

Working Group 27 on North Pacific Climate Variability and Change

The 2014 meeting of the Working Group on *North Pacific Climate Variability and Change* (WG 27) was held from 9:00 to 18:00 h on October 16, 2014 in Yeosu, Korea, under the chairmanship of Drs. Shoshiro Minobe (Japan), Emanuele Di Lorenzo (USA), and Michael Foreman (Canada) who welcomed participants. All member countries except China were represented (*WG 27 Endnote 1*).

AGENDA ITEM 2

Meeting agenda

The agenda was reviewed and no changes were made (*WG 27 Endnote 2*).

AGENDA ITEM 3

Presentations on recent work related to terms of reference

Dr. Di Lorenzo reviewed the terms of reference and reminded WG members to download the form developed by him from <http://goo.gl/IP3vE1> for input of key information by each member responsible for their relevant term of reference.

TOR#1 and #2

Drs. Sang-Wook Yeh and Di Lorenzo volunteered to oversee these sections. (References and summary of key articles to be collected in the form.)

TOR#3

Publish the ECOFOR Workshop report <http://wg27.pices.int/ecofor/> as a PICES scientific report. This report contains at least 10 examples of developing physical-biological process models.

TOR#4

Although some work done by several WG 27 members (*e.g.*, Minobe, Mochizuki, Foreman, Ustinova, Bograd, and Di Lorenzo/Furtado), members discussed incorporating the following items:

1. There is uncertainty in the tropical/extra-tropical teleconnections and in detecting the signatures of climate change on the natural variance of key atmospheric forcings (*e.g.*, Yeh). Often climate models do not capture the relationships between atmospheric forcing and oceanic response (*e.g.*, Furtado). Dr. Bunmei Taguchi added that the work done by Miyasaka *et al.* appears to be relevant to this context and Sang-Wook Yeh's earlier studies. It discusses how the natural atmospheric variability associated with Pacific decadal variability and the related tropical-extratropical linkage modulate on multi-decadal time-scale (Miyasaka, T., H. Nakamura, B. Taguchi, and M. Nonaka (2014), *Geophys. Res. Lett.*, 41, 2948–2955).
2. East-west asymmetry in the challenges of downscaling model outputs (*e.g.*, Minobe)
3. Determining the signal-to-noise ratio in wind trends, both in open ocean and coastal winds, is still unclear and CMIP5 models are not consistent (*e.g.*, upwelling trends, Sydeman *et al.*, 2014; Mantua *et al.*, 2014). There are issues about intensity and phenology. The issues of signal-to-noise ratio applies also to other physical and biological properties including (*e.g.*, oxygen).
4. The Arctic response in the IPCC model and impacts on coastal freshwater (*e.g.*, Ustinova). There is uncertainty in topography and sea ice.

(References and summary of key articles to be collected in the form.)

WG 27-2014

TOR#5

WG 27 has contributed dynamical frameworks that can be used as metrics to test processes in the models. This will allow us to move beyond the comparisons of statistical patterns of variability. These frameworks include the connectivity between North Pacific and tropics (*e.g.*, footprinting and meridional mode feedbacks), connectivity between eastern and western boundary both in the surface and subsurface, and the relation between atmospheric forcing and oceanic response. (References and summary of key articles to be collected in the form.)

TOR#6

WG members agreed that reference to a recent synthesis paper of Di Lorenzo *et al.*, (2013, *Oceanography* 26) was a good starting point. Dr. Shin-ichi Ito also noted that Ito *et al.* (2010, In: M. Barange, J.G. Field, R.H. Harris, E. Hofmann, R. I. Perry, F. Werner (Eds.) *Global Change and Marine Ecosystems*. Oxford University Press) synthesized the gaps and future perspectives. Following productive discussion, WG 27 identified the following items:

1. Linking eddy-scale circulation dynamics to fish processes (*e.g.*, fish life cycle) → ended in a proposal for a new US CLIVAR working group. (Models are still work in progress, ecosystem observation are not available.)
2. Horizontal advection, eddy and submesoscale open-ocean nutrient supply and temperature dependence: temperature is well known, but others are less known and their impact on the ecosystem is just emerging (*e.g.*, Di Lorenzo *et al.*, 2013, *Oceanography* 26; McGillicuddy *et al.*, 2007, *Science* 316) (Models are still work in progress, ecosystem observations exist for specific case studies, but hard to have a broader picture.)
3. Resurrect CFAME tables on mechanisms of physical–biological interactions for three regions. Review table and underline gaps of understanding. Dr. Jacquelynne King will clean up the table and WG 27 will discuss.
4. Physical processes that influence aggregation (*e.g.*, frontogenesis) (Physical and ecosystem models are still unable to resolve the scale of the problem as well as identify the dynamics to be resolved.)
5. In a changing climate, understanding the broader view of upwelling, including efficacy of nutrient supply, changes in stratification and water sources, the role of extreme events on productivity of upwelling system and their impact on higher trophic levels → CLIVAR focus theme (IPCC models do not resolve the proper scales and their downscaling is still problematic and there are not guidelines agreed in the community.)
6. Climate change impacts on marine ecosystem associated with acidification and de-oxygenation.

TOR#7

Strong connection to CLIVAR has been developed (*e.g.*, see Minobe's report).

TOR#8

Plenty of sessions have been organized (see <http://wg27.pices.int/>).

TOR#9

WG 27 is working on this.

Dr. Di Lorenzo reminded members the justification for WG 27's request for a 1-year extension at PICES-2013. The extra year will allow WG 27 to examine the latest available models from the CMIP5, analyze further FUTURE gaps (as a result of recommendations from the FUTURE Evaluation Panel (see Agenda Item 8), and organize contributions for the 3rd International Symposium on the "*Effect of climate change on the world's oceans*" in 2015. POC forwarded the request to Science Board who recommended it to Governing Council where it was endorsed.

AGENDA ITEM 4

Contributions to 3rd Climate Change Symposium

WG 27 discussed the upcoming 3rd International PICES/ICES/IOC Symposium on “*Effects of climate change on the world’s oceans*” March 23–27, 2015, in Santos, Brazil. Dr. King is one of the symposium convenors and Dr. Minobe is on the Scientific Steering Committee. Dr. Minobe, who is co-convening a 2-day workshop on “*Upwelling systems under future climate change*”, along with Dr. Kenneth Drinkwater, reported that Drs. Enrique Curchitser and William Sydeman will be invited speakers at the workshop. Dr. Minobe is also a co-convenor, with Dr. Curchitser, for the Topic Session on “*Regional models for predictions of climate change impacts: methods, uncertainties and challenges*”, and Dr. Ito will be an invited speaker.

AGENDA ITEM 5

CLIVAR collaborations

Dr. Minobe reported that CLIVAR has officially changed its name from the “Climate Variability and Predictability Program” to “Climate and Ocean – Variability, Predictability, and Change”, re-aligning its focus with the re-organization of the World Climate Research Program (WCRP), where it is one of WCRP’s core projects. CLIVAR is planning a major symposium in 2016 in Qingdao, China, and is inviting PICES to be a co-sponsor. Dr. Minobe represented PICES at the 1st Pan-CLIVAR meeting, July 17–18, 2014, in The Hague, The Netherlands. He and Dr. Curchitser continue to be active members in both CLIVAR and PICES.

AGENDA ITEM 6

WG 27 products

Based on the ECOFOR workshop that WG 27 coordinated, to date, members discussed how some the synthesis products address the key questions of the FUTURE program.

1. *What determines an ecosystem’s intrinsic resilience and vulnerability to natural and anthropogenic forcing?*
2. *How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?*

WG 27 has worked towards identifying relevant physical drivers and the type of sensitivities of marine populations to climate forcing. Specifically, from the workshop synthesis the following results emerge:

- Lower-trophic levels variability tracks regional and locally defined physical forcing;
- Higher-trophic levels integrate multiple forcing and track large-scale climate modes;
- Changes in large-scale and eddy-scale ocean circulation play a dominant role in driving ecosystem variability;
- Spatial dimension is key for understanding the links between physical variability and ecosystem response.

3. *How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?*

WG 27 members have worked towards understanding the significance of observed changes in the coastal climate and uncertainties in IPCC model projections, and integrating the human dimension. Results from these activities are currently being synthesized for the final report.

WG 27 is continuing to update the group website with relevant publications and activities from its members.



AGENDA ITEM 7
Final WG 27 report

Dr. Di Lorenzo reviewed progress on the final report. WG members discussed and agreed on the format and content of the final report. Action items have been developed and assigned to different members. An early draft of the report is now in place and will be expanded during the next calendar year.

AGENDA ITEM 8
FUTURE evaluation report and relation to WG 27

Dr. King, one of the FUTURE Evaluation Panel members at the FUTURE Open Science Meeting in Kohala Coast, Hawaii, April 15–18, 2014, gave a brief summary of the Panel’s findings and recommendations. The Panel noted that FUTURE, through WG 27, has strong links with the international CLIVAR project, and recommended that these links should be nurtured as tactically, linkage to CLIVAR provides PICES with additional credibility in the climate change and climate variability research area, and strategically such a linkage ensures that the climate aspects of FUTURE are delivered in partnership. The Panel also noted that WG 27 has updated the synthesis of climate processes in the North Pacific and has identified climate forcing functions that are relevant to specific North Pacific ecosystems, and has also interpreted the IPCC 5th Assessment Report projections in the context of North Pacific climate dynamics, all of which is highly respected internationally and has contributed to PICES’ international recognition. However, one of the

challenges for ocean–climate forecasting work in PICES is to attract of early career scientists from the natural sciences, as inter-disciplinary research in the natural sciences is often a focus for later career scientists.

AGENDA ITEM 9

Follow-up to WG 27

After considerable discussion, WG members recommended PICES form an expert group to look into funding opportunities relevant to FUTURE in each PICES member country. Also, ideas for potential working groups to contribute to FUTURE (*e.g.*, seasonal to multi-year projections, mesoscale processes) after WG 27's term has ended were suggested, but no firm decision was reached. WG 27 requests that its parent committee, POC, provide advice on a follow-up expert group for PICES-2015.

AGENDA ITEM 10

Other business

None

WG 27 Endnote 1

WG 27 participation list

Members

Steven J. Bograd (USA)
 Enrique Curchitser (USA)
 Emanuele Di Lorenzo (USA, Co-Chairman)
 Michael Foreman (Canada, Co-Chairman)
 Shin-ichi Ito (Japan)
 Chan Joo Jang (Korea)
 Jacquelynne King (Canada)
 Takashi Mochizuki (Japan)
 Shoshiro Minobe (Japan, Co-Chairman)
 Jae-Hun Park (Korea)
 Sang-Wook Yeh (Korea)
 Elena I. Ustinova (Russia)
 Yury I. Zuenko (Russia)

Observers

Nico Caltabiano (CLIVAR)
 Kyung-Il Chang (Korea)
 and others

WG 27 Endnote 2

WG 27 meeting agenda

1. Welcome and introductions
2. Meeting agenda
3. Brief presentations (max 10 min) on recent work related to our TORs and the justification for our 1-year extension
4. Contributions to 3rd Climate Change Symposium
5. CLIVAR collaboration
6. WG 27 products: publications, synthesis papers, ocean currents database
7. The final WG 27 report; we are now in our last year
8. A discussion of the FUTURE evaluation report and how it relates to both WG 27 and a possible follow-on to WG 27
9. A follow-up to WG 27 that fits within FUTURE's vision for the next 5 years
10. Other business