

ICES-PICES-IOC Symposium on Climate Change

by William T. Peterson

Thunderous applause ended the extraordinarily successful symposium on “*Effects of climate change on the world’s oceans*”, held from May 18–23, 2008, in northern Spain in the lovely seaside community of Gijón. With Dr. Luis Valdés saying “*I now declare this Symposium closed*”, more than 2½ years of planning, fund-raising, and labouring over the scientific and logistical details resulted in the first international meeting to treat the broader issues of climate change and its effects on marine ecosystems and society. The objectives of the symposium were fulfilled. Views, ideas and data were exchanged by oceanographers from around the world to facilitate the development of new research directions and ideas.

The symposium was organized by the International Council for the Exploration of the Sea (ICES), North Pacific Marine Science Organization (PICES) and Intergovernmental Oceanographic Commission of UNESCO (IOC), and co-sponsored by the Global Ocean Ecosystem Dynamics (GLOBEC) project, Scientific Committee on Oceanic Research (SCOR), and the World Climate Research Programme (WCRP). Financial support was also provided by Fisheries and Oceans Canada, U.S. National Aeronautics and Space Administration, U.S. National Oceanic and Atmospheric Administration, Korea Ocean Research and Development Institute, and several Spanish sources (Asturias Science Plan 2006–2009, Ayuntamiento de Gijón, Port Authority of Gijón, and Sociedad Mixta de Turismo de Gijón). In addition to covering the costs of the facility and travel for plenary and invited speakers, these contributions

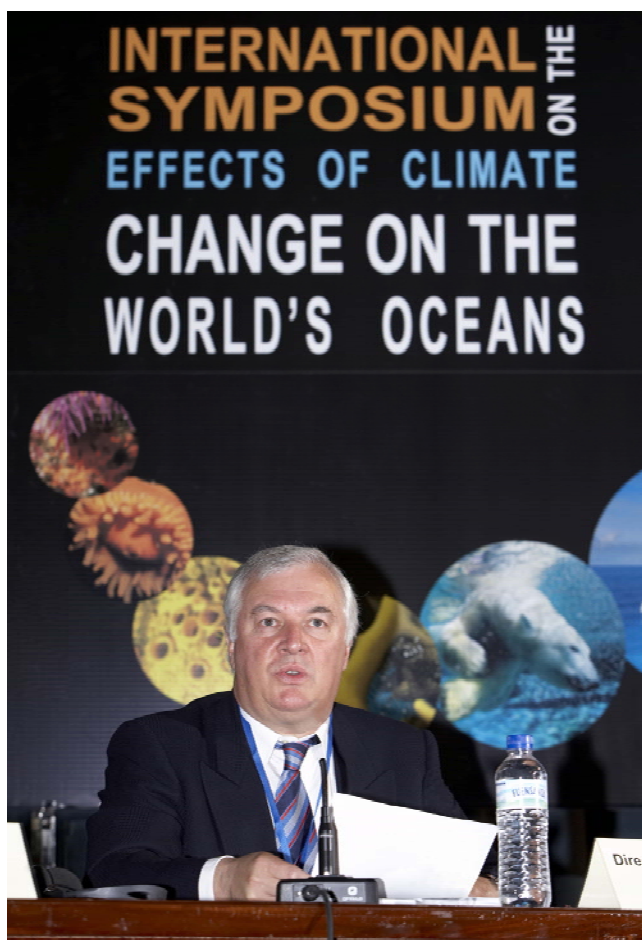
enabled the participation of ~60 young scientists and scientists from countries with economies in transition. The local organization was responsibility of the Instituto Español de Oceanografía – Centro Oceanográfico de Gijón (IEO), and their staff worked together with members of the PICES Secretariat to ensure that all things progressed efficiently.

The primary sponsors were represented by three convenors: Luis Valdés, (ICES, Spain), William Peterson (PICES, U.S.A.) and John Church (IOC, Australia). The science was led by a Scientific Steering Committee (SSC) that included Richard Feely (U.S.A.), Michael Foreman (Canada), Roger Harris (UK), Ove Hoegh-Guldberg (Australia), Harald Leong (Norway), Liana McManus (U.S.A. and The Philippines), Jorge Sarmiento (U.S.A.) Martin Visbeck (Germany) and Akihiko Yatsu (Japan).

The full program of the symposium included 4 workshops and 5 topics divided into 10 Theme Sessions. The formal Opening Ceremony took place on Monday (May 19) morning and involved local political authorities and representatives of the primary international sponsors. Each day, a Plenary Session, with two 45-minutes talks, was held in the morning, followed by two parallel Theme Sessions. In addition to the scientific sessions, 3 full-day workshops were convened on Sunday (May 18), the day prior to the symposium; one more half-day workshop was organized on Wednesday (May 21). Posters were on display during the entire symposium, with all coffee breaks arranged in the poster area to maximize opportunities to see



Full attendance at the plenary session (first row, second from the right is Dr. John Church, former Chairman of the Joint Scientific Committee for the World Climate Research Programme and IOC convenor of the symposium).



Dr. Luis Valdés, ICES convenor of the symposium and local host.



Press conference featuring from left to right, Patricio Bernal (Executive Secretary of IOC), William Peterson (ICES convenor of the symposium) and Joe Horwood (President of ICES).

these contributions and to interact with the presenters. Two evening “Wine and Tapas” Poster Sessions (May 22 and May 24) were a highlight of the symposium, with high attendance and lively discussions. In total, 382 participants from 48 countries contributed 215 oral presentations

(including 10 plenary and 20 invited talks) and 133 posters for this week-long event. Selected experts also had an opportunity to directly communicate their findings and thoughts on how climate change is affecting oceans and their ecosystems at daily press conferences with the regional and national media (press, radio and TV). In the evening of the first day, participants were invited to a Welcome Reception hosted by the Mayoress of Gijón at an old style restaurant (El Trole) in the suburbs of the city. Wednesday (May 21) afternoon was free for touring Gijón, and this was followed by a fabulous symposium dinner, where all participants enjoyed a traditional Asturian feast.

By design, the symposium covered a wide scope of topics, including: changes in oceanic circulation and physical characteristics of the oceans, climate modeling, changes in cycling of carbon and other biogeochemical elements, acidification of shallow seas, oligotrophy of temperate seas, impacts on lower and higher trophic levels, sea level rise and coastal erosion, *etc.* The symposium brought together global and regional data sets and models, and resulted in spirited discussions of climate change scenarios, revision of predictions from models and role of IPCC in assessing the predictions, reports on the effects of global warming in the oceans and methods for adaptation, and finally, the identification of challenges and “hot spots” for special consideration in the next 5 years.

Three general conclusions were reached at the symposium:

1. The global warming trend and increasing emissions of CO₂ and other greenhouse gases (GHG) are already affecting environmental conditions and biota in the oceans on a global scale.
2. We do not fully appreciate how large and deep these effects will be in the near future and we do not understand the mechanism and processes converting the individual responses of single species into shifts in the functioning regime of marine ecosystems.
3. We need to maintain the existing time series, establish more in some regions, do more experimental research, and develop more complex and higher resolution models.

Many other results can be highlighted. For example, experts studying CO₂ emissions described how atmospheric CO₂ is increasing at a rate of 4 parts per million (ppm) per year, instead of 3 ppm per year during the last decade. This acceleration indicates that the intermediate scenario portrayed in the Fourth Assessment Report of IPCC (IPCC AR4) is not the one we should consider, as future climate changes are likely to be much larger than what we have experienced. It was also confirmed that anthropogenic warming and sea level rise would continue for centuries, even if GHG concentrations were stabilized at or above today’s levels. Furthermore, IPCC AR4 estimates 0.2 to 0.6 m sea level rise by 2095 (relative to 1990) from thermal expansion of sea water, contributions from glaciers and icecaps, and estimates of the contributions of ice sheets

using the current generation of ice-sheet models. However, sea level could rise by an additional 0.1 to 0.2 m or more as a result of poorly understood dynamic responses of the ice sheets. It was noted that melting could potentially exceed precipitation as the earth warms, leading to an ongoing contribution to sea-level rise. The Greenland and West Antarctic Ice Sheets are “hot spots” to be monitored in the next decade. The response of the high latitude climate system to climate change is also uncertain due to poorly quantified feedbacks and thresholds associated with the ocean circulation models.

Hurricane intensity and the size of regions where they are formed will increase as the sea warms and accumulates more energy earlier in the year over a larger area. The combined effect of acidifying the world ocean and increasing its temperature has accelerated the bleaching of coral reefs. Corals are vulnerable to climate change and may disappear at CO₂ levels above 450–500 ppm or at a further temperature increase of 1°C above today’s level. This change is risking not only the corals, but the entire biological community associated with them. This community includes several thousand species of different classes, and approximately 50% of these species may disappear. It was also noted that the size of oligotrophic oceanic gyres has increased over the last decade, and the depletion of nutrients in the surface layer should be explored in regional seas as well. The depletion of oxygen in upwelling areas should also be carefully observed in the following years.

Fisheries are affected by the cumulative and interactive effects of fishing, pollution, coastal development, and climate change. The ecosystem effects of fishing (such as habitat destruction, bycatch, species interactions and practices of selective catch of old fat female fish) were considered to have a greater influence on population dynamics than the effect of climate change. Nevertheless, climatic effects may be detected in the migratory routes of tuna and in geographic displacement of small pelagic fishes in the northern hemisphere (and east–west displacements in the southern hemisphere). Increased water temperatures are likely to shift species ranges to higher latitudes but are unlikely to lead to the extinction of present arctic fish species.

Many commented that observing marine ecosystems is significantly more difficult than observing terrestrial ecosystems. Besides, research in the oceans tends to be ephemeral and concentrated in coastal waters. Lack of accessibility to most marine ecosystems prevents many nations from investing the economic resources needed to establish permanent programs to monitor these seas. Satellite observing systems are effective but generally restricted only to seeing what is at the sea surface. Even shallow areas, such as sea grass meadows and coral reefs, remain hidden from satellites. New and powerful instruments are now available to observe the physical properties of oceans, but we continue to lack technologies to monitor biological communities with the proper spatial and



Lively discussions during the “Wine and Tapas” Poster Session at Palacio de Congresos de Gijón.



Group photo taken on the grounds of the restaurant El Trole prior to the Welcome Reception.

temporal resolution. The southern hemisphere and the Indian Ocean are vast regions that are poorly (or not at all) covered by monitoring programs. This causes bias in perceptions and in the predictions of models. It was suggested that international collaboration should be pursued to establish permanent research programs in these areas.

The last afternoon of the symposium was capped off with a review of the highlights and a lengthy discussion of impressions. John Church reminded us that climate change has become the environmental issue of our time, with a wide range of impacts that may have little effect upon us but certainly will affect our children's futures. He also noted that the marine science community has been slow to enter into the climate change debate, and gave as evidence the shortage of information on climate impacts on the ocean. Chapter 1 of Working Group II of IPCC AR4 lists only 30 marine data series (biological and physical) in the synthesis of climate impacts, compared with 622 series from the cryosphere and 527 series from terrestrial biological systems. Furthermore, only 4 out of 43 authors of this chapter were marine biologists, which results in a greater likelihood that changes in the ocean are under-represented.

IPCC criteria for accepting data in assessments demand that each time series be at least 20 years long and end in 1990 or later. One way to bolster confidence and enhance transparency in the IPCC process would be to provide the details of each time series used in the report as an appendix, as is the norm in large meta-analyses. In addition to identifying gaps, it would allow the broader scientific community to provide quality control of the data gathering and interpretations that underpin the assessment. The hope was expressed by many participants that this symposium has stimulated further engagement and further interactions among the IPCC and marine scientists. Many recognized that here is a clear need for the community of scientists to communicate with the community of policy and decision makers.

The need to maintain existing physical and biological time series was strongly emphasized. These will provide the data required to understand interdecadal variability underlying global warming, as well as the effects of the global warming per se. But exploring the effects of climate change cannot rely solely on observations. New experiments are needed, and ocean acidification is a clear example. Several people stressed the importance of good communication systems that would allow delivery of data in real-time and facilitate data exchange. An added value is that the community would have access to a greater variety of data. Finally, more complex and finer scale models are needed to provide accurate and timely information to the policymakers and to society.

A recurring theme of the discussions was the need to identify "mechanisms" which lead to ecosystem change. Correlations of physical variables collected at basin scales, with fish catches recorded locally, are not going to be very useful in our quest to understand, forecast and predict future fish catches and ecosystem productivity. Far more hypothesis testing will be necessary. Down-scaling from basin to regional scales, species life histories and physiological traits become important. There is a need for process studies of feeding, growth, respiration and mortality of key species to improve the parameters used in ecosystem models. Comparative ecosystem studies will continue to provide new insights into mechanisms through which ecosystems may respond to physical forcing. Moreover, there is a clear need to expand our knowledge of the rates at which species might be able to adapt to a rapidly changing planet.

The new challenges for the next 5–10 years include the study of non-linear effects on biological processes leading to shifts in ecosystems, the decadal variability underlying the signal of climate change, the rate of melting in Greenland, the acidification of the oceans, the expansion of oligotrophic gyres (how productive will the ocean be in the

future), detrimental changes in upwelling systems, species sensitivity to climate change, and the interaction of climate change with other human impacts and activities.

Jane Lubchenco reminded us that there is no cohesive community of researchers to study adaptation and mitigation of societies to impacts of climate change on national and local economies and societies. Such studies are often piecemeal and anecdotal in nature. Thus, there is a need to integrate social science and natural science. Although these socio-economic studies are in their infancy, the child needs to develop very quickly. For managers and policy makers, major choices are on the horizon and decisions may have to be made that are based largely on values, economics, and politics rather than on a clear scientific understanding of a given problem. For this to change, scientists will need to become engaged with the policy community. And on this point, Andy Rosenberg reminded us that the scientific community must not be afraid to share with managers what is known about our science (but of course within the bounds of some uncertainty). After all, we do know far more about science than the managers and the best way to impart the knowledge is through frequent dialogue.

Several participants noted that the internet has provided access to current literature at a frightening pace, but it has come at a cost. Libraries, especially at marine stations, are becoming under-utilized and funds are being cut. This is a growing threat to the historical literature. Old papers can be an inspiration for new ideas. If nothing else, they are an untapped source of data and observations of our world as it was. Students may not be reading the classical papers any more because they are not available as pdf files on journal websites. Hence, they can fail to recognize the rich history of ideas in the marine literature.

A selection of papers from the symposium will be published as a special issue of the ICES *Journal of Marine Science* in the spring/summer of 2009. Guest Editors for this volume will be appointed accordingly with the disciplines of the manuscripts submitted for evaluation.

At the Panel Discussion on the last day, it was remarked that this was the largest and most important symposium that has ever been held on the effects of climate change on the oceans and that a follow-on symposium, patterned after the Gijón meeting, must occur within 3–5 years. Earlier dates in this range are needed if the work is expected to

influence IPCC AR5. The marine science community is soliciting a host for the Second Symposium on “*The Effects of climate change on the world’s oceans*”.

At the Closing Ceremony, we also honored the early career scientists who gave the best talk and prepared the best poster. The recipients were: Laura M. Parker (University of Western Sydney, Australia) for her presentation on “The effect of ocean acidification and temperature on the fertilization and development of the Sydney rock oyster, *Saccostrea glomerata* (Gould, 1850)”, and Meike Vogt (University of East Anglia, UK) for her poster on “The dynamics of dimethylsulphide and dimethylsulphoniopropionate in a global prognostic model”. Honorable mentions were awarded to: Stephanie Henson (Princeton University, U.S.A.) for her talk on “Decadal changes in North Atlantic phytoplankton blooms”, and Sam Dupont (Göteborg University, Sweden) for his poster on “CO₂-driven acidification radically affects larval survival and development in marine organisms”.

As the symposium convenor representing PICES, I am satisfied that the PICES community was well represented by members of SSC and session co-convenors (Richard Feely, Michael Foreman and Akihiko Yatsu), by invited speakers (Sanae Chiba, Michio Kishi and Gordon Kruse), and by leaders of two workshops: on “*Zooplankton and climate: Response modes and linkages among regions, regimes, and trophic levels*” (David Mackas) and on “*Linking Global Climate Model output to (a) trends in commercial species productivity and (b) changes in broader biological communities in the world’s oceans*” (Anne Hollowed, Thomas Okey and Michael Schirripa). Brief reports of these workshops are included in this issue of PICES Press. I am most proud of the PICES Secretariat who provided professional assistance in the planning, coordination and development of the symposium. Special thanks go to Julia Yazvenko who created and maintained the symposium website and the database, communicated with more than 400 potential participants, co-sponsors and convenors, and prepared (with Dawn Ashby of GLOBEC) the book of abstracts.

I also wish to express my sincere gratitude to Dr. Luis Valdés who, in addition to being the ICES convenor, led the Local Organizing Committee and put an enormous amount of time and efforts into making this symposium a success. His staff at IEO, and especially Audrey Lecornu, worked tirelessly before and during the symposium to assure that the show ran smoothly.



Dr. William (Bill) Peterson (Bill.Peterson@noaa.gov) is an oceanographer and zooplankton ecologist at the Hatfield Marine Science Center in Newport, Oregon. He works for NOAA's National Marine Fisheries Service, and his research focuses on climate effects on zooplankton, particularly euphausiids and copepods. Within PICES, Bill has served on several expert groups and is currently a member of the Biological Oceanography Committee and Co-Chairman of the Working Group on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim.