

Planning meeting for an open science conference on "Climate driving of ecosystem changes - making the connection"

Royal Society, London, 7 Dec 2006. Start time 0930 (to be confirmed)

Introduction

The Science and Implementation plans of the GLOBEC, SOLAS and IMBER programs state the importance of variations of the physical climate system on ocean biogeochemistry and ecosystems. Sensitivity of the marine environment to climate change is one of the main themes of these SCOR/IGBP programs. However, the expertise on patterns of climate variability and their projected changes in future climate lies in the CLIVAR project of WCRP. Therefore, there is a need for cooperation and information exchange between the SCOR/IGBP programs and WCRP-CLIVAR.

At the meeting of the Atlantic Implementation Panel of CLIVAR (Venice, Oct. 2005) a GLOBEC representative was invited and informed the Atlantic Implementation Panel of the importance of climate variability for the marine environment. A list of questions from the GLOBEC community was delivered to CLIVAR. These questions concern impacts of patterns of climate variability, such as the North Atlantic Oscillation and the El Niño-Southern Oscillation, on marine systems. One example is the impact on upper ocean temperature, upwelling characteristics in past and future climate (see Appendix 1). The Pacific Panel has formulated an answer (Appendix 2), but more action is needed. Consequently, it is proposed to organize an open science meeting on these issues.

Proposal for an open science meeting

At the SSG meeting of CLIVAR (Buenos Aires, April 2006) it was proposed to accommodate an open science meeting together with the marine programs of SCOR/IGBP to address the issues mentioned above. This plan was positively received at the SSC meeting of IMBER (Brest, May 2006) at which representatives of SOLAS and GLOBEC were present. The goals of such an open science meeting could be

1. To exchange information on climate variability impacts and marine impacts between physical climate science and marine biogeochemistry and ecosystems communities
2. To foster cooperation between WCRP and SCOR/IGBP projects
3. To take stock of IPCC-AR4 results where relevant for impacts on the marine environment.

We are envisioning an open science meeting (conference/workshop) with 50-100 participants to be held at the end of 2007.

Planning meeting

We propose to discuss this proposal for an open science meeting just prior to the SCOR Project Summit in December 2006 in London. This planning meeting is expected to have active involvement of the chairs of the SCOR/IGBP-sponsored and -affiliated programs, and CLIVAR representatives. To set the scene, it is proposed to include a science lecture on changes in the physical climate system as a component of the planning meeting.

Specific goals of the planning meeting are to:

1. Inform on modes of climate variability relevant for marine environment in the form of a science lectures.
2. Discuss the desirability of holding an open science meeting on “Climate impacts on the marine environment”, and if desirable, form an organizing committee.
3. Set up terms of reference for the committee
4. Initial planning of venue and date

Suggested invitees:

Chairs of the SCOR and IGBP programs GLOBEC, IMBER and SOLAS, as well as other projects attending the Project Summit.

CLIVAR representatives (CLIVAR IPO Director, and IMBER-CLIVAR liaison).

The planning meeting will be held on the morning of 7 December 2006 at the Royal Society, London. It will be chaired by Dr Howard Cattle (Director, ICPO).

Proposed agenda:

9:30-10:15: Lecture on changes of patterns of climate variability in future climate (?)

10:15-10:30 Coffee

10:30-12:30: Discussion on GLOBEC/IMBER-CLIVAR open science meeting

- Background of the proposed meeting (W Hazeleger, see background document)
- Define scope and goals of the workshop (All)
- Define format of the workshop (All)
- Suggestion for organizing committee (scientific and organization-IPO) (All)
- Suggestion for venue and date (All)

Appendix 1:

Some Issues and Questions raised by GLOBEC Studies where input from CLIVAR would be helpful.

Atmospheric Teleconnections between the Atlantic and Pacific appear to be driving ecosystem changes, especially noticeable in upwelling systems. What are the links? Will they change under global warming?

NAO. Many ecosystem changes in the North Atlantic reflect the variability in the NAO, e.g. primary production, individual growth rates of fish, recruitment, etc. What determines the variability in the NAO? What is the link between the NAO and regional processes? What is the relative importance of various teleconnections on the NAO, e.g. Indian Ocean forcing vs. snow over Eurasia?

Multidecadal Variability in the physical environment leads to major ecosystem shifts such as distribution and production (e.g. upwelling areas, 1920-1960 warming in North Atlantic). What controls this multidecadal variability? What are the changes in the ocean circulation on these time scales?

Modelling. Better parameterization of the shelf-open ocean exchanges are needed to help understand the exchange of plankton and larvae between these regions. This is needed to determine the movement of zooplankton, such as *Calanus finmarchicus*, that overwinter in the deep waters but are important prey for larval and juvenile fish on the shelves during the spring and summer. There is also a need to better link global ocean-atmosphere-ice models with ecosystem models.

Predictions. One of the objectives of GLOBEC is to predict what will happen to marine ecosystems on annual to decadal scales. This is especially important given the relatively recent decision by governments to adapt to Ecosystem Based Management. Good atmospheric and oceanographic scenarios are needed upon which to base these predictions.

Climate Change. GLOBEC needs future climate scenarios, especially for the ocean on regional scales, in order to predict possible ecosystem responses to anthropogenic forced climate change. Changes to the wind and wind forcing will be critical for many shelf regions as will what will happen to the MOC. Seasonal changes will be extremely important as they may lead to shifts in primary production with ripple effects throughout the upper trophic levels.

IPY. GLOBEC, through their regional program on Ecosystem Studies of Sub-Arctic Seas (ESSAS) is heading an IPY cluster that focuses on climate variability on subarctic and arctic ecosystems, from phytoplankton to seabirds. Cooperation with CLIVAR on IPY programs, perhaps even sharing resources (ship time, moorings, etc.) could be useful to both parties.

Paleo Studies. GLOBEC would also like to know how representative the present day ecosystems are compared to what existed previous, especially under different climate or climate variability regimes? This can only be answered by paleo studies. Another question of interest that paleo studies can shed light on is how robust is the multi-decadal variability?

Indices and Data. GLOBEC studies often require time series of many atmospheric and oceanic variables, either measured data or model output. Atmospherically these include atmospheric reanalysis products for regional studies, air temperature, air pressures, winds, P-E, air-sea fluxes, clouds, etc. From the ocean, we need circulation fields, temperature, salinity, turbulence levels, O₂, light levels, MLD, intensity of stratification, nutrients, etc. The GLOBEC WG3 on modelling asked whether there is an inventory of available model data or if there any plans to work on such an inventory?

Possible ways forward in terms of cooperation and collaboration between CLIVAR and GLOBEC include:

- Information Exchanges (e.g. Venice CLIVAR meeting, future newsletters, Jim Hurrell being on GLOBEC's SSC, etc.)
- Combined meetings/workshop on specific issues.
- Joint programs.
- Shared data products.

Appendix 2:

Response of CLIVAR Pacific Implementation Panel to GLOBEC questions

- *Atmospheric Teleconnections between the Atlantic and Pacific appear to be driving ecosystem changes, especially noticeable in upwelling systems. What are the links? Will they change under global warming?*
 - Our group discussed pan-oceanic teleconnections, in particular the impacts of changes in the meridional overturning circulation in the Atlantic on the ITCZ and on Pacific climate. This will be one of the major topics at the upcoming CLIVAR workshop on multidecadal to centennial climate variability which will be held in Honolulu on November 15-17th 2006. For more information, please go to the website: <http://www.phys.uu.nl/%7edijkstra/AMO/index.html>
- *Predictions. One of the objectives of GLOBEC is to predict what will happen to marine ecosystems on annual to decadal scales. This is especially important given the relatively recent decision by governments to adapt to Ecosystem Based Management. Good atmospheric and oceanographic scenarios are needed upon which to base these predictions.*
 - Interannual predictability: The panel found that the crucial problems common to many forecasting systems are initialization shocks, weak MJO-ENSO interactions and errors in the simulated ENSO statistic. These issues will be addressed in a proposed CLIVAR workshop on ENSO to be held in late 2007.
 - Decadal thermocline predictions: Panel member Scott Power showed model results illustrating the possibility of decadal predictability of thermocline depth in mid-latitudes. This idea is being pursued by members of the panel.
- *Climate Change. GLOBEC needs future climate scenarios, especially for the ocean on regional scales, in order to predict possible ecosystem responses to anthropogenic forced climate change. Changes to the wind and wind forcing will be critical for many shelf regions as will what will happen to the MOC. Seasonal changes will be extremely important as they may lead to shifts in primary production with ripple effects throughout the upper trophic levels.*
 - Akio Kitoh gave an overview of biases in the mean state of the IPCC AR4 coupled models citing in particular the cold bias in the central equatorial Pacific and the warm bias in the southeastern tropical Pacific. Kitoh also noted that uncertainties in future climate change projections are still very large and exacerbate regional assessments of future climate change in the Pacific.
 - Dick Feely presented results from the most recent field programs in the Pacific, illustrating that the interannual and interdecadal trends of surface water pCO₂ variability show significant large-scale spatial differences due to natural variability and anthropogenic impacts on atmosphere-ocean CO₂ fluxes.
 - Panel member Rodney Martinez reports that CIIFEN are working on determination of Climate Change indexes and indicators in Western South America. This includes ocean indicators that can be translated in possible

fisheries and/or long term scenarios if we can complement them with marine ecosystems analysis. This could be a good point of further exchanges between CLIVAR and GLOBEC.

- ***Multidecadal Variability*** in the physical environment leads to major ecosystem shifts such as distribution and production (e.g. upwelling areas, 1920-1960 warming in North Atlantic). ***What controls this multidecadal variability? What are the changes in the ocean circulation on these time scales?***
 - This issue will be addressed at the upcoming CLIVAR meeting on multidecadal variability (see website above).
- ***Paleo Studies***. GLOBEC would also like to know how representative the present day ecosystems are compared to what existed previous, especially under different climate or climate variability regimes? This can only be answered by paleo studies. Another question of interest that paleo studies can shed light on is how robust is the multi-decadal variability?
 - Members of our group are coordinating efforts between paleoceanographers and climate modellers to address the question of how ENSO changed under past climate regimes.
- ***Indices and Data***. GLOBEC studies often require time series of many atmospheric and oceanic variables, either measured data or model output. Atmospherically these include atmospheric reanalysis products for regional studies, air temperature, air pressures, winds, P-E, air-sea fluxes, clouds, etc. From the ocean, we need circulation fields, temperature, salinity, turbulence levels, O₂, light levels, MLD, intensity of stratification, nutrients, etc. The GLOBEC WG3 on modelling asked whether there is an inventory of available model data or if there any plans to work on such an inventory?
 - Given the large biases in model mean states and variability, the group discussed a possible synthesis of IPCC AR4 models in terms of how well they do at simulating the real climate and ENSO variability. This issue will be addressed at an informal workshop on ENSO in IPCC AR4 models this month. We would like to engage in discussions about which indices the GLOBEC community would be interested in from climate models to test whether they are properly simulating the relevant processes.
 - Several field programs were presented at the panel meeting which have possible overlaps with the interests of GLOBEC: SPICE (presented by Lionel Gordeau) focusing on the southern Pacific western boundary currents, PUMP (presented by Billy Kessler) – a process study on mixing in the eastern equatorial Pacific, and VOCALS (presented by Roberto Mechoso) focusing on the air-sea-land interactions in the south-eastern tropical Pacific. Our panel gave some scientific input to all programs.
 - Panel member Rodney Martinez reports that Eastern Pacific Consortium for Oceanographic Research is project involving 8 countries of Eastern Pacific, and may be a useful starting point for collaboration among CLIVAR, GLOBEC and ocean observation partners in the region.