

New AP-CREAMS Action Plan with Rationale for extension of AP-CREAMS focus area and revision of Terms of Reference (GC Decision 2026/S/7))

1. AP-CREAMS tasks and their implementation

The AP-CREAMS (Advisory Panel on *Circulation Research in the East Asian Marginal Seas*) was established in October 2005 with the following tasks:

1. To initiate and coordinate studies on hydrography, circulation, and biology, as well as on variability of oceanographic and biological properties in the PICES area of the East Asian Marginal Seas;
2. To estimate climate-scale and long-term changes in abiotic and biotic environments of this region;
3. To facilitate the establishment of permanent observation and data exchange networks in this region;
4. To convene workshops/sessions to evaluate and compare the results of national and international research programs.

Primarily the activity of the AP-CREAMS is focused on the Northeast Asian marginal seas, which are sensitive to climate change and anthropogenic impacts, where intensive national activities take place, and where a strong need for international coordination and collaboration to study the variability of hydrodynamics, biogeochemistry, ecosystems, fisheries, and influence of human activities at multiple scales in the area exists.

Research activities among PICES member countries in the region of the Northeast Asian marginal seas have a permanent character and need ongoing coordination, as the interests of different countries tightly overlap. Some ideas on further development of international surveys and observation networks have already been discussed by AP-CREAMS though specific details, such as joint standard sections, format of data exchange, operational information on planned and ongoing cruises, extension of the target area, *etc.* are not yet developed.

Meetings of the AP-CREAMS are organized 2-3 times each year with exchange of results of international and national activities and plans. Results of the joint research in the CREAMS area have been published in leading scientific literature. AP-CREAMS is continuing the preparation of publications on the state of the regional ecosystem, namely on the PICES Scientific Report “Oceanography of the Yellow and East China Seas”, and regional chapters (Areas 19 and 21) for the North Pacific Ecosystem Status Report-3.

During the most recent period (2023-2025) the AP convened the following workshops and scientific sessions:

- a workshop on “Changing social-ecological-environmental system of the North East Asian Marginal Seas: New challenges for integrative marine science” during PICES-2023 in Seattle, USA;
- CREAMS 30th Anniversary & CSK-II Joint-Workshop « International collaboration for science of East Asian Marginal Seas in a changing climate: circulation, biogeochemistry, and socio-economic research», July 25-26, 2024, Seoul, Korea;
- scientific session “Past, Present and Future of CREAMS program: 30 years of international research in North East Asian Marginal Seas” at PICES-2024 in Honolulu, USA;

- scientific session on “Changing ecosystem structure under global climate change: monitoring, detecting, modelling, and socio-ecological impacts” at the PICES-2025 in Yokohama, Japan.

AP-CREAMS maintains close contacts with leading regional international organizations, such as Intergovernmental Oceanographic Commission (IOC) / Subcommission for the Western Pacific (WESTPAC), UN Environment Programme (UNEP)/Northwest Pacific Action Plan (NOWPAP) and Coastal Environmental Assessment Regional Activity Centre (CEARAC), IMBeR (Integrated Marine Biosphere Research) and others. Their representatives participate in the AP meetings and other activities. Information on their current programs and proposals for collaboration is provided and discussed at the AP meetings.

2. Revision of AP-CREAMS Terms of References

During recent years, in addition to the primary tasks, AP-CREAMS started activity in new directions, as a contribution to PICES/FUTURE and in response to their request:

- i) to pursue an integrative approach, to include multiple disciplines beyond the physics and chemistry to cover the whole social-ecological-environmental-system framework developed by FUTURE,
- ii) to extend geographic coverage to include all North-East Asian Marginal Seas beyond the EAST-I and EAST-II regions, and
- iii) to prioritize involvement of Early Career Ocean Professionals (ECOPs) in its activity.

Correspondingly, the AP members drafted new terms of reference, as below.

1. To coordinate programs to study marine ecosystems and their variability in the East Asian Marginal seas and their interaction with the western North Pacific in a light of global change;
2. To facilitate the establishment of permanent observation and data exchange networks in this region;
3. To convene workshops/sessions/mentoring and build knowledge networks to advance, evaluate and compare results from the program and its linkages to broader PICES activities;
4. Develop recommendations for PICES to better collaborate within PICES, and with indigenous and international initiatives relevant to the Asian marginal seas;
5. To enhance capacity building, knowledge dissemination, and cooperation with other international marine organizations/programs in the region with relevant expertise (e.g., IOC/WESTPAC, NOWPAP, NEAR-GOOS etc.);
6. To provide more opportunities for Early Career Ocean Professionals (ECOPs) to join.

3. Justification of the AP-CREAMS focus area

To understand the processes in the Asian Marginal seas and their impact on adjacent areas of the Pacific it is important to -include the wider area, to account for physical-biological connectivity across the western North Pacific and to evaluate potential climate impacts across a broader PICES domain. In addition to Northeast Asian marginal seas the proposed extension would cover the Okhotsk Sea, western part of the Northwestern Pacific and western part of the Bering Sea, including regions 16, 17, 18, 22 and narrow northwestern part of region 23 (Fig. 1). This extension is timely because of increasing human activity along new maritime routes in the Arctic and their gateways which must pass the Northeast Asian marginal seas and currently developing new international research programs like Cooperative Study of Kuroshio-2 (CSK-2) by

IOC/WESTPAC, when branches of the Kuroshio impacting marine ecosystems in the broader western Pacific areas including the marginal seas. However, the AP will keep its primary focus on, and encourage a balance among, the initial marginal seas (regions 19, 20, and 21) to not dilute the specificity of CREAMS. Some examples of recent activities of the AP in the regions 20-21 are presented in the Endnote 1.

The extension of coverage will:

1. provide more opportunities for the PICES community to be involved in the AP-CREAMS activity (e.g., bringing more attention to the workshops/sessions/mentorships the AP-CREAMS convenes),
2. enhance capacity of the AP-CREAMS to better coordinate programs to study the marine ecosystem, its variability in the core areas (19, 20, and 21) as well as the influence, exchange and interactions of ecosystem components between the core area and the extended areas. The extension will also facilitate the establishment of permanent observation and data exchange networks in a larger western North Pacific and its marginal seas, and disseminate more knowledge on the extended area.

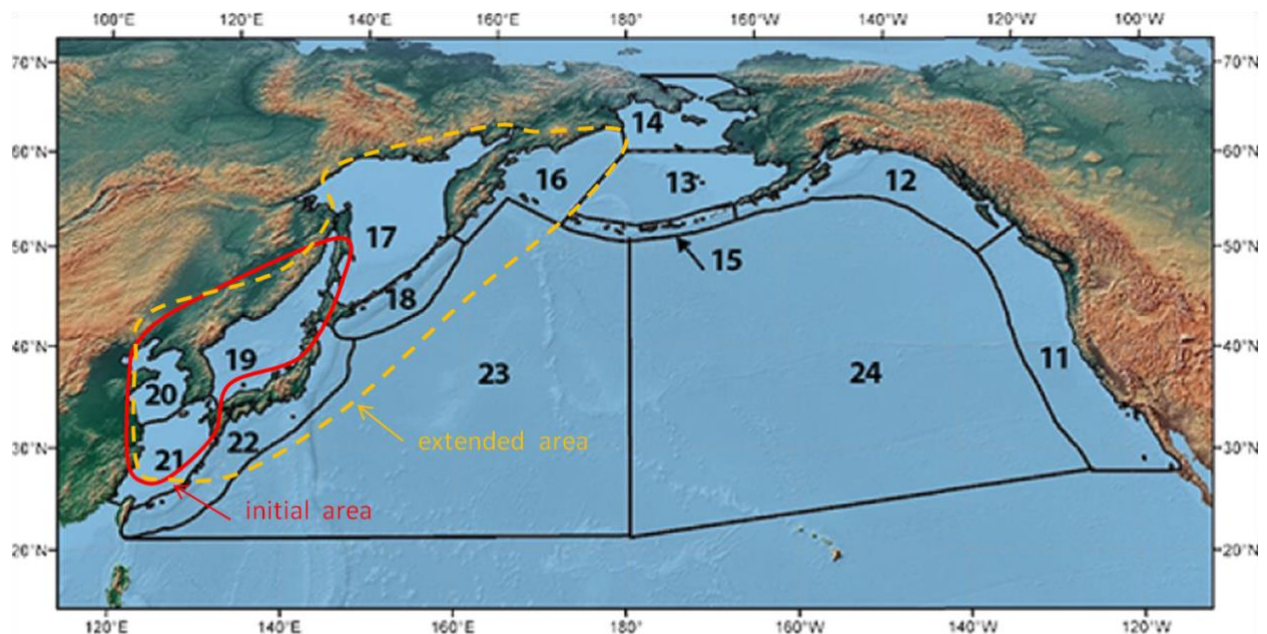


Figure 1. AP-CREAMS initial focus area (red line) and proposals of its extension (yellow dashed line) overlapped on PICES NPESR regions map

Considering the goals of PICES, the extension will:

1. better promote and coordinate marine research in the western North Pacific marginal seas (not limited to the core areas 19-21 but also the extended areas),
2. advance more scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impact of human activities, focused on the western North Pacific marginal seas, and better promote the collection and rapid exchange of scientific information on more issues that affect the North East Asian Marginal Seas.

The extension will not overlap in spatial extent with other existing PICES EGs AP-ARC and AP-NPCOOS because of AP-CREAMS will focus on the areas off the coast (not near the coast, thus be separated from focus of AP-NPCOOS) and mid-latitude Asian marginal seas (not Pacific

Arctic and its Gateway and thus be separated from focus of AP-ARC). However, the AP-CREAMS will develop closer collaboration with these APs to support any joint activities.

Below we present a few cases for better understanding that science/knowledge for the core areas of AP-CREAMS (19, 20, and 21) is linked to that for the extended areas (16, 17, 18, and 22).

Case 1. Interannual variability of winter sea levels induced by local wind stress: Interannual variations of sea level averaged over the core area (Areas 19, 20, and 21) are significantly affected by sea surface wind patterns, particularly on the extended area (Area 17). See Figure 2 below originating from Han et al. (2020).

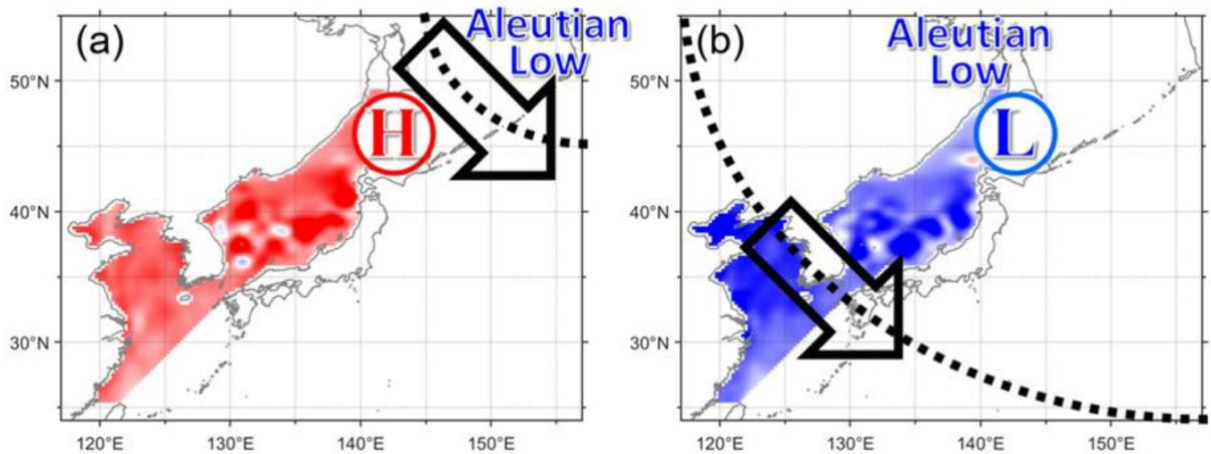


Figure 2. Schematic diagrams accounting for the winter North East Asian Marginal Seas (NEAMS, Areas 19, 20, and 21) mean sea level anomalies. (a) A stronger winter monsoon with northwesterly wind or southeasterly wind stress (black arrows) and associated atmospheric pressure gradients (black dotted lines) in the southern Sea of Okhotsk (Area 17); e.g., the northeastward retreat of the Aleutian Low obstructs the outflow transport from the Area 19 into the Pacific by Ekman dynamics to yield a higher (red) NEAMS sea level during Period H (period of positive NEAMS mean sea level anomaly). (b) In contrast, a stronger winter monsoon in the southern Area 19 obstructs the inflow transport from the Pacific to the Area 21 and to the Area 19 to yield a lower (blue) NEAMS sea level during Period L (period of negative NEAMS mean sea level anomaly). Source: Han et al. (2020)

Case 2. Hydrographic structure and material concentrations, and their variability within and beyond the Area 19 linked to processes outside the core area (extended area): Hydrographic structure and material (e.g., ^{134}Cs) concentrations, and their natural and human-induced variations in the core area (Area 19) are significantly affected by those in the extended areas (Areas 17, 18, and 22) as well as the other core areas (Areas 20 and 21) via the current systems shown in Figures 3 and 4 originating from Yasuda (2003) and Inoue et al. (2023).

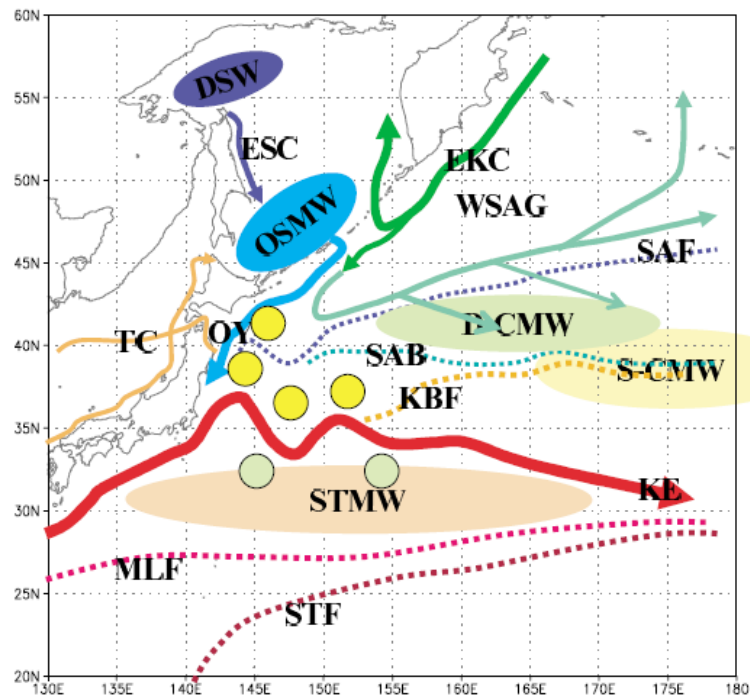


Figure 3. Schematic illustration of the near-surface current, front and water-mass structures in the Kuroshio-Oyashio transition area. EKC: East Kamchatka Current, WSAG: Western Subarctic Gyre, ESC: East Sakhalin Current, OY: Oyashio, KE: Kuroshio Extension, TC: Tsushima Warm Current, SAF: Subarctic Front, SAB: Subarctic Boundary, KBF: Kuroshio Bifurcation Front, STF: Subtropical Front, MLF: Mixed Layer Front, STMW: Subtropical Mode Water, S-CMW: Shallow Central Mode Water, D-CMW: Dense Central Mode Water, DSW: Dense Shelf Water, OSMW: Okhotsk Sea Mode Water. The yellow circles denote warm-core rings and light green ones cold-core rings. Source: Yasuda (2003)

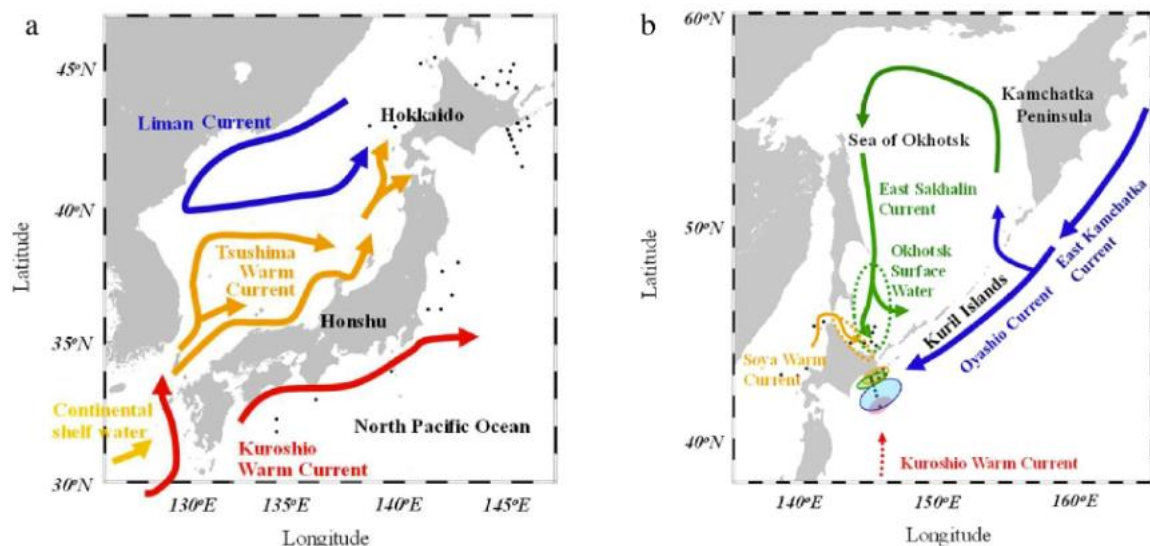


Figure 4. (a) Seawater sampling locations around the Honshu and (b) Hokkaido islands in Japan, along with the major current systems. Source: Inoue et al. (2023)

References

- Han, M., Nam, S., Cho, Y. -K. *et al.* Interannual variability of winter sea levels induced by local wind stress in the northeast Asian marginal seas: 1993-2017. *J Mar Sci Eng* 8(10), 774 (2020). <https://doi.org/10.3390/jmse8100774>
- Inoue, M., Mashita, K., Kameyama, H. *et al.* Subarctic-scale transport of ^{134}Cs to ocean surface off northeastern Japan in 2020. *Sci Rep* 13, 7524 (2023). <https://doi.org/10.1038/s41598-023-34775-8>
- Yasuda, I. Hydrographic structure and variability in the Kuroshio-Oyashio Transition Area. *J Oceanogr.* 59, 389-402 (2003). <https://doi.org/10.1023/A:1025580313836>

Endnote 1

Some examples of the AP-CREAMS activity in the regions 20 and 21 over last 10 years

AP-CREAMS activity in the regions 20 and 21 (Yellow Sea and East-China Sea), or EAST-II area, is the same as for another AP-CREAMS target region 19 (EAST-I), as presented in the annual reports available at the PICES web site (e.g. <https://meetings.pices.int/publications/annual-reports/2016/2016-AP-CREAMS.pdf>). Basically it consists of the following main activities:

- organization and maintaining of international observational programs and joint cruises;
- presentation on national activities and discussion of their results;
- workshops, scientific sessions, special symposia, training courses;
- publications

1. Joint cruises

Over 10 recent years three joint cruises were implemented in 2016-2018, while the following joint cruises were cancelled because of political situation with the EEZ between the neighbor countries and the pandemic situation since 2020. The avoid EEZ problem AP-CREAMS discussed a strategy of coordinated cruise when each country works in its EEZ but the national programs are coordinated and data exchange is permitted when it is possible.

A cruise of Japanese T/V *Nagasaki-maru* was carried out in the eastern East China Sea in July 19–28, 2016. Chinese students of Ocean University of China (OUC) and members from Korean Institute of Ocean Science and Technology (KIOST) participated in the cruise [1]. Participants from China (OUC) and Korea (KIOST) attended the cruise of T/V *Nagasaki-Maru* on July 17-27, 2017 [2]. A cruise of new T/S *Nagasaki-maru* in the East-China Sea in which researchers from KIOST and OUC took part jointly with their colleagues from Kyushu University, University of Toyama, Nagoya University and Ehime University was carried out in July 2018 [3]. Next year Dr. Guebuem Kim reported on planned international cruises by Korea in the EAST-II area. However due to difficulties in EEZ permission, China–Korea–Japan joint cruises were modified to a Korea-only cruise [4]. Later Dr. SungHyun Nam announced planned joint Korea-USA cruises in September 2020 and March 2021. However because of COVID pandemic situation these cruises were postponed [5].

2. Presentation on national activities and discussion of their results

The reports on national and international activities in the AP-CREAMS areas always covered both two areas EAST-I (reg. 19) and EAST-II (reg. 20 and 21). These were presented at every AP-CREAMS meeting usually followed by discussion on cooperation and coordination by multi-national efforts [6].

3. Workshops, scientific sessions, special symposia, training courses

Over recent 10 years AP-CREAMS organized the following symposia which covered evenly whole domain including regions 20 and 21:

- 2025-PICES AM: S2. Changing ecosystem structure under global climate change: monitoring, detecting, modelling, and socio-ecological impacts (Nov 11-12, 2025)
- 2024-PICES AM: S6, Past, Present and Future of CREAMS program: 30 years of international research in North East Asian Marginal Seas
- 2023-PICES AM: W4, Changing social-ecological-environmental system of the North East Asian Marginal Seas: New challenges for integrative marine science
- 2019-PICES AM: W4, Circulation, biogeochemistry, ecosystem, and fisheries of the western North Pacific marginal seas: Past and future of CREAMS (Circulation Research of East Asian Marginal Seas)

- 2024 Intersessional Symposia: July 25–26, 2024, Korea, CREAMS 30th Anniversary & CSK-II Joint Workshop “Promoting international collaboration for science of East Asian Marginal Seas in a changing climate: Circulation, biogeochemistry, ecosystem, and socio-economic researches”.
- 2022 PICES AP-CREAMS Virtual Summer School: August 22–26, 2022 “Ocean Turbulence: From Observing to Research”. Sponsors/Organizers: PICES, Marine Observation Branch of the Chinese Society for Oceanology and Limnology (CSOL)
- 2016 Joint Training Course: Nov. 30 - Dec. 10, 2016, Nagoya University, Japan The 26th International Hydrological Program (IHP) training course Coastal vulnerability and freshwater discharge

As an example of the workshop coverage below are presented below a few geographic maps of AP-CREAMS interest from 2024 CREAMS 30th Anniversary & CSK-II Joint Workshop (PICES Press, winter 2025) [7].

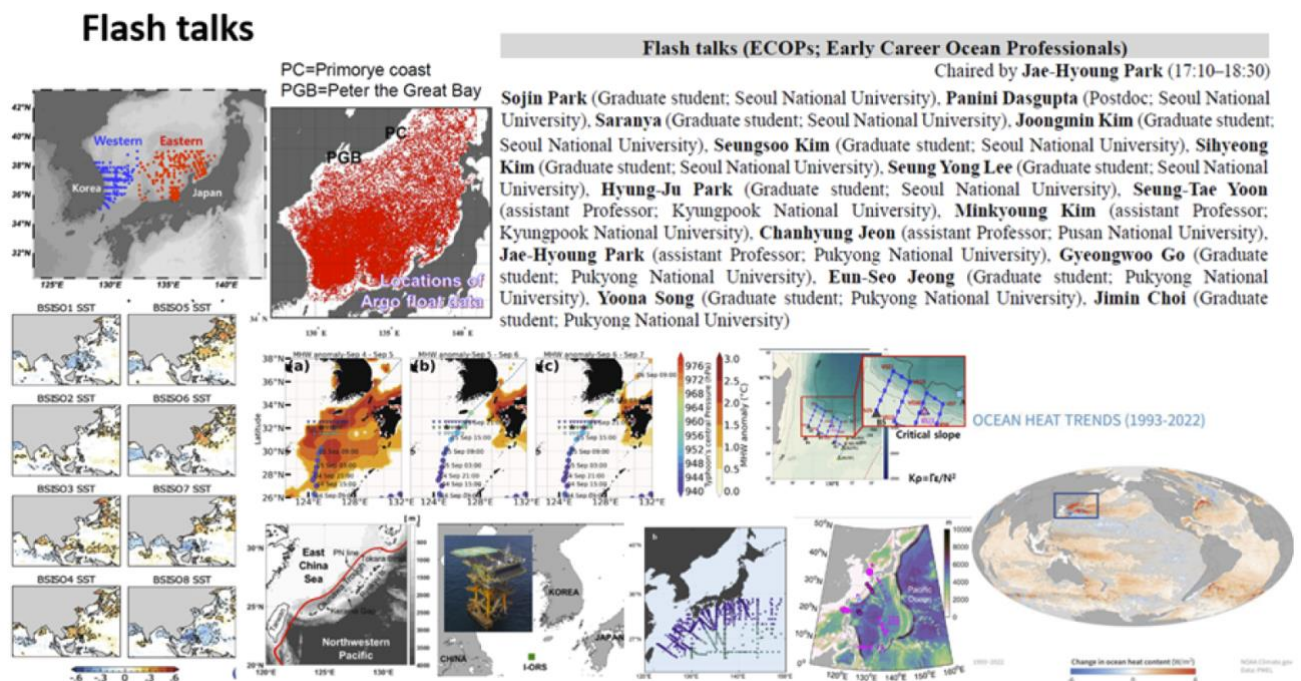
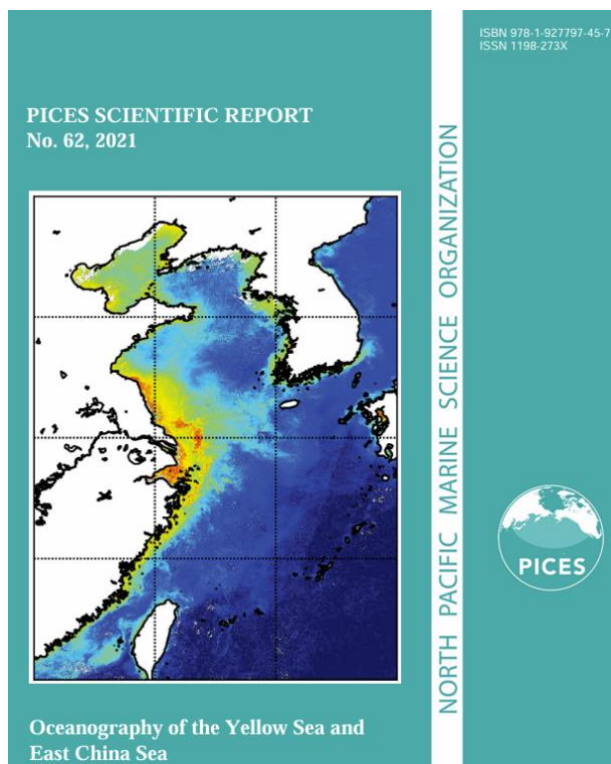


Figure 4. Examples of ECOPs presentations during the Flash Talk session, demonstrating geographic areas of interest.

4. Publications

Among the special publications prepared by AP-CREAMS focused on the EAST-II area (reg. 20 and 21) it should be mentioned the following:

4.1 Ishizaka, J., Kim, G., Lee, J.H., Liu, S.M., Yu, F. and Zhang, J. (Eds.) 2021. Oceanography of the Yellow Sea and East China Sea. PICES Sci. Rep. No. 62. North Pacific Marine Science Organization, Sidney, BC, Canada, 298 pp. <https://doi.org/10.60786/NQVR-2C62> Editors are former or current Co-Chairs of AP-CREAMS. The report contains many maps showing geographic areas of interest shown in this report [8].



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Oceanography of the Yellow Sea and East China Sea

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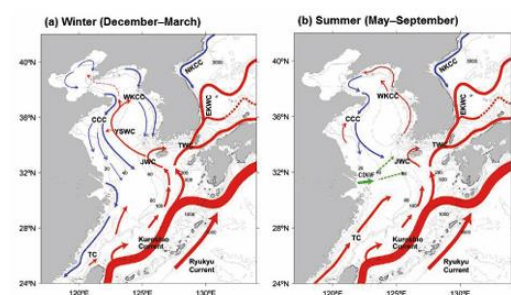


Fig. 1.1.2 Schematic pattern of circulation in the Bohai Sea, the YS and the ECS during (a) winter and (b) summer. JWC, YSWC, CCC, WKCC, and CDWF stand for Jeju Warm Current, Yellow Sea Warm Current, Chinese Coastal Current, and West Korea Coastal Current, Changjiang Diluted Water Flow, respectively. Modified from Park *et al.* (2017).

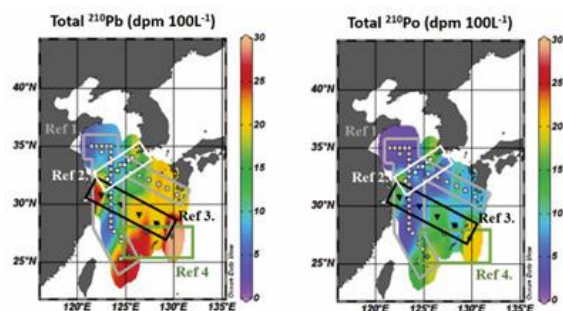
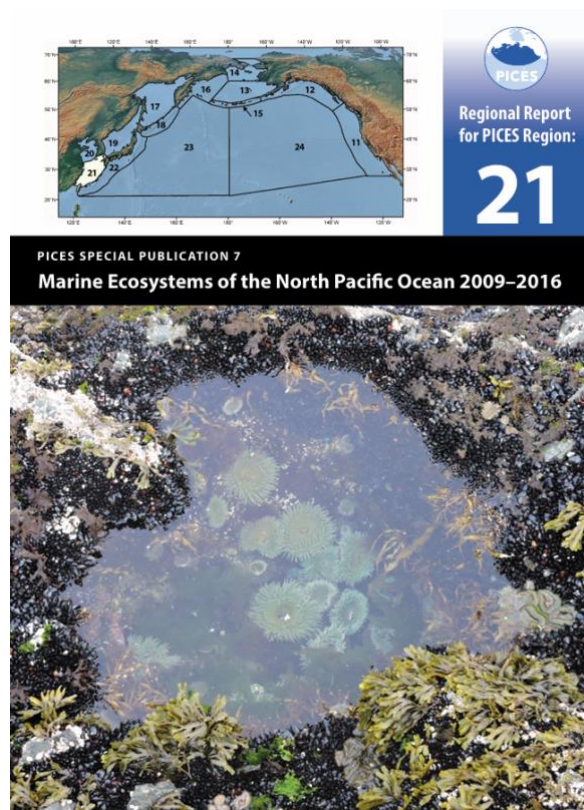


Fig. 2.4.2 Maps showing the locations of the data acquired and the distributions of ^{210}Pb and ^{210}Po in previous studies. Data from Nozaki *et al.* (1990, 1991), Hong *et al.* (1999) and Su *et al.* (2017).

4.2 Chandler, P.C. and Yoo, S. [Eds.] 2021. Marine Ecosystems of the North Pacific Ocean 2009–2016: Synthesis Report, PICES Special Publication 7, 82 pp.

<https://meetings.pices.int/publications/special-publications/NPESR/2021/index> Chapter 21 is prepared by the AP-CREAMS Co-chair Dr. You Fei, and many contributors are either co-chair or members of the AP-CREAMS. The chapter contains many maps showing geographic areas of interest [9].



PICES North Pacific Ecosystem Status Report, Region 21 (East China Sea)

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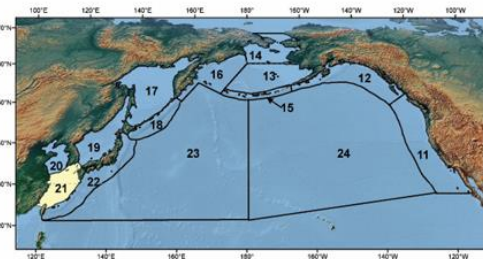


Figure R21-1. The PICES biogeographical regions and naming convention for the North Pacific Ocean with the area discussed in this report highlighted.

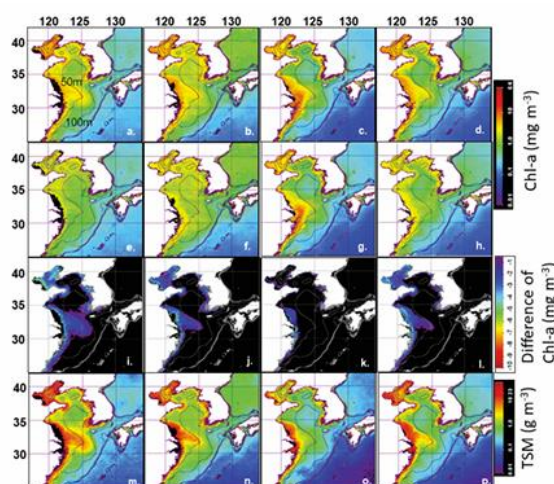


Figure R21-6. Distribution of 10-year (1997–2006) average of monthly chlorophyll-a (chlorophyll-a; mg m^{-3}) from (a-d) standard MODIS algorithm and (e-h) from local YOC algorithm, (i-l) the difference between the two (chlorophyll-a, mg m^{-3}), and (m-p) total suspended matter (TSM; g m^{-3}) with bathymetry. (a, e, i, m) January, (b, f, j, n) April, (c, g, k, o) July, and (d, h, l, p) October. Redrawn from (Yamaguchi et al., 2013).

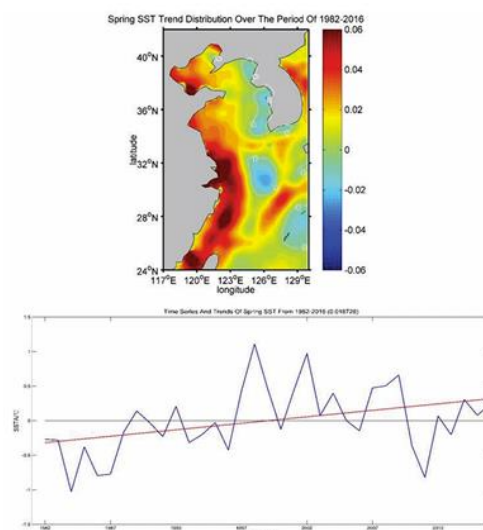


Figure R21-3. (Top) Spatial distribution of SST trend in spring from 1982 to 2016. (Bottom) Regression analysis of sea surface temperature (SST) by daily Optimum Interpolation Sea Surface Temperature (OISST) of the ECS from 1982 to 2016.

5. References

1. <https://meetings.pices.int/publications/annual-reports/2016/2016-AP-CREAMS.pdf>
2. <https://meetings.pices.int/publications/annual-reports/2017/2017-AP-CREAMS.pdf>
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