequate sanitation for vast populations, ongoing and accelerating aquatic ecosystem collapses , and growing political disputes over water allocation, management, and use, even in regions where substantial investment in water has been made. Progress in resolving these problems, especially in the face of unavoidable climate changes, growing populations, and constrained financial systems, will require bridging hydrologic and social sciences in new ways. Integrating social and cultural knowledge with new economic and technological tools and classical hydrologic and climatological sciences can produce a new "soft path for water" that offers the opportunity to move toward sustainable water systems. This talk will define the soft path for water and offer examples of innovative steps already being taken along that path in the western United States, South Africa, India, and elsewhere.</p>
<p>Recent Advances in Climate Impacts, Vulnerability, and Adaptation Studies in California</p>	<p>Using Downscaled Climate Data in Impact and Adaptation Studies I</p>	<p>Global Environmental Change</p>	<p>['Franco, G*', 'Cayan, D R', 'Moser, S C', Hanemann, M', 'Pittiglio, S']</p>	<p>2010</p> <p>The State of California is committed to preparing periodic climate change impacts and adaptation assessments to inform and develop policy in the State. The most recent assessment was released late in 2009 and a new vulnerability and adaptation assessment is underway for release in late 2011. Both assessments use IPCC climate simulations that were statistically downscaled to a horizontal resolution of about 12 Km. The 2009 California assessment attempted to translate some impacts and adaptation options into monetary terms which introduced additional uncertainties. The 2011 California assessment combines a set of coordinated statewide and regional/local studies because many adaptation options, though informed by state and national policies, will be implemented at regional and local levels. The 2011 assessment expands the number of climate simulations that are employed in order to form a fuller estimate of the potential envelope of climate change and its impacts in the state. It also introduces a subset of dynamically downscaled scenarios to understand how well statistical</p>

					relationships, developed using historical data, hold up in future climate regimes. Investigations are on-going to translate the ensemble of climate simulations and to begin to attach probabilities to the scenarios using subjective and objective techniques. In addition to advances in climate simulations and downscaling techniques, the new vulnerability and adaptation assessment also increasingly integrates social science approaches to assessing vulnerabilities and adaptation options. This presentation will illustrate results from the 2009 assessment and describe the design and initial implementation of the 2011 assessment.
Energy Literacy: A Natural and Essential Part of a Solutions-Based Approach to Climate	Climate Literacy: Integrating Research and Education, Science and Solutions, and the Role of Education and Human Resources		[Inman, M M*]	2011	As with climate science topics, many Americans have misconceptions or gaps in understanding related to energy topics. Recent literacy efforts are geared to address these gaps in understanding. The U.S. Global Change Research Program's recently published "Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education" offers a welcome complement to the Climate Literacy Essential Principles released in 2008. Research and experience suggest that education, communication and outreach about global climate change and related topics is best done using a solutions-based approach. Energy is a natural and effective topic to frame these solutions around. Used as a framework for designing curricula, Energy Literacy naturally leads to solutions-based approaches to Climate Change education. An inherently interdisciplinary topic, energy education must happen in the context of both the natural and social sciences. The Energy Literacy Essential Principles reflect this and open the door to curriculum that integrates the two.
Communicating Uncertainty about Climate Change for Application to Security Risk Management	Scientific Uncertainty: A Multidisciplinary Assessment | Posters	Public Affairs	[Gulledge, J M*]	2011	The science of climate change has convincingly demonstrated that human activities, including the release of greenhouse gases, land-surface changes, particle emissions, and redistribution of water, are changing global and regional climates. Consequently, key institutions are now concerned about the potential social impacts of climate change. For example, the 2010 Quadrennial Defense Review Report from the U.S. Department of Defense states that "climate change, energy security, and economic stability are inextricably linked." Meanwhile, insured losses from climate and weather-related natural disasters have risen dramatically over the past thirty years. Although these losses stem largely from socioeconomic trends, insurers are concerned that climate change could exacerbate this trend and render certain types of climate risk non-diversifiable. Meanwhile, the climate science community—broadly defined as physical, biological, and social scientists focused on some aspect of climate change—remains largely focused scholarly activities that are valued in the academy but not especially useful to decision makers. On the other hand, climate scientists who engage in policy discussions have generally permitted vested interests who support or oppose climate policies to frame the discussion of

				<p>climate science within the policy arena. Such discussions focus on whether scientific uncertainties are sufficiently resolved to justify policy and the vested interests overstate or understate key uncertainties to support their own agendas. Consequently, the scientific community has become absorbed defending scientific findings to the near exclusion of developing novel tools to aid in risk-based decision-making. For example, the Intergovernmental Panel on Climate Change (IPCC), established expressly for the purpose of informing governments, has largely been engaged in attempts to reduce unavoidable uncertainties rather than helping the world's governments define a science-based risk-management framework for climate security. The IPCC's Fourth Assessment Report concluded that "Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes to risk." In risk management, key uncertainties guide action aimed at reducing risk and cannot be ignored or used to justify inaction. Security policies such as arms control and counter-terrorism demonstrate that high-impact outcomes matter to decision makers even if they are likely to be rare events. In spite of this fact, the long tail on the probability distribution of climate sensitivity was largely ignored by the climate science community until recently and its implications for decision making are still not receiving adequate attention. Informing risk management requires scientists to shift from a singular aversion to type I statistical error (i.e. false positive) to a balanced presentation of both type I error and type II error (i.e. false negative) when the latter may have serious consequences. Examples from national security, extreme weather, and economics illustrate these concepts.</p>
<p>In a Time of Change: Integrating the Arts and Humanities with Climate Change Science in Alaska</p>	<p>Science Data Reuse: Art and Literacy Programs for Engagement I</p>	<p>Education and Human Resources</p>	<p>['Leigh, M*', 'Golux, S', 'Franzen, K']</p>	<p>2011</p> <p>The arts and humanities have a powerful capacity to create lines of communication between the public, policy and scientific spheres. A growing network of visual and performing artists, writers and scientists has been actively working together since 2007 to integrate scientific and artistic perspectives on climate change in interior Alaska. These efforts have involved field workshops and collaborative creative processes culminating in public performances and a visual art exhibit. The most recent multimedia event was entitled In a Time of Change: Envisioning the Future, and challenged artists and scientists to consider future scenarios of climate change. This event included a public performance featuring original theatre, modern dance, Alaska Native Dance, poetry and music that was presented concurrently with an art exhibit featuring original works by 24 Alaskan visual artists. A related effort targeted K12 students, through an early college course entitled Climate Change and Creative Expression, which was offered to high school students at a predominantly Alaska Native charter school and integrated climate change science, creative</p>

				<p>writing, theatre and dance. Our program at Bonanza Creek Long Term Ecological Research (LTER) site is just one of many successful efforts to integrate arts and humanities with science within and beyond the NSF LTER Program. The efforts of various LTER sites to engage the arts and humanities with science, the public and policymakers have successfully generated excitement, facilitated mutual understanding, and promoted meaningful dialogue on issues facing science and society. The future outlook for integration of arts and humanities with science appears promising, with increasing interest from artists, scientists and scientific funding agencies.</p>
<p>Developing Curriculum to Help Students Explore the Geosciences' Cultural Relevance</p>	<p>Climate Literacy: Engaging and Evaluating Public and K-12 Audiences Around Complex and Contentious Earth Systems Science Posters</p>	<p>Education and Human Resources</p>	<p>['Miller, G*', 'Schoof, J T', 'Therrell, M D']</p>	<p>2011</p> <p>Even though climate change and an unhealthy environment have a disproportionate affect on persons of color, there is a poor record of diversity in geoscience-related fields where researchers are investigating ways to improve the quality of the environment and human health. This low percentage of representation in the geosciences is equally troubling at the university where we are beginning the third and final year of a project funded through the National Science Foundation's (NSF) Opportunities to Enhance Diversity in the Geosciences (OEDG). The purpose of this project is to explore a novel approach to using the social sciences to help students, specifically underrepresented minorities, discover the geosciences' cultural relevance and consider a career in the earth, atmospheric, and ocean sciences. To date, over 800 college freshmen have participated in a design study to evaluate the curriculum efficacy of a geoscience reader. Over half of these participants are students of color. The reader we designed allows students to analyze multiple, and sometimes conflicting, sources such as peer-reviewed journal articles, political cartoons, and newspaper articles. The topic for investigation in the reader is the 1995 Chicago Heat Wave, a tragic event that killed over 700 residents. Students use this reader in a core university course required for entering freshmen with low reading comprehension scores on standardized tests. To support students' comprehension, evaluation, and corroboration of these sources, we incorporated instructional supports aligned with the principles of Universal Design for Learning (UDL), reciprocal teaching, historical reasoning, media literacy, and quantitative reasoning. Using a digital format allows students to access multiple versions of the sources they are analyzing and definitions of challenging vocabulary and scientific concepts. Qualitative and quantitative data collected from participating students and their instructors included focus groups, a content test, an epistemology survey (with think-aloud interviews that also served for cognitive testing purposes), classroom observations, student work, and tracking of student navigation through the digital reader. Overall, the impact this curriculum had on students' affective and academic learning varied; however, the instructional supports we developed to temper challenge with instructional support appear to have had a</p>

				<p>positive impact on student learning. Analysis of data illustrates how these supports improved their comprehension of multiple, and sometimes conflicting sources. Student feedback from focus groups and interviews also indicate that using a social science lens to learn about concepts such as urban heat island was engaging. In terms of students' understanding of the nature of knowledge in the sciences, the epistemology survey and interview seem to indicate that students lack a complex understanding of continuity and change in scientific knowledge. Further, participants appeared to have many misconceptions about scientific inquiry. As a result, we are currently developing a similar curriculum for a lab-based geography course, GEOG104: Weather, Climate, and Society.</p>
<p>Developing Curriculum to Help Students Explore the Geosciences' Cultural Relevance</p>	<p>Climate Literacy: Engaging and Evaluating Public and K-12 Audiences Around Complex and Contentious Earth Systems Science Posters</p>	<p>Education and Human Resources</p>	<p>['Miller, G*', 'Schoof, J.T', 'Therrell, M.D']</p>	<p>2011</p> <p>Even though climate change and an unhealthy environment have a disproportionate affect on persons of color, there is a poor record of diversity in geoscience-related fields where researchers are investigating ways to improve the quality of the environment and human health. This low percentage of representation in the geosciences is equally troubling at the university where we are beginning the third and final year of a project funded through the National Science Foundation's (NSF) Opportunities to Enhance Diversity in the Geosciences (OEDG). The purpose of this project is to explore a novel approach to using the social sciences to help students, specifically underrepresented minorities, discover the geosciences' cultural relevance and consider a career in the earth, atmospheric, and ocean sciences. To date, over 800 college freshmen have participated in a design study to evaluate the curriculum efficacy of a geoscience reader. Over half of these participants are students of color. The reader we designed allows students to analyze multiple, and sometimes conflicting, sources such as peer-reviewed journal articles, political cartoons, and newspaper articles. The topic for investigation in the reader is the 1995 Chicago Heat Wave, a tragic event that killed over 700 residents. Students use this reader in a core university course required for entering freshmen with low reading comprehension scores on standardized tests. To support students' comprehension, evaluation, and corroboration of these sources, we incorporated instructional supports aligned with the principles of Universal Design for Learning (UDL), reciprocal teaching, historical reasoning, media literacy, and quantitative reasoning. Using a digital format allows students to access multiple versions of the sources they are analyzing and definitions of challenging vocabulary and scientific concepts. Qualitative and quantitative data collected from participating students and their instructors included focus groups, a content test, an epistemology survey (with think-aloud interviews that also served for cognitive testing purposes), classroom observations, student work, and tracking of student navigation through the digital reader. Overall, the impact this</p>

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Conveying researcher knowledge of climate change on multiple new media platforms	Scientist Participation in Science Communication II Posters	Education and Human Resources	['Byrne, J M*', 'McDaniel, S', 'Graham, J', 'Hoggan, J C']	2011	We are developing a climate change education and communication program (ECP) for application in high schools, colleges and in public education. The objective of this work is to convey climate change knowledge from the best scientists and social scientists using a series of new media formats. The ECP utilizes high quality video and television production built on interviews and field visits with outstanding colleagues from around the globe. The deliverables will include a high definition documentary production and an interactive website that includes the documentary, a series of single concept/topic teaching webisodes (short videos) and teaching and study plans for application with each webisodes. The presentations will feature three levels of discussion: (i) what is the state of climate change knowledge, impacts, mitigation and adaptation? (ii) What international locales exist where climate change is creating immediate critical challenges and risks? (iii) How can we mitigate, adapt and other wise address current and pending climate change challenges? The ECP will be distribution FREE via the WWW to educational users anywhere on the planet. We have discussions ongoing for collaborations with international colleagues that may lead to translations of the work into other languages. The intent herein is to share research outcomes from the best global scientists and social scientists with the public and numerous stakeholders, and for use in education at all levels. The work will be publicised through film festivals and possibly through television broadcast licenses, over the WWW and through the many connections of the academics and through our industry partner, an internationally regarded Public Relations and Communication Firm.

<p>Climate Change Education Today in K-12: What's Happening in the Earth and Space Science Classroom?</p> <p>Climate Literacy: Precollege Activities That Support Climate Science Careers and Climate Conscious Citizens II</p> <p>Education and Human Resources</p>			2011	<p>Climate change is a highly interdisciplinary topic, involving not only multiple fields of science, but also social science and the humanities. There are many aspects of climate change science that make it particularly well-suited for exploration in the K-12 setting, including opportunities to explore the unifying processes of science such as complex systems, models, observations, change and evolution. Furthermore, this field of science offers the opportunity to observe the nature of science in action - including how scientists develop and improve their understanding through research and debate. Finally, climate change is inherently highly relevant to students - indeed, students today will need to deal with the consequences of the climate change. The science of climate change is clearly present in current science education standards, both at the National level as well as in the majority of states. Nonetheless, a significant number of teachers across the country report difficulties addressing climate change in the classroom. The National Earth Science Teachers Association has conducted several surveys of Earth and space science educators across the country over the past several years on a number of issues, including their needs and concerns, including their experience of external influences on what they teach. While</p>
<p>In a Time of Change: Integrating the Arts and Humanities with Climate Change Science in Alaska</p> <p>Science Data Reuse: Art and Literacy Programs for Engagement I</p> <p>Education and Human Resources</p>		<p>['Leigh, M*', 'Golux, S', 'Franzen, K']</p>	2011	<p>The arts and humanities have a powerful capacity to create lines of communication between the public, policy and scientific spheres. A growing network of visual and performing artists, writers and scientists has been actively working together since 2007 to integrate scientific and artistic perspectives on climate change in interior Alaska. These efforts have involved field workshops and collaborative creative processes culminating in public performances and a visual art exhibit. The most recent multimedia event was entitled In a Time of Change: Envisioning the Future, and challenged artists and scientists to consider future scenarios of climate change. This event included a public performance featuring original theatre, modern dance, Alaska Native Dance, poetry and music that was presented concurrently with an art exhibit featuring original works by 24 Alaskan visual artists. A related effort targeted K12 students, through an early college course entitled Climate Change and Creative Expression, which was offered to high school students at a predominantly Alaska Native charter school and integrated climate change science, creative writing, theatre and dance. Our program at Bonanza Creek Long Term Ecological Research (LTER) site is just one of many successful efforts to integrate arts and humanities with science within and beyond the NSF LTER Program. The efforts of various LTER sites to engage the arts and humanities with science, the public and policymakers have successfully generated excitement, facilitated mutual understanding, and promoted meaningful dialogue on issues facing science and society. The future outlook for integration of arts and humanities with science appears promising, with increasing interest from artists, scientists and scientific funding agencies.</p>

				<p>the number of teachers that report external pressures to not teach climate change science are in the minority (and less than the pressure to not teach evolution and related topics), our results suggest that this pressure against climate change science in the K-12 classroom has grown over the past several years. Some teachers report being threatened by parents, being encouraged by administrators to not teach the subject, and a belief that the “two sides” of climate change should be taught. Survey results indicate that teachers in religious or politically-conservative districts are more likely to report difficulties in teaching about climate change than in other areas of the country. This presentation will provide an overview of our most recent survey results on climate change education in the K-12 Earth and space science classroom, including highlighting some of the strategies that teachers are using to bring this critically important area of science to their students.</p>
Using and Applying Focus Groups in Climate Change Impact Assessment Projects	Climate Change Challenge in Social-Ecological Systems: From Science to Service II Posters	Global Environmental Change	[DeLorme, D*, Hagen, S']	<p>2011</p> <p>The focus group social science research method is an efficient and flexible data collection tool with broad applicability across disciplines and contexts. Through group dynamics, this interviewing approach offers strengths in gathering candid, spontaneous comments and detailed firsthand descriptions from stakeholders’ perspectives. The method, which can stand alone or be integrated with other research frameworks, has much potential for helping to manage complex issues of global change. For optimal outcomes, however, careful planning and procedures are paramount. This presentation offers guidance in this regard via examples, tips, and lessons learned from a multidisciplinary NOAA-funded project: Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico (EESLR-NGOM). Focus groups are a key component of the EESLR-NGOM project as they are being used to better understand coastal resource managers’ operational and information behaviors and needs regarding sea level rise (SLR), erosion, and hurricane storm surge impact; to learn how to best develop and translate the project’s expected scientific results into straightforward, useful, and readily-disseminated products; and to gather outreach recommendations. As part of an EESLR-NGOM project kickoff workshop, 12 coastal resource managers participated voluntarily in a focus group. A summary of findings and illustrative participant quotations will be included in the presentation. The initial focus group was productive in gaining insights into challenges and opportunities associated with a climate change project such as the EESLR-NGOM. It highlighted the importance of considering the interrelationships of natural and built environments and new avenues for resilience and sustainability. The coastal resource managers are not only end-users but also opinion leaders in their local communities who will diffuse this information widely through their networks of other potential end-users. Engaging coastal resource managers in this manner will result in successful</p>

				<p>communication and tailoring of the scientific products so that they are most appropriate and beneficial in helping to determine the viability of future management actions relative to predicted conditions and will put resource managers in a more knowledgeable position to inform policy makers as to the likely results of their decisions. Further, by addressing the gap in the interdisciplinary literature on regionally-based climate change issues as studied using qualitative social science research approaches such as focus groups, our work makes theoretical and methodological scholarly contributions.</p>
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Useful to Usable (U2U): Transforming Climate Variability and Change	Climate Change, Food, and Water: III Posters	Global Environmental Change	['Niyogi, D', 'Andresen, J*']	2011	Corn and soybean production contribute over \$100 billion annually to the U.S. economy, most of which comes from the intensely cultivated corn-belt region of the Midwest. Successful crop production in this region is highly dependent on favorable temperatures and appropriate precipitation patterns, making this industry vulnerable to changes in climate patterns. Though predictive models are constantly improving, there are gaps in our understanding of how different management practices can be used to help farmers adapt to changes in climate while maintaining economic viability. Furthermore, currently available tools and models are not meeting producers' needs, and little is known about the types of information they would like to access. Useful to Usable (U2U): Transforming Climate Variability and Change Information for Cereal Crop Producers is an integrated research and extension project that seeks to improve the
Two-Sides of the Same Coin: Communicating Climate Change Science to Water Utilities and Stakeholders in Florida and Hawai'i	Scientist Participation in Science Communication II Posters	Education and Human Resources	['Keener, V W*', 'Staal, L']	2011	The NOAA-funded Regional Integrated Sciences and Assessment (RISA) programs act as boundary organizations that both conduct and translate academic climate research in the physical and social sciences for a variety of stakeholder applications, including for local and state governments, natural resource managers, non-climate scientists, and community members. For the past six years, I have worked with two RISAs—one in the southeast United States, and recently in the Pacific region. In confronting the most immediate impacts of climate change, Florida and Hawai'i are both currently dealing with saltwater intrusion effects on infrastructure and water supply, sea level rise impacts on vulnerable coastlines, and expect the problems to worsen in the future. Both RISAs have focused on water resource sustainability as a topic of interest, and held workshops on climate variability and change impacts for water utilities and a wider range of relevant stakeholders. Methods that have been used to communicate climate science, projected impacts, and risk have included: working groups/collaborative learning, scientific presentations and presentations of relevant case studies, beach management planning, in-depth interviews, and educational radio spots. Despite the similarities in the types of issues being confronted, stakeholders in each location have responded with differing levels of acceptance, which has resulted in the usage of different methods of communication of the same types of climate science information. This talk will focus on the success of a variety of different methods in communicating similar information on comparable risks to different audiences.

				<p>resilience and profitability of farms in the North Central Region amid variable climate change through the development and dissemination of improved decision support tools, resource materials, and training. The goal is to work closely with producers to help them make better long-term plans on what, when and where to plant, and also how to manage crops for maximum yields and minimum environmental damage. The U2U team is composed of a uniquely qualified group of climatologists, crop modelers, agronomists, economists, and social scientists from 10 partner universities across the Midwest. Over the span of 5 years, collaborators will complete tasks associated with 5 objectives that will enhance the usability of climate information for the agricultural community and lead to more sustainable farming operations. First the team will produce research on the biophysical and economic impacts of different climate scenarios on corn and soybean yields in the North Central Region (objective 1) and conduct complementary research to understand how producers and advisors are likely to use this information (objective 2). Based on these findings, decision support tools (DSTs) and training materials will be developed to effectively deliver climate information to stakeholders (objective 3). Next, DSTs will be piloted in a four-state region (Indiana, Iowa, Nebraska, and Michigan) to help improve tools and evaluate effectiveness (objective 4). After several iterations with stakeholders to ensure the usability and utility of the tools, the program will be extended to all twelve states in the region (objective 5). Decision support tools, along with training products, surveys, feedback mechanisms and collaborative social tools, will be supported using the NSF-funded and Purdue University developed HUBzero™ web-based technology.</p>
<p>IPCC and other assessments as vehicles for integrating natural and social science research to address</p>	<p>Integrating Natural and Social Science Research to Address Human Dimensions of Global Change II</p>	<p>Global Environmental Change</p>	<p>['Field, C B*']</p>	<p>2012</p> <p>IPCC and other assessments address both natural and social science aspects of climate change, but this approach has historically involved relatively little integration across the two sets of disciplines. In a framing that is only slightly oversimplified, past relationships were mostly sequential. From a physical climate perspective, human behavior was a boundary condition setting the trajectory of atmospheric forcing. And from an impacts perspective, changes in the physical climate set the stage upon which humans experienced impacts and made decisions about adaptation and mitigation. Integrated assessment models have been the main locus of research on questions about bi-directional coupling, where the trajectory of the physical climate influences GHG balance related to the need for agricultural land as well as GHG emissions from other activities. In the IPCC AR4 (2007), feedbacks from the natural carbon cycle to climate were a focus, but with little discussion of the potentially important feedbacks from climate-carbon interactions in the human domain. Detailed research and modeling in this area are still in the relatively early stages. For the future, IPCC and other assessments potentially provide a vehicle</p>

				<p>for new insights about the interaction of natural and social science dimensions of climate change. Several aspects could be interesting. Some of these relate to the decisions that modulate GHG emissions. For example, how does scientific understanding of climate change influence people's interest in mitigation and adaptation? How does it influence their willingness to pay? How are these modulated by regional and global geopolitics? Other potentially interesting aspects relate to interactions between mitigation and adaptation. For example, how does local experience of climate change alter the balance of focus on adaptation and mitigation? Still others relate to the nature of impacts and the role of sustainable development. With an aggressive sustainable development agenda aimed at building resilience, would societies be more or less focused on impacts? Finding ways to address these questions in the context of an assessment presents a range of challenges, beginning with the challenge that the assessments are generally not designed to conduct new research. But on the other hand, the juxtaposition of disciplines, perspectives, and tools creates a fertile ground for new insights.</p>
Balancing benefits and costs in a 4°C world: the need for and challenges of natural-social science dialogue	The Anthropocene: Confronting the Prospects of a +4°C World I (Video On-Demand)	Global Environmental Change	[Kopp, R E*]	<p>2012</p> <p>Making wise policy decisions regarding mitigation, adaptation and geoengineering requires fair assessments of the risks of both action and inaction. Such assessments necessitate dialogue between natural and social scientists. Recent attempts by the U.S. government to estimate the social cost of carbon (SCC) for use in balancing the benefits and costs of proposed mitigatory regulations highlight some of the challenges involved. Among them: (1) Scale: The costs and benefits of adaptation decisions generally take place locally, while the benefits of mitigation accrue globally. Most studies to inform adaptation decision have, quite reasonably, taken place at the local scale, but this has left globally aggregate estimates of climate risk in a fairly tenuous state, engaging only a handful of economists. More accurate assessments, needed for making critical policy decisions as we approach a 4°C world, will require both better top-down analyses and a better framework for integrating bottom-up analyses. (2) Historical validation: Integrated assessment models have not been subject to validation studies, such as the historical runs used to test physical climate models. Conducting such studies for impact analyses will require the integration and further development of statistical analyses of the human impact of past and ongoing climate change. If models don't work for a 0.8°C world, there's no reason to think they'll work for a 4°C world. (3) Looking beyond a 4°C world: A world that reaches 4°C in this century may exceed it in the next century; and even if temperature is stabilized, understanding the economic impacts of 4°C warming will require more than the current approach of extrapolating from 2°C impacts. Natural scientists and social scientists need to work together to estimate damage calibration points for considerably warmer conditions. Recent work on the loss of</p>

Tabla 1 Trabajos analizados que incluyen las CC y las HH en los estudios del cambio climático en las reuniones de AGU 2010-2018

				<p>physiologically habitable regions in a >8°C warmer world is a rare step in this direction (Sherwood and Huber, 2010). (4) Characterizing the economic impacts of climate surprises and other hard-to-model climatic events: Complex climate models are tuned to perform well against historical observations, but such tuning leads to undersampling of the tails of probability distribution. Characterizing these tails is critical for risk assessment. Non-model-based approaches (e.g., paleoclimatic studies) can help in assessing the likelihoods of physical climate events that are either hard to model or vary greatly between models (e.g., ice sheet melt, ENSO strengthening, AMOC slowdown, Amazon die-off, etc.) With the exception of sea level change associated with ice sheet melt, the social science literature on the impacts of these events is limited or non-existent. Sherwood, S.C., Huber, M., 2010. Proc. Natl. Acad. Sci. 107, 9552 -9555.</p>
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