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Eighteenth meeting

15 to 19 May 2017
(United Nations Headquarters)

Panel discussion
"The effects of climate change on oceans"

Biographies and abstracts of panellists

Segment 1
Monday, 15 May
3 – 6 pm

The effects of climate change on oceans, including environmental, social and economic implications

Ms. Ko Barrett
Vice-Chair of the Intergovernmental Panel on Climate Change

Bio

Ms. Ko Barrett was elected to serve as vice chair of the United Nations Intergovernmental Panel on Climate Change (IPCC) in 2015. She is one of the first women elected to serve in this position. For over 15 years, Ms. Barrett has represented the United States on delegations charged with negotiating and adopting scientific assessments undertaken by the IPCC, the international body created to review and assess the most recent scientific, technical, and socio-economic information produced worldwide that is relevant to understanding climate change. She has also served for over a decade as a lead negotiator for the United States on the United Nations treaty on climate change. She is widely recognized as an expert on climate policy, particularly on issues related to climate impacts and strategies to help society adapt to a changing world. She was part of the IPCC community that was awarded the Nobel Peace Prize in 2007.

Ms. Barrett is also the Deputy Assistant Administrator for Research at the National Oceanic and Atmospheric Administration (NOAA). In this leadership position, Ms. Barrett supervises daily operations and administration of NOAA's research enterprise, and the execution of NOAA programs on climate, ocean acidification, weather and air quality, ocean exploration and the National Sea Grant College Program. Ms. Barrett comes to this position from seven years of serving as Deputy Director of NOAA's Climate Program Office, which oversees and coordinates climate activities across NOAA, addressing climate observations and monitoring, research and modeling, and the development and delivery of climate services.

Abstract

"Overview of the problem, with a focus on the findings of the IPCC Fifth Assessment Report and preparations of a special report on climate change and oceans and the cryosphere".

Abstract for Segment 1: The effects of climate change on oceans, including environmental, social and economic implications.

Findings from the IPCC Fifth Assessment Report and Preparations for the Sixth Assessment.

The IPCC's last report, the Fifth Assessment Report or AR5, completed in 2014, was a major contribution to our growing understanding of climate change and to the Paris Agreement. What science tells us is clear, especially when it comes to the effects of climate change on oceans. AR5 documented that land and ocean temperatures are increasing, sea level is rising, oceans are acidifying, and ice cover is shrinking as greenhouse gas concentrations and emissions climb. The impacts of these changes in our oceans are projected to directly impact fisheries throughout the world and threaten the viability of coastal cities and entire island nations. AR5 also points to gaps in our knowledge, which include assessing the risks of reduced habitats of marine fish and shellfish and the impacts of long-term sea-level rise beyond 2100. The Sixth Assessment Report or AR6, and three special reports to be undertaken during that cycle will help address these gaps. One of these special reports will specifically address oceans and cryosphere in a changing climate and is expected to be completed in 2019. Emphases on high mountain areas, polar regions, sea level rise, marine ecosystems, and extremes will be assessed in this special report. The main AR6 assessment comprises three reports from each of the IPCC's working groups, plus

a Synthesis Report, will be delivered in early 2022 in time for the first global stocktake under the Paris Agreement in 2023.

Ms. Françoise Gaill
Committee for Marine and Coastal Research (France) / Centre Nationnal de la Recherche Scientifique (CNRS)
Bio
Ms. F. Gaill has been involved in the field of marine biology with a specific interest in the thermal adaptation of deep-sea animals. After a PhD at the Museum national d'Histoire naturelle on the taxonomy and biology of Tunicates, she decided to work on liquid crystals and its biological analogs at the CNRS center for cell biology.

After the discovery of hydrothermal vents, she returned to the study of deep-sea animals by integrating the Roscoff biological station. She was involved in the study of biopolymers from vent and cold seep tube worms in the nineties, and then created a research group, AMEX, dedicated to adaptation and evolution of symbiotic organisms from deep sea ecosystems. Molecular adaptation, stress response, development and evolution of symbiosis were the main aspects studied on worms and bivalves.

Ms. F. Gaill has developed specific tools for supramolecular analysis of marine organisms with the help of cryoelectron microscopy. Her team has conceived new high-pressure equipment for in vivo studies on deep-sea organisms with expertise in molecular detection and imagery of invertebrate larvae and symbionts. The invitation to create an Electron microscopy center in Paris was the opportunity for participating in the Developmental Biology laboratory of Jussieu (Sorbonne University) and then to the creation of a new Research Unit focused on marine biodiversity studies.

This scientist has organized national and international hydrothermal vent cruises using submersibles. She has a solid knowledge of the US and French submersibles such as Alvin, Nautile and ROV Victor6000. She has been involved in the coordination of the deep-sea research community at the international level with InterRidge and Census of marine life or with the European Science Foundation. This scientist has more than 150 publications and several patents.

This researcher was in charge of CNRS foreign affairs at the department of life sciences before becoming chair of the department of environment and sustainable development, then in charge of the CNRS Institute of Ecology and Environment following that. The objective of this institute, called INEE, was to promote and coordinate top-level fundamental research in global ecology conducted by research units in the fields of ecology and environment, including biodiversity and human-environment interactions. Such an institute comprises about 80 research units associated with 25 French universities and other national research organisms. She was also Vice President of the Alliance Allenvi, a national research consortium dedicated to environmental sciences, and is now scientific advisor for the CNRS INEE.

Ms. Françoise Gaill has held positions on several boards of national and international research organisations. She has been at the head of the "Grenelle de la mer" in charge of research and innovation, and of the scientific and strategic committee of the large scale infrastructure, FOF (French Oceanographic Fleet). She is chair of the national committee for marine and coastal research (COMER) and is vice chair of the National Agency for Biodiversity (AFB). She is also a member of the steering committees of diverse companies, foundations or institutions involved in biodiversity and marine activities (Total, Veolia foundation, IFM, Tara expeditions, MNHN,…). She is vice chair of the IOC French delegation (intergovernmental Oceanographic Committee) of UNESCO, and coordinator of the scientific committee of the Ocean Climate Platform. She was

involved in the first United Nations Word Ocean Assessment and in the SDG UN reports, especially goal 14 dedicated to the oceans. She is also a member of the BBNJ French delegation. This scientist is “commandeur” for the National Order of Légion d’Honneur and “Mérite”.

Abstract

"Ecosystem services and climate change, including thermal adaptation".
CNRS & Ocean and Climate Platform

Ecosystem services are the benefits provided by nature which contribute to human well-being. These benefits can range from tangible products, such as food and fresh water, to cultural services such as recreation and aesthetics. The Millennium Ecosystem Assessment (MEA) defines an ecosystem as ‘a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit” and goes on to define ecosystem services as “the benefits that humans obtain from ecosystems” . Four types of ecosystem services were identified in the MEA : provisioning, regulating, supporting and cultural services. We will illustrate the way in which climate change may impact those ecosystem services, and will raise awareness on the question of tipping points and resilience. Mangroves are ecosystems providing a diversity of services we will present. Their location has recently evolved with climate change and especially thermal variation. At least thermal adaptation process will be considered in marine species including deep sea ones.

Mr. Fangli Qiao
First Institute of Oceanography, State Oceanic Administration, Qingdao 266061, P R China
Government Secretary General and Deputy Director General, First Institute of Oceanography (FIO), State Oceanic Administration (SOA) of China

Bio

Dr. Qiao is chair professor of Physical oceanography at the First Institute of Oceanography, State Oceanic Administration of China. He has been an ocean and climate numerical modeler since 1991. For the first time, he clarified the crucial importance of non-breaking surface waves in large-scale circulation and climate system through ocean vertical mixing, which is used as the theoretical base for ocean model improvement. The theory has been confirmed by laboratory experiment and field observations, and applied by different research groups of US, UK, Germany, France, Sweden, Australia, Hungary etc. The wave-induced vertical mixing theory can correct the systematic errors of ocean circulation models in the upper ocean, under-predicting surface mixed layer depth and over-predicting sea surface temperature, particularly during the summer. These improvements are also important for climate system and marine ecosystem. He develop the first ocean and climate models with surface wave. Due to Dr. Qiao’s excellence in research, he has received numerous awards, including 2016 ACM Gordon Bell Prize Finalist, Wooster Award of PICES, and Outstanding Scientist of IOC/WESTPAC etc. He has been founder director of the UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate since 2011, and now served as vice chair of IOC/WESTPAC. He has more than 260 publications on peer-review scientific journals.

Abstract

“Climate projections and predictions: Challenges and possible solutions”

Oceans, have absorbed more than 90% heat content due to climate change, play crucial important role in the protection of the earth system. For climate change mitigation and adaptation, both long-term projections and short-term predictions are the scientific backbones. However, we have been facing great challenge in developing climate models in the past several decades, as a result, climate models show common problems such as tropical biases. One vital reason should be that we can not simulate accurately the thermal structure in the upper ocean. Recently, we find a solution to greatly improve climate models through revealing that the small-scale surface wave, which has been omitted in climate system, plays dominant role in the vertical distribution of heat in the upper ocean. In other words, the ability on climate projection

and prediction can be much improved. Amazingly, as a member of CMIP5 climate models and the only one including surface wave, our model shows that the arctic will not be ice-free in summer in this century except under RCP85, which is totally different with all other climate models. All above suggest that climate change estimations based on climate models still have large uncertainty, and the omitted surface wave in climate system should be a low lying fruit.

<u>Mr. Francisco Armando Arias Isaza</u>

Bio

Mr. Francisco Armando Arias Isaza is Director General Instituto de Investigaciones Marina y Costeras INVEMAR in Colombia.

Abstract

"The effects of climate change on the coasts of a highly vulnerable and mega-diverse country: The case of Colombia"

Colombia ha recorrido una larga singladura enfrentando los efectos del cambio climático sobre sus costas y áreas marinas. Siendo el único país sudamericano con costas sobre el Océano Pacífico y el Mar Caribe hereda de ese privilegio de la naturaleza la complejidad de una variedad de paisajes, ecosistemas y variabilidad climática que se refleja no solamente en una enorme biodiversidad concentrada sino también en diferentes modos de vida de las poblaciones costeras que dependen directamente de los bienes y servicios ambientales proveídos por la generosidad de la naturaleza.

En este contexto hemos desarrollado varias estrategias encaminadas a orientar nuestros esfuerzos para enfrentar los efectos del cambio climático que podríamos resumir en cinco grandes frentes:

1. Entender la expresión del fenómeno sobre nuestras costas y mares – DIAGNÓSTICO
2. Desarrollar estrategias para responder al cambio climático en las costas – PLANIFICACIÓN
3. Poner al servicio de la sociedad la información para tomar buenas decisiones – SISTEMAS DE SOPORTE DE DECISIONES
4. Empoderar a las comunidades para enfrentar el cambio climático – PROYECTOS CON COMUNIDADES LOCALES
5. Hacer seguimiento a la evolución e impactos en las costas y mares – INVESTIGACIÓN Y MONITOREO CIENTÍFICO.

1. DIAGNOSTICO:

A partir de 1999 iniciamos la construcción de un diagnóstico de los efectos potenciales del cambio climático sobre las costas colombianas, el reto principal se situaba en el campo de generar las capacidades nacionales para iniciar un proceso de producción de conocimiento donde no teníamos gran experiencia, otros retos estaban en la existencia de unas costas biogeofísica y socialmente complejas, sujetas bajo una fuerte presión por nuevos desarrollos económicos, áreas de difícil acceso (y por ende bien conservadas) y por que no decirlo, bajo los efectos del conflicto armado que ha azotado a nuestro país por décadas.

Los resultados de nuestro esfuerzo inicialmente se enfocaron en hacer una caracterización de gran escala de la totalidad de las costas colombianas (Caribe, Archipiélago de San Andrés Providencia y Santa Catalina y Pacífico) a la luz de los efectos potenciales del aumento del nivel del mar (ANM) y su impacto sobre los ecosistemas costeros y sobre las poblaciones humanas presentes en nuestras costas.

Los resultados mostraron la gran vulnerabilidad de las costas colombianas al ANM en especial sobre la destrucción de hábitats y pérdida de biodiversidad, la inundación de extensas zonas incluyendo las urbanas y la pérdida de fuentes de agua dulce. Nuestros estudios y las proyecciones sobre los potenciales efectos calculados sobre los parámetros del IPCC mostraron que la costa del Pacífico podría llegar a inundarse en una extensión de 6.400 km2 afectando a una población de alrededor de 21.000 habitantes, el 28% de la región mientras que la Costa del Caribe, incluyendo el Archipiélago de San Andrés Providencia y Santa Catalina la inundación cubriría una extensión de 4900 Km2 afectando 590.000 habitantes el 72% del total de la población. Más allá nuestros estudios avanzaron en calcular los efectos económicos que tales efectos ocasionarían sobre la pérdida de infraestructura, a la industria, a la disminución de áreas productivas de las actividades agropecuarias, el turismo, la pesca e inclusive a pérdida de valores culturales únicos. Nuestros cálculos advierten que en un escenario "optimista" para el año 2100 el efecto del ANM sobre el PIB nacional podría costar entre 0,1 y 0,5% mientras que en el escenario "pesimista" el costo podría variar entre 0,4% y 3,0% del PIB.

Uno de los hallazgos más importantes tiene que ver con el rol que juega en la valoración de la vulnerabilidad la ausencia de información y la poca capacidad institucional para enfrentar el cambio climático. En el primer caso, la ausencia de conocimiento científico marca la alta incertidumbre para saber QUÉ enfrentar de los efectos del cambio climático y en el segundo, la dificultad de la sociedad en su conjunto (el sector público, el privado y las comunidades) para organizarse y determinar CÓMO enfrentar el cambio climático son determinantes para aumentar la vulnerabilidad y así de qué manera responder y qué medidas de adaptación adoptar.

Hemos estado mejorando el diagnóstico nacional identificando y trabajando las zonas más críticas y mejorando la escala espacio-temporal de análisis y ampliado la cobertura a otros fenómenos como los cambios en la ocurrencia e intensidad de eventos climáticos sobre las costas (huracanes, aumento y/o disminución en las intensidades de las lluvias, etc.), la erosión costera y la acidificación del océano, principalmente.

Pero también hemos progresado en la identificación de ecosistemas saludables y resilientes capaces de servir de amortiguadores de los efectos del cambio climático y encontrando también la oportunidad de nuevas formas de enfrentar el cambio climático que contribuya en la protección del medio marino y sobre todo que tengan un efecto sobre el bienestar de las comunidades costeras.

2. PLANIFICACION

Como resultado del diagnóstico nacional sobre la vulnerabilidad al cambio climático se inició un proceso para planear la manera de afrontar los efectos que se identifican en los estudios. Se abordaron dos frentes de trabajo, el primero desde lo nacional (Departamento Nacional de Planeación) y el segundo a nivel de las unidades administrativas locales (municipios, distritos especiales) o especializadas (Corporaciones Ambientales, Parques Nacionales Naturales).

En el primer caso se establecieron diferentes instrumentos de planificación iniciando con una herramienta que en el caso de Colombia se denomina CONPES que son documentos orientadores de política gubernamental del mas alto nivel y asignación de recursos para acciones especificas para enfrentar el cambio climático. De manera complementaria se logró que en los Planes de Desarrollo de cada gobierno se dedique un capítulo específico sobre los temas marinos donde se incluyen metas relacionadas con adaptación al cambio climático en las costas nacionales.

A nivel local, con la identificación de las áreas prioritarias en función de su vulnerabilidad se inició un trabajo con las alcaldías locales a fin de incorporar dentro de las herramientas de

planificación, denominadas planes de ordenamiento territorial o POT, acciones conducentes a reducir los riesgos climáticos, a preparar acciones de respuesta y lo más importante a definir territorios "adaptados o adaptables" al cambio climático. Adicionalmente se trabajó en la concepción de que una ciudad costera que se prepara oportunamente para los impactos del cambio climático es una ciudad con mayor potencial económico y menor propensión a los desastres naturales. De especial importancia es el piloto que adelantamos con la ciudad de Cartagena de Indias, escogida por la cantidad de valores en riesgo (económicos, culturales, etc.), su complejidad social (mas rica y mas pobre del país) y su reconocimiento a nivel internacional. Hoy Cartagena cuenta con un plan de adaptación al cambio climático que es referente nacional y en la región como proceso de respuesta a su vulnerabilidad y el cual fue adoptado por el Concejo de la ciudad asegurando que tenga continuidad en el tiempo más allá de la administración que lo propuso y asegura que tenga recursos y herramientas para financiarse.

Otros frentes abordados desde lo ambiental con la definición de unidades de planificación ambiental definiendo áreas que se han denominado unidades ambientales costeras UAC, que son zonas del territorio costero que conjugan características ambientales, sociales y político-administrativas homogéneas que les brindan características únicas que deben responder a un plan coordinado de ordenamiento, el cual se implanta bajo la concepción de manejo integrado de zonas costeras (MIZC) en los llamados POMIUAC que son los planes de ordenamiento ambiental de las UAC.

Finalmente, como parte de nuestros compromisos internacionales nos enfocamos en dar cumplimiento a las metas de Aichi y las contenidas en la SDG 14 en el sentido de dar protección de AL MENOS el 10% de nuestras aguas marinas en alguna forma de conservación. Más allá de declarar un numero de kilómetros cuadrados decidimos la creación de un Subsistema de Áreas Marinas Protegidas (SAMP) que abordara cuatro aspectos clave: el establecimiento legalmente vinculante del subsistema como área temática del sistema de áreas protegidas de Colombia; el establecimiento de una estrategia de sostenibilidad financiera, la creación de capacidades nacionales y locales para administrar las áreas marinas protegidas y finalmente, la divulgación de la existencia y la apropiación social del SAMP. Hoy Colombia está a un paso de cumplir las metas de Aichi al 2019 con casi 8,9 millones de hectáreas declaradas en diferentes formas de conservación de las cuales se debe resaltar nuevas con las comunidades locales como agentes de conservación.

3. SISTEMAS DE SOPORTE DE DECISIONES

Uno de los problemas más graves que ha tenido el cambio climático ha sido la incapacidad de la ciencia para convencer e influir las decisiones políticas para responder con acciones efectivas para afrontar el cambio climático, en mi país todavía hay escépticos que lo niegan.

Uno de los grandes retos esta en poner a conversar a los científicos y a la sociedad en el lenguaje y los tiempos apropiados para que actúen coordinadamente en especial para los tomadores de decisiones, tanto políticos pero también los privados.

Hemos estado en la tarea de producir herramientas de divulgación de conocimiento para que esté disponible para quienes necesitan información clara y oportuna, en especial nos hemos enfocado en el montaje de sistemas de soporte de decisiones basados en la información disponible y con herramientas informáticas como SIG, sensores remotos, sistemas inteligentes de integración de datos y aplicaciones en redes sociales que parece ser una de las formas más prácticas que tenemos disponibles en este momento.

4. PROYECTOS CON COMUNIDADES LOCALES Y OTROS ACTORES SOCIALES

Estamos convencidos que en un país como Colombia donde la mayoría de las comunidades costeras corresponden a grupos sociales pobres que dependen fuertemente de los bienes y servicios ambientales que ofrecen los ecosistemas, la incidencia del cambio climático representa una grave amenaza para su supervivencia. Actividades económicas como la pesca artesanal, la obtención de recursos de los bosques costeros, como madera para construcción o combustible, la protección a la erosión y otros recursos críticos, están seriamente amenazados.

Sin embargo consideramos que esta situación de vulnerabilidad puede y debe revertirse con el diseño e implementación de estrategias de conservación que produzcan beneficios ambientales que contribuyan a la disminución y mitigación del cambio climático pero que también representen beneficios económicos a las comunidades que se involucren en ellos.

Se han diseñado proyectos piloto encaminados a la protección de áreas de manglar para que actúen como sumideros de carbono, involucrando a las comunidades en esquemas REDD derivando beneficios ambientales y económicos y la búsqueda e implantación de actividades productivas alternativas como turismo ecológico, entre otros.

Por otra parte con las empresas privadas hemos avanzado en la definición de acciones encaminadas a reorientar actividades económicas que sean amigables con el medio ambiente marino y que representen modos de adaptación y transformación productiva. Con el sector portuario concertamos proyectos de adaptación para todos grandes puertos del país, esta en marcha actualmente y promete contar con un sector portuario adaptado al cambio climático para el 2030. Otros frentes de trabajo con la industria están en revisión y esperamos se concreten en el futuro cercano, en especial con el sector turístico y el de hidrocarburos.

5. INVESTIGACION Y MONITOREO CIENTIFICO

Un aspecto crítico es hacer el seguimiento a las acciones del país frente al cambio climático. En lo que tiene que ver con el trabajo de un instituto como INVEMAR nos hemos enfocado en el diseño de proyectos científicos en diferentes campos de las ciencias del mar y en mejorar las capacidades de análisis pero muy especialmente en el montaje de redes de monitoreo y colecta de datos para observar tendencias e identificar nuevos problemas derivados del cambio climático en las costas. También en la necesidad de incorporar otras disciplinas de las ciencias sociales para trabajar en conjunto con las ciencias naturales para generar propuestas encaminadas a mejorar la capacidad de respuesta de la nación y en la implementación de medidas de adaptación y nuestra contribución a la mitigación del cambio climático.

CONCLUSIONES

- ✓ Bajar la escala de colecta de datos, mejorar la cobertura

Scale of the data - Downscaling. Increase “meteocean stations”.

- ✓ Desarrollar escenarios específicos para ANM, Temperatura Superficial, Acidificación

Para areas en particular
Develop specific scenarios for SLR, SST, pH, etc. in detail for key coastal areas.

- ✓ Establecer una red de ecosistemas sentinelas que den alarmas de peligro

Establish a “sentinel-ecosystems” network-strategy

- ✓ Aumentar la investigación sobre "Carbón Azul", por ejemplo ecosistemas olvidados como las paraderas de fanerógamas marinas que juegan un papel clave en la mitigación del cambio climático

"Blue carbon" research is urgent in systems like seagrasses (ex. 4,200 and 8,400 million tons of carbon just one meter deep - 8,400 million CO2 is what all human beings emit over a year).

- ✓ Aumentar la investigación en acidificación, ciclos biogeoquimicos en determinados sistemas.

Acidification research must be a priority. Biogeochemical processes high influence in biodiversity stability (ex. Corals, hard shelled organisms).

- ✓ Describir los patrones y tendencias de los patrones de deterioro de los ecosistemas

Describe deterioration patterns of ecosystems (Coral reef, Mangroves, Dunes, Beaches), fish communities, and landuse in relation with climate change impacts.

- ✓ Mejorar las capacidades de monitoreo y análisis de los ecosistemas marinos

Improve capabilities for monitoring and analysis on coastal and marine ecosystems at local level (Caribbean and Pacific particularities).

- ✓ Desarrollar acciones acciones novedosas que incluya a las comunidades locales

Develop new applications to include local population (ex."smart devices" in order to exchange data in real time)

- ✓ Implantar modelos integrales de planificación con mirada de largo plazo y acciones de corto plazo, en especial con temas urgentes como disminución de pobreza.

Sectoral vs Integrated Planning and Long Term Planning

- ✓ Integración de los tomadores de decisiones con los científicos y las comunidades

Integration between decission makers – scientists - local comunities

- ✓ Propender por análisis costo beneficio de inversiones vs. Sostenibilidad. Migrar hacia conceptos de adaptación basada en ecosistemas

Investments vs. Sustainablity: not only "hard engineering"

ECOSYSTEM-BASED ADAPTATION is the option for developing countries!

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Bio

Ms. Briones received her education from the following institutions :
Universidad Nacional Autónoma de México
Instituto de Ciencias del Mar y Limnología
Unidad Académica Ecología y Biodiversidad Acuática
A.P. 70-305 Ciudad Universitaria 04510 México

She was awarded a PhD in Biological Oceanography with honors, Gabino Barreda recognition UACPyP CCH, UNAM in 1987, the MS Biological Oceanography and Fisheries with honors UACPyP CCH, UNAM in 1984 and a BS Biology Universidad Autónoma Metropolitana, Iztapalapa in 1981 .

Her appointments include the following:
2011-2015 and 2015-2019 : Director, ICML UNAM
1993-1998 Associate Professor (Investigador Titular A, T.C.). Tenured ICML, UNAM-CU

1998-2006 Full Professor (Investigador Titular B, T.C.,). Tenured ICML, UNAM-CU
2006 Full Professor (Investigador Titular C, T.C.). Tenured ICML, UNAM-CU
1989-1991 Research Associate (Investigador Asociado C, T.C.), ICML, UNAM-CU
1999-2008 Head of Department Ocean and Coastal Systems ICML, UNAM-CU
1998- Undergraduate teacher, School of Sciences, UNAM
1991-1993 Postdoctoral fellow Texas A & M, Dept. Oceanography Prof. Gilbert T. Rowe
1987-1998 Associate teacher (Profesor Asociado A), School of Sciences, UNAM
1984-1987 Teacher Assistant, Graduate Program in Marine Sciences and Limnology UNAM

Positions held include: Thesis director for 35 undergraduate students, 24 MSc. Students, and 3PhD students; Member of tutorial committees; teacher of Graduate Program in Aquatic Ecology, Ecology of Sediments; and the Undergraduate Program in Aquatic Ecosystems. Additionally, she was involved in several synergistic activities as Deep Sea Ocean Stewardship Initiative leader, Deep Sea benthic ecology and conservation advisor, Mexican LTER President and ISA's LTC member.

Abstract

"Climate Change in Ocean systems in Mexico: Current records, challenges and opportunities"

This text synthesizes what is known on the effects of climate change on oceans, including environmental and some social and economic implications. It lists some of the challenges and opportunities recognized for the coming decades.

Mexico and its oceans - Oceans surround Mexico. On the west it borders with the Eastern Tropical Pacific Ocean (ETP), an active margin, on the east with the Gulf of Mexico and Caribbean Sea, interconnected marginal seas with a passive margin, from the western tropical Atlantic Ocean. The diversity of atmospheric and oceanic phenomena that affect weather and climate in Mexico is ample and the variability of these phenomena include a wide range of spatial and time scales that need to be considered when assessing the climate change in ocean systems.

The national sectorial programs addressing climate change in ocean systems in Mexico are limited to actions in the coastal ecosystems. Most of the climate change impacts and effects recorded occur in the watersheds and represent losses imperilments of services that society values highly. Diverse authors have considered the coastal zone as "the thin blue line". This "thin blue line" according to these authors represents humanity's fragile safety cordon in the face of rising sea level and other effects related to climate change. The coastal zone in Mexico is inhabited by 15% of Mexico's total population. The services provided by the coastal zone and immediate open and deep ocean zone are valuable services that support the country's economy. The climate change effects on the coastal zone are perceived up in the megacities, in high altitude like Mexico City, Monterrey and Guadalajara, where the demand of services required by the society is affected negatively.

Knowledge of climate change in Mexican oceans - In contrast to the national sectorial programs scientific research has evaluated climate change from diverse disciplines for at least the last three decades. Scientific research addressing climate change in the oceans not only incudes the coastal zone, although efforts are extended, it encompasses the diverse disciplines in oceanography and a wide variety of ocean features and issues that include food security, health issues in addition to basic science that describes the main processes occurring in the regional oceans of Mexico. Basic scientific research is carried out with support of the Mexican National Council for Science and Technology (CONACyT) with a small budget available for public educational and research institutions. Offshore and deep sea scientific research is carried out onboard the Mexican scientific fleet and through international collaborative efforts with

major research institutions from Europe and North America. Observatories and remote sensing support basic research and recognize features geographically and in time.

Many of problems derived with climate change in marine ecosystems are shared in the regional seas (Eastern Pacific; Western Atlantic) with many other nations. Among these is the loss of water quality, the water of future generations and of all life inhabiting the planet, including human life; the loss of scleractinian coral forms by whitening, decalcification due to the fragility of the symbiotic relationships and harvesting of light, thermal stress and acidification, the loss of seagrasses by eutrophication, the significant reduction of mangrove forests and dunes, the implicated coastal erosion, the more prolonged hypoxic events, the harmful algal blooms occurrence that depend on a large number of factors including low salinity waters into the ocean, higher temperature, enhanced nutrient availability and water residence time, all of them sensitive to climate change and in transition of ENSO or upwelling events in the Eastern Tropical Pacific.

The publications produced by a mature scientific community assessing climate change in Mexico are diverse and offer a better understanding of the trend of sea level rise in Mexican coastal areas; the ocean surficial temperature and its variability; the coastal erosion rate in the, the changes of the mangrove forest productivity in time, flood events in the coastal zone and expected scenarios during storm events for upcoming decades, the loss of services an economic impact to local coastal settlements, the effects of water quality change and vulnerability to in which local coastal communities adapt and survive, the costs to the nation in climate change mitigation and adaptation actions.

Long term observations - The acquisition of long term quality observations have been fundamental to better understand the evolution of diverse meteorological and oceanographic variables that in conjunction with sedimentary paleo-records have the capacity to feedback the numerical models with the goal to strengthen future forecasts and projections of weather and climate in Mexico. Supported by funds for basic research, these multidisciplinary, inter-institutional efforts have helped recognize the onset, presence of a long duration of the El Niño-Southern Oscillation (ENSO) phenomenon that could favor the rains of winter in the Northwest of Mexico and prevent coastal communities from major losses. ENSO arrives in Mexican regional oceans with a time lag due to the tele-connection of events with a delay in the main peak of rainfall during the monsoon and a delay in its completion.

We have better forecasting tools today however in the case of Mexico we receive the tele-connection of El Niño, which means with a time lag. Other associated events include a significant decrease of rainfall in Southern Mexico due to changes in the Caribbean jet stream; a decrease in the global average frequency of occurrence of tropical cyclones, in particular on the coastal areas of the Atlantic and the Eastern Pacific, but with an increase in frequency of more intense and longer lasting cyclones; a northern shift of storm occurrence in the tropical Atlantic which would imply a reduction in the number of storms that will enter Mexico through the Gulf of Mexico and the Caribbean Sea in the near future; the strengthening and early onset of the mid summer drought, and an increase of northern winter storms, which would decrease in the rainfall events in winter in the Southern Gulf of Mexico.

The coastal observatories are important assets; the data records are available as open access environmental information (TULUM) at the UNINMAR database and shared with society, with the scientific community in Mexico, with nations in the region and with the worldwide international programs.

The recorded trends observed in the Mexican oceans related to climate change are: 0.1 °C.decade-1 in surficial water temperature, changes in thermal energy content, upper water column with stronger stratification, photosynthetic biomass surficial distribution changes,

variable upwelling patterns in the Pacific Ocean and diverse efficiency of mixing by tidal currents. Sea level rise projections in Mexican costal areas for the end of the century will vary from 0.44 m to 0.74 m with scenarios of 0.5 cm. y-1 increase in the Pacific Ocean and a local variability of ± 0.2 cm. y-1 in the Gulf of Mexico expected in the winter.

Minimum oxygen zone (MOZ) - The increase in temperature has been associated to a lower eutrophication threshold that explains the more frequent massive algal growth, hypoxia and the export of CO2 to the atmosphere recorded in the coastal zone and offshore ecosystems. The CO2 fluxes between the ocean and the atmosphere recognize that offshore areas in the ETP are a source to the atmosphere with mean annual fluxes of 0.41 mol C m-2 y-1; the coastal ecosystems captures CH4 and CO2.

The MOZ is the result of the combined effects to limited oxygen solubility due to ocean warming, reduced ventilation, reduced by stratification, the flux of organic particles to deep and changes in the circulation pattern. The MOZ in the ETP expanded the last 60 years. The California Current off Baja California has been losing dissolved oxygen and expanding the MOZ. Part of this change is attributed to the Decadal Oscillation of the Pacific and the ENSO phenomenon displaying an expansion with intense gradients. In the MOZ climate change affects the Nitrogen cycle. The deep-sea communities are affected with the expansion of MOZ and in synergy with other new uses of the deep ocean resources these changes are unpredictable.

The regional CO2 absorption in surface waters when included in the scenarios of models for the 21st century in the ETP suggests a 0.3 to 0.4 pH reduction. The coastal records along the Baja California Peninsula show 0.5 pH reduction that represent values only foreseen in scenarios for the next 50 years. The impacts are perceived in the regional fisheries that follow the environmental changes resulting in changes in the distribution pattern, abundance of the populations subject to exploitation and sizes.

The past climate variability (Pleistocene, Deglaciation and Holocene) has been studied in ocean sediment and corals in the Mexican regional seas. These records recognize changes in rainfall associated to insolation and solar cycles, geographical changes of the monsoon and trade winds related to latitudinal changes in the average position of the Inter-tropical Convergence Zone and the ENOS phenomenon.

Vulnerability - The structure and function of the coastal ecosystems has developed over thousands of years subject to environmental forces and constraints imposed mainly by local boundaries of the watershed, the coastal ocean and offshore areas without the presence of humans. In the Anthropocene phenomena that transcend these conventional scales have emerged as human populations increase, and especially the modern global culture shaped by the human presence has modified the natural conditions. Mexico's geographical position and surrounded by oceans has a natural exposition to hydrometeorological phenomena. The combined extreme meteorological events, sea level rise require to gather better information through cooperation, community engagement and capacity building actions in scales that assemble as networks to reduce risks in the coastal zone and apply adaptation practices.
We recognize in Mexico the following as vulnerability factors related to the coastal ocean: storm events, sea-level rise, rainfall, drought floods and heat waves. All these affect the Mexican society and the local economies along the coastal zone. Mexico's vulnerability requires strengthening the risk management actions, privilege prevention over reconstruction, and act to strengthen the knowledge of dangers and threats to which the Mexican population is exposed. Mexico has acted to natural disasters in a reactive rather than preventive manner as can be recognized from the allocated federal budget in the 2005 to 2011 period where the Emergency Attention Fund (FONDEN) was 37 times larger than the Natural Disaster Prevention Fund (FOPREDEN).

Mexico´s Programs and legal instruments - The National Climate Change System (SINACC) provides the synergies address Mexico's vulnerabilities and risks to natural phenomena and establish priority actions for mitigation and adaptation. It coordinates the different levels of government and among the public, private and social sectors. The SINACC is integrated by the following: Intersecretary Commission for Climate Change (CICC); the National Institute of Ecology and Climate Change (INECC); The Climate Change Council (C3); the federal entities; the associations of local authorities and the Congress.

The National Climate Change Law (LGCC) is the most important legal instrument in the country to address the climate change issues. This instrument regulates, fosters and enables the implementation of the national policy on climate change and incorporates long term, systematic, decentralized, participatory and integrated actions for the adaptation and mitigation. Its principles are the sustainability, co-responsibility, citizen participation and transparency. The LGCC went into effect in 2011, diverse commitments have been integrated and strengthened. Mexico's Intended Nationally Determined Contributions (INDCs) were presented in 2015 with two components mitigation and adaptation that has derived in diverse commitments.
The National Biodiversity Strategy (ENBioMex) is a guiding document with elements to conserve, restore and sustainably manage biodiversity and the services it provides in the short, medium and long terms comprising six strategic axes, 24 lines of action and 160 actions. In its mission establishes the foundations to promote, guide, coordinate and harmonize the efforts of governments and society for the conservation, sustainable use and fair and equitable sharing of biological diversity and integration to Mexico's sectorial priorities in a vision to 2030, recognizing among the challenges climate change. Biodiversity and its services are recognized as well being of Mexicans and as heritage to the world.

To fulfill the ENBioMex commitments and goals the necessary funding is being explored with the Biodiversity Finance Initiative (biofin-Mexico) with the support to the United Nations Development Program. Biodiversity is part of the adaptation strategies that may help to reduce poverty, determinant factor of vulnerability.

Other documents of interest are the 3 volumes of the Mexican Report on climate change in 3 volumes, the country's vision and other important commitments (Aichi, Sustainability Development Goals). Services that sum to the climate change commitment of Mexico are the National tidal and sea level service with over 50 years of service and data in some of the coastal locations, the consideration of Natural protected areas and Ramsar sites in the decision making of climate change planning. The ONGs participation has been of great importance to the country especially in the coastal basin climate change context.

Cooperation, Opportunities and Challenges - Oceans are more complex, are interconnected and more expensive to study. There are still many unknowns on the impacts and effects of climate change in coastal and open ocean ecosystems. In order to reduce these unknowns science is required to contribute urgently to recognize vulnerability hotspots for the different coastal locations in the ocean regions. Understanding clearly the tipping points, recognizing the thresholds, and the tails of likelihood of the impacts and effects of climate change in the oceans will provide Mexican decision makers of tools to have a better coordination across institutions. To transform "the thin blue line", as cited by diverse authors, into a "thick blue line" requires bridging the science-policy interfaces to better understand the unknowns. Cooperation is expected to achieve this at three different scales: Local, regional and global actions. Among the local actions (within Mexico) are: to increase the scientific knowledge on Minimum Oxygen Zone thresholds and persistence; to preserve and restore coastal ecosystems to increase ecological connectivity, offshore and deep sea ecosystems may be difficult and most probably impossible to restore. Mexico requires increasing conservation of species action programs and strengthen the marine C storage and coastal ecosystems protection and recovery (reefs, mangroves, seagrass, dunes) programs.

Among the regional actions cooperation with other nations with similar problems is important. Ocean connectivity is an important criterion. For the Caribbean Sea integrating with regional programs on coral bleaching, ocean acidification, Sargassum aggregation and marine biodiversity; for the Eastern Tropical Pacific integrating efforts on better understanding the oxygen minimum zone expansion, strengthening the intercallibration of oxygen concentration measurements.

In both regions, the western Atlantic and eastern Pacific oceans, evaluating the sea level change and ecosystem service loss by this loss are important cooperation in addressing climate change in the ocean. Capacity building, technology transfer and big data infrastructure, financing South-South for climate change adaptation and joint cruises in the region will help understand the latitudinal hydrographic variability.
Among the global actions integrating Mexico's climate change actions to the scientific, socioeconomic and interdisciplinary research initiatives such as the Global Ocean Oxygen Network (GO2NE) established under IOC to improve and coordinate international research on de-oxygenation, the Peer 2 Peer mentoring program and regional networks established under the Global Ocean Acidification Observing Network and others.

Databases are important at all complexity levels, knowledge is the best tool for better decision making therefore having a better spatial-temporal coverage of ocean processes is a prerequisite for progress in ocean sciences. The coverage of Mexico's coastal zone and oceans is a vast area and acquiring information has a high cost. Defining ecosystem integrity criteria that describe all marine ecosystems is difficult. However sharing environmental data and maintaining the databases in the long term is fundamental although expensive. Ocean scientists in Mexico have contributed with the sparse information that practicable ocean observation systems can provide. All environmental and biodiversity data should be open access to better understand the social and economic implications of the loss of services provided. Therefore reliability of future funding is required to allow the survival of long-term programs and its adaptation to new technology.

A way forward is to sensitize the sectors of its importance and the benefits; sensitize the science and technology council in Mexico to invest in ocean knowledge and demand combining observation strategies in the future that employ platforms and instruments in collaborative way locally and within the region. There is a need to invest in long-term data gathering. Scientists should envisage using the innovative new platforms and instruments and combine it with the existing knowledge. Cooperation among developed and developing countries is required within a new perspective on how future ocean observing systems shall be conceived being many of the problems similar and interconnected.

The challenges for cooperation recognized include identifying goals that are reachable and that can be maintained in the long term when needed, quantify adaptation commitments, define the baselines, thresholds and criteria that allow reducing vulnerability and establish national commitments strengthening dialog with sectors, research institutions and enterprises.

Finally this panel deals with oceans, Mexico as many other countries have ice caps that are disappearing and we need to consider these as well.

Mr. Philip Sutton
National Institute of Water and Atmospheric Research (New Zealand)

Bio

Dr Philip Sutton is a physical oceanography research scientist at New Zealand's National Institute of Water and Atmospheric Research (NIWA). He graduated with a PhD in Physical Oceanography from Scripps Institution of Oceanography in 1993 and then returned to New Zealand to start at NIWA. His New Zealand research has covered a broad range, but has always had a focus on the ocean's role in climate. He has been involved in Argo since 1999. Argo is an international programme that maintains a global network of about 3500 drifting, profiling floats with each float making a measurement of the upper 2000m of the ocean every ten days. Argo has revolutionised oceanography, providing global coverage and near-real-time data to a field that previously relied on sparse and expensive shipboard surveys and satellite remote sensing of the ocean surface. Phil's Argo collaborations have involved regional, hemispheric and global studies of heat content changes. Some of the largest changes in ocean heat content are occurring at around 40°S- making them very relevant for New Zealand. Phil is now involved in the development of Deep Argo, aiming to measure the ocean down to 6000m depth.

Abstract

"Oceanic impacts on regional climate and the ARGO Programme"

Climate change is ocean change. About 93% of the increase in global energy since the 1970s is accounted for by ocean warming. This is a result of the high heat capacity of water compared with air. The dominance of the ocean in heat storage makes it imperative to measure and understand the changes in the ocean if climate variability and change are to be monitored and interpreted. Historically, the ocean was very sparsely measured by expensive research vessel voyages. These voyages were intermittent, scattered and biased towards the northern hemisphere and summer. Furthermore, there were very few repeat surveys to study change.

Argo is an international programme maintaining an array of profiling floats in all of the world's oceans. There are currently nearly 4000 freely-drifting floats deployed, with each float measuring the temperature and salinity of the upper 2000m of the ocean every 10 days. The data are transmitted by satellite and are freely and openly available in near-real-time. The Argo array achieved global coverage in 2004.

The unprecedented global coverage of Argo enables us to see that ocean warming and freshening are not uniform. In fact the regional variability is larger than the global mean signal. Results from the Argo era have indicated that the global ocean heat content has continued to rise, even while atmospheric warming slowed through the 2000s. The strongest warming signals are from the southern hemisphere with peaks centred at $\sim 40^0$S through all of the ocean basins. Changes in surface salinity are consistent with an acceleration of the hydrological cycle- that is wet places have tended to get wetter and dry places drier. Sea level is also affected by the changes in ocean heat content. Warm water is less dense, and so stands taller. The density-related changes in sea level account for half of the total changes. Argo has revolutionised marine science with its near-real-time global coverage. It is imperative to maintain the global array. The next steps are to increase coverage in the remaining undersampled regions including marginal seas, seasonal ice zones and the ocean deeper than 2000m. To achieve these aims it is important to allow floats to be deployed freely and allow their drift into EEZs.

Ms. Lisa Beal

School of Marine and Atmospheric Science at the University of Miami

Bio

Lisa Beal is Associate Dean of Research and Professor of Ocean Sciences at the University of Miami's Rosenstiel School of Marine & Atmospheric Science. She serves as Oceans Editor for international journal Geophysical Research Letters and is the co-Chair of the Indian Ocean Panel, a steering committee of the Global Ocean Observing System. Lisa is a renowned expert on the Agulhas System of currents off South Africa and has brought recognition to the key role this System plays in a warming climate through her international leadership and publications. She has participated in 15 scientific voyages to the Atlantic and Indian Oceans, totalling 326 days at sea, leading 5 of these voyages as Chief Scientist. She has published over 40 peer-reviewed scientific publications and her work has been featured on BBC Radio 4's Material World. Lisa received her PhD from the National Oceanography Centre at the University of Southampton in the United Kingdom before moving to the United States as a postdoctoral scientist at Columbia University in New York and then at Scripps Institution of Oceanography in San Diego, CA. She joined the faculty at the University of Miami in 2003, where her research focuses on ocean circulation and heat transport, as well as the ocean's role in the coupled climate system. In addition to her research, Lisa is involved in community work to increase the recruitment and retention of minorities in oceanography, and to advance resources and capacity building towards sustained observations of the southwest Indian Ocean and Agulhas system off Africa.

Abstract

"Western Boundary Currents in a Changing Climate: A case study of the Agulhas Current"

Western boundary currents such as the Agulhas Current in the Indian Ocean carry heat poleward, moderating Earth's climate and fuelling the mid-latitude storm tracks. They could exacerbate or mitigate warming and extreme weather events in the future, depending on their response to anthropogenic climate change. Climate models show an ongoing poleward expansion and intensification of the global wind systems, most robustly in the Southern Hemisphere, suggesting that western boundary currents will intensify and shift poleward as a result. Observational evidence of such change has come from accelerated surface warming and air–sea heat flux rates within all western boundary currents, which are two or three times faster than global mean rates. Despite these expectations, we find, using in situ measurements, that the Agulhas Current has not intensified since the early 1990s. Instead, it has broadened as a result of more eddy activity. Recent analyses of other western boundary currents, the Kuroshio and East Australia currents, hint at similar trends. These results indicate that intensifying winds may be increasing the eddy kinetic energy of boundary currents, rather than their mean flow. This could act to decrease poleward heat transport and increase cross-frontal exchange of nutrients and pollutants between the coastal ocean and the deep ocean. Sustained in situ measurements are needed to properly understand the role of these important current systems in a changing climate.

Ms. Elizabeth Jewett

NOAA Office of Atmospheric Research

Bio

Dr. Libby Jewett
Director, Ocean Acidification Program
National Oceanic and Atmospheric Administration
Silver Spring, MD, USA

Dr. Elizabeth (Libby) Jewett, a NOAA scientist with diverse science and management experience, is the director of NOAA's Ocean Acidification Program. As director, Jewett oversees current

NOAA research on ocean acidification which includes monitoring open ocean and coastal conditions and studying the impacts on marine organisms. In addition to developing adaptation strategies and coordinating and expanding international efforts to understand the socioeconomic impacts. Jewett earned a Ph.D in biology at the University of Maryland, a Master of Public Policy at Harvard University's Kennedy School of Government, and a B.A. at Yale University. She has served as an adjunct professor of biology at George Washington University and Middlebury College and has authored a number of peer-reviewed publications and interagency research assessments and plans.

Abstract
"Ocean Acidification: Increasing Understanding and Action"
UNICPOLOS
Climate Change Impacts on the Oceans
Ocean acidification (OA) is the term used to describe how the chemistry of the ocean is changing as a result of human activity. Carbon dioxide emissions released into the atmosphere from burning fossil fuels are dissolving in the ocean, making it more acidic. These changes to seawater chemistry are already affecting commercially and ecologically important marine life, with negative implications for human populations. The United States' active OA research program focuses on improving the understanding of how ocean chemistry is changing, how relevant species respond to these changes, and what the socioeconomic impacts may be. Through partnerships among government, NGOs and industry, we are also actively engaged internationally, equipping partners with technical knowledge and approaches for both monitoring their oceans and identifying the marine resources along their coasts that might be vulnerable. Ongoing capacity building efforts include, most recently, training for early and mid-career scientists in Africa and the Pacific Small Island Developing States. The US helped found and leads the Global OA Observing Network (GOA-ON) which, by connecting scientists from around the world, optimizes access to best practices for OA observing. The GOA-ON recently launched an active data portal for public access to OA data and information products. Like climate change, ocean acidification is a global issue but impacts will be felt at the local level. Thus, a multi-pronged approach that works to enhance scientific capacity around the world is needed to equip all countries with the tools needed to adapt.

Ms. Katharina Fabricius
Australian Institute of Marine Science
Bio
Dr. Fabricius is a coral reef ecologist, and a Senior Principal Research Scientist at the Australian Institute of Marine Science (AIMS) in Townsville, Australia. She has dived and researched coral reefs around the world, and has spent over 1000 days on research vessels since 1988. She received her PhD from the University of Munich in 1995 for her work on the Great Barrier Reef and Red Sea. A major focus of her research is to understand the effects of disturbances (especially ocean acidification, changes in water quality, and climate change with all of its consequences) on ecological processes in coral reefs. She presently leads a large research program to investigate long-term acclimatisation of coral reef organisms and adaptation of ecosystems to ocean acidification, using volcanic CO2 seeps in Papua New Guinea as natural laboratories. Dr. Fabricius has published >130 journal articles and book chapters, and holds advisory roles for various government bodies and NGOs as coral reef expert on ocean acidification, water quality and climate change issues.

Abstract
"**Ocean Acidification and Ecosystem Management"**
Ocean acidification is a term used to describe the chemical changes in the ocean caused by the uptake of increasing atmospheric carbon dioxide. Today, the acidity in the seawater is > 30%

higher than it was during pre-industrial times. Further increases will depend on the trajectories of future atmospheric CO2 emissions. Recent research suggests that ocean acidification will be irreversible at human time scales: it will take thousands of years of geological and biological processes to revert CO2 in the oceans back from levels predicted under business-as-usual emissions scenarios for the year 2100 to pre-industrial levels.

Ocean acidification is known to affect rates of calcification and photosynthesis in many organisms. Abundances of several groups of sensitive organisms, and some ecosystem processes such as rates of reef calcification, are already affected, and ocean acidification has also started to affect some industries including the oyster farm hatcheries in North America. However, there are still few ecological studies to predict the long-term consequences of ocean acidification on ecosystems, and their economic implications. Volcanic carbon dioxide seeps, where carbon dioxide bubbles out from the sea floor, have been used as natural laboratories to find answers on how organisms and whole ecosystems respond to the long-term exposure to ocean acidification. These studies suggest massive erosion in the resilience of some ecosystems at CO2 levels predicted for later this century. Changes are attributed to shifts in the competitive strengths between sensitive and robust species, between calcifying habitat-forming organisms (e.g., corals) and photosynthetic organisms (e.g., fleshy algae), and their flow-on effects on many marine communities. Other changes are attributed to the declining capacity of some organisms to grow and recolonise areas after disturbances. Long gaps in fossil reef deposits coincide with geological times of high CO2, suggesting that coral reefs have had a limited capacity to adapt to ocean acidification in the geological past.

The most effective marine ecosystem management options in the face of increasing ocean acidification are the minimisation of cumulative impacts from multiple stressors, while not losing sight on CO2 emission reductions as the ultimate solution. Particularly relevant for coastal areas are reductions in nutrient pollution, overfishing, and sedimentation: nutrient management can regionally stabilise CO2 levels, healthy fish populations graze down algal blooms, and prevention of sedimentation can increase the capacity of benthic ecosystems to recover from disturbances. However, large knowledge gaps remain about the interactive effects of ocean acidification with ocean warming and deoxygenation of the seawater, about the effectiveness of ecosystem management in specific locations, and about the capacity of ecosystems to acclimatise or adapt to the simultaneously occurring ocean acidification and warming.

Mr. Dimitri Gutiérrez Aguilar
Institute of Marine Research
Bio
Instituto del Mar del Perú, Esquina Gamarra y General Valle, Callao, Peru. E-mail: dgutierrez@imarpe.gob.pe
Dr. Dimitri Gutiérrez Aguilar is a Peruvian biological oceanographer, and currently, Director of Research in Oceanography and Climate Change of the Peruvian Marine Research Institute (IMARPE) since 2012. His research is focused on benthic responses to natural and human-induced anoxia, paleo-reconstruction of the Peruvian upwelling ecosystem history, and climate variability and global warming impacts on the upwelling ecosystems. He has authored or co-authored over 40 ISI scientific publications or book chapters and is involved in several programs and projects related to climate change impacts and adaptation for Peruvian marine coastal ecosystems. Currently he is also a member of the IOC-UNESCO Global Ocean Oxygenation Network (GO2NE).

Abstract

Climate change effects on the Oceans' productivity and oxygenation; the case of the South Eastern Pacific.

Global warming drives oxygen loss in the open ocean and threats the overall marine productivity. Near the coasts, ocean deoxygenation is also occurring due to increased coastal anthropogenic nutrient loads. Nevertheless, patterns of change and vulnerability vary across ocean basins and marine ecosystems. For instance, the South Eastern Pacific (SEP), and particularly the Peruvian waters, are normally characterized by a high primary productivity and a shallow oxygen minimum layer, while supporting one of the largest fisheries in the globe. Coastal embayments are particularly productive due to the frequent input of nutrient-rich, though oxygen-poor upwelled waters. Observations, models and paleo-records indicate the high sensitivity of SEP productivity and oxygenation to climate variability and associated changes in circulation patterns, from El Niño/La Niña to decadal and even longer time scales. In turn, these changes yield important consequences for economies and societies that depend on the marine biological resources. Until recently, sea surface cooling trends have dominated off the tropical SEP coasts, but climate change models for the region suggest warming, increased thermal stratification and lesser coastal upwelling off Peru will prevail for the next decades, which will likely reduce the primary productivity in the region. Current models are still uncertain to provide future regional scenarios for the oxygen content, but enhanced stratification near the coast, combined with pollution due to population growth and economic activities, might augment the likelihood of harmful algal blooms and amplify seasonal coastal hypoxia events, compromising artisanal fisheries or open aquaculture activities. Offshore, large-scale circulation and stratification changes will certainly affect the intensity of oxygen-depleted waters, altering the size and distribution of oxygenated habitats, and therefore the food-webs and availability of fish resources. Occurrence of El Niño events under climate change will likely amplify ecosystem impacts, by causing more intense warming, stratification and lower ventilation to subsurface waters. In conclusion, even though urgent actions and policy-making are needed to reduce the vulnerability of SEP coastal zones to deoxygenation and undesired phytoplankton productivity changes, only global-scale mitigation actions can reduce or reverse the looming impacts of climate change in the region.

Ms. Jennifer Howard

Conservation International

Bio

To be submitted.

Abstract

The international climate community is increasingly recognizing the role of natural ecosystems in climate change mitigation. While historically forests have been the primary focus of such efforts, coastal wetlands, particularly seagrasses, tidal marshes, and mangroves, are now considered important and effective long-term carbon sinks. As researchers and conservation managers build the scientific evidence supporting the importance of coastal habitats in addressing climate change, there is interest in expanding to consider other marine systems (coral reefs, phytoplankton, kelp forests, and marine fauna) in climate mitigation strategies. Dr. Howard will analyze the scientific evidence regarding whether these marine ecosystems are viable long-term carbon sinks and whether they can be managed for climate mitigation. This analysis and clarification is essential to support decision makers and conservation practitioners in identifying which coastal and marine ecosystems should be prioritized in current climate mitigation strategies and policies.

Mr. Carlos Garcia Soto
Spanish Institute of Oceanography
Bio
Mr. Carlos Garcia-Soto is a Senior Researcher and Director of International Relations at the Spanish Institute of Oceanography (IEO) specializing in Satellite Oceanography, Climate Change, Blue Economy. He obtained his PhD IN OCEANOGRAPHY at the University of Southampton (1994). He has worked at the following OCEANOGRAPHIC CENTRES: IEO (1997-present), PML (1990-1997) and AZTI (1988-1990).

Mr.Garcia-Soto participated in the National delegate in the UN Framework Convention for Climate Change, the UN Preparatory Committee on BBNJ, the UN Regular Process (World Ocean Assessment) and the International Seabed Authority. He was part of the UN List of Experts on marine Scientific Research of UN DOALOS and expert in the UNESCO/IOC Intersessional Working Group of ABNJ, and delegate in the National Council of Climate and the National Council of Maritime Safety.

As PRINCIPAL INVESTIGATOR of 5 International Research Projects, the European Union and the Europen Space Agency, his Last 2 Projects (H2020) were:
2016-20 Climate change and European aquatic RESources (Contract EU: 678193) 300K € and
2016-20 Support to the BLUEMED Initiative: Coordination of marine and maritime research and innovation activities in the Mediterranean. (Contract EU: 727453) 145K €

Mr.Garcia-Soto was involved in more than fifty SCIENTIFIC WORKS (Journal articles, Books, Chapters and Communications). He was 2009 Editor of the book, Oceanography and Satellites (Spain), 2012 and 2014 Lead Guest Editor of Deep-Sea Research 2 (Oceanography of the Bay of Biscay, Satellite Oceanography and Climate Change), 2011-present Editorial Board of Continental Shelf Research. He is LECTURER of the European MSc programme on Marine Environment and Resources (MER, 2006-present).

Mr.Garcia-Soto's HONORS AND AWARDS include the following:
2005 AWARD on Science Divulgation from the Spanish Foundation for Science and Technology
2012 Erasmus Mundus AWARD from the European Union. Master MER.
2015 Chair of the WG Advancing Citizen Science for Ocean Research (European Marine Board)
2016 Vice-President of the European Centre for Information on Marine Science and Technology
2017 Stering Committee of the European Network of Excellence Euromarine
2017 Vice-President of the European Marine Board
2017 Executive Committee of GEO BluePlanet.

Abstract
Forecasting and anticipating the effects of climate change in fisheries and aquaculture
In the context of an increasing global population and demand for sufficient and safe food supplies, it is critical to predict and anticipate the nature and magnitude of potential impacts of climate change on fisheries and aquaculture. The topic is addressed through the following key points: (i) Major climate change drivers impacting fisheries. (ii) The effects of climate change on biogeography and fishery catches (iii) Projected vulnerabilities associated with climate change in ocean regions. (iv)Climate change drivers impacting aquaculture. (v) Adaptation options suggested by AR5 relevant for fisheries and aquaculture. (vi) Climate change and European aquatic Resources: The European Project CERES (2016-2020). (vii) Vulnerability of the national economies to the impact of climate change on fisheries. And (viii) some final conclusions relevant to the fisheries policies and to Sustainable Development Goal -14.

Mr. William Cheung
University of British Columbia, Canada
Nippon Foundation-UBC Nereus Program, Institute for the Oceans and Fisheries, The University of British Columbia, Vancouver, B.C., Canada
Bio
Dr. William Cheung is an Associate Professor and the Director (Science) of the Nippon Foundation-UBC Nereus Program at the Institute for the Oceans and Fisheries, UBC. His research addresses the key challenges in understanding and predicting the responses of marine ecosystems and fisheries to global changes, as well as identifying and evaluating solution options to ensure the sustainability of marine and coastal ecosystems and communities.
Dr. Cheung is actively involved in international and regional initiatives that bridge science and policy. He was a Lead Author in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and a Coordinating Lead Author in the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). He serves as member of the editorial board of Fish and Fisheries, Fisheries Oceanography and Frontier in Marine Sciences, and as scientific advisors in a number of international organizations including BioDiscovery, IUCN and WWF Canada

Abstract
Sustaining global marine fisheries under climate change
Climate change alters ocean conditions, including seawater temperature, ocean acidity and oxygen level that affect the biology and ecology of marine fishes and invertebrates. As a result of ocean warming, marine fishes and shellfishes are shifting their distribution by 10s to 100s of kilometers towards higher latitude or 10s of meters to deeper waters where waters are cooler. Changes in ocean primary productivity are also impacting the reproduction of marine species, affecting the replenishment of fish stocks. These ecological impacts affect fisheries directly through reducing abundance of targeted fish stocks, impacting the effectiveness of fisheries management, and increasing disputes in the sharing of transboundary fisheries resources. These impacts will intensify in the future. Under the 'business-as-usual' scenario of climate change, global fisheries may suffer from a decrease in catch by more than 10% relative to now in the 21st century, leading to a loss of potential revenues of more than $10 billion per year. Tropical fisheries are highly vulnerable to climate change, with a potential decrease in fisheries catches of more than 30% by the 2050s in areas where people's dependence on fish as a source of nutrients is also amongst the highest in the world. Mitigating climate change and meeting the Paris Agreement global warming targets can largely reduce climate impacts on fisheries. In addition, adaptation measures that have large co-benefits on coastal communities, including conserving and restoring fish stocks and critical habitats as well as improving capacity of fishing communities to response to changes, are important to ensure the long-term sustainability of marine fisheries under climate change.

Ms. Nathalie Hilmi
Monaco Scientific Center
Bio
Dr Nathalie Hilmi is a specialist in Macroeconomics and International Finance. After doing research and giving lectures at the CEMAFI (Centre d'études en Macroeconomie et Finance Internationale), University of Nice-France, she obtained her PhD thesis entitled «The real dimension of the global and regional integrations process: the case of Turkey » with honours in 2000. She successfully passed her post-doctoral diploma (HDR) after research about multidisciplinarity and sustainable development. She then joined Allergan, a pharmaceutical American group, as a financial analyst and continued giving lectures in economics and management in private business schools. Subsequently she taught at EDHEC Business School and continued her research work with EDHEC Risk and Asset Management Research Centre. In

2006, she was employed at the International University of Monaco as Professor of Macroeconomics and Finance. Her research work encompassed academic studies and conference presentations to develop the network of the Hedge Funds Research Institute (HFRI), and applied researches on investment strategies in Alpstar, a hedge fund in Geneva. She was responsible for research in Macroeconomics for HFRI and Alpstar, and was the head of external activities for HFRI. She continued to teach in executive programs in EDHEC and a national training centre for banking executives. Concomitantly, she continued working at the CEMAFI, University of Nice-Sophia-Antipolis (France) as an associate researcher. Recently, she organized conferences for HFRI and UNSA: on "Bridging Mathematics, Social Sciences and Finance" and the "8th MEEA International Conference". Dr Nathalie Hilmi is a member of several international associations in economics and finance and she actively participates in the reviewing and editing of specialized publications. In 2010, she joined the Centre Scientifique de Monaco as section head of environmental economics and collaborated with IAEA's Environment Laboratories to initiate correlation studies between environmental sciences and economics to better evaluate the socioeconomic extent of impacts and costs of action versus inaction with regard to carbon emissions. On the basis of the outcomes of the workshop "Bridging the gap between ocean acidification impacts and economic valuation" held in Monaco 16-18 November 2010; she was in charge of the coordination for the preparation and organization of the follow-up workshops in November 2012, January 2015 and October 2017. She is head of the « environmental economics » section in the Scientific Center of Monaco.

Abstract

"***Bridging the Gap between Ocean Acidification Impacts and Economic Valuation*** "

Ocean acidification is a growing environmental concern. The chemistry and therefore biology of world oceans will be impacted to varying degrees depending on region and type of ecosystem. Ocean acidification, through impacts on marine organisms and ecosystems, has the potential to seriously impact coastal communities and their economies. Communities ranging from mega-cities to subsistence fishing villages differ significantly in population, maritime activity, reliance on marine natural resources and therefore their respective adaptability. Identifying the magnitude and types of impacts ocean acidification will have on communities will become a concern of governments of coastal countries seeking to maintain current marine activities and benefits.

In 2008, the Monaco Declaration (requested by HSH Prince Albert II) advocated for the development of links between economists and scientists in order to better evaluate the socioeconomic impacts of ocean acidification. In line with the Monaco Declaration and in accordance with the wishes of Prince Albert II, an International workshop series « Bridging the Gap between Ocean Acidification Impacts and Economic Valuation » was launched by the 'Centre Scientifique de Monaco' and the Environment Laboratories of the IAEA. Three workshops have been organized since 2010 all gathering multidisciplinary international experts, to work on providing recommendations and an appropriate methodology for considering different policy or management options. These workshops resulted in clear conclusions and recommendations for policy makers.

The first workshop (2010) focused on the impacts of ocean acidification on the global economy. For the first time, economists and scientists came together to open the lines of communication and foster cooperation and coordination. The second workshop (2012) focused on impacts of ocean acidification on fisheries and aquaculture in different regions of the world. Social and economic impacts of ocean acidification on livelihoods, commerce and food security were discussed. What are the socio-economic impacts of ocean acidification on coastal communities? The third workshop (2015) discussed impacts on major coastal fisheries and tourism activities, and considered ways to model the cascade of potential impacts of ocean acidification on human activities. The workshop also discussed potential adaptation and capacity-building options and policy responses available to these various sectors and governments. Each of the workshops

provided a set of specific recommendations for policy makers on possible mitigation and adaptation measures, and research priorities.

The 4th workshop on the Economics of Ocean Acidification will continue the series initiated in 2010 and will build on the work developed by the previous editions in identifying and evaluating the socio-economic risks of OA, as well as the most vulnerable regions and areas of human activity. A series of recommendations for policy makers were developed as a result of the first three workshops, including:
•systematic reduction of CO2 emissions as the first-order objective for any sustainable solution;
•reducing local threats and establishing Marine Protected Areas;
•since adapting solutions (e.g. migration of populations, habitat restoration, coastal protection, changes in craft practices) can be quite costly, preference should be given to encouraging mitigation solutions (reducing CO2 emissions) and including oceans in all international negotiations on climate change;
•increasing ecosystem and societal resilience through improved fisheries and aquaculture management practices; restoring fish stocks and biodiversity; empowering most vulnerable communities;
•searching for innovative sources of funding and including ocean acidification in the "green background climate";
•promoting knowledge development, data collection platforms and information sharing;
•taking into account social aspects in the design of environmental solutions;
•promoting an interdisciplinary approach should be encouraged to be complementary to propose solutions to decision makers.
In order to take these recommendations one step further, and respond to issues raised by policy makers and ecosystem management teams, the 4th workshop will focus on the economically and socially important, but highly threatened, coral reefs ecosystems, using a case study approach.

Mr. Essam Yassin Mohammed
International Institute for Environment and Development
Bio
To be submitted
Abstract
The presentation will seek to examine the contribution of fisheries to poverty reduction and food security, and portray the potential impacts of climate change on the already strained resources in Sub-Saharan African (SSA) countries. Fish is a major source of food for the majority of poor and vulnerable communities in SSA. The sector also provides jobs to many men and women and is one of the most traded food commodities in the region. However, the benefits gained from the sector are often overlooked in national economic planning. While the importance of fisheries to national economies is often understated, the impacts of climate change on the sector and its implications for the socio-economics of the coastal and riparian communities are difficult to ignore. The presentation will provide a review of projected physical and biological impacts of climate change on fisheries in SSA. In addition, the importance of fisheries to poverty reduction is demonstrated using empirical data from 42 SSA countries. We conclude that increased and sustained investments in market development, fisheries governance and provision of economic incentive mechanisms are crucial in order to minimize the potential impacts of climate change on fisheries and food security and increase the resilience of many poor fishing communities in SSA.

Ms. Maria Fossheim
Institute of Marine Research
Bio
Dr. Fossheim is Head of Research Program, Barents Sea and Arctic Ocean at the Institute of Marine Research in Norway. She is leading the Marine Fisheries Sector in the EU-project ClimeFish 2016-2020 (*Co-creating a decision support framework to ensure sustainable fish production in Europe under climate change*), and a contributing author to the last *State of the Climate in 2015* report. Dr. Fossheim has been working with effects of climate change on the marine Arctic ecosystems for more than 10 years, and has documented that ocean warming and sea ice retreat in Arctic waters has induced poleward community-wide shifts in fish, leading to ecosystem changes and potential biodiversity loss.
Abstract
"Ecosystem effects of climate change in polar waters"
Climate change is causing the ocean temperature to rise, but the rate of warming is not evenly distributed across the globe. In the Arctic, temperature is increasing more than twice as fast as the global average. Additionally, the loss of sea ice induces a major habitat change for the Arctic ecosystems. The highest increase in ocean temperature in the last 50 years is experienced by the Barents Sea, a shallow shelf sea shared between Norway and Russia. This highly productive biological system has also changed from being mostly covered by sea ice in the winter time, to having almost no ice year-round. In this region, poleward shifts of species have been documented for most animal groups, from plankton and fish to sea mammals and sea birds. The story of the cod in the Barents Sea is presented as an example of one of the most shifting species in this region.

The North-East Arctic cod is the commercially most important fish species in the Barents Sea. Currently, it reached a record high population size due to a favourable climate and lower fishing pressure. Increased temperature and improved food conditions in the northern Barents Sea may explain the area expansion and increase in abundance of this species. Thus, cod is a climate change winner, and the fishermen are happy. On the other hand, Arctic fish species do not seem to cope with rising temperatures and have been declining in numbers. Additionally, cod is a ferocious predator, and it is likely to both compete with and feed directly on the Arctic fish species. The Arctic species have nowhere to move, as they soon run out of shelf habitat when entering the deep Arctic Ocean. It is anticipated that this could result in the local extinction of Arctic fish species.

Ms. Marlene Moses (Ambassador - The Republic of Nauru)
Association of Small Island States (AOSIS)
Bio
To be submitted
Abstract
"Climate Change Impacts on Small Island Developing States"
Small Island Developing States, with our low-lying geographies and locations in the historical paths of tropical storms, are increasingly experiencing the impacts of climate change. Many SIDS are the bearers of large ocean territories and are dependent upon the oceans, which absorb 93% of excess heat, for our livelihoods. There is a saying "out of sight, out of mind," and for many, when it comes to thinking about the impacts of climate change on the oceans, this is the case. But for SIDS, with economies dependent on the oceans and strong historical and cultural ties to ocean, it is the opposite. The impact of climate change on the oceans is often on our minds and we do not have the luxury to wait for a disaster situation to act. Already rising ocean temperatures are increasing the severity of storms, coral reefs are undergoing bleaching events more often, the loss of oxygen is diminishing species habitats and this is all happening while sea-levels continues to rise. Our ability to sustainable develop is being affected and we hope to raise awareness of the urgency of this issue so that it becomes less "out of sight, out of mind."

Segment 2

Cooperation and coordination in addressing the effects of climate change on oceans: current action and opportunities for further enhancement

Wednesday, 17 May

10 am – 1 pm

Mr. Hernan Garcia

NOAA National Environmental Data Satellite, Data and Information Service, National Centers for Environmental Information

Bio

Hernan Garcia leads the scientific stewardship and quality control of the measured chemical oceanographic data in the World Ocean Database (WOD) and the World Ocean Atlas (WOA). He documents ocean variability based on historical observations. His interests extend to integration of science-based observational oceanographic data into useful decision-relevant ocean data products, services, strategic planning, and climate research. Currently, he leads the NCEI Arctic Team lead, Director of the ICSU World Data Service (WDS) for Oceanography, and U.S. National Data Management coordinator for the International Oceanographic Data and Information Exchange of the Intergovernmental Oceanographic Commission of UNESCO. He contributes to national and international science stewardship projects and programs.

Abstract

"Science stewardship projects and programmes"

International cooperation enabling open, timely, and unrestricted scientific ocean data use is critical to document ocean dynamics, its mean-state, and its short and longer-term variability. At present, no one country or program can sample the entire ocean volume at reasonable spatial and temporal scales. National and International surveys and time series of in situ chemical, physical, and biological variables have been carried out since the 1950s including the Geochemical Ocean Sections Study (GEOSECS), World Ocean Circulation Experiment (WOCE), International Geophysical Year (IGY), the Argo Program, the Climate and Ocean: Variability, Predictability and Change (CLIVAR). While these data were collected using evolving in situ ocean observing systems and for addressing different scientific questions, these data can be melded with appropriate metadata and integrated into common data formats and quality-controlled databases to enable scientist to study the role of the ocean in the context of the earth climate system. for example, based on historical and modern in situ temperature data, the oceans have absorbed over 90% of the Earth's energy imbalance since the 1950s (e.g., Cheng et al., 2017). These changes in ocean heat storage are expected to have impacts in ocean-atmosphere dynamics (e.g., fresh-water balance, sea level change, air-sea exchange) and in ocean chemistry and biology (e.g., ocean acidification, coral bleaching, ocean deoxygenation). Documenting such large-scale changes in the subsurface ocean is not possible from remote sensing satellites. It will require integrated global quality controlled ocean databases. While many of these oceanographic data have been slowly and steadily integrated in public access databases such as the NOAA World Ocean Database, much critical oceanographic data and metadata still remains in many geographic locations and in varying digital formats and unavailable for use by the scientific community. In some instance, the data are not being made easily discoverable or made readily available because the data reside in non-interoperable online services that allow human-to-machine and machine-to-machine data transactions across different networks. In other cases, the data are not being openly shared for public unrestricted use and redistribution for a number of reasons. We live in an era when we need to gain rapid insight into regional to global environmental changes to enable governments and communities to make informed decisions for their future and the future of the planet. All governments and societies would benefit from such international cooperation to help them directly understand and mitigate future environmental changes.

References:
Lijing Cheng, Kevin E. Trenberth, John Fasullo, Tim Boyer, John Abraham and Jiang Zhu, 2017. Improved estimates of ocean heat content from 1960 to 2015. Science Advances 10 Mar 2017: Vol. 3, no. 3, e1601545. DOI: 10.1126/sciadv.1601545

Mr. Vladimir Ryabinin
UNESCO/IOC
Bio
Executive Secretary
Intergovernmental Oceanographic Commission of UNESCO

Abstract
"You cannot manage what you cannot measure!" Almost every statement on the state of the ocean to be made at this ICP forum will be based on observations. When delegates say that "93% of the excess heat due to the enhanced greenhouse gas effect have been absorbed by the ocean since 1950s", they may not always fully realize the gigantic work of scientists and practitioners that underpins such statements. Ocean observing is a challenge that cannot be met by individual nations and that is why the Intergovernmental Oceanographic Commission of UNESCO, with contribution of some partners, leads on coordination of the Global Ocean Observing System (GOOS).

The ocean component of the Global Climate Observing System, GOOS development and maintenance is a global annual investment of roughly 1 Billion US$. Its design started in 1990s. The progress is quantitatively monitored through various technical arrangements and programs, most of all, the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). Similarly to GCOS, which operates Essential Climate Variables, GOOS operates Essential Ocean Variables (EOVs), which are designed on the basis of their impact and feasibility, progressing from the concept, to pilot and eventually to mature variables.

GOOS is designed by scientists, in a dialogue with practitioners, and is intended to support both the needs of real-time services and delayed mode applications. The Framework for Ocean Observing (FOO) guides this process. Major conferences, OceanObs'99 (Saint Raphael, France), OceanObs'09 (Venice, Italy) and the future OceanObs'19 (Hawaii, USA) are milestones in the GOOS progress.

Driven by societal needs, GOOS unites a variety of networks facilitating different types of observations. Examples are the Global Sea-Level Observing System (GLOSS), the Global Ocean Acidification Observing Network (GOAON, with a strong contribution from the IAEA), the Global Ocean Oxygen Network (GO2NE) and many others. Both satellites and in-situ networks are developing. The scope of observations initially included EOVs in the domain of physical oceanography. Now, more and more, GOOS embarks on the EOVS characterizing ocean biogeochemistry, biology and ecosystem functioning. Ocean is not transparent to radio waves, and it is therefore impossible to use satellites for detailed profiling of its parameters. The Argo floats made it possible to dramatically increase the density of physical observations in the upper 2000 m. Among other outcomes, this allowed to explain the recent non-existed "climate hiatus", but, more importantly, to start monitoring the heat content of that layer. Significant changes were discovered. They are taking place in many locations and are already affecting ocean life, sea level rise, tropical cyclones, sea ice, and many other phenomena and variables.

Ocean science remains the main source of inspiration and funding for ocean observations. There is a need for Governments to be supporting GOOS more sustainably than they do it now. Every Dollar invested in ocean observations comes back several times with returns in ocean ("blue") economy and trade, safety of people and environment, health and wellbeing. There are at

present major projects spearheading the development of all ocean observations in major ocean basins: Tropical Pacific Observing System 2020, AtlantOS, Second International Indian Ocean Expedition (IIOE-2). Scientists are embarking on observations in the deeper ocean, e.g. via Deep Ocean Stewardship Initiative and Deep Ocean Observing Strategy. The SCAR and SCOR develop the Southern Ocean Observing System (SOOS). There are several initiatives in the Arctic Ocean but overall, this important and fast changing region suffers from insufficient progress in internationally accepted and coordinated ocean observations.

Think globally but act locally! Oceanography is a regional science. To facilitate regional applications that often require best practices and capacity development, GOOS has promoted so called GOOS Regional Alliances. They respond to identified regional needs and have a rich variety of activities of national and regional value.

GOOS coordination is achieved through a rather effective intergovernmental process led by IOC. Significant contribution comes from the research institutes united under the Partnership for Observations of the Global Ocean (POGO). The CLIVAR Project and the Regional Sea-Level Rise Grand Challenge of the World Climate Research Programme are major drivers in terms of scientific developments. GOOS operates in strict compliance with UNCLOS. Entry of Argo buoys into Exclusive Economic Zone of countries is monitored by the JCOMMOPS. Countries are duly informed of such occasions. Similar requirements may be needed for operation of ocean gliders, a fast-developing and very promising network. The IOC International Ocean Data and Information Exchange Program (IODE) facilitates data management. A major real-time service is the IOC-coordinated tsunami warning and mitigation service operated in 4 tsunami-prone regions of the World Ocean. It is also a system worth of hundreds of millions US$.

IOC proposes to the UN a Decade of Ocean Science for Sustainable Development, towards the Ocean We Need for the Future We Want. The intention is to unite efforts of UN, nations and mainstream science-based solutions for healthier ocean and blue growth. This will require a sustained and comprehensive observing and information system and major capacity development efforts so that all countries could benefit from it. Oceanography, which used to be a curiosity driven science, will have to transform into a science- and observations- underpinned information technology of direct societal relevance.

Mr. Sindre Langaas
Institute for Water Research (Norway

Bio

Dr Sindre Langaas is research manager for the section, Water and Society, at the Norwegian Institute for Water Research (NIVA). He has been instrumental in the establishment and development of the Norwegian Blue Forests Network (www.NBFN.no). This network gathers the collective expertise of Norwegian blue forests experts from the Institute for Marine Research (IMR), GRID-Arendal and NIVA, with knowledge about blue forests in both temperate and tropical parts of the World. Langaas has previously worked knowledge-based for a variety of organisations ranging from UNEP/GRID-Arendal (UN), the Royal Institute of Technology (research), County Administrative Board of Stockholm (authority) to the Federation of Swedish Farmers (interest organization) before taking up the current position at NIVA. He has been a key person and project manager in several national and international EU projects, within different thematic areas, such as water and coastal management, research, environmental information technology and agri-environmental advisory. Langaas has also represented the UN within the Helsinki Commission for the Baltic Sea region and COPA-COGECA (EU's farmer organisations) in the review process of the revised EU water policy; Blueprint to safeguard Europe's waters. He has published around 25 peer reviewed scientific papers, numerous other publications, co-edited a book on the role and use of environmental information in transboundary water management, hosted several conferences and been invited as key speaker to several others.

Abstract

"*The role of 'blue forests' to capture and store atmospheric carbon and their ability to provide a variety of other beneficial ecosystem services, both nationally and globally"*

Blue forests are marine and coastal ecosystems that are particularly valuable through their provision of multiple ecosystem services, of which carbon capturing and sequestration are one. The ability to assimilate and store atmospheric carbon is shared by all marine ecosystems (a concept also termed 'blue carbon'). Some are particularly effective at this. Mangrove forests, seagrass meadows and saltwater marshes in tropical areas account for more than 50 % of all carbon storage in ocean sediments; despite they only cover 0.5 % of the sea bed. In the northern and southern hemispheres, kelp forests are particularly important. Kelp forests live on temperate and boreal rocky reefs, covering 25 % of the world's coastline and are found, for example, along most of the Norwegian coast. The carbon value of coastal blue forests is being recognized as important by the UN Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC), not at least due to the ability to sequester vast amounts of carbon – up to five times that stored in tropical forests. Blue forests ecosystems also provide many other important services beyond the carbon sequestration. In tropical areas the mangrove ecosystems are particularly important for coastal and island communities by protecting against coastal erosion, storms and flooding; also making them valuable for climate change adaptation. They provide food from fisheries, as well as a habitat for juvenile fish and shrimps to thrive in. They improve coastal water quality by trapping sediments and nutrients. They can provide local revenue from tourism, as well as materials for building or ingredients for medicines. All tropical blue forests ecosystems are under considerable human pressure, thus their conservation and sustainable use is crucial.

Mr. Elliot Harris

UN Assistant Secretary-General, Director of the New York Office, United Nations Environment

Bio

On 1 April 2015, United Nations Secretary-General Ban Ki-moon appointed Elliott Harris as Assistant Secretary-General and Head of the New York Office of the United Nations Environment Programme (UNEP). Mr. Harris joined UN Environment as Director of the New York Office and of the Secretariat of the UN Environment Management Group (EMG) in September 2013. Prior to joining UN Environment, he worked as an Economist in the IMF from 1988 to 2013, gaining extensive policy and programmatic experience in African and Central Asian countries, as well as in the Fiscal Affairs Department on public expenditure policy issues. From July 2002 onward, Mr. Harris served as Advisor, Chief of the Development Issues Division, and Assistant Director of the IMF's Strategy, Policy and Review Department. From September 2008 until May 2012, he was also the IMF's Special Representative to the United Nations, and was closely involved in interagency collaboration in the areas of social protection, green economy, and fiscal space for social policy. From September 2009 until October 2013, he was the Vice Chair of the High-Level Committee on Programs (HLCP) of the UN Chief Executives Board for Coordination.

Abstract

"Regional strategies to address climate change through the application of ecosystem-based adaptation"

Even under the most ambitious mitigation scenarios, the impacts of climate change will be severe for coastal communities as well as business sectors and countries dependent on the marine environment. Adaptation measures that use natural ecosystems to reduce vulnerability can reduce climate change impacts. Such ecosystem-based solutions are readily available, can be applied in combination with conventional adaptation options, and are often comparatively cost-effective. Because marine and coastal ecosystems as well as climate impacts are transboundary, the development and implementation of adaptation plans incorporating ecosystem based approaches requires regional coherence to increase the efficacy of adaptation actions. Regional

level exchange of best practice, data and tools as well as leveraging of adaptation finance also brings added gains. The presentation will provide an overview of how regional frameworks promote ecosystem-based adaptation, and thereby also delivery of the sustainable development goals, with concrete examples from the work of UN Environment and Regional Seas Conventions and Action Plans.

Ms. Bethan O'Leary
Environment Department, University of York (UK

Bio

Dr. Bethan O'Leary is a Research Associate in the Environment Department at the University of York, UK. Currently she is undertaking research on large-scale marine protected areas (MPAs) and MPAs in areas beyond national jurisdiction in association with Professor Callum Roberts and with support from the Pew Charitable Trusts.

Abstract

"Building resilience into ocean management: Marine reserves in a changing climate"

The impacts of greenhouse gas emissions on marine life, ecosystem services, and human well-being are increasingly apparent and likely to intensify in coming years. Strong decreases in greenhouse gas emissions are required to meet the reduction trajectory resolved within the 2015 Paris Agreement. However, even this will not avert serious stress and damage to life on Earth and additional steps are needed to boost the resilience of ecosystems, safeguard their wildlife and protect their capacity to supply vital goods and services. One of the most practical and cost-effective strategies in ocean conservation is the creation of well-managed marine protected areas (MPAs), places in the ocean where human activities are restricted to varying degrees. Benefits of MPAs, however, are highly contingent on the level of protection given. Fully protected areas closed to all extractive uses, and strongly protected areas that are closed to all but limited, low impact fishing methods, often referred to as marine reserves, produce the greatest conservation benefits. Evidence shows that well-managed MPAs, and particularly marine reserves, can be an effective tool for repairing damage to overexploited fish stocks and habitats, and for conserving biodiversity. However, evidence also suggests that the act of protection itself may enhance the biological processes that underpin adaptation and resilience to climate change, both for the benefit of the protected ecosystem and for the people that depend on it.

Prominent impacts from rising greenhouse gases include: (1) ocean acidification, due to absorption of atmospheric carbon dioxide (CO2); (2) sea-level rise and intensification of storms, driven by warmer oceans; (3) shifts in species distribution, because of changes in ocean heat content and in currents; and (4) decreased productivity and oxygen availability, arising from surface warming. Marine reserves can help contribute to mitigating and enhancing adaptation to these impacts through a variety of mechanisms. For instance, by protecting coastal wetland habitats marine reserves help secure a major sink for carbon. Such habitats may offer daytime refuges to calcifying organisms from ocean acidification because of localised reductions in CO2 concentrations caused by high photosynthetic activity. Similarly, these habitats, together with mudflats and biogenic reefs, like oyster and coral reefs, offer effective coastline protection against rises in sea-level and extreme weather events. Larger populations of protected animals with extended age structures will also reduce the variability of population replenishment, increase resilience, and may offset predicted declines in productivity, helping to support fisheries. Regionally networked marine reserves can also provide stepping stones for dispersal and safe 'landing zones' for climate migrants, and possible refuges for those unable to move.

Marine reserves will not halt change or stop many of the threats associated with climate change affecting communities within their boundaries. Nor are they a substitute for rapid reductions in

greenhouse gas emissions or appropriate land and water management. However, marine reserves are a viable low-tech, cost-effective adaptation strategy that would yield multiple co-benefits from local to global scales, improving the outlook for the environment and people into the future. They provide an essential foundation of the marine management portfolio, building resilience into ocean ecosystems and improving the outlook for continued ecosystem functioning and delivery of ecosystem services.

Mr. Cyrille Barnerias
Global Environment Facility
1899 Pennsylvania Ave NW – Washington DC, USA (cbarnerias@thegef.org
Bio
Cyrille Barnerias is a Senior Environmental Specialist at the Global Environment Facility working on marine and biodiversity issues mainly in Africa and Small Island Developing States. Prior to joining the GEF, he worked for the French Ministry of Ecology in Martinique as a project manager on Biodiversity, Protected areas and Marine turtles. During this phase, in addition to local projects, he participated in Regional and National networks as well as in cooperation action with Cuba on marine biodiversity inventories. He also serves as an expert to evaluate biodiversity projects funded by EU in the overseas territories and Regions in the Caribbean within the BEST initiative. Cyrille Barnerias holds a Master Degree from Agro Paris-tech on management of living resources and a Master Degree on Forest Biology.

Abstract
"Climate finance".
The Global Environment Facility and climate change finance, lessons learned and way forward
With more than US$209 million and US$ 788 million in co-financing invested in active projects around the globe on climate change and marine and coastal habitats, the Global Environment Facility (GEF) has developed a wide portfolio. It ranges from roads and ports reinforcing, early warning systems for fishermen, mangrove plantation to fisheries adaptation. Starting with a rapid analysis of the GEF portfolio, we will present innovative financing mechanisms such as blue bonds and debt-for-nature financing or impact investment funds to reflect on their potential interest for ocean climate finance.

Mr Hassan Moustahfid
Food and Agriculture Organization of the United Nations
Bio
Dr. Moustahfid has studied fisheries oceanography for the past 23 years. Prior to joining UN FAO as a senior fisheries resources officer, he served as a federal scientist and manager of US National Oceanic and Atmospheric Administration (NOAA), US Integrated Ocean Observing System Program (U.S. IOOS), managing the implementation of projects and programs to improve the integration of ecosystem observations to support sustainable fisheries, marine biodiversity conservation and climate change research. He is currently co-authoring a chapter on marine biodiversity assessment for the 4thUS National Climate Assessment. Dr. Moustahfid was instrumental to the development of the concept of the Blue Belt Initiative to boost Coastal and Marine Resilience to Climate Change launched at the 22nd Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC COP22), held in Marrakech, Morocco in November 2016. Over his Fisheries research career, he has worked on issues involving understanding the impacts of human activities on the sustainability of marine ecosystems. His work has moved more towards applied ecological modeling and practical

fisheries science for management. Recent efforts have focused on understanding the impacts of changing environment on the abundance and distribution of ocean pelagic species and improving multispecies population assessments models by accounting for ecosystem and environmental considerations. He has published in numerous peer-review journals and collaborated in books including recent book on "World Squid Fisheries".

Abstract

"Current Actions, Identified Solutions and Opportunities in Addressing the Effects of Climate Change on Fisheries and Aquaculture"

The recent Conference of the Parties (COP22) held in Marrakech, Morocco 2016, increased political will and momentum to move towards greater transparency and accountability in addressing the causes and consequences of climate change. For the oceans, awareness raising continues but with greater emphasis on defining sustainable solutions. Nationally Determined Contributions (NDCs) became a reality upon ratification of the Paris Agreement, with 70 percent of countries identifying adaptation commitments, of which 60 countries specifically referred to fisheries and aquaculture in their adaptation and/or mitigation commitments.

The Food and Agriculture Organization of the United Nations (FAO) works collaboratively with its Members and relevant partners, supporting the incorporation of adaptation and mitigation strategies into development policies and projects, while continuing to alleviate hunger and poverty. FAO within its mandate plays a unique role in raising awareness, disseminating information, and providing an open forum to discuss climate change solutions. In this context, FAO actively supports countries to effectively mitigate and adapt to the effects of climate change for fisheries and aquaculture and aquatic systems through research based and practical programs and projects. FAO advocates adapting to climate change at four different levels in a coordinated manner: 1. Institutional and governance adaptations, 2. Livelihood adaptations, 3. risk management and reduction, and 4. increasing resilience resource base, communities and value chains.

The design and integration of Fisheries and Aquaculture issues in National Climate Change Adaptation Plans (NAPs) are critical, as are access to resources to enable implementation. In this presentation, FAO will describe its approach, using examples, such as the recently developed 'Africa Package' for developing climate-resilient ocean economies, for coastal regions and the Small Island Developing States. This ambitious package, coordinated with the African Development Bank and World Bank, draws together climate change knowledge and activities for ocean-related sectors.

FAO recognizes that for adaptation and mitigation actions to be sustainable, they must target both short and long-term needs and incorporate local voices and actions in the implementation of programme of work. In this context, FAO incorporates the Blue Growth Framework designed to restore the potential of the oceans and wetlands, by supporting responsible and sustainable approaches to reconcile economic growth and food security together with the conservation of aquatic resources. The main goal of this framework is to create an enabling environment for people employed in fisheries and aquaculture to act not only as resource users, but also as stewards.

Mr. Muhammad Lukman1, Mr. Widi A. Pratikto2 , Mr. Destyariani L. Putri3
Coral Triangle Initiative
Bio
Technical Program Senior Manager, Regional Secretariat of CTI-CFF. Jl. A.A. Maramis, Kayuwatu, Kairagi II, Manado 95254, North Sulawesi, Indonesia;

Executive Director, Regional Secretariat of CTI-CFF. Jl. A.A. Maramis, Kayuwatu, Kairagi II, Manado 95254, North Sulawesi, Indonesia;

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Abstract
"Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) measures and steps in addressing climate-change related coral reef issues in the region"
Coral Triangle (CT) region is recognized as one of the world's most ecological, biological rich on earth, and has its significant ecological, social, and economic values to support people life. Alas, it is inevitable from the cumulative effects of the climate change due to ocean warming and acidification, coupled with anthropogenic stresses particularly unsustainable resource exploitation and pollution. There is ample and increasing scientific evidence in the CT region and adjacent seas showing catastrophic effects of the ocean warming and acidification on the marine biodiversity – species and ecosystems -, and fisheries resources. Inter-alia, increasing coral bleaching and its cascading effects diminish the resilience of the coral reefs, eventually affecting social, cultural, livelihoods and economies of those directly dependent on living marine resources. Conserving this area is a global investment to the future of biodiversity, fisheries resources and seafood security in the world, and it should be promoted as collective nation-efforts. Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF) is a regional, multi-lateral partnership and an inter-governmental initiation established in 2009 by six countries –Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste, and supported by multi non-governmental organization, international organization and other governments. Needless to say, CTI-CFF is a world's investment in conservation management, which works to improve resilience of marine ecosystems and capacity of people for securing sustainability of biodiversity and fisheries resources. CTI-CFF addresses various emerging anthropogenic challenges and climate change impacts, through five strategic and measureable major goals, consequently implemented as major cores of 10-year regional (RPOA) and country's national plan of action (NPOA). It includes (1) effective management of priority seascapes, (2) promoting ecosystem approach to fisheries management, (3) improved management of marine protected areas, (4) improved climate change adaptation (CCA), and (5) threatened species management. The CTI-CFF levels off countries' capacity in ocean governance through establishing regional frameworks e.g. Region-wide Early Action Plan (REAP) and Local Earlier Action Plan (LEAP) for CCA of the near-shore marine and coastal environment and small islands ecosystems. At national level, CTI-CFF encouraged tens of various tangible and on-ground initiatives, activities and programs to prepare readiness, resilience and adaptive capacity of the coastal community to the (or potential) impacts of the CC. Instead of having established early warning system, vulnerability assessment, and disaster risk management, all CTI-member countries initiated more various CC-related actions, including e.g. blue carbon initiative and coastal resilience (Indonesia), integrated CC on integrated coastal zone

management (Malaysia), building community resilience and ecosystem rehabilitation (Papua New Guinea), building capacities on disaster risk reduction and climate change adaptation in small island communities (Philippines), use of LEAP and REAP for CCA implementation at community/provincial level projects (Solomon Islands), developing and operating national information network on climate change early warning and response (Timor-Leste). However, the dynamic challenges of the climate change impacts in the region is far beyond cumulative countries financial capacity to deal with. Therefore, global attention and commitment need to be further drawn specifically for CT region, which eases movement of supports from any possible climate-related finance instruments and mechanisms available.

Mr. Andi Eka Sakya

Bio

CURRENT POSITION
Head of BMKG, 2013 – now
Chair of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), 2017 – 2019
President of Regional Association V (South-West Pacific) of the World Meteorological Organization (WMO), 2014 – 2018
Member of the Executive Council of the WMO
Permanent Representative of Indonesia with the WMO
Indonesia Focal Point for ASEAN Sub Committee on Meteorology and Geophysics (SCMG)

EDUCATION
Aeronautical Engineering, Nagoya University, Japan, Dr. Eng., 1994
Aeronautical Engineering, Nagoya University, Japan, M. Eng., 1991
Physics, Bandung Institute of Technology, Indonesia, 1982

PREVIOUS PROFESSIONAL EXPERIENCE
Executive Secretary of BMKG, 2006 – 2013
Assistant to the Deputy Minister for Priority and Strategic Research Program, Ministry of Research and Technology, 2003 – 2005
Assistant to the Deputy Minister for Program Planning, Ministry of Research and Technology, 2000 – 2003
Head of Division for Research and Development on Aero-Gas Dynamics and Vibration Technology, Aero-Gas Dynamics and Vibration Laboratory, the Agency for the Assessment and Application of Technology, 1994 – 2000
During the period as Executive Secretary:
Board Member of IBCS and Involved actively at IBCS – GFCS since its inception representing Indonesia;
Responsible for directing, supervising and coordinating of planning, international cooperation, and human resource development;
Edited and published a book titled of: “Natural Disasters – Policy Issues and Mitigation Strategies”, published in 2011 by NAM S&T Center, India;
The driver of the promulgation of the Indonesian Law No. 31 on Meteorology Climatology and Geophysics in 2009.
Indonesian COST (Committee on Science and Technology) Coordinator for ITTIN Development (Industrial Technology Transfer Infrastructure Network), 2005 – 2006
Member of delegation on China – Asean Dialogue for SME Empowerment, 2005 – 2006
Founder of Center for Management of Innovation and Technology, 2005
Coordinator of an European Small Project Facility for Management of Innovation and Technology Program, in collaboration with International Center for Science and High Technology (ICS – UNIDO) – Trieste and Turino di Politechno, 2004 – 2005

Head of Sub-Division for Innovation to Research at Science and Technology Working Group (ISTWG) APEC for Research to Innovation, 2003 – 2006
AWARDS/ MEDAL
Presidential Awardee on Civil Servant Devotion of 10, 20, and 30 Years
Presidential Awardee on Distinguished Order for National Development Achievement, 2004
Ganesa Awards from Bandung Institute of Technology - Ganesa Wirya Jasa Utama, 2015
Bintang Jasa Utama (Presidential Awards), 2016

Abstract

"***The effect of climate change on people living in coastal areas in Indonesia: mitigation and adaptation experience and possible international cooperation".***

The complexity of atmospheric dynamics, in Indonesia as the biggest archipelagic country laying right in the topical line, and the increasing uncertainty of weather and climate pattern due to the inevitability of climate change, often cause weather anomalies. Those, combined with potential tsunamis, though rarely occurring, pose a threat to those who live in the coastal areas.

In the objective of disaster risk reduction, Indonesia has established weather, climate and tsunami early warning systems. The system has been proven to operate properly. The tsunami early warning system established on 2008 has been able to provide earthquake and its tsunami potential information within less than five minutes after earthquake occurred in all regions of Indonesia. Together with India and Australia, Indonesia became a regional tsunami service provider for countries in the Indian Ocean.

Likewise, the weather and climate early warning systems, inaugurated in 2011 and 2013, respectively, are able to provide early warning information on potential weather and climate extremes and their potential impact, such as flood, land slide, small tornado, drought, forest fire, volcanic ash trajectory, wave height, coastal inundation as well as storm surge. The latest development tool is the Ocean Forecast System (OFS) that enables forecasting of direction and velocity of currents, temperatures and salinity in each layer under the sea for a week ahead.

OCS is able to provide forecast of changes in direction and velocity of currents, temperatures and salinity in each layer under the sea for a week ahead.

The learning experience and facts on operationally running the systems for more than 5 years have, however, shown that a well developed early warning system requires that two factors are fulfilled. The first is the system in the upstream part that should have a proper technical structure and guarantee that the warning information is disseminated in a timely, accurate, broad and understandable manner.

The second is on the downstream part that deals directly with the people impacted which is level of disaster literacy. The susccesfull indicator of this is measured by the properness of response upon receiving the warning.

This brief report describes BMKG's effort in improving the effectiveness of the downstream part. It started with the the Climate Field School (CFS) which particularly aimed at increasing the undertanding of farmers in the field to the climate information on local areas. The CFS has been conducted in all provinces and even in the ASEAN and WMO RA V (South West Asia Pacific Region) member countries.

In the last two years, the CFS type of activities has been expanded for fishery sectors including salt miners and, even for the purpose of particularly tsunami ready program, to local media as well as local disaster management offices in the tsunami prone area in the form of program of Earthquake and Tsunami Field School (Table Top Exercise).

Learning from the successful experience in many provinces as well as facilitating the training activities for other neighboring countries, Indonesia is ready to provide training for other small-

island and coastal countries prone to natural disaster. Video clip concerning the testimony of activities will be shown.

Keywords: Climate Change, Hydro-meteorlogical and Geological Disaster, Early Warning System, Literacy, Coastal Area, Climate Field School, Fishery, Tsunami.

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Bio

Christina Hioureas is a Counsel in the International Litigation & Arbitration Department and the Chair of the United Nations Practice Group at Foley Hoag LLP. She represents States, private entities, and individuals on international disputes and public international law matters, including: investment treaty claims (ICSID, UNCITRAL); international commercial arbitration (ICC, ICDR, Swiss Rules) and litigation; treaty drafting and interpretation; international human rights; law of the sea; and energy law and gas pricing disputes. She also advises States before the United Nations and its bodies. Hioureas has served as a delegate at the UN, handling the Sixth Committee to the General Assembly (Legal Affairs), UN Commission on International Trade Law (UNCITRAL), and matters before the Security Council. She is an elected Term Member at the Council of Foreign Relations, a leading independent, nonpartisan U.S. foreign policy think-tank and publisher. She has served as an Adjunct Professor of Law at Fordham University School of Law and is on the Teaching Staff at the University of Piraeus, Department of International & European Studies - Energy Strategy, Law & Economics Program in Athens, Greece. She received her Juris Doctorate from the University of California Berkeley School of Law and her Bachelor of Arts from UC Berkeley in Political Science and Peace & Conflict Studies. She has been recognized in Legal 500, Chambers & Partners, and The Global Arbitr*ation Review.*

Abstract

"Effects of rising sea levels on maritime boundaries and deterritorialization".

Climate change and resulting rising sea levels have increasingly become an issue of global security, with ocean acidification causing territorial erosion, rising sea levels inundating territory, and increasing irregular weather patterns leaving areas uninhabitable. Consequences include the potential loss of maritime entitlements and the displacement of millions of persons. Greater challenges exist in circumstances where a population might be forced to move across borders, requiring international cooperation, financing, and recognition of refugees from conditions induced by climate change. For these and other reasons, the potential impact of rising sea levels on the spatial extent of national claims to maritime jurisdiction should be of concern for all States. Most critically, low-lying coastal States and small-island States face the threat of partial or even total de-territorialization.

This presentation will address the general approach to "normal" baselines under Article 5 of the 1982 United Nations Convention on the Law of the Sea (UNCLOS).[1] The question of changing maritime zones has been studied by the ILA Baselines Committee, which has argued that, "if the legal baseline changes with human-induced expansions of the actual low-water line to seaward, then it must also change with contractions of the actual low-water line to the landward" and that "existing law of the normal baseline does not offer an adequate solution to this potentially serious problem."[2] Following this introduction, the presentation addresses the implications of shifting baselines on maritime entitlements as well as the possible alteration of the capacity of certain maritime features to generate entitlements. The presentation will conclude with the possible results of such claims and proposals for the way forward.

[1] Article 5 of the 1982 United Nations Convention on the Law of the Sea, UN doc. A/CONF.62/122; text in UNTS, vol. 1833, at 3; text reprinted in (1982) ILM, Vol 21, at 1261; available at www.un.org/ Depts/los.
[2] ILA Baselines Committee, *Final report* (2012).