

TRIBUNA

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SEMANA TEMÁTICA 6

Cambio Climático y Fenómenos Extremos

Ejes temáticos

Cambio Climático; Fenómenos Extremos

21 – 24 de julio

Programa
definitivo

Bi



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Marco de referencia

El agua dulce es un recurso básico para la vida en la tierra y para el bienestar de los seres humanos. Aunque la humanidad emplea directa o indirectamente más de la mitad de toda el agua dulce a la que tenemos acceso, y los recursos hídricos subterráneos se están agotando, la seguridad del agua es un problema para muchos que no tienen acceso a un agua potable de calidad. El desarrollo humano está íntimamente relacionado con garantizar agua segura para todos y así queda reconocido en los Objetivos de Desarrollo del Milenio. El cambio climático, no obstante, plantea un importante reto para el logro de estos objetivos.

Según el IV Informe de Valoración del IPCC (Panel Intergubernamental sobre Cambio Climático), el calentamiento global puede alterar el ciclo del agua y con ello, la cantidad de lluvia, la forma en la que llueve, cuándo y dónde. Así, es posible que cambien la cantidad de agua disponible para el hombre y los riesgos relacionados con el agua. De hecho, el calentamiento global observado durante las últimas décadas ha estado relacionado con los cambios percibidos en los patrones de precipitación, la intensidad y los extremos, así como los grandes deshielos, y los cambios en la humedad del suelo y en las escorrentías. Entre otras observaciones se incluyen aumentos de fuertes precipitaciones y en el interior clasificadas como secas, descensos en las reservas de agua de los glaciares montañosos, cambios en la amplitud y el tiempo de escorrentía de los ríos que se abastecen de glaciares y del deshielo, y en los fenómenos del hielo en ríos y lagos. Una investigación reciente indica que en algunas regiones algunos de estos cambios hidrológicos que se han observado se pueden atribuir a la influencia humana sobre el clima.

Durante este siglo, como el clima sigue calentándose, los modelos climáticos concuerdan con la previsión de más cambios en el ciclo del agua. Estos cambios incluyen cambios en las precipitaciones, con aumentos en las altas latitudes y en partes de los trópicos, y descensos en algunas regiones subtropicales y de latitudes medias inferiores. A mediados del siglo XXI, está previsto que la escorrentía anual de los ríos y la disponibilidad de los recursos hídricos aumente entre un 10 y un 40% a latitudes altas y en algunas zonas tropicales húmedas, y que descienda entre un 10 y un 30% en algunas regiones secas en latitudes medias y en los trópicos secos. Muchas zonas semiáridas y áridas (por ej. la cuenca mediterránea, la parte occidental de EE.UU., el sur de África y el Nordeste de Brasil) se hallan particularmente expuestas a los impactos del cambio climático y se prevé que sufran una disminución de los recursos hídricos debido a dicho cambio climático. En el transcurso del siglo, se prevé que disminuyan las reservas de agua almacenadas en glaciares y nieve, con la consiguiente reducción de la disponibilidad de agua en las regiones abastecidas por el deshielo de las principales cadenas montañosas, y la afectación de una fracción considerable de la población mundial. La elevación del nivel del mar ampliará zonas de salinización de aguas subterráneas y estuarios, lo que dará como resultado un descenso de la disponibilidad de agua dulce para consumo humano y ecosistemas en las zonas costeras. La frecuencia de las fuertes precipitaciones muy posiblemente aumentará en la mayoría de las zonas durante el siglo XXI, al igual que el riesgo de inundaciones por lluvia. Existe una tendencia a la sequía en los interiores continentales durante el verano, especialmente en las zonas subtropicales, en las bajas y medias latitudes. A nivel mundial, está previsto que aumente la proporción de superficies en extrema sequía en un momento dado, así como la frecuencia y gravedad de dichos momentos de sequía extrema. Se espera una elevación de las temperaturas del agua, un aumento de la intensidad de las precipitaciones y períodos más largos de flujos bajos. Se prevé que este hecho agrave muchas formas de contaminación de las aguas (desde sedimentos, nutrientes, carbono orgánico disuelto, patógenos, pesticidas y sal, además de la contaminación térmica) con impactos negativos sobre los ecosistemas, la salud humana y la fiabilidad y los costes operativos de los sistemas hídricos.

La semana de la “Tribuna del Agua” dentro de EXPOZARAGOZA 2008 dedicada al agua y al cambio climático contemplará algunos de los principales temas relacionados con el impacto del cambio climático sobre el ciclo del agua y sus consecuencias para el hombre. La semana temática se organiza en nueve sesiones, tres por cada día de duración. El primer día está dedicado a evaluar las tendencias y previsiones climáticas, los extremos climáticos relacionados con el agua y sus impactos. La primera sesión dirigirá una mirada retrospectiva hacia las tendencias observadas con respecto a los pluviogramas mundiales del siglo pasado. Por lo tanto, se necesitan unas previsiones sobre un futuro clima más cálido para evaluar lo que podemos esperar de los años venideros. El futuro, no obstante, está plagado de incertidumbres que deberán concretarse para orientar la futura adaptación. Inundaciones y sequías son los dos riesgos con más probabilidades y activos en las vidas humanas y los dos se tratarán de manera específica en una sesión que se centrará en los cambios en la frecuencia e intensidad y en la magnitud de los impactos previstos. Cuando la lluvia cae sobre la tierra, de camino al mar el agua se queda en forma de nieve o hielo o en los humedales durante un cierto período de tiempo. La nieve y el hielo son cruciales para millones de personas, puesto que alimentan los ríos en verano cuando escasean las lluvias. De igual modo, los humedales son la principal fuente de recursos hídricos, nos ayudan a mantener la riqueza de vida y son una parte muy valorada de nuestra referencia diaria con respecto al lugar donde vivimos. Los impactos sobre los sistemas hídricos se tratarán por tanto en una sesión.

El segundo día está dedicado a hablar sobre la disponibilidad y los usos del agua y sus impactos sobre la producción de alimentos, la economía y la sociedad. La primera sesión tratará sobre la disponibilidad del agua.

Gran parte del agua que cae sobre la tierra es abstraída por el hombre. Esta cantidad depende de cuántas personas se encuentren en ese lugar y de los usos a los que vaya destinada. La cantidad y la calidad del agua así como la demanda cambiarán conforme vaya cambiando el clima y con el tamaño de las poblaciones que habiten en cuencas con restricciones de agua. Cuáles son las futuras tendencias y los puntos conflictivos que hay que detectar. Aparte de su utilización como agua de boca, la seguridad alimentaria está entre nuestras primeras necesidades. Gran parte de la agricultura del planeta depende de los cultivos de secano; otros cultivos dependen del regadío y el ganado depende de los alimentos y pastos naturales, ambos íntimamente relacionados con la lluvia. La relación entre la lluvia y el PIB en muchos países sigue siendo una realidad en el sentido de que el PIB varía según la lluvia que cae cada año. Los riesgos que plantea el agua con respecto al abastecimiento de alimentos se tratarán en una sesión específica. Además, los cambios en la disponibilidad de alimentos y recursos debido a los cambios en la lluvia afectarán a muchos aspectos de nuestra vida diaria. Comprender los costes económicos y sociales de dichos cambios, El hambre y el empobrecimiento pueden provocar la emigración y la inseguridad y el conflicto en muchas partes del planeta.

El tercer y último día está dedicado a tratar los temas de adaptación a la vida en un mundo con escasez y variabilidad de recursos hídricos. Los sistemas de gestión nos ayudan a organizar y distribuir los recursos hídricos y cuando es necesario independientemente de la lluvia. Nuestros sistemas se planificaron basándose en un mundo que se consideraba estable, pero ya no será así. Por consiguiente, tenemos que evaluar nuestro grado de vulnerabilidad a los cambios previstos en la disponibilidad de recursos hídricos y qué opciones tenemos para adaptarnos a un mundo con menos agua y más variable en el tiempo y en el espacio. Tenemos que volver a diseñar el modo de organizar nuestros sistemas de gestión para afrontar este nuevo paradigma de un mundo en constante evolución y que sean “resistentes al clima”. A la hora de contemplar necesidades futuras, hay que evaluar los mecanismos de gobernanza y volver a evaluar las opciones para afrontar la escasez entre partes competidoras, un hecho especialmente necesario en los países en vías de desarrollo, aunque también en el mundo más desarrollado que afronta nuevos retos. El ejemplo de Europa y las zonas del sur del Mediterráneo nos ayudará a identificar de antemano las necesidades.

Programa

21 de julio: CLIMAS EXTREMOS Y MASAS DE AGUA

7:30 - 8:45	Acreditación (Centro de acreditación de Tribuna del Agua)
9:00 - 9:50	Inauguración de la Semana Temática
9:55 - 10:25	<p>Conferencia magistral: <i>El reto del futuro régimen del cambio climático. Adaptación y recursos hídricos como asunto crucial para España.</i></p> <p>Teresa Ribera. Secretaria de Estado de Cambio Climático. Ministerio de Medio Ambiente y Medio Rural y Marino</p>
10:30 - 10:45	<p>Introducción a la Semana Temática</p> <p>José Manuel Moreno. Director del Departamento de Ciencias Ambientales. Universidad de Castilla-La Mancha, Toledo</p>
10:50 - 12:45	<p>Sesión 1: Clima y agua</p> <p>Moderador: Ernesto Rodríguez Camino. Agencia Estatal de Meteorología, Madrid, Spain</p> <p>Ponencia 1: <i>Los recursos hídricos según el IV Informe de Evaluación del IPCC</i> Jean Palutifoff. IPCC Working Group II Technical Support Unit; Meteorological Office of the United Kingdom, Exter, UK</p> <p>Ponencia 2: <i>Previsiones futuras de lluvia.</i> Ulrich Cubasch. Meteorological Institute, Free University of Berlin, Berlin, Germany</p> <p>Ponencia 3: <i>Cómo afrontar las incertidumbres del futuro clima: El reto especial de las regiones semiáridas.</i> Robert L. Wilby. University of Lancaster, Lancaster, UK.</p> <p>Preguntas y debate</p>
Desplazamiento al World Trade Center	
13:30 - 14:20	Comida en el World Trade Center
14:30 - 16:20	<p>Sesión 2: Extremos climáticos (World Trade Center)</p> <p>Moderador: Juan Satrústegui Marcos. MAPFRE RE, Madrid, Spain</p>

Ponencia 1: *Riesgo de sequías: Caracterización, retos y oportunidades*

Juan B. Valdés. Department of Civil Engineering and Engineering Mechanics, The University of Arizona, Tucson, AZ, USA

Ponencia 2: *Fuertes precipitaciones e inundaciones*

Z. Kundzewicz. Research Centre for Agricultural and Forest Environment, Polish Academy of Sciences, Pozna, Poland/ Potsdam Institute for Climate Impact Research, Potsdam, Germany

Ponencia 3: *Cartografía del riesgo de inundación*

Jesús Yagüe Cordova. Subdirector General de Gestión Integrada del Dominio Público Hidráulico Ministerio de Medio Ambiente y Medio Rural y Marino

Preguntas y debate

16:20 - 16:40

Pausa café

16:50 - 18:10

Sesión 3: Impactos sobre los sistemas hídricos (World Trade Center)

Moderador:

Ricardo Anadón Álvarez. Facultad de Biología, Universidad de Oviedo, Oviedo.

Ponencia 1: *Nieve y hielo sobre el planeta Tierra: Situación actual, impactos y previsiones.*

Gino Casassa. Centro de Estudios Científicos, Valdivia, Chile

Ponencia 2: *Impactos del cambio climático sobre los ecosistemas de los humedales.*

José Lucas Pérez Llorens. Departamento de Biología. Universidad de Cádiz, Puerto Real

Preguntas y debate

22 de julio: DISPONIBILIDAD DEL AGUA E IMPACTOS

9:00 - 9:15

Guión Científico "AGUA EXTREMA"

Javier Martín Vide. Departamento de Geografía Física y A.G.R. Facultad de Geografía e Historia. Universidad de Barcelona

9:15 - 10:55

Sesión 4: Recursos Hídricos

Moderador:

Jean Palutikof. IPCC Working Group II Technical Support Unit; Meteorological Office of the United Kingdom, Exeter, UK

Ponencia 1: *El cambio climático y la transformación del sistema mundial del agua.*

Joseph M. Alcamo. Centre for Environmental Systems Research, University of Kassel, Kassel, Germany/ The Global Water System Project

Ponencia 2: *Los cambios climáticos y la gestión de las necesidades de agua.*

Henk van Schaik. Cooperative Programme on Water and Climate, Delft, The Netherlands

Preguntas y debate

11:00 - 11:20

Pausa café

11:30 - 13:00

Sesión 5: Agua y producción de alimentos

Moderador:

Francisco García Novo. Dirección Departamento de Ecología, Universidad de Sevilla, Sevilla

Ponencia 1: *Cultivos para la alimentación en un entorno de calentamiento global y de cambio en la disponibilidad de agua*

Marco Bindi. Department of Agronomy and Land Management, University of Florence, Florence, Italy

Ponencia 2: *Cambio climático y praderas: consecuencias inesperadas de cambios en los patrones de precipitación extrema.*

Alan K. Knapp. Department of Biology, Colorado State University; Fort Collins, Colorado, USA

Preguntas y debate

13:10 - 14:10

Comida

14:20 - 17:00

Sesión 6: Clima, agua, economía y sociedad

Moderador:

Luís Jiménez Herrero. Observatorio de la Sostenibilidad en España, Alcalá de Henares, Madrid, Spain

Ponencia 1: *Las implicaciones económicas de los cambios en la disponibilidad del agua.*

Diego J. Rodríguez Energy, Transport and Water Department, World Bank, Washington DC, USA

Ponencia 2: *Cambio climático, globalización y escasez de agua.*

Karen L. O'Brien. Department of Sociology and Human Geography, University of Oslo, Norway

Ponencia 3: *Cambio climático: Un reto mundial para la gobernanza del agua*

Claudia Pahl-Wostl. Institute of Environmental Systems Research/Department of Mathematics and Computer Science, University of Osnabrück, Osnabrück, Germany

Preguntas y debate

17:00 - 18:00

Presentación del libro de Glaciares (Ministerio de Medio Ambiente y Medio Rural y Marino)

19:00 - 21:00

Visita guiada VIP al Pabellón de España. Exposición de Cambio Climático a cargo del director científico de la exposición Jorge Wagensberg

Cóctel de honor ofrecido por el Pabellón de España

23 de julio: ADAPTACIÓN A LA ESCASEZ DE AGUA Y A LOS CAMBIOS CLIMÁTICOS

9:00 - 9:30

Conferencia magistral: *Los recursos hídricos y la experiencia del Banco Mundial*

Abel Mejía. Energy, Transport and Water Department, The World Bank, Washington DC, USA.

9:40 - 11:10

Sesión 7: Adaptación a la escasez de agua: perspectivas generales

Moderador:

Joseph M. Alcamo. Centre for Environmental Systems Research, University of Kassel, Kassel, Germany/ The Global Water System Project

Ponencia 1: *Implicaciones del cambio climático sobre las sequías y la escasez de agua.*

Luis Mata. University of Arizona, Tucson, AZ, USA

Ponencia 2: *Cambio climático y agua: Adaptación.*

Stewart J. Cohen. Department of Forest Resources Management, University of British Columbia, Vancouver, BC Canada

Preguntas y debate

11:10 - 11:30

Pausa café

11:40 - 13:10

Sesión 8: Adaptación a la escasez de agua en los países menos favorecidos

Moderador:

Luis J. Mata. University of Arizona, Tucson, AZ, USA

Ponencia 1: *La adaptación al cambio climático en África occidental*

N. van de Giesen. Faculty of Civil Engineering and Geosciences, Delft University of Technology, Netherlands

Ponencia 2: *Los recursos hídricos en Oriente Medio y Norte de África*

N. Vijay Jagannathan. Middle East and North Africa Region, World Bank, Washington DC, USA

Ponencia 3: *La gestión de la escasez de agua en los países Latinoamericanos*

Seraphine Marie Haeussling. Latin America and Caribbean Region, World Bank, Washington DC, USA.

Preguntas y debate

13:15 - 14:15

Comida

14:20 - 16:30

Sesión 9: Adaptación al cambio: el foco regional

Moderador:

José Manuel Moreno. Department of Environmental Sciences, University of Castilla-La Mancha, Toledo, Spain

Ponencia 1: *La adaptación a la escasez de agua en Europa*

Wolfram Mauser. Department for Geography, Ludwig-Maximilians University (LMU), Munich, Germany

Ponencia 2: *Ser miembro de la UE y adaptarse al cambio: el caso del sudeste de Europa*

Ron N. Hoffer, Sustainable Development Sector Unit, Europe and Central Asia Region, The World Bank, Washington DC, USA

Ponencia 3: *Impactos previstos del cambio climático sobre los recursos hídricos en España*

Juan Manuel Ruiz Centro de Estudios y Experimentación de Obras Públicas (CEDEX).

Ponencia 4: *La adaptación en España a los efectos del cambio climático sobre los recursos hídricos*

Teodoro Estrela. Subdirector General Planificación y Uso Sostenible del Agua. Ministerio de Medio Ambiente y Medio Rural y Marino.

Preguntas y debate

16:40 - 17:00

Conclusiones:

José Manuel Moreno. Director del Departamento de Ciencias Ambientales. Universidad de Castilla-La Mancha, Toledo

Joseph M. Alcamo. Centre for Environmental Systems Research, University of Kassel, Kassel, Germany/ The Global Water System Project

Luis J. Mata. University of Arizona, Tucson, AZ, USA

Jean Paluikof: IPCC Working Group II Technical Support Unit; Meteorological Office of the United Kingdom, Exeter, UK

Documento de Emplazamiento

CAMBIO CLIMÁTICO Y FENÓMENOS EXTREMOS: Hacia un mundo de escasez de agua y de incertidumbre, así como de aumentos de los riesgos

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Resumen

More than half of all accessible freshwater is used by humankind. Underground water resources are being depleted. Water security is a problem for the many that do not have access to safe drinking water. Human development is closely related to guaranteeing safe water for all. According to the IV Assessment Report of the IPCC, global warming can alter the water cycle. Climate models are consistent in projecting alterations in precipitation, with increases at high latitudes and parts of the tropics, and decreases in some subtropical and lower mid-latitude regions. Water supplies stored in glaciers and snow is projected to decline, thus affecting a sizable fraction of the world population. Sea-level rise is projected to decrease freshwater availability for humans and ecosystems in coastal areas. The frequency of heavy precipitation events will very likely increase over most areas during the 21st century, as will the risk of rain-generated floods. There is a tendency for drying in continental interiors during summer, especially in the subtropics, low and mid-latitudes. The global production of food is likely to be affected, and water availability is likely to modify the global economy and society at large. The thematic week is organized in three days and nine sessions. The first day is devoted to evaluate climate trends and future projections, including their uncertainties, climate extremes related to water (droughts and floods), and the impacts on water bodies and water systems. The second day is devoted address water availability and uses, its impacts on food production, and on the economy and society. The third day is devoted to address the issues of adaptation to live in world of water scarcity and uncertainty, and to case studies from several regions of the world, from less favoured countries down to Europe, and Spain.

Palabras clave:

Climate change; hydrological cycle; water extremes, water security; water adaptation.

1. Introduction

Freshwater is a basic resource for life on earth and for the well being of humans. Humankind is currently using more than half of all accessible freshwater and depleting underground water resources. Water security is a problem for the many that do not have access to safe drinking water. Human development is closely related to guaranteeing safe water for all, as is acknowledged in the Millennium Development Goals (Goal 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation)(UN 2002). Climate change, however, poses a great challenge for accomplishing these goals.

According to the IV Assessment Report of the IPCC (IPCC 2007), global warming can alter the water cycle, and with it how much it rains, the form in which it does, when and where. Thus, how much water is available for man and the risks related to water are likely to change. In fact, the observed global warming during the past decades has been linked to observed changes in precipitation patterns, intensity and extremes, as well as widespread melting of snow and ice and changes in soil moisture and runoff. Additional observations include increases in heavy precipitation and in land classified as dry, decrease in water stored in mountain glaciers, shifts in amplitude and time of run-off glacier- and snowmelt-fed rivers and in ice phenomena in rivers and lakes. Recent research shows that, in some regions, some of these observed hydrological changes can now be attributed to the human influence over the climate (Barnett et al. 2008).

During this century, as climate continues warming, climate models are consistent in projecting further changes in the water cycle (Bates et al. 2008). These include changes in precipitation, with increases at high latitudes and parts of the tropics, and decreases in some subtropical and lower mid-latitude regions. By the middle of the 21st century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics. Many semi-arid and arid areas (e.g., the Mediterranean basin, western USA, southern Africa and north-eastern Brazil) are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources due to climate change (Fig. 1). In the course of the century, water supplies stored in glaciers and snow are projected to decline, thus reducing water availability in regions supplied by melt-water from major mountain ranges, thus affecting a sizable fraction of the world population. Sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas.

The frequency of heavy precipitation events will very likely increase over most areas during the 21st century, as will the risk of rain-generated floods. There is a tendency for drying in continental interiors during summer, especially in the subtropics, low and mid-latitudes. Globally, the proportion of land surface in extreme drought at any one time, as well as the frequency and severity of extreme drought events, is projected to increase. Higher water temperatures, increased precipitation intensity and longer periods of low flows are expected. This is projected to exacerbate many forms of water pollution (from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution), with negative impacts on ecosystems, human health and water system reliability and operating costs.

2. Questions addressed

The “Tribuna del Agua” week within EXPOZARAGOZA 2008 devoted to climate change and water extremes, will address some of the major issues relating to the impact of climate change on the water cycle and its consequences for humans. The thematic week is organized in nine sessions, three per each of the three days that it will last. The first day is devoted to evaluating climate trends and future projections, in particular rainfall, climate extremes related to water and their impacts on water bodies and systems. The first session will take a retrospective look at the trends observed with regard rainfall patterns across the globe during the past century. Now we have learned that anthropogenic forcing has had a detectable influence on observed changes in average precipitation within latitudinal bands, and these changes cannot be explained by internal climate variability or natural forcing (Zhang et al. 2007). Projections for a future warmer climate are then needed to evaluate what we can expect for the coming years. The future, however, is plagued by uncertainties, and these needs to be identified in order to guide future adaptation.

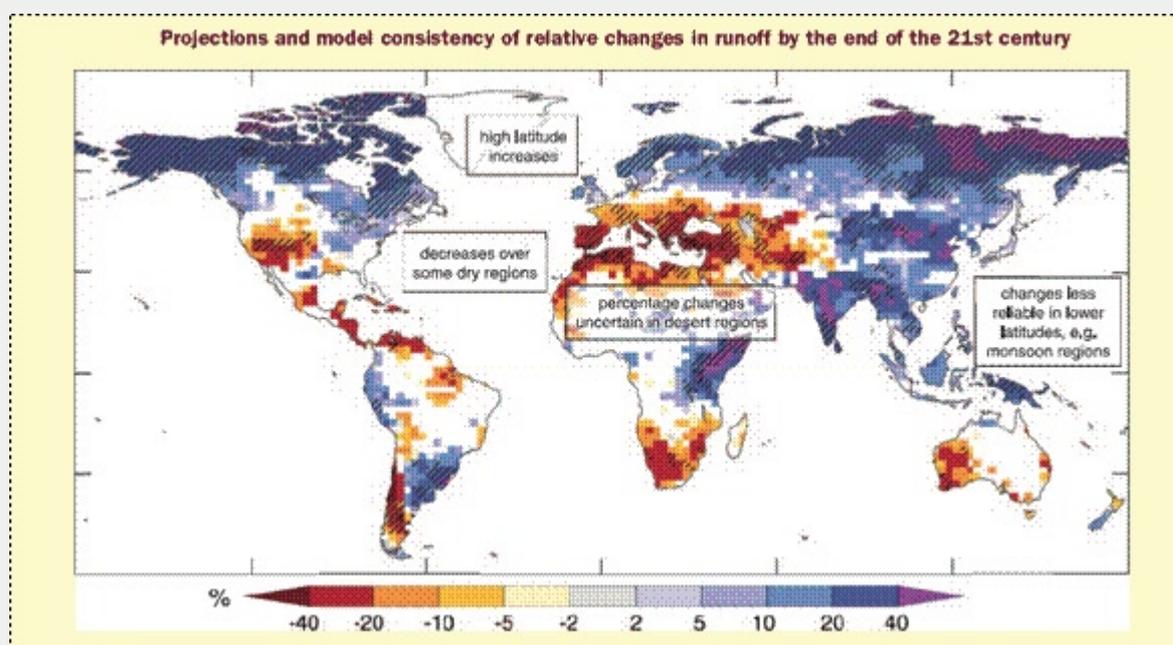


Fig. 1. Large-scale relative changes in annual runoff (water availability, in percent) for the period 2090-2099, relative to 1980-1999. Values represent the median of 12 climate models using the SRES A1B scenario. White areas are where less than 66% of the 12 models agree on the sign of change and hatched areas are where more than 90% of models agree on the sign of change. Source: IPCC 2007.

Floods and droughts are among the two climate-related hazards that take a highest toll in human lives and assets every year. The two will be specifically addressed in one session focussing on the changes in frequency and intensity of both hazards and on the magnitude of projected impacts. A particular case study of how Spain is addressing flood risk will be presented. As rain falls on earth, on its way to the ocean water remains as snow or ice or in wetlands for a certain period of time. Snow and ice are crucial for millions of people, since they feed the rivers in summer when rainfall might be low. Millions of people rely on water provided by these two sources. Wetlands, equally, are the main sources of water, provide support to a wealth of life and are a dearest part of our daily reference with regard to where we live. Impacts on water systems will therefore be addressed in one session.

The second day is devoted to deal with water availability and uses and its impacts on food production and on the economy and society. The first session will address the availability of water. Much of the water that falls on earth is abstracted by man. This amount depends on how many people will be there and on what uses it will be needed for. The quantity and quality of water as well as the demand will change as climate changes. The size of the populations living in water-stressed watersheds can increase by 62-75% by 2050, depending on the models and scenarios (Alcamo et al. 2007). Identifying future trends in supply and demand and the hotspots of stress are high priorities. Besides direct use of water in drinking, food security is first among our needs. Much of agriculture in the world depends on rain-fed crops; other crops depend on irrigation and livestock depends on natural grass and feed, both closely coupled to rain. The relationship between rain and annual GDP for many countries is still a reality in the sense that annual GDP varies with the rain falling each year. The risks posed by water to food provision will be addressed in a specific session. In addition, changes in available food and resources due to shifting rainfall will affect many aspects of our daily life. The economic and social costs of such shifts need equally to be understood. Hunger and impoverishment may cause many people to migrate and to cause insecurity and conflict in many parts of the world (EC 2008; Raleigh et al. 2008). Climate change poses many challenges for the governance of our environment, including water.

The third and final day is devoted to address the issues of adaptation to live in world of water scarcity and uncertainty due to climate changes. Management systems help us organize and distribute water where and when it is needed independently of the amount of rain. Climate change is very likely to affect the function and operation of existing water infrastructure as well as water management practices (Kundzewicz et al. 2007). Our systems were planned based on a world that was considered stable and, therefore, predictable. The future was projected based on the past but that will no longer be the case. Climate change undermines a basic assumption that historically has facilitated the management of water supplies and demands (Milly et al. 2008). Therefore we need to evaluate how vulnerable we are to the changes in water resources that are projected, and what options we have to adapt to a world of less water and more variable in time and space and through the years. The way we organize our managements systems needs to be rethought to deal with this new paradigm of a changing world, and to “climate proof” them (Biemans et al. 2006). In addressing future needs, options for dealing with water scarcity reevaluated among competing stakeholders. This is particularly necessary in less developed countries but also in the more developed world that faces new challenges. The example of Europe and the conflicts arising between countries as a result of having to adapt to a change in the resource as well as in regulations, will provide insights as to how deal with competing demands. Finally, we will focus on a mostly Mediterranean country like Spain, short of water but with one of the longest traditions of managing water.

3. Emerging conclusions

1. According to the IV Assessment Report of the IPCC, warming of the climate system is unequivocal, as evidenced by observations of increased global air temperature, as well as of the oceans, widespread snow and ice melting and sea level raise. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. There is high confidence that the following effects on hydrological systems are occurring: increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers, and warming

of lakes and rivers in many regions, with effects on thermal structure and water quality. Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century. Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if GHG concentrations were to be stabilised.

Global warming can alter the water cycle. Climate models predict in the case of an enhanced greenhouse gas concentration an increase in the mean precipitation due to the higher temperature, but the distribution is not even. Generally, dry regions become dryer, while wet regions become wetter. In the regions with rainfall, there is a tendency towards more intense precipitation. Semi-arid regions, such as the Mediterranean, face a range of threats from climate change, including droughts, flash flooding, soil degradation and erosion, desertification and water scarcity. However, precipitation scenarios are notoriously difficult to produce for such areas because of the high variability, intermittence of rainfall in space and time, and complex orography, among other. Methods are available to identify “low regret” adaptation solutions or “tipping points” or limits to adaptation.

2. The intensification of the hydrological cycle causes floods and droughts to get more frequent and/or extreme. Droughts, particularly in arid and semi-arid regions, are of particular concern due to their large spatial extent and long durations. Methods are now being developed to facilitate the early warning of drought and its related impact in agriculture and possible famine. The moisture-holding capacity of the atmosphere has been increasing with temperature, with consequence for flood risk. Observational evidence indicates increasing probability (and number) of heavy precipitation events. Climate-related changes in flood frequency are complex and depend on the flood-generating mechanism (e.g. heavy rainfall vs snowmelt). In order to anticipate future changes in flood, countries are introducing measures to reduce flood risks. Spain is implementing a National Cartographic System of Floodable Areas to reduce risks.

3. Cryospheric components are undergoing a generalised reduction in response to global warming, with already detectable effects on the environment and on different human activities. The effects include the modification of runoff patterns, the earlier occurrence of spring snow melting, or changes in freshwater and marine ecosystems affected by lake, river and sea ice reduction, among other. As for wetlands, climatic and non-climatic drivers are expected to act synergistically on them, resulting in abrupt and large changes that can be difficult, expensive, or impossible to reverse. Climate change is projected to change structure and functioning of wetland ecosystems by affecting the abiotic and the biotic components, with unforeseen ecological changes that may threaten the goods and services these systems provide to humans.

4. Over the coming decades, changes in climate and society will drive a major transformation of the global water system. Water scarcity due to climate change will intensify in specific parts of the world including southern Europe, northeast Brazil, and southern Africa. The combination of climate change and socio-economic factors could lead to increasing water stress over roughly two-thirds to three-quarters of the entire river basin area of the world in the decades spanning 2000 and 2050. Society needs to respond immediately to these risks, and this response should take place at all levels, from local to global. This means exploring new ways of managing water at the global level through novel interna-

tional institutions and conventions. Increased water stress will exacerbate water-related problems. Governments must re-evaluate the adequacy of their infrastructural facilities as well as their legal, technical, and economic, policy and institutions approaches for water management and water services. Integrated water resources management provides an important framework to achieve adaptation goals.

5. Changes in the water cycle may play a fundamental role in global food security. Future projections of climate, together with other external factors (increases in food demand, changes in human diet, etc.) may determine important impacts on food crops productions and the following food availability. Climatic variability is an inherent feature of grasslands and will likely increase in the future. Primary productivity in most grasslands is limited by water availability. Thus, most grasslands will be sensitive to climate change. However, not all grasslands respond equally to changes in precipitation extremes. Understanding interactions between rainfall amount and its distribution in grasslands is key to forecasting responses to climate change.

6. Water is a critical core sector so that impacts here have a cascading effect. Economic sectors which are projected to be most affected are agriculture (increased demand for irrigation), energy (reduced hydropower potential and cooling water availability), health (worsened water quality), recreation (water-linked tourism), fisheries and navigation. The top priority for adaptation in the water sector should be to reduce the vulnerabilities of people and societies. Water scarcity in an era of globalization is influenced by water policies as much as by changes in physical supply. Those who are most likely to be negatively affected by climate change are also most likely to experience the negative outcomes of globalization. Water policy decisions must take into account potential outcomes of both climate change and globalization. Dealing with challenges of climate change requires increasing the adaptive capacity of water governance regimes. Required are robust strategies that perform satisfactorily under a range of initially uncertain but possible future developments. Such strategies can only perform effectively in water management regimes that allow for learning and adapting to new insights. Further innovative processes for global governance need to be developed to deal with challenges requiring a global, coordinated response.

7. Adaptation strategies to face water scarcity should include ways that improve water use efficiency and management. Adaptation to climate change should be at the core of the international poverty agenda. Current approaches to adaptation planning in many countries center on the idea of using a climate-proofing approach. Adaptation and mitigation need to be viewed as complementary responses to climate change. Climate change poses major conceptual challenges to resource managers since it is no longer appropriate to assume that past hydrological conditions will continue into the future. Future adaptations may include technical changes that improve water use efficiency, demand management (e.g. through metering and pricing), and institutional changes that improve the tradability of water rights. The barriers to implementing adaptation measures include the inability of some natural systems to adapt at the rate of combined demographic pressures and climate, incomplete understanding and quantifying of water demands, and impediments to the flow of timely and reliable knowledge and information relevant for decision makers.

8. Water resource management faces critical obstacles in many areas of the world that are in a process of development and that do not have integrated political structures. In the Middle East and North Africa (MENA), where water resources are scarce, growing populations, inefficient infrastructures and an almost certain reduction in future precipitation patterns all further exacerbate the quality and quantity of water made available to both urban

and rural users. Measures are needed to alleviate water shortage in the MENA region for the near and longer-term future. In other regions of the world, such in many Latin-American countries, where water resources were not so limiting, are facing increasing challenges. Changes induced by tropical glacier retreat, such as in the Andes, constitute an early case of the need for adaptation and therefore an example. Other examples of climate change vulnerabilities associated with water scarcity include: coastal wetlands in Mexico, potential of salinization of aquifers in the Caribbean, Páramos in Colombia. Adaptation options need to be identified to reduce climate change vulnerability.

9. In developed areas, like Europe, that have more integrated political structures, but where integration in policies are still occurring, climate change will pose challenges for managing water resources. In this part of the world, considerable changes in rainfall amounts and distribution are foreseen. This would lead to an increased polarisation of water availability between the north, where rainfall amounts are expected to increase and the South, where they may sharply decrease. Central Europe, exemplified by the upper Danube basin, faces a complete change in the hydrological regime. Countries in Southeastern Europe, that are new members of the European Union, candidate or potential candidates for accession face costly investments to meet EU standards and regulations, at the time they face shortage of rainfall and other hydrological changes. In countries like Spain, that are arid or semiarid, climate change will modify water quantity and quality, as well as increased risk of drought. Adaptation measures are already being taken to face future reductions in water resources.

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21 de julio:

CLIMAS EXTREMOS Y MASAS DE AGUA

Sesión 1:

Clima y agua

Ponencia 1

Los recursos hídricos según el IV Informe de Evaluación del IPCC

Autor

Jean Palutikof

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Resumen:

The Intergovernmental Panel on Climate Change has recently published its Fourth Assessment Report. This presents an up-to-date assessment of the scientific literature on the physical basis of climate change (Working Group I), impacts, adaptation and vulnerability (Working Group II) and mitigation (Working Group III). Some 500 authors from around the world came together over a period of five years to write the three assessment reports, together with the Synthesis Report, each of which has undergone a rigorous process of review by experts and governments. The last publication of the Fourth Assessment will be a Technical Paper on 'Climate Change and Water'. This is a distillation of all the material in the IPCC Assessment and Special Reports which deals with the topic, although naturally it focuses primarily on the Fourth Assessment, since this is the most up to date. It is expected to appear in August 2008, and will be translated into all the official UN languages. This talk presents the major findings of the IPCC Fourth Assessment as these relate to climate change and water resources. It looks at the process by which Assessment Reports are written, reviewed and approved. It reports briefly on the decisions made to date on the Fifth Assessment.

Ponencia 2

Lluvias intensas e inundaciones

Autor

Ulrich Cubasch

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Resumen:

The rainfall distribution in a future climate is calculated using global climate models. These models, frequently derived from weather forecast models, solve the physical equations on a grid representing Earth's atmosphere. As rainfall is very patchy, multiple simulations with

various models developed by different research groups are combined. These models predict in the case of an enhanced greenhouse gas concentration in the mean an increase of precipitation due to the higher temperature, but the distribution is not even. Generally, dry regions become dryer, while wet regions become wetter. In the regions with rainfall, there is a tendency towards more intense precipitation. The grid of global models has a resolution of typically 200-400 square kilometres. This is too coarse to estimate the precipitation change on a regional scale, for example a country with the size of Spain, or river catchments. High resolution regional models are imbedded into the global models to estimate the climate change up to a horizontal resolution of 10 kilometres. Statistical models have also been developed to obtain information on a regional scale.

Ponencia 3

Cómo afrontar las incertidumbres de clima futuro: El reto especial de las regiones semiáridas

Autor

Robert L. Wilby

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Resumen:

Semi-arid regions face a range of threats from climate change, including droughts, flash flooding, soil degradation and erosion, desertification and water scarcity. For example, climate change is expected to decrease runoff and increase water resources stresses around the Mediterranean basin. However, precipitation scenarios are notoriously difficult to produce for such areas because of the high variability and intermittence of rainfall in space and time. The task may be further exacerbated by complex orography and sparse observational networks. Nonetheless, tools and techniques are urgently needed to support regional climate change assessments, especially for developing countries in semi-arid and arid regions. This paper reviews the latest techniques for constructing regional rainfall scenarios in semi-arid areas such as the Mediterranean basin, North Africa, South America and parts of the Middle East. Projections made from different climate models and downscaling techniques typically show large variations at river basin scales. Hence, there is increasing emphasis on indentifying “low regret” adaptation solutions – those that make good sense regardless of the future climate scenario. Examples include seasonal forecasting to improve preparedness for drought, or a return to traditional water harvesting techniques. Other approaches such, as sensitivity analysis, help identify “tipping points” or limits to adaptation. However, efforts to characterise supply-side uncertainties must ultimately be balanced by initiatives to reduce water demand and hence minimise long-term vulnerability.

Sesión 2:

Extremos climáticos

Ponencia 1

Riesgo de sequías: Caracterización, retos y oportunidades

Autor

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Resumen:

Climate change will have a significant impact in the water resources of the planet. Particularly the intensification of the hydrologic cycle will imply an increase of the climate variability and the frequency and magnitude of extreme events like droughts and floods. Droughts are of particular concern in arid and semi-arid regions where the competition for the water resources due to population pressure and non-sustainable use of both surface and groundwater will need to be addressed soon. The water-energy nexus will also be exacerbated and the competition between agriculture and residential/industrial used of water will be intensified. The US Southwest is a region severely affected by these pressures and current efforts to characterize, forecast and mitigate the impact of droughts will be presented. Droughts are of particular concern due to their large spatial extent and long durations and the lack of a uniform and consistent definition of their intensity and frequency. Recent advances in teledetection and identification of climatic precursors like ENSO and its relationship to regional climates has facilitated the early warning of drought and its related impact in agriculture and possible famine.

Ponencia 2

Precipitaciones intensas e inundaciones

Autor

Zbigniew W. Kundzewicz

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Potsdam Institute for Climate Impact Research, Potsdam, Germany.

Resumen:

The average annual economic flood damage worldwide has increased by order of magnitude in the last four decades, in inflation-adjusted monetary units. This has been largely due to socio-economic (increasing population and assets in flood-prone areas and land-

use change); terrestrial (land-cover change and reduction of natural storage); and climatic factors. The anthropogenic increase in atmospheric concentration of greenhouse gases leads to enhancement of the greenhouse effect, resulting in the warming and such impacts as glacier melt, and sea-level rise. Increase of temperature causes intensification of the hydrological cycle, by which floods and droughts get more frequent and/or extreme. Indeed, several examples of occurrence of a drought and a flood in the same area in a short time interval have been observed recently (e.g. in Spain). The moisture-holding capacity of the atmosphere has been increasing with temperature, at a rate of about 7% per 1°C, with consequence for flood risk. Observational evidence indicates increasing probability (and number) of heavy precipitation events. However, due to strong natural variability in high river flows and multiple flood generating mechanisms, no ubiquitous, and statistically significant, change has been documented. Regional changes in timing of floods have been observed in many areas, with increasing late autumn and (rain-caused) winter floods. In contrast, the number and intensity of snowmelt and ice-jam-related floods has been decreasing in much of Europe. Climate-related changes in flood frequency are complex and depend on the flood-generating mechanism (e.g. heavy rainfall vs. snowmelt).

Ponencia 3

Cartografía del riesgo de inundación.

Autor

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Ministerio de Medio Ambiente y Medio Rural y Marino, Madrid, Spain.

Resumen:

La repercusión social y económica de las inundaciones cada día es mayor. Las previsiones sobre el cambio climático no parecen favorecer este hecho sino todo lo contrario. Por este motivo tanto el gobierno europeo como el español han introducido en sus legislaciones una serie de medidas que frenen esta tendencia y minimicen los daños en la medida de lo posible. Con la entrada en vigor de la Directiva Europea sobre Inundaciones y la Modificación del Reglamento del Dominio Público Hidráulico se han puesto en marcha una serie de actuaciones encaminadas al conocimiento, gestión y paliación del riesgo. Una de estas medidas es la elaboración de los mapas de peligrosidad de las inundaciones a nivel nacional, otras es la organización de estos mapas dentro del Sistema Nacional de Cartografía de Zonas Inundables. Dado que la solución al problema de las inundaciones no es única sino que además las medidas propuestas tienen un carácter holístico además de las citadas el Ministerio se enfrenta al problema desde varios frentes: seguridad del patrimonio hidráulico, ya que este es fundamental en la gestión de las avenidas, restauración de cauces, Sistemas Automáticos de Información Hidrológico que incorporen Sistemas de Alerta Temprana, etc.

Sesión 3:

Impactos sobre las masas de agua

Ponencia 1

Nieve y hielo sobre el planeta Tierra: Situación actual, impactos y previsiones.

Autor

Gino Casassa

Centro de Estudios Científicos, Valdivia, Chile.

Resumen:

Snow and ice on our planet includes mountain glaciers, ice shelves, continental ice sheets, seasonal snow, frozen ground, sea ice and freshwater ice that occur in polar regions and in high mountain zones. There is abundant and significant evidence that most of these cryospheric components are undergoing a generalised reduction in response to global warming, with already detectable effects on the environment and on different human activities. The reduction includes a strong decrease of Arctic sea ice, a decreasing snow cover at a global level, widespread glacier wastage, and the collapse of floating ice shelves in the Arctic and the Antarctic, with associated flow acceleration and thinning of inland glaciers. The effects associated to cryosphere reduction include the modification of runoff patterns due to the increase of glacier melt; the earlier occurrence of spring snow melting; decrease of vehicle traffic on frozen Arctic roads; increased danger associated to glacier and slope instabilities due the mechanical weakening of soils under deglaciation; changes in freshwater and marine ecosystems affected by lake, river and sea ice reduction; changes in Arctic and mountain livelihoods; reduced skiing, ice climbing and outdoor activities in mountain areas affected by deglaciation; and higher ship traffic in the Arctic.

Ponencia 2

Impactos del cambio climático sobre los ecosistemas de los humedales.

Autor

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Resumen:

Wetlands cover a heterogeneous spectrum of aquatic habitats, widely recognized as biodiversity hotspots and key components of the global carbon budget. They provide a wide range ecosystem goods and services. Wetlands are highly dependent on water levels, and so changes in climatic conditions (e.g. hydrological cycle) will highly influence its structure and functioning. There is a widespread and ongoing degradation and loss of wetlands. Direct non-climatic anthropogenic impacts have been more noteworthy than impacts di-

rectly attributed to climate change. Climatic and non-climatic drivers are expected to act synergistically on wetlands resulting in abrupt and large changes that can be difficult, expensive, or impossible to reverse. Climate change is projected to change structure and functioning of wetland ecosystems by affecting the abiotic and the biotic components. The overall impact will depend on the ecosystem resilience and the rate and magnitude of change in several critical climate drivers such as temperature and water availability (in inland wetlands), and, in addition, the sea level and storm surges (in coastal and low-lying wetlands). Temperature will affect both the abiotic and the biotic compartments. Changes in the hydrological cycle together with a rising sea level and increasing storm surges will result in enhanced erosion of coastal habitats, salinization of groundwater aquifers and estuaries, altered tidal ranges, changes in sediment inputs and nutrient loadings, increased flooding and, consequently in a decrease of freshwater availability for humans and ecosystems. Predictions about the extent and direction of climate change on species and ecosystems are associated with varying degrees of confidence, which arise from uncertainties about how regional climate will change, the influence of non-climatic drivers and how complex ecological systems will respond. Indeed, as climate change alters ecosystem metabolism and species composition, unforeseen ecological changes are expected that may threaten the goods and services these systems provide to humans.

22 de julio:

DISPONIBILIDAD DEL AGUA E IMPACTOS

Sesión 4:

Recursos Hídricos

Ponencia 1

El cambio climático y la transformación del sistema mundial del agua

Autor

Joseph M. Alcamo

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Resumen:

Over the coming decades, changes in climate and society will drive a major transformation of the global water system. But not all regions will be affected in the same way; the intensity and type of risks will vary greatly from region-to-region. For example, results from computer modeling suggest that water scarcity due to climate change will intensify in specific parts of the world including southern Europe, northeast Brazil, and southern Africa. A recent global scenario analysis estimated that the combination of climate change and socio-economic factors could lead to increasing water stress over roughly two-thirds to three-quarters of the entire river basin area of the world in the decades spanning 2000 and 2050. Meanwhile, global warming has also already quickened the pace of glacier-melting in the Alps, Himalayas, and elsewhere. As the melting continues, river runoff fed by

these glaciers will at first increase. Later, though, glaciers will diminish along with runoff, and this will endanger water supplies downstream. Increasing precipitation over Europe, especially in winter, is likely to lead to more frequent flooding in the central and northern sections of Europe. At the same time, the higher rate of precipitation over parts of Europe and other continents will lead to a greater outflow of freshwater to many of the world's coastal zones and this is likely to disrupt coastal ecosystems. Society needs to respond immediately to these risks, and this response should take place at all levels, from local to global. At the global level there are three main tasks to take on. First, we have to reduce the immediate risk to society by establishing comprehensive early warning systems for droughts and floods. Second, we have to extend our knowledge of transformations going on in the global water system by expanding the scope of remote earth observations, and by conducting new large-scale field experiments and surveys. Third, we must protect nature and society over the long run by strengthening the global governance of water. This means exploring new ways of managing water at the global level through novel international institutions and conventions. These tasks need to be given high priority because the all-encompassing changes taking place in the global water system justify an equally wide-ranging response from society.

Ponencia 2

Los cambios climáticos y la gestión de las necesidades de agua

Autor

Henk van Schaik, Marloes Bakker

Cooperative Programme on Water and Climate, Delft, The Netherlands.

Resumen:

Climate is a fundamental driver of the water cycle. It determines how much water is available (supply) and it also an important factor determining how much water is needed (demand) in the short and long term for people, food and ecosystems. By 2020, between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change. Globally, water demand will grow in the coming decades primarily due to population growth and increasing affluence; regionally, large changes in irrigation water demand as a result of climate changes are expected. If nothing is done, both trends will adversely affect livelihoods and exacerbate water-related problems. With growing evidence to the contrary, all governments must begin by re-evaluating the adequacy of their infrastructural facilities as well as their legal, technical, and economic, policy and institutions approaches for water management and water services in the light of predicted impacts of climate change. Adaptation measures to ensure water supply during average and drought conditions can be distinguished as demand-side and supply-side measures. The former improve water-use efficiency, e.g., by new technologies such as drip irrigation, restrictions on use, water conservation campaigns and pricing. Supply-side strategies generally involve increases in storage capacity, abstraction from water courses, and water transfers. Integrated water resources management provides an important framework to achieve adaptation measures across socio-economic, environmental and administrative systems. This article presents a brief introduction on supply and demand management and selected examples.

Sesión 5:

Agua y producción de alimentos

Ponencia 1

Cultivos para la alimentación en un entorno de calentamiento global y de cambios en la disponibilidad de agua

Autor

Marco Bindi

Department of Agriculture and Land Management, University of Florence, Florence, Italy.

Resumen:

Much of food availability in the world depends on rain-fed crops, thus present and future changes in the water cycle (e.g. total amount, annual distribution and intensity of precipitation) may play a fundamental role in global food security. In particular, projecting further changes include increasing in temperature and changes in precipitation, with decreases in some dry regions at mid-latitudes and in the dry tropics (e.g., the Mediterranean basin, western USA, southern Africa and north-eastern Brazil) that may intensify present limited water resources. Moreover, increases in the frequency and severity of heavy precipitation and extreme drought events are expected during the 21st century. Finally, sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of water availability for irrigation in coastal areas. All these projections, together with other external factors (increases in food demand, changes in human diet, etc.) may determine important impacts on food crops productions and the following food availability. This work aim to present a complete overview of the impacts that global warming and changing water availability will have on food crops and the adaptation strategies that may be used to cope with these.

Ponencia 2

Cambio climático y praderas: Consecuencias inesperadas de los patrones de precipitación extrema

Autor

Alan K. Knapp

Colorado State University; Fort Collins, Colorado, USA.

Resumen:

Climatic variability is an inherent feature of grasslands, with large fluctuations in temperatures combined with precipitation regimes characterized by floods and severe drought occurring within and between years. Global climate models and emerging data indicate that extremes in precipitation regimes are increasing worldwide. Thus, variability in temporal patterns of water availability in grasslands, as directly influenced by altered precipitation patterns and indirectly by forecast increases in temperature, will likely increase in the futu-

re. Analyses of long-term relationships between grassland productivity and rainfall patterns coupled with experimental manipulations of precipitation inputs have yielded a number of surprising insights regarding how these grasslands will respond to future more extreme climates. Long-term data and experiments have shown that even in relatively mesic grasslands, water availability limits aboveground productivity in most years. Thus, most grasslands will be sensitive to climate change. Sensitivity can be influenced by dormant season soil moisture conditions as well as by within-season precipitation patterns. Surprisingly, increases in precipitation extremes (larger rainfall events with longer intervening dry periods) during the growing season reduced productivity in mesic grasslands but increased production in semi-arid grasslands. Understanding interactions between rainfall amount and its distribution in grasslands is key to forecasting responses to climate change.

Sesión 6:

Clima, agua, economía y sociedad

Ponencia 1

Las implicaciones económicas de los cambios en la disponibilidad del agua

Autor

Diego J. Rodríguez
The World Bank; Washington, D.C., USA.

Resumen:

While the potential impacts of climate change are broad, some aspects of human society are more sensitive than others. By the same token, some of the adverse effects of climate change may fall disproportionately on poorer parts of the world where adaptation capacity is more limited. Changes in precipitation, combined with rising temperatures and reduced snow cover, will have impacts on water quality and quantity (water availability), requiring water managers to incorporate climate change in their planning and investment decisions. Strategies for adaptation need to be embedded within existing national policy and institutional frameworks. Overall adaptation seems to be facilitated if it coincides with other objectives, and if win-win solutions can be implemented that also have other benefits. Water is a critical core sector so that impacts here have a cascading effect. Economic sectors which are projected to be most affected are agriculture (increased demand for irrigation), energy (reduced hydropower potential and cooling water availability), health (worsened water quality), recreation (water-linked tourism), fisheries and navigation. From the sustainable development perspective, various authors have posed that the top priority for adaptation in the water sector should be to reduce the vulnerabilities of people and societies to shifts in hydro-meteorological trends, increased climate variability, and extreme events. A second priority should be to protect and restore ecosystems that provide critical land and water resources and services. A third should be to close the gap between water supply and demand by enhancing actions which reduce demand. A wide range of strategies are available in the literature to address these priorities, including sharing the losses, preventing the effects, "no regrets" measures, research and education. Economics plays a major role in many of the above mentioned measures and some of the existing preliminary

assessments and potential applications need to be further understood. Understanding the economic principles used to address climate change in water are crucial as the application of economics may help minimize some of the potential effects of changes in temperatures, hence, water availability.

Ponencia 2

Cambio climático, globalización y escasez de agua.

Autor

Karen L. O'Brien¹, Robin M. Leichenko²

¹ Department of Sociology and Human Geography, University of Oslo, Oslo, Norway.

² Department of Geography, Rutgers University, USA.

Resumen:

Much of the world's population is likely to be directly or indirectly affected by climate change-induced water scarcity, which is related to changes in the amount, timing, and distribution of rainfall, in the supply of glacier melt-water, and in the amount, quality and accessibility of surface and groundwater. However, these changes are not the only ones taking place at a global scale. Water marketization and trade, combined with increasing agricultural, urban and industrial demands, are creating new contexts for accessing water, as well as new competition for water resources. In this paper we explore the relationship between climate change, globalization, and water scarcity and consider the implications for human security. Using a "double exposure" framework, we discuss why those who are most likely to be negatively affected by climate change are also most likely to experience the negative outcomes of globalization. Water scarcity in an era of globalization is influenced by water policies as much as it is by changes in physical supply. As the Human Development Report 2006 points out, poverty, power, and inequality are at the heart of water scarcity problems. As the double exposure framework shows, water policy decisions must take into account potential outcomes of both climate change and globalization

Ponencia 3

Cambio climático: Un reto mundial para la gobernanza del agua

Autor

Claudia Pahl-Wostl

Institute of Environmental Systems Research/Department of Mathematics and Computer Science, University of Osnabrück, Osnabrück, Germany.

Resumen:

The 21st century poses extreme challenges for the governance of environmental problems. Climate change and the concomitant increase of extreme events have exposed vulnerabilities of current resource governance regimes. This has provided further arguments for the need to develop flexible and adaptive governance approaches and innovative approaches to deal with risk and uncertainty to implement and guarantee the long-term sustainability of water management. It has also provided strong arguments for the need to

adopt a global and multi-level perspective on water governance issues. Dealing with challenges of climate change requires increasing the adaptive capacity of water governance regimes. Required are robust strategies that perform satisfactorily under a range of initially uncertain but possible future developments. Such strategies can only perform effectively in water management regimes that allow for learning and adapting to new insights. The global dimension of the governance challenge is manifold. Global processes are needed to share and evaluate in a systematic fashion lessons learned to develop a “diagnostic approach” that allows linking specific characteristics of a climate change adaptation problem with appropriate governance approaches towards its solution. Further innovative processes for global governance need to be developed to deal with challenges requiring a global, coordinated response.

23 de julio:

ADAPTACIÓN A LA ESCASEZ DE AGUA Y A LOS CAMBIOS CLIMÁTICOS

Sesión 7:

Adaptación a la escasez de agua: perspectivas generales

Ponencia 1

Implicaciones del cambio climático sobre las sequías y la escasez de agua.

Autor

Luis José Mata
University of Arizona, Tucson, AZ, USA.

Resumen:

Droughts and water scarcity are important issues related both with climate change and sustainability. Water quality deficiency can be a major cause of water scarcity. Water scarcity is also a matter of poverty. There are many regions in the world already experiencing severe droughts and under a water scarcity situation. Climate change will substantially increase the number of people under water scarcity. If climate change implies greater water scarcity in some regions relative to water demand, then, adaptation strategies should include ways that improve water use efficiency and management. Many developed and developing countries have conducted detailed studies on climate change impacts. Several are moving toward implementation of adaptation strategies. Adaptation to climate change should be at the core of the international poverty agenda. The poorest of the world will hardly escape from dangerous climate change. Current approaches to adaptation planning in many countries center on the idea of using a climate-proofing approach. Adaptation to climate change should reduce the risk of damage when taken in advance. There are many factors that contribute to limiting adaptation; those factors influence the adaptive capacity of water management systems. Adaptation and mitigation need to be viewed as complementary responses to climate change. The presentation aims to offer a comprehensive assessment of the current knowledge about the effect of climate change on droughts and

water scarcity in dry regions and also its effects on sustainability. How climate change will impact the already existing problems. Why water scarcity is a climate and sustainable development issue. Impacts of climate change on droughts and adaptation responses and the regional implications of the relation between climate change and droughts.

Ponencia 2

Cambio climático y agua: Adaptación.

Autor

Stewart J. Cohen¹, Roger S. Pulwarty²

¹University of British Columbia, Vancouver, BC Canada.

²National Integrated Drought Information System, NOAA, Boulder Colorado USA

Resumen:

Climate change poses major conceptual challenges to resource managers, in addition to the challenges caused by population and land use change. As is widely acknowledged, it is no longer appropriate to assume that past hydrological conditions will continue into the future. The robustness of present water resources adaptations will be tested under a changing climate. Climate information services designed to support adaptation will be important in coping with current and future climate extremes and their effects on water resources. Useful information may be available, and can produce positive results, but its effective use for adaptation can be overwhelmed by rates and magnitudes of social, economic and environmental changes. Future adaptations may include technical changes that improve water use efficiency, demand management (e.g. through metering and pricing), and institutional changes that improve the tradability of water rights. However, the availability of water for each type of use may be affected by other competing uses of the resource. Consequently a complete analysis of the effects of climate change on human water uses would consider cross-sector interactions, including the impacts of changes in water use efficiency and intentional transfers of the use of water from one sector to another. The barriers to implementing adaptation measures include the inability of some natural systems to adapt at the rate of combined demographic pressures and climate, incomplete understanding and quantifying of water demands, and impediments to the flow of timely and reliable knowledge and information relevant for decision makers. In this paper we review demand side and supply side adaptations being recommended in the water resources sector. Many of these are technology and efficiency based. Priorities for early warning information on management thresholds, as well as decision support tools across climate timescales, from extremes through changes in averages, should include a mixed portfolio of experimental and scenario-based approaches for securing shared lessons, i.e. an integrated watershed management approach in which adaptive management is an operational tool for learning.

Sesión 8:

Adaptación a la escasez de agua en los países menos favorecidos

Ponencia 1

La adaptación al cambio climático en África occidental

Autor

Nick van de Giesen¹, Winston Andah², Marc Andreini³, Boubacar Barry³, Gerlinde Jung⁴, Harald Kunstmann⁴, Wolfram Laube⁵, Jens Liebe⁵

¹ Faculty of Civil Engineering and Geosciences, Delft University of Technology, Netherlands.

² Water Resources Institute/Challenge Program Water for Food, Ghana.

³ International Water Management Institute.

⁴ Institute for Meteorology and Climate Research (IMK-IFU).

⁵ Center for Development Studies (ZEF), Germany.

Resumen:

Impacts of climate change vary from region to region. The 4th Assessment Report of the IPCC mentions that drier areas will be affected by more droughts and that the rainfall regime, in general, will become "rougher". In West Africa, specifically the area below the Sahel, the climate change signal may be more subtle. Anecdotal evidence from farmers suggest that the onset of the rainy season has been shifting forward in time over the past two generations. Recently, detailed atmospheric modeling over the region shows that also in the near future, the onset of the rainy season will shift to later in the year, roughly from April towards May. The end of the rainy season as well as the total amount of rainfall will remain more or less fixed. This implies that adaptation strategies should be twofold. The first part of a comprehensive adaptation strategy would be a continuation of the efforts to produce faster growing rainfed crop cultivars, mainly corn and sorghum. The second part would consist of increased water storage during the wet season for use in the dry season. River runoff in West Africa is very sensitive to the rainfall distribution. When the same amount of rain falls within a shorter period, as is suggested by climate projections, runoff will show an important increase. Also the recharge of groundwater will improve under these circumstances. Storage of surface runoff in small reservoirs would be an important part of climate change adaptation. Extensive use of (shallow) groundwater in the dry season could be a second, highly complimentary adaptation strategy. The development of large dams would probably be less successful given the flatness of the landscape and the move towards decentralized development in most West African countries. Shortening of the rainy season will reduce rainfed agriculture, which is the dominant mode of food production in the region. Use of surface and groundwater in the dry season may partially offset this negative effect. Success of any of these adaptation strategies will to a large extent depend on institutional and socio-economic developments within the region.

Ponencia 2

Los recursos hídricos en Oriente Medio y Norte de África

Autor

N. Vijay Jagannathan

Middle East and North Africa Region, World Bank; Washington, D.C., USA.

Resumen:

Water resource management faces critical obstacles in the Middle East and North Africa (MENA) particularly given the impending impacts of regional climate change and global warming. Annual renewable water resources per capita are some of the lowest in the world with most available surface and groundwater sources already mobilized. In addition, growing populations, inefficient infrastructures and an almost certain reduction in future precipitation patterns all further exacerbate the quality and quantity of water made available to both urban and rural users. This presentation recommends several steps to be taken to alleviate water shortage in the MENA region for the near and longer-term future. These include optimization of water consumption, enforcement of better water policies, engagement with non-water sectors and improvement of public accountability. Several steps can be taken by MENA nations to initialize impactful and sustainable change in the water sector. Besides the engineering amelioration of water and wastewater collection, distribution and treatment networks, these steps include accelerating the pace of reform by involving non-water sectors (media, academia, policy etc), finding opportunities in changing the political economy, and turning promise into reality by enforcing better public accountability.

Ponencia 3

La gestión de la escasez de agua en los países Latinoamericanos

Autor

Seraphine Marie Haeussling

Latin America and Caribbean Region, World Bank, Washington D.C., USA.

Resumen:

Glacier retreat in the Andes places in doubt the sustainability of current patterns of water use and ultimately the viability of the economies and ecologies of glaciated basins, and may also have wider impacts on the entire Andes region. The changes induced by tropical glacier retreat constitute an early case of the need for adaptation and therefore an example of the type and size of associated economic and social impacts caused by climate change. As an example, the retreat of the Tuni-Condoriri glacier is one with the most dramatic likely consequences of global warming. It has lost 56 percent of its surface in 50 years, with most of the loss concentrated during the last decade, and is now projected to completely disappear by 2045. This retreat will burden water management and supply in the area of influence of the basin (which includes the cities of La Paz and El Alto, where 21 percent of the population of Bolivia lives) caused by the loss of the water regulatory capacity provided by the glacier. This likely outcome requires the identification and planning of alternative adaptation measures to avert what could become a serious crisis. Three additional cases are presented exemplifying the climate change vulnerabilities faced in Latin America countries associated with water scarcity: coastal wetlands in Mexico, potential

of salinization of aquifers in the Caribbean, Paramos in Colombia. In each case the basis for the vulnerability assessment is introduced; adaptation options are identified, and the countries selection presented. Lessons from these case studies are discussed.

Sesión 9:

Adaptación al cambio: el foco regional

Ponencia 1

La adaptación a la escasez de agua en Europa

Autor

Wolfram Mauser, Tobias Hank

Department for Geography, Ludwig-Maximilians University (LMU), Munich, Germany.

Resumen:

According to IPCC projections Europe will experience considerable changes in rainfall amounts and distribution during this century. This would lead to an increased polarisation of water availability between the north, where rainfall amounts are expected to increase and the South, where they may sharply decrease. Large scale implications of this possible development on water scarcity in Europe will be discussed. Results from a coupled regional climate impact model, which simulates the reaction of the water regime of the mountainous Upper Danube river basin in the expected climate change, demonstrates as a case study, that a complete change in the hydrologic regime of Central and Southern European mountain water resources is likely. The consequences, more severe low-flow conditions, sharply decreased snow storage, reduced hydropower potential and spread of demand for irrigation, are demonstrated. Possible ways to adapt by changing the operational mode of existing reservoir structures are discussed.

Ponencia 2

Ser miembro de la UE y adaptarse al cambio: el caso del sudeste de Europa

Autor

Ron N. Hoffer

Europe and Central Asia Region, World Bank, Washington DC, USA.

Resumen:

Countries in Southeastern Europe that are new members, candidates or potential candidates for accession to the European Union face necessary but costly investments to meet EU environmental standards over the coming decades. Investment plans will also need to reflect the emerging understanding of climate science. Southeastern Europe is expected to be one of the most negatively impacted by climate change in the Eurasian continent

even in the first half of this century. Temperature increases, shortages of precipitation and more frequent intense rains will present challenges and new approaches to understand and adapt to these changes are required. Partnerships amongst countries, international institutions and stakeholders will be necessary to understand and respond in a manner that balances risks and uncertainties. Advances in disaster risk reduction and management can provide both short and longer term benefits as climate knowledge is refined.

Ponencia 3

Impactos previstos del cambio climático sobre los recursos hídricos en España.

Autor

Juan Manuel Ruiz

Centro de Estudios Hidrográficos (CEDEX), Ministerio de Medio Ambiente - Ministerio de Fomento, Madrid, Spain.

Resumen:

Los diferentes escenarios de cambio climático poseen un indudable impacto sobre los recursos hídricos de nuestro país. Para evaluar su magnitud bastaría, en una primera aproximación, con utilizar los modelos convencionales de evaluación de recursos hídricos introduciendo como variable de entrada los nuevos valores climáticos, sobre todo a nivel de precipitaciones y temperaturas. Esta evaluación se está realizando actualmente en el CEDEX con el modelo SIMPA utilizando los escenarios confeccionados por la AEMET. Asimismo, se está evaluando la influencia que el cambio climático puede tener sobre las demandas de agua, fundamentalmente en la agricultura, con el objetivo de estudiar cómo los sistemas de gestión del agua, como balance entre recurso y demanda, se comportarían ante los diferentes escenarios. Las decisiones futuras sobre planificación y gestión del recurso hídrico deberán adoptarse según la vulnerabilidad de las cuencas hidrográficas españolas ante los diferentes escenarios climáticos, y los estudios que se presentan por parte del CEDEX van en esta dirección, en la de informar a la Dirección General del Agua y al Consejo Nacional del Clima sobre la fragilidad del sistema de gestión del agua y la mejor estrategia de adaptación.

Ponencia 4

La adaptación en España a los efectos del cambio climático sobre los recursos hídricos

Autor

Teodoro Estrela Monreal

Subdirección General de Planificación y Uso Sostenible del Agua, Dirección General del Agua, Ministerio de Medio Ambiente, Medio Rural y Marino, Madrid, Spain.

Resumen:

Los recursos hídricos representan un asunto estratégico en España para el desarrollo económico social y ambiental, y se prevé que el Cambio Climático los modifique en cantidad y calidad. Según los escenarios previstos para el país, y la evaluación preliminar, algunos de los efectos ligados al agua incluirán el aumento de la frecuencia y severidad de las sequías hidrológicas, la disminución general de los recursos hídricos, la reducción en aportaciones de hasta el 50% en las regiones áridas y semiáridas (30% de la superficie nacional), el aumento de la frecuencia y severidad de las crecidas, la disminución de la calidad del recurso, o la disminución de niveles piezométricos en los acuíferos con la consecuente intrusión salina asociada. Por todo ello, es necesario considerar el Cambio Climático en la planificación de distintos sectores, por lo que se está desarrollando un Plan Nacional de Adaptación al Cambio Climático. Este Plan establece el marco general de referencia para evaluación de sus impactos, vulnerabilidad y adaptación y trata de cumplir con los compromisos adquiridos por el país ante Naciones Unidas y la Unión Europea. En concreto, dentro de la Planificación Hidrológica, las principales líneas de acción que se han establecido dentro del Plan, se centran en los recursos hídricos en régimen natural, las demandas de agua (riego, abastecimiento urbano e industria), los sistemas de explotación de los recursos, y el estado ecológico de las masas de agua. Estos estudios, más avanzados en las tres primeras líneas, se están desarrollando desde la Dirección General del Agua del Ministerio de Medio Ambiente, y Medio Rural y Marino, con apoyo del Centro de Estudios Hidrográficos del CEDEX. Para el desarrollo de los estudios se están utilizando modelos de simulación, anuales y mensuales, que analizan diferentes variables hidrológicas utilizando además series históricas disponibles. Estos trabajos, están respaldados por instrumentos normativos como son el Real Decreto del Reglamento de Planificación Hidrológica (RD 907/2007) y la Instrucción Técnica asociada (actualmente en trámite). El Decreto establece que los planes hidrológicos de cuenca evaluarán el posible efecto del cambio climático sobre los recursos hídricos naturales de las demarcaciones, y sobre el balance entre los recursos disponibles y las demandas previsibles correspondientes a los diferentes usos. Asimismo, se tendrán en cuenta los posibles impactos en el seguimiento del régimen de caudales ecológicos y de su relación con los ecosistemas acuáticos. En conclusión, los estudios en desarrollo permitirán integrar los posibles impactos por el Cambio Climático en la planificación hidrológica, adaptando consecuentemente las medidas de gestión en los planes de cuenca.