Report of Working Group 40 on *Climate and Ecosystem Predictability*

The fifth and final business meeting of Working Group (WG 40) on *Climate and Ecosystem Predictability* was held virtually on September 9, (September 10, western Pacific), 2021. There were 11 WG 40 members in attendance plus four additional participants (WG 40 *Endnote 1*). The meeting was used to present recent developments and upcoming initiatives relevant to the Working Group, and to discuss next steps for PICES engagement in climate and ecosystem prediction. The agenda for the meeting is presented *WG 40 Endnote 2*.

AGENDA ITEM 2

Update on WG 40 special issue in *Frontiers in Marine Science*

WG 40 has developed a *Frontiers in Marine Science* research topic entitled "North Pacific climate and ecosystem predictability on seasonal to decadal timescales[1]". This collection of papers draws on the WG 40 Topic Session on "*Advances in North Pacific marine ecosystem prediction*" at PICES-2019. A total of 10 manuscripts have now been accepted for publication. The WG 40 Co-Chairs have also submitted a perspectives paper (Minobe *et al*., "Toward regional marine ecological forecast using global climate model predictions from subseasonal to decadal timescales: bottlenecks and recommendations"), and will write an introductory paper to contextualize the special issue and summarize each paper within it.

AGENDA ITEM 3

Next steps

Proposal for a new working group on Climate Extremes

A proposal for a new PICES working group on Climate Extremes is under development (*WG 40 Endnote 3*)[2]. The goal is for the working group to address "end-to-end" effects of extreme events, from physics to human dimensions. The expertise of WG 40 will feed into the physical and, to a lesser extent, ecological aims of the new working group. There was some discussion of how this new working group will relate to other activities including WCRP lighthouse activities, CLIVAR, and the UN Decade of Ocean Science. There are several mechanisms through which WCRP and CLIVAR could engage South American scientists in these efforts.

Relevant activities from WG members

- WG 40 Topic Session at PICES-2021(Ryan Rykaczewski)

WG 40 has organized a FUTURE/POC Topic Session on "*Predictions of extreme events in the North Pacific and their incorporation into management strategies*" at the Annual Meeting, with the session taking place 7–9pm PST, Wednesday, October 27, 2021. At the time of the WG business meeting, seven abstracts had been submitted on topics, including marine heatwaves, harmful algal blooms, and ocean acidification.

- Ocean Decade Laboratory on "A Predicted Ocean" (Steven Bograd)

The Ocean Decade Laboratory on "A Predicted Ocean" will take place September 15–17, 2021. The laboratory intends to bring together diverse groups to discuss gaps and potential solutions for ocean prediction. Dr. Fangli

[1] https://www.frontiersin.org/research-topics/12240/north-pacific-climate-and-ecosystem-predictability-on-seasonal-to-decadal-timescales#articles

[2] Working Group on *Climate Extremes and Coastal Impacts in the Pacific* (WG 49) was approved at PICES-2021 (GC Decision 2021/S/11/ii)

Qiao noted that he is heavily involved in this activity; he will give a keynote at the laboratory and will share more information on this activity.

- Potential operational forecasts to share with PICES member nations (Fangli Qiao, Yajuan Song)

Drs. Yajuan Song and Qiao presented results from China's First Institute of Oceanography (FIO) climate prediction system, named FIO-ESM v2.0. The forecasts are currently physics-only (though could potentially be run with biogeochemistry), and are run operationally with 20 ensemble members generated on the first day of every month. Relative to the previous version of FIO's climate prediction system, skill is improved, particularly by increased resolution and the inclusion of wave effects. FIO is interested in working closely with the PICES community to make the physical forecasts more broadly useful, and outputs from the climate model can be used to drive ecosystem models, or to provide surface and ocean boundary conditions for regional downscaling. While there are a number of climate modeling centers globally that produce seasonal forecasts, it is a great opportunity to have a modeling center that is eager to work directly with PICES to serve ecosystem science. The new working group on climate extremes may be an ideal venue to pursue this relationship, identifying priority outputs/products from the forecast system and developing applications.

WG 40 Endnote 1

WG 40 participation list

Members

Michael Jacox (USA, PICES Co-Chair)
Masami Nonaka (Japan, PICES Co-Chair)
Antonietta Capotondi (USA, CLIVAR Co-Chair)
Shoshiro Minobe (Japan, CLIVAR Co-Chair)
Ryan Rykaczewski (USA, CLIVAR Co-Chair)
James Christian (Canada)
Akinori Takasuka (Japan)
Chan Joo Jang (Korea)
Vladimir Kulik (Russia)
Yury Zuenko (Russia)
Emanuele Di Lorenzo (USA)

Members unable to attend

Canada: Caihong Fu
China: Ying Bao, Fei Chai, Jinqiu Du
Korea: MinHo Kwon, Chung Il Lee
USA: Samantha Siedlecki

Observers

Steven Bograd (USA, FUTURE SSC Co-Chair)
Jing Li (China)
Fangli Qiao (China)
Yajuan Song (China)

WG 40 Endnote 2

WG 40 meeting agenda

1700 – 1900 PDT, Thursday, September 9, 2021 (0000 – 0200 UTC, Friday, September 10)

1. Opening remarks (Nonaka/Jacox)
2. Update on WG 40 special issue in *Frontiers in Marine Science* (Minobe)
3. Discussion of next steps (All)
   - Proposal for new WG on climate extremes
   - Relevant activities from WG members
   - WG 40 final report
4. Final comments (Co-Chairs)
5. Adjourn

WG 40 Endnote 3

Proposal for a Working Group on
Climate Extremes and Coastal Impacts in the Pacific

Parent Committees: FUTURE (possibly POC, BIO, HD)

Requested Term: October 2021 – October 2026

Goals

1. Increase our understanding of climate extreme events with a focus on their drivers, predictability, and the impacts on coastal communities and marine ecosystem services.
2. Facilitate partnerships between PICES, the Asia Pacific Network (APN), CLIVAR, WCRP and other organizations in the Pacific.
3. Contribute to PICES activities supporting the UN Decade of Ocean Science for Sustainable Development, including the SMARTNET, CoastPredict, and GEOS Programs.

Motivation

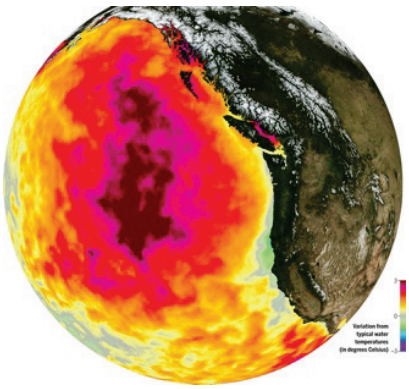

Fig. 1: Marine Heat Wave in the eastern North Pacific

There is recognition of increased risk of more frequent and more severe extreme events within the Pacific domain. For example, a series of Marine Heat Waves (MHW) has occurred in the eastern North Pacific over the past 5 years, with substantial ecological and socioeconomic impacts on the west coast of North America. The 2015 MHW resulted in one of the largest harmful algal blooms ever recorded, leading to lost shellfish harvest, marine mammal deaths and lasting impacts on coastal communities (McCabe et al. 2015). In the western North Pacific Ocean near Japan, another long-term MHW occurred in the Oyashio region from 2010 to 2016, with significant impacts on local communities through changes in fish species available for catch (Miyama et al. 2021). There is a clear need to better understand the physical drivers and assess the predictability of MHWs and other extreme events, such as heavy rainfall, typhoons, and coastal inundation, and to be more prepared to resolve the socioeconomic impacts resulting from these events. Coastal communities around the Pacific Rim, which are highly reliant on coastal ecosystem services, are particularly vulnerable to these extreme events and in need of a suite of potential solutions to these climate-driven changes.

The PICES FUTURE Science Program has implemented a Social-Ecological-Environmental Systems framework to facilitate transdisciplinary exchange of information within the organization. When applied to 'crisis' case studies, this framework proved effective in understanding large-scale ecosystem change and resulting impacts on coastal communities (Bograd et al., 2019). The FUTURE Science Program has also taken a central role in planning PICES' leadership and engagement within the UN Decade of Ocean Science for Sustainable Development (UNDOS). FUTURE's Phase III Science and Implementation Plan positions PICES to provide the scientific and organizational infrastructure to implement the activities of UNDOS in the Pacific. A key objective of these efforts is to identify and facilitate engagement of partner organizations to implement joint UNDOS activities that will enhance communication and outreach to diverse stakeholders. Several key partner organizations participated in recent PICES meetings in which ideas for collaborative work, including

within the context of UNDOS, were discussed. In particular, we have identified significant interest in and high potential for collaboration around the theme of 'Climate Extremes and Coastal Impacts in the Pacific' with APN and CLIVAR.

Workshop decisions

PICES held a Workshop on June 23rd, 2021, to strategize on developing an Expert Group proposal on 'Climate Extremes and Coastal Impacts'. There was general agreement among the ~40 participants on several key points:

1. We will develop a single transdisciplinary PICES Working Group proposal for Science Board/Governing Council consideration at PICES-2021 (WG-EXTREMES).
2. We will begin reaching out to partner organizations, stakeholders, and other communities (including indigenous communities) to ensure early participation.
3. The first year of the WG-EXTREMES will have a focus on continued scoping for additional partnerships, as this is a major undertaking and will require additional time and effort amongst partner organizations, stakeholders, and other communities. To facilitate progress on the issue of climate extremes, we prefer to begin the work as a Working Group rather than a Study Group.
4. We will frame the Working Group proposal in the context of contributions to the UN Decade of Ocean Science (including the SMARTNET and GEOS Programs), with anticipation of continued work on climate extreme events beyond the timeframe of WG-EXTREMES.
5. We strongly encourage Early Career Ocean Professionals (ECOPs) to take a leading role in proposal development and eventual implementation of the WG.

WG proposal

We propose a PICES Working Group to address multi-disciplinary aspects of climate extreme events, including their physical drivers, attribution to climate change, predictability on seasonal to interannual time scales, and impacts on coastal marine ecosystems and the coastal communities that are reliant on their ecosystem services. The principal objectives will be to (a) gain a better understanding of the drivers and impacts of extremes under changing climate conditions, (b) assess the predictability of different climate extreme events, and (c) explore potential solutions to mitigate their societal impacts. We seek to engage partner organizations in this Working Group, including APN and CLIVAR, to expand the scope and impact of the work, in support of PICES' engagement in UNDOS, in particular the Decade-endorsed ICES-PICES SMARTNET Program. We seek to leverage the organizational infrastructure of PICES as well as the APN network and its history of capacity development across Pacific developing countries.

We would also work closely with the PICES Study Groups on Early Career Ocean Professionals (SG-ECOP) and on Science Communications (SG-SCICOMM), or subsequent Expert Groups, with the aim of training ECOPs in multi-disciplinary ocean research, organization of multi-partner collaborations, and communication of WG activities and products to diverse stakeholders. The partnerships fostered by this WG will bring together diverse networks to increase the overall capacity to conduct ocean science research in support of sustainable development and to foster the range of skills necessary to support broad and overarching marine science goals. This Working Group will facilitate transformative science and address several UNDOS key societal objectives as well as incorporate strategies to facilitate UNDOS cross-cutting inclusivity themes relating to gender equality, early career ocean professional engagement, and significant involvement of Indigenous communities and developing nations in the planning and implementation of joint activities.

Terms of Reference

1. Develop a census of historical climate extreme events around the Pacific Rim to describe their characteristics, identify potential climate and ocean drivers, and catalog the ecological and socioeconomic consequences.
2. Focus on case studies (e.g., MHWs) for full exploration: drivers, predictability, ecological and societal impacts, and dissemination of information for actionable solutions.
3. Assess the predictability of climate extremes and establish leading indicators to mitigate impacts on coastal communities.
4. Develop models to predict how existing ecosystem services may be affected by climate extremes and what effects those would have on different human communities.
5. Identify a set of social, economic, and cultural indicators that account for the suite of human dimension impacts from climate extremes.
6. Work with experts in science communications and participants in the UN Decade of Ocean Science (e.g., SMARTNET) to develop and disseminate information and products related to the drivers, predictability and impacts of climate extremes.
7. Identify and engage partners in the prioritization of activities and deliverables.

Proposed internal and external organizational partners

CLIVAR (Pacific Panel); WCRP (lighthouse activities "explaining and predicting earth system change," "my climate risk," and "WCRP academy"); APN.

- Joint PICES-APN Study Group on Scientific Cooperation in the Pacific Ocean
- PICES Expert Group on Early Career Ocean Professionals (ECOPs): to provide WG leadership
- PICES Expert Group on Science Communications: to assist communication of WG activities and products to the PICES community, the broader scientific community and the general public
- PICES Expert Group on UN Decade of Ocean Sciences: to coordinate with SMARTNET and other Decade activities

Proposed membership

1. Seek to maintain regional, expertise (natural and social sciences), gender and career-stage balance, including involvement of ECOPs.
2. Seek representation from the Indigenous community.
3. Seek representatives from the partner organizations (CLIVAR, WCRP, APN).
4. Include members who participated in the June 2021 Workshop on Climate Extremes.
5. Given cross-disciplinary and cross-organizational nature of WG, anticipate relatively large membership and an extended lifetime.

References

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