2025 Report of Working Group 49 on Climate Extremes and Coastal Impacts in the North Pacific (WG49)

WG49 remains active in the work initiated in 2022 to achieve its seven TOR. This large working group has two main teams leading specific activities.

- ToR 1, 2, 4, 5: To compile documented extreme climate events, and explore their causal progression from physical drivers to management responses and indicators/metrics, the bibliometrics team completed a systematic literature review of extreme climate event publications using Covidence. We completed the screening of papers (abstracts and then full text) to arrive at a final corpus for analyses. We initiated bibliometric analysis using literature from systematic search led by Wakamatsu-san. We presented preliminary findings of the bibliometric thematic analysis at PICES Session 15. We also conducted a workshop at PICES-2025 to pilot the proposed methodology to be used to compile associated ToR 1, 4, and 5 outputs. *Bibliometrics Team meetings held January 22, February 19, June 16, October 15*
- ToR 3, 4, 6: The physical drivers/predict team continues to organize webinars in conjunction with the activities of the CLIVAR Research Focus group on marine heatwaves. There is a new suggestion to compile MHW physical drivers for past events that have occurred in the PICES regions, as per discussions at the 2025 AGM business meeting (see below).

In February 2025, WG49 received very sad news of the death of our esteemed colleague, Dr. Dan Lew. Dan was a very active member of the WG where he provided his expertise and guidance especially to the bibliometrics team. We carry on the research with him and his ideas in mind. We are all so grateful for the time we were able to spend with him.

Summary of WG49 2025 Activities

1. **Interim/Pre-PICES Meeting, October 1, 2025**

New Members 2025 - Mackenzie Mazur (Canada), Nima Farchadi (USA), Peng Lian (China)

During the meeting, 10 participants reviewed achievements in 2024-2025 as reported to Science Board ISB in May 2025. Further, PICES-2025 events were discussed including the WG49 workshop, session, and business meeting planned for the annual meeting. Lastly, discussions on new ideas for 2026 workshop and/or session proposals and any new requests for the Science Board were initiated.

Discussion on needs and next steps:

- Biblio and Predict Teams may or may not find a way to combine findings and efforts
- Physical drivers team has been focusing on ongoing, and only partially documented, extreme events such as the extreme warming in the Northeast Pacific, due to the severity of these anomalies for this PICES region. There may be a time delay between the output of the bibliometric team products and the physical drivers team's product. However, the exact focus of this team is still under discussion, as there may be value in considering the local manifestation of past events in the PICES regions. This would allow a better overlap with the biblio team and possibly leverage analyses of mooring data conducted by another PICES group.
- A lot that we don't understand about ECEs (MHWs), more exploration to do on past events

- Possible resurrection of Media/newspaper articles assessment for ECE knowledge development (from a cultural perspective) or explore this as a new study group
- Explore ideas for a Special Edition/Issue Journal related to WG49

2. In-person PICES 2025 Business Meeting, November 8, 2025, Yokohama

Working Group 49 held its fourth in-person business meeting at PICES-2025 on November 8, 2025, in Yokohama.

The 2025 biannual WG49 business meeting focused on strengthening collaboration among member countries, reviewing progress toward WG49's terms of reference, and planning deliverables that address climate extremes and their ecological and socioeconomic impacts.

In the morning, representatives from each member nation and ex-officio organizations presented on recent research related to climate extremes: Canada, Japan, Korea, China, Japan, US, World Climate Research Program (WCRP), Explaining and Predicting Earth System Change Lighthouse Activity (EPESC-LHA), and Basin-Scale Events and Coastal Impacts (BECI). In the afternoon, participants reconvened to discuss specific topics related to understanding the physical drivers of extreme events in the eastern and western Pacific and how they are defined. After the conclusion of the business meeting, the physical drivers team outlined plans to conduct a regional review of heatwave drivers around the North Pacific. Those interested in participating in this activity should reach out to Antonietta Capotondi (maria-antonietta.capotondi@colorado.edu) and/or Chan Joo Jang (cjjang@kiost.ac.kr), who are co-leading the effort.

Key Results from Discussion

- Scientific Insights
    - Two main classes of extreme events identified:
        1. Short-term atmospheric-driven events (e.g., heatwaves linked to anticyclonic circulation).
        2. Longer-term ocean current-driven events (e.g., Korean waters heatwaves tied to Kuroshio Extension).
    - Proposal for a taxonomy paper on heatwave definitions and drivers.
    - Recognition of data gaps in monitoring oxygen, acidification, and hypoxia.

- Socioeconomic Dimensions
    - Strong management responses exist to address coupling between climate extremes and fisheries/aquaculture impacts in the western Pacific, less in the eastern Pacific.
    - National approaches differ: Japan's insurance covers losses, Korea uses a shared government/insurance model.
    - Need for Chinese perspectives given China's global aquaculture leadership.
- Management & Communication
    - Divergence between scientific and management definitions of "extreme events" complicates policy alignment. It would be useful to align scientific and management thresholds to improve disaster response and insurance frameworks, although such thresholds may be dependent on the region, and, for instance, the type of marine species that are more prominent/valuable in that region. A general definition may or may not be feasible.
    - Emphasis on clear, easy-to-communicate metrics for public and policy use. Simplify metrics and break language barriers to make science actionable for communities and policymakers.
    - Adaptive Management: Balance immediate disaster response with long-term ecosystem-based fisheries management.
    - Cross-National Learning: Comparative studies of compensation and management approaches can inform best practices.
    - Language barriers hinder integration of western Pacific knowledge; communication tools (interactive maps, knowledge library) proposed.
- Next Steps
    - Deliverables: physical drivers paper, bibliometric review, management approaches paper.
    - 2026 meeting planned to advance physical drivers research.

3. PICES 2025 AGM Workshop and Session

2025 Bibliometrics Team Workshop 9: Applying social-ecological frameworks to explore actionable solutions for climate extreme events across the North Pacific

Convenors: Helen Killeen, Karen Hunter, Hiroki Wakamatsu; Sponsoring PICES Expert Groups: FUTURE

Duration: 0.5 days

Abstract: Extreme climate events (ECE) occur with regularity across the North Pacific. Physical ocean and atmospheric events cascade into ecological anomalies such as harmful algal blooms, marine species die offs, and changes in the distribution and abundance of species. These physical and ecological dynamics often have direct consequences for social systems requiring management such as through fishery closures or expansion, damage to infrastructure and property, and health problems. Currently, many resource management and policy frameworks do not yet handle the impacts of ECEs efficiently. In this workshop, participants will explore ECE case studies in the North Pacific to outline drivers, and their ecological and societal impacts using the DSPIR (drivers, pressures, states, impacts, responses) framework. The DSPIR framework has been broadly applied to identify management and policy actions related to environmental problems. It draws out interactions between state changes and human impacts to identify where the system experiences shifts in ecosystem services and societal

benefits and starts to identify suitable responses to control the adverse effects of the drivers and pressures. Participants will also link knowledge generated in the workshop to the PICES-specific SEES (social-ecological environmental system) framework. The SEES framework can help identify how PICES can streamline ECE science activities and solutions for the North Pacific. The workshop will aim to generate information for researchers and decision-makers to enable actionable solutions and build understanding of the similarities and differences in outcomes across different ECEs.

Summary: The workshop conducted a successful pilot review of DPSIR framework components for select ECE literature. Workshop convenors received excellent feedback from the pilot which is being used to guide next steps in the process to extract a census of ECEs and related drivers and indicators related to various documented ECEs.

Physical Drivers Team Session S05: Climate Extremes and Coastal Impacts in the Pacific

Convenors: Antonietta Capotondi, Shoshiro Minobe, Charles Hannah, Saranya J.S. and Chan Joo Jang; Sponsoring PICES Expert Groups: POC, FUTURE-SSC, Non-PICES cosponsoring organizations: CLIVAR, WCRP EPESC LHA

Duration:1 day

Abstract: Over the past several decades, extreme climate events (ECEs) have generally become more frequent and intense, resulting in devastating, long-lasting ecological and socio-economic impacts on both global and regional scales. ECEs include both extreme physical conditions (e.g., marine heatwaves) as well as biogeochemical extremes (e.g., ocean acidification, deoxygenation, harmful algal blooms, coral bleaching). Although the episodic nature of these events may be due to natural causes, their extreme character is exacerbated by the changing background conditions associated with global warming. These events affect marine ecosystems at all trophic levels mainly through shifts in habitat distribution, biodiversity, and communities, resulting in the destruction of coastal biogenic habitats. A deepened understanding of the complexity of these impacts, which may unfold over time, is needed, and requires continuing analysis of conditions following past events. Since mid-2023, the Earth’s climate has exhibited exceptional heating conditions. Among the world's oceans, the highest sea surface temperature anomalies have occurred in the Kuroshio-Oyashio region, with anomalies extending from the East Asian marginal seas to the central North Pacific across the International Dateline. Understanding these unprecedented recent conditions in terms of natural processes and/or anthropogenically-forced warming, is of paramount importance for the PICES community.

Prediction of these extreme events is critical, but an accurate identification of the key driving mechanisms is still lacking.

Summary

Session S05 intended to provide a platform for sharing recent advances in all the above topics. Ample time for discussion was allocated to allow sharing of ideas and methodological approaches. The session had a very high attendance during both morning and afternoon sessions, highlighting the need of such a platform for discussing ideas and identifying most promising ways forward. This session was at the core of the physical drivers’ theme and provided excellent input to shape the physical drivers team’s activities. In particular, a subset of session S05 presentations was devoted to various aspects of the extreme Northwest Pacific warming and possible driving mechanisms. Presentations

and ensuing discussion provided very stimulating ideas and indicated that this topic is still a very active area of research by different groups, suggesting that a focus on the intercomparison of historical events across the PICES regions may be more appropriate for the physical drivers team.

Given its success, a similar session was proposed for PICES-2026 and was just approved as Session S02 of that meeting.

WG49 Endnote 1
WG49 participation list

Interim/Pre-PICES Meeting, October 1, 2025
Members
Karen Hunter (Canada, Co-Chair)
Hiroki Wakamatsu (Japan, Co-Chair)
Chan Joo Jang (Korea, Co-Chair)
Antonietta Capotondi (USA, Co-Chair)
Peng Lian (China)
Shoshiro Minobe (Japan)
Haruka Nishikawa (Japan)
Changsin Kim (Korea)
Jongseong Ryu (Korea)
Helen Killeen (USA)

In-person PICES 2025 Business Meeting, November 8, 2025, Yokohama
Members
Karen Hunter (Canada, Co-chair)
Hiroki Wakamatsu (Japan, Co-Chair)
Helen Killeen (Co-chair, USA)
Antonietta Capotondi (USA, Co-Chair)
Charles Hannah (Canada)
Peng Lian (China)
Hiroshi Kuroda (Japan)
Shoshiro Minobe (Japan)
Haruka Nishikawa (Japan)
Changsin Kim (Korea)
Jongseong Ryu (Korea)
Sung Yong Kim (Korea)
Steven Bograd (USA)

Members unable to attend
Canada: Jennifer Jackson
China: Changming Dong, Jian Tony Ma, Song Yajuan
Korea: Minho Kwan, Chan Joo Jang (Co-chair), Sukgeun Jung, Chun Ok Jo, Hyoeun Oh
Russia: N/A
USA: Emmanuele di Lorenzo, Rob Suryan

Observers
Kathryn Berry (BECI)
Julia Schmid (BECI)
Byoung-Jun Lim (Korea)
Sarnaya JS
Fancisco Warner (USA)
Enrique Curchister (USA)
Mercedes Pozo Buil (USA)