Report of the Advisory Panel on *North Pacific Coastal Ocean Observing Systems*

The Advisory Panel on North Pacific Coastal Ocean Observing Systems (AP-NPCOOS) held its inaugural meeting from 1400–1800 h on October 17, 2015, in Qingdao, China. Terms of Reference and membership list can be found on the AP-NPCOOS webpage. Eight of the 11 AP-NPCOOS members and about 11 observers attended the meeting (*AP-NPCOOS Endnote 1*).

The AP-NPCOOS meeting was preceded by the AP-NPCOOS Workshop W6 on "*Best practices for and scientific progress from North Pacific Coastal Ocean Observing Systems*" held from 0855 to 1250 h on October 17, 2015 (for a summary of W6, Session Summaries in the 2015 PICES Annual Meeting Report). The workshop built on the successful Workshop W4 on "*Networking ocean observatories around the North Pacific Ocean*" held last October at PICES-2014 in Yeosu, Korea (see a summary of W4 in Session Summaries in the 2014 PICES Annual Meeting Report).

AGENDA ITEMS 1, 2, 3
Introductions and Terms of Reference

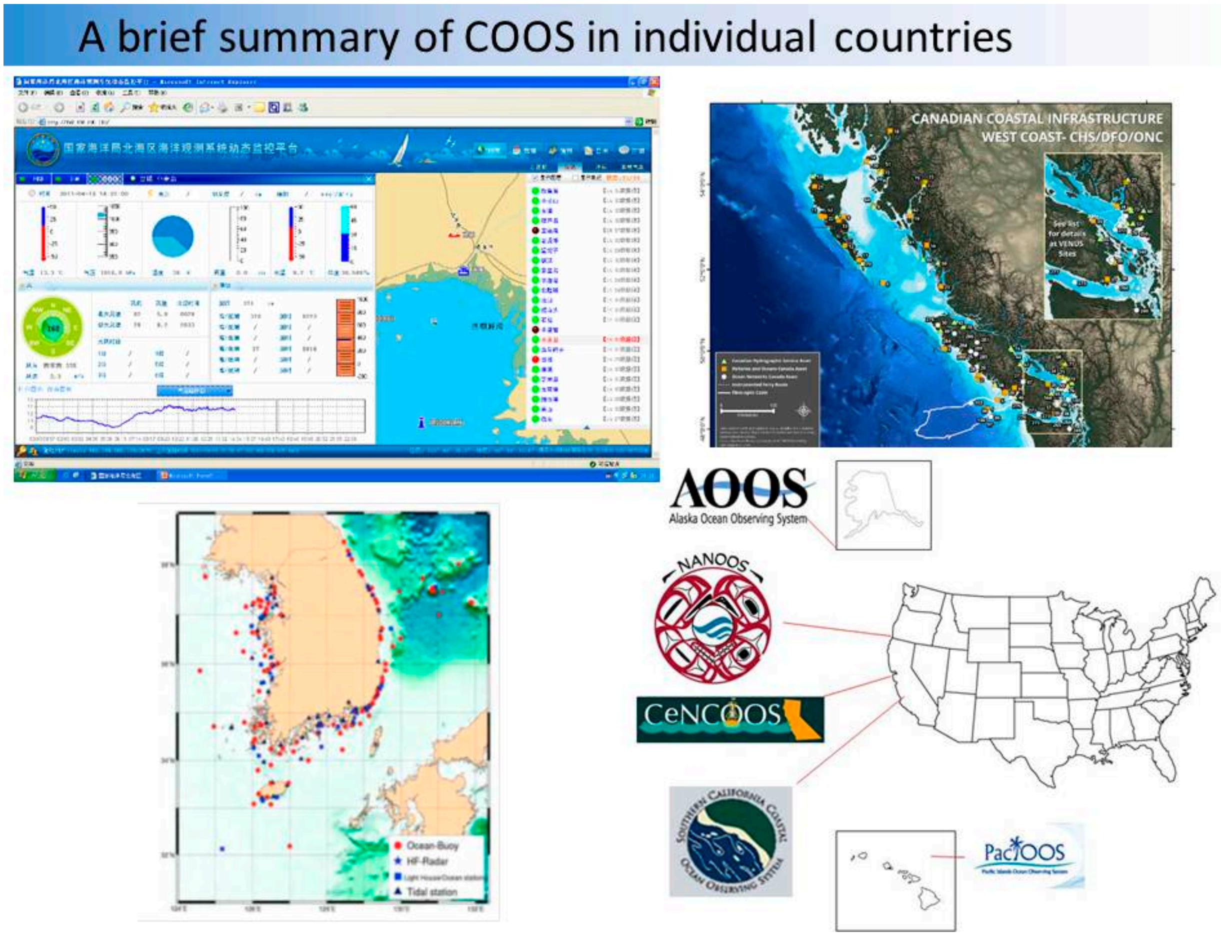
The meeting started with all members and observers introducing themselves. This was followed by the Co-Chairs, Drs. Jack Barth (USA) and Sung Yong Kim (Korea) describing the AP-NPCOOS Terms of Reference and goals for the meeting and the upcoming year (*AP-NPCOOS Endnote 2*; see also *AP-NPCOOS Endnote 3* on preparation materials, including country reports, in advance of the AP-NPCOOS meeting). The Co-Chairs noted that with Workshop W6 and the AP-NPCOOS business meeting, progress was already being made on one of the Terms of Reference, namely convening workshops/sessions to engage those involved in coastal ocean observing systems from around the North Pacific.

AGENDA ITEM 4
Report from FUTURE SSC

Dr. Vyacheslav Lobanov briefed AP-NPCOOS on the activities of the **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems (FUTURE) Scientific Steering Committee (SSC), of which he is a member. He reminded us of FUTURE's three goals: 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? 3) How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems? Dr. Lobanov explained that we must all work to establish strong linkages among FUTURE, the FUTURE SSC and the existing PICES expert groups, of which AP-NPCOOS is one. In particular, he asked AP-NPCOOS members to think about how AP-NPCOOS fits into the FUTURE conceptual diagram.

AGENDA ITEM 5
Coastal Ocean Observing Systems in PICES member countries

Dr. Sung Yong Kim introduced the series of country reports by presenting a summary map of coastal ocean observing in four of the PICES member countries.



The coastal observing efforts of five countries were then reviewed in brief 15-minute presentations by members of AP-NPCOOS.

- Canada (S. Kim Juniper and Akash Sastri)
  - NEPTUNE Canada, VENUS, DFO coastal stations, ferry routes,
  - Coastal observations connect with historic Line P observations and deep-ocean Argo,
  - Best practices on instrument selection, preparation, deployment, data processing,
  - Working on coordinating a ferry program with the state of Washington which runs ferries in Puget Sound.
- China (Chuanxi Xing and Xiao Li for Wenhai Lu)
  - Quarterly ship stations,
  - Annual “Marine Environment Status Bulletin of China Seas”,
  - Additional observing stations for pollutants in bays (*e.g*., Bohai); seabed instruments,
  - Data submission system; web-based entry system; web-based data access system,
  - Numerical models,
  - Storm surge warnings.
- Korea (Sung Yong Kim and Jae-Hak Lee)
  - Motivations for Korean coastal observation: beach erosion, red tides, freshwater input, weather, tidal power station, end user ocean status (ship/vessel, fisheries, coastal communities),
  - Extensive CTD bi-monthly by fisheries (NFRDI); includes biology,
  - GOCI (Geostationary Ocean Color Imagery): Korean satellite; 0.5 km horizontal resolution and hourly images,
  - Buoys: ~11; T/S/T-air/air pressure operated by meteorological agency,
  - Wave buoys all around coast; hourly,

    - Argo floats,
    - Tide gauges on mainland and islands; tidal currents.
- Russia (Vyacheslav Lobanov)
    - Coastal tidal stations with ocean and met sensors were improved in 2014,
    - Academy of Sciences is doing research on hypoxia in Peter the Great Bay (PGB), slope convection at PGB, Primorye upwelling, Sakhalin and Okhotsk Sea northern shelf for oil and gas,
    - Observations in PGB since 2005; deep water upwelling ventilates PGB,
    - Observations in Primorye upwelling region since 2010,
    - Joint transects across the East-Japan Sea (w/Korea and Japan).
- USA (Jack Barth)
    - U.S. Integrated Ocean Observing System (IOOS) and its west coast regional associations:
        - Alaska Ocean Observing System (AOOS),
        - Northwest Association of Networked Ocean Observing Systems (NANOOS),
        - Central and Northern California Coastal Ocean Observing System (CeNCOOS),
        - Southern California Coastal Ocean Observing System (SCCOOS),
    - NOAA fisheries surveys,
    - National Science Foundation's Ocean Observatories Initiative (OOI),
    - Best practices for real-time data (NOAA's "Quality Assurance of Real Time Ocean Data," QARTOD, http://www.ioos.noaa.gov/qartod/welcome.html),
    - Best practices for instrument selection and accuracy (NOAA's "Alliance for Coastal Technologies," ACT, http://www.act-us.info/).

All PICES participating countries put effort into building and maintaining coastal ocean observing programs which have been developed with active collaboration of local universities, institutions, and government-funded agencies in terms of national- and regional-wide needs. Nonetheless, the technical maturity in operation and maintenance of observational assets and the national priorities driving the coastal ocean observing programs vary in individual countries. The diversity across PICES member countries' coastal ocean observing systems helps us to share the best practices on technical challenges and to prioritize the primary topics that AP-NPCOOS can focus on in future workshops and scientific sessions.

AGENDA ITEM 6

AP-NPCOOS issues and next steps

After the summaries of PICES countries coastal ocean observing efforts, the AP-NPCOOS discussed the need for action on several topics. Regarding proposals for the 2016 PICES Annual Meeting which were due on Monday, October 19, 2015, it was decided to propose a workshop and a scientific session. [Note: we have subsequently heard that both these proposals were accepted for the 2016 Annual Science Meeting.]:

PICES-2016

- Workshop proposal on "*Delivering quality multi-parameter data from the coastal ocean*" (*AP-NPCOOS Endnote 4*)
- Topic Session proposal on "*Understanding the changing coastal ocean: advances and challenges in multi-parameter observations*" (*AP-NPCOOS Endnote 4*)

Inter-sessional Activities

Members discussed the desire to hold any inter-sessional activities this coming year and it was decided to not hold any while the AP was just spinning up. We noted that a list of international meetings AP-NPCOOS members will be attending in the next year would be useful (*e.g.*, Ocean Sciences Meeting, New Orleans, USA, February 2016).

FUTURE and AP-NPCOOS

AP-NPCOOS discussed how it fits into the FUTURE program. AP-NPCOOS can play a role in each of the three main FUTURE goals:

1. What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?
   AP-NPCOOS:
   - Measure coastal ecosystem response to forcing, natural and anthropogenic;
   - Create time series of essential ocean and ecological variables of sufficient accuracy and stability to detect changes, both events and trends;
   - Need to define a reasonable set of variables to measure and establish best practices (sensor choice, deployment techniques including biofouling mitigation, metadata standards, data processing and distribution).
2. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?
   AP-NPCOOS:
   - See above regarding measurements;
   - Work with modelers to verify and develop predictive models.
3. How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?
   AP-NPCOOS:
   - Measure variables related to hypoxia, HABs and pollutant transport (T, S, currents, chl-fl, CDOM, DO, nutrients).

Regarding FUTURE SSC Terms of Reference (approved May 18, 2015), one of the AP-NPCOOS Terms of Reference aligns with FUTURE TOR 6: "Identify and facilitate interactions with national/international research programs from which FUTURE could benefit." AP-NPCOOS will engage with international groups working on defining essential ocean and ecological variables (GOOS, GEO, *etc*.). AP-NPCOOS can help match FUTURE goals to these variables and promote PICES member countries to make high-quality observations of these variables.

AP-NPCOOS suggests it participate in the proposed expert groups:
1. Study Group or Working Group on "Common Ecosystem Reference Points across PICES Member Countries"
   AP-NPCOOS: establish best practices for essential ocean and ecological variables to set reference points.
2. Working Group on "Ecosystem Impacts of Mesoscale and Sub-Mesoscale Processes in the North Pacific"
   AP-NPCOOS: mesoscale and submesoscale are key for coastal ocean; establish time and space scales of measurements to understand mesoscale and submesoscale.
3. Working Group on "Additive, Synergistic and Antagonistic Interactions of Cumulative Stressors"
   AP-NPCOOS: measure multi stressors, *e.g*., hypoxia and OA, temperature and nutrients, *etc*.

AP-NPCOOS Planned Activities and Outcomes; Recommendations
The next order of business was to agree on some AP-NPCOOS activities and desired outcomes for the following year (2015–2016).

Recommendation: AP-NPCOOS members agreed unanimously that PICES should amend its convention to include the Arctic coastal ocean if it does not include that region already. The Arctic coastal oceans are becoming increasingly important and there is much coastal ocean observing going on there. It would be good for PICES to have this region "officially" in their area of interest.
Action: recommend this proposal to MONITOR and TCODE, and the PICES Secretariat.

AP-NPCOOS members unanimously agreed there was a need to educate the next generation of coastal ocean observers. It was decided to conduct a survey of classes, cruises, summer schools and other teaching and training efforts on coastal ocean observing taking place in PICES member countries. The survey will be led by AP-NPCOOS Co-Chairs Drs. Barth and Kim and will take place over the next 4 months.

Recommendation: Based on the need for regular training of the next generation of coastal ocean observers and the success of the 2013 PICES-sponsored Summer School on "*Ocean observing systems and ecosystem monitoring*" held in Newport, Oregon (PICES Press, Vol. 22, No. 1, pp. 24–27), we recommend that PICES sponsor an annual coastal ocean observing summer school that rotates around the PICES countries. This could start in 2017 in a member country on the west side of the North Pacific, perhaps associated with and co-sponsored by AP-CREAMS. The PICES Secretariat would provide some organizational support and help arrange travel funds. The host country would be responsible for helping support the on-site summer school costs. It was noted that a survey should be conducted with students after they complete the class to see how they are using what they learned in their research and job activities. Dr. Juniper (Ocean Networks Canada, ONC) expressed interest in ONC helping to support the annual summer school in some way.
Follow-up for getting the annual summer school started will be done by Drs. Barth and Lobanov.

Several AP-NPCOOS members pointed out the utility of making repeated measurements from regular passenger ferries in many of the PICES member countries. For example, ferries are run by Canada and the USA in the Salish Sea, and by Korea around the Korean peninsula. It was recognized that besides technical issues and challenges, there may be political challenges that need to be overcome to make these observations routine.
AP-NPCOOS members Drs. Akash Sastri and Jae-Hak Lee agreed to lead an effort to study this issue over the next year.

It was agreed that producing a quality assurance/quality control (QA/QC) flow diagram would be helpful for coordinating our coastal ocean observing efforts.
Dr. Juniper agreed to help with this and the AP-NPCOOS Co-Chairs will ask Dr. Wenhai Lu to participate. A draft of this flow diagram will be produced in the next 4–6 months.

AP-NPCOOS members recognized that the list of standard variables that are universally measured include sea level, temperature, salinity, currents, and chlorophyll–fluorescence. It is important that other more ecological ocean variables be measured too. What are these next ecological/biological variables? Perhaps dissolved oxygen, pH/pCO$_2$/alkalinity, and/or something about zooplankton and fish? It was recognized that many international organizations are working on identifying "Ecological Essential Ocean Variables (eEOVs)." The AP agreed to look into recent progress by other organizations (GOOS, GEO programs, Framework for Ocean Observations, *etc*.). The next step would be to review how PICES member countries measure these variables and to standardize across our observing efforts. This should be done in coordination with MONITOR, TCODE, BIO, POC, *etc*. AP-NPCOOS could provide advice to PICES member countries on how they might make and standardize measurements. AP-NPCOOS should advise PICES to be part of this internationally agreed set of EOVs once consensus is further along.
Drs. Tony Koslow (proposed AP-NPCOOS member, Scripps Institution of Oceanography) and Andrew Ross (Fisheries and Oceans Canada) agreed to help get this activity started.

Some miscellaneous topics were discussed but not acted upon. They are listed here for potential future action:

- How much of western Pacific PICES member countries' data goes into NEAR-GOOS? What are the minimum useful data that should go into NEAR-GOOS?
- Recommendation to collect basic environmental data from fisheries surveys; identify existing surveys that have these data and those surveys that should have them added;
- Map coastal ocean observing motivators (fisheries, pollution, shipping, erosion, storm surges, *etc*.) with FUTURE goals;
- Inventory of time series that are long enough to provide trends;
- Coastal weather stations (inventory, capability, data to weather centers, *etc*.).

Suggested changes in AP-NPCOOS membership
Through discussions with Japanese members of MONITOR (Drs. Sei-Ichi Saitoh, Sanae Chiba) it was agreed that we add an additional Japanese member to AP-NPCOOS. We recommend that this be Dr. Naoki Yoshie (Ehime University) given his expertise in interdisciplinary coastal oceanography. It was also agreed that we add one more USA representative and that Dr. Tony Koslow (Scripps Institution of Oceanography) would be a

good choice to represent the need for biological observations higher in the food chain than phytoplankton and because of his membership on TCODE, one of the parent committees of AP-NPCOOS.

AP-NPCOOS Endnote 1

AP-NPCOOS participation list

Members	**Observers**
Jack Barth (U.S.A., Co-Chair)	Mathew Baker (NPRB)
S. Kim Juniper (Canada)	Sonia Batten (SAHFOS)
Sung Yong Kim (Korea, Co-Chair)	Kyung-Il Chang (POC)
Jae-Hak Lee (Korea)	David M. Checkley (USA)
Xiao Li (China, representing Wenhai Lu)	Valery Detemmerman (CLIVAR)
Vyacheslav Lobanov (Russia)	Hee-Dong Jeong (NEAR-GOOS)
Akash Sastri (Canada)	
Chuanxi Xing (China)	*and others*

AP-NPCOOS Endnote 2

AP-NPCOOS meeting agenda

1. Introduction of AP-NPCOOS (Co-Chairs Barth and Kim)
2. Introduction of AP-NPCOOS members (members)
3. Discussion of how to fulfill AP-NPCOOS Terms of Reference
4. Report from FUTURE SSC (Lobanov)
5. Coastal Ocean Observing Systems in PICES member countries (members); 15-minute presentations by 5 member nations (missing: Japan)
6. Discussion of AP-NPCOOS issues, questions (below) and next steps
7. End

AP-NPCOOS Endnote 3

Preparation materials in advance of AP-NPCOOS meeting

1) Questions to consider for our AP-NPCOOS Annual Meeting

- What are "best practices" for coastal ocean observing platforms, sensors and sensor calibration, data quality control, user interfaces to data and information products, data delivery to users, data archiving? (Term of Reference #1)
- How can AP-NPCOOS advise/assist FUTURE? (Term of Reference #3) FUTURE is the PICES Scientific Program "Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems" (http://pices.int/members/scientific_programs/FUTURE/FUTURE-main.aspx)
- What is relationship of AP-NPCOOS and CREAMS? And MONITOR? And TCODE?
- How might AP-NPCOOS advise/assist PICES in preparation of the North Pacific Ecosystem Status Report (http://pices.int/projects/npesr/default.aspx)? (Term of Reference #3)
- How might AP-NPCOOS relate to global programs like GOOS, Argo, POGO, *etc*.? It might be helpful to visit the GOOS page (http://www.ioc-goos.org/). (Term of Reference #3)
- What are the motivations and applications for your country's coastal ocean observing (*e.g*., fisheries, shipping, aquaculture, *etc*.)?

- What is unique to AP-NPCOOS that is not being covered elsewhere in PICES or internationally? For example, AP-NPCOOS is definitely "coastal," but what about other unique aspects?
- What open-ocean observing assets are most relevant to your coastal issues and how are they linked into your coastal ocean observing systems? If they are not lined in efficiently, how might that be done?

2) Request for materials in advance of AP-NPCOOS meeting. Due to Co-Chairs by August 31, 2015.

- Please provide a map and list of coastal ocean observing assets for your country. This might include moorings, shore stations, ship-based measurements (especially cross-shelf sections), autonomous vehicles, cabled observatories, *etc*. Please include the list of sensors and variables that are being measured, and how frequently they are observed. We know this is a big effort, but ask that you do the best you can to provide an overview and as many details as possible. We can build on these maps and lists over time.
- Please provide a list, either from your country or ones you know of internationally, of "best practices" documents. These might include documents on sensor maintenance, calibration, quality control, data delivery, *etc*. Examples include the "PICES Special Publication 3: Guide to best practices for ocean CO_2 measurements" (http://cdiac.ornl.gov/oceans/Handbook_2007.html)
- Please provide a list of technical groups, meetings, workshops in each country that deal with coastal ocean observing and provide their contact information.

Reports from participating countries

Coastal regions, as scientifically, societally, and economically important areas, have been received attention with scientific studies of air-sea-land interactions, environmental issues, and fishery business. Recently, coastal ocean observing programs have been established in several countries to monitor the ocean environment including from nearshore waves to climate change and to improve the forecast skill using archived observations. Particularly, multiple oceanic signals and telecommunication of climate signals are included in in-situ observations in open ocean and coastal regions ranging from mesoscale to submesoscale.

All PICES member countries have operated their own coastal ocean observing programs. In this first year report, we addressed the on-going coastal ocean observing programs and various best-practices documents. For this purpose, we have requested the information described below:

Motivation and questions for the AP-NPCOOS Annual Meeting

- What are "best practices" for coastal ocean observing platforms, sensors and sensor calibration, data quality control, user interfaces to data and information products, data delivery to users, data archiving?
- How can AP-NPCOOS advise/assist FUTURE, and what is the relationship of AP-NPCOOS and AP-CREAMS? And MONITOR? And TCODE?
- How might AP-NPCOOS advise/assist PICES in preparation of the North Pacific Ecosystem Status Report and relate to global programs like GOOS, Argo, POGO, *etc*.?
- What are the motivations and applications for your country's coastal ocean observing (*e.g*., fisheries, shipping, aquaculture, *etc*.)?
- What is unique to AP-NPCOOS that is not being covered elsewhere in PICES or internationally?
- What open-ocean observing assets are most relevant to your coastal issues and how are they linked into your coastal ocean observing systems? If they are not lined in efficiently, how might that be done?

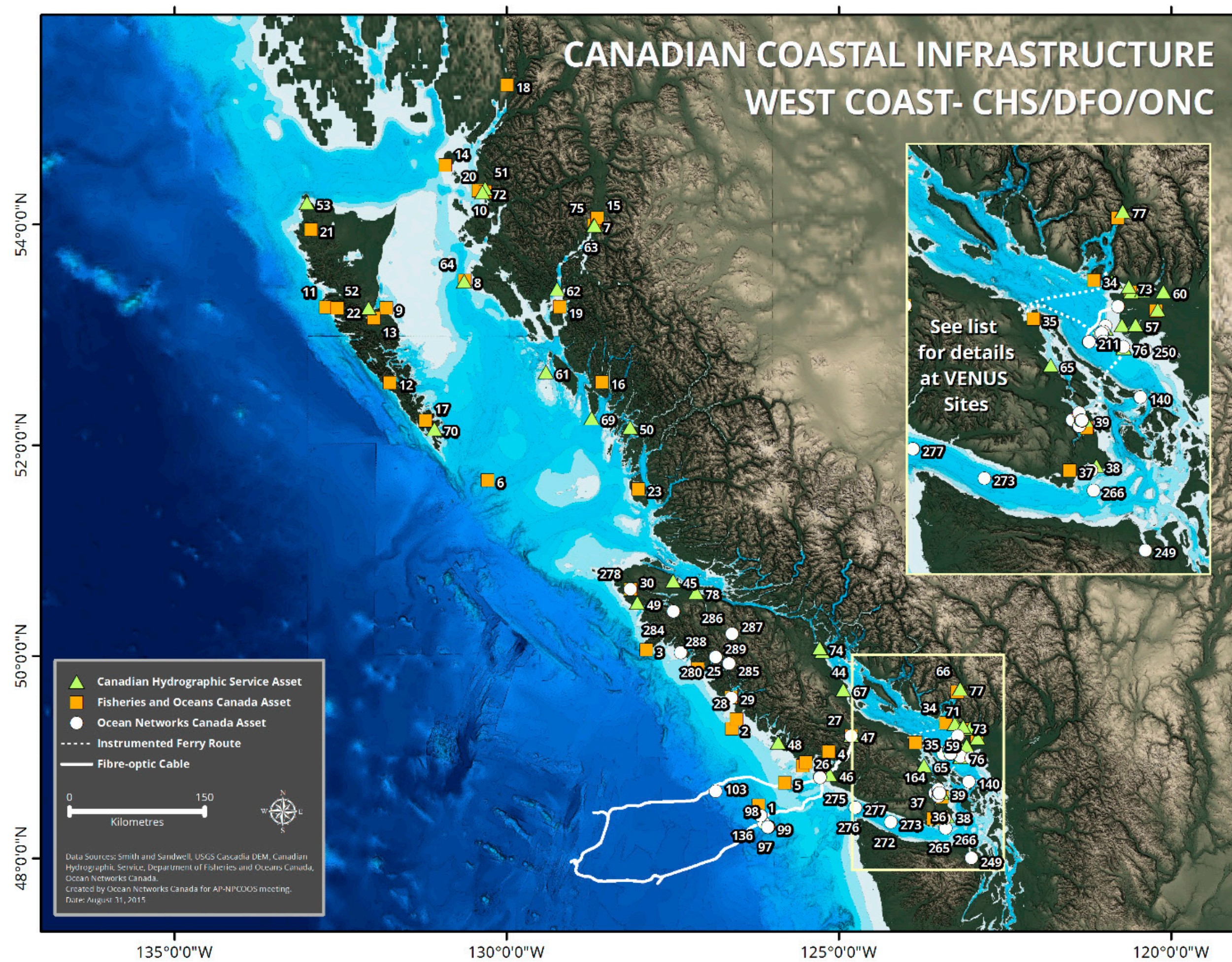
Information received from member countries on coastal observations

- A map and list of coastal ocean observing assets for each country including moorings, shore stations, ship-based measurements (especially cross-shelf sections), autonomous vehicles, cabled observatories, *etc*.
- A list of "best practices" documents including documents on sensor maintenance, calibration, quality control, data delivery, *etc*.
- A list of technical groups, meetings, workshops in each country that deal with coastal ocean observing and provide their contact information.

Reports are presented in this order: Canada, USA, People's Republic of China, and Republic of Korea.

Report from Canada

Map and list of assets for coastal ocean observations



MAP ID REFEREI	ORGANIZATION	OBSERVATORY	SITE NAME	SUB_SITE	INSTRUMENT_DEVICE_SENSOR	LONGITUDED_D	LATITUDED_D	DEPTH (m)
1	Fisheries and Oceans Canada		A1-55	A1-55	Longterm Moorings	-126.204750	48.529667	0.00
2	Fisheries and Oceans Canada		EO1-55	EO1-55	Longterm Moorings	-126.603850	49.288733	0.00
3	Fisheries and Oceans Canada		BP1-55	BP1-55	Longterm Moorings	-127.891300	50.059217	0.00
4	Fisheries and Oceans Canada		EFO4-L	EFO4-L	Longterm Moorings	-125.151550	49.064400	0.00
5	Fisheries and Oceans Canada		LAP1-A	LAP1-A	Whale Listening Devices	-125.808333	48.753333	0.00
6	Fisheries and Oceans Canada		RA1-C	RA1-C	Whale Listening Devices	-130.283217	51.671167	0.00
7	Fisheries and Oceans Canada		Meteorological Station	Meteorological Station	Meteorological Station	-128.678983	53.992653	0.00
8	Fisheries and Oceans Canada		Planned CODAR RADAR	Planned CODAR RADAR	Planned CODAR RADAR	-130.627182	53.498949	0.00
9	Fisheries and Oceans Canada		Planned CODAR RADAR	Planned CODAR RADAR	Planned CODAR RADAR	-131.804024	53.253375	0.00
10	Fisheries and Oceans Canada_Canadian Coast Guard		Digby Island	Digby Island	CCG Communication sites	-130.418333	54.297500	0.00
11	Fisheries and Oceans Canada_Canadian Coast Guard		Hunter Point	Hunter Point	CCG Communication sites	-132.714722	53.258611	0.00
12	Fisheries and Oceans Canada_Canadian Coast Guard		Barry Inlet	Barry Inlet	CCG Communication sites	-131.753611	52.575000	0.00
13	Fisheries and Oceans Canada_Canadian Coast Guard		Cumshewa	Cumshewa	CCG Communication sites	-131.996389	53.159167	0.00
14	Fisheries and Oceans Canada_Canadian Coast Guard		Dundas Island	Dundas Island	CCG Communication sites	-130.915278	54.521111	0.00
15	Fisheries and Oceans Canada_Canadian Coast Guard		Kitimat	Kitimat	CCG Communication sites	-128.630833	54.055556	0.00
16	Fisheries and Oceans Canada_Canadian Coast Guard		Klemtu	Klemtu	CCG Communication sites	-128.562500	52.579167	0.00
17	Fisheries and Oceans Canada_Canadian Coast Guard		Rose Inlet	Rose Inlet	CCG Communication sites	-131.215000	52.221667	0.00
18	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Dent	Mount Dent	CCG Communication sites	-129.988333	55.216111	0.00
19	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Gil	Mount Gil	CCG Communication sites	-129.195000	53.262778	0.00
20	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Hays	Mount Hays	CCG Communication sites	-130.313611	54.286667	0.00
21	Fisheries and Oceans Canada_Canadian Coast Guard		Naden Harbour	Naden Harbour	CCG Communication sites	-132.941667	53.955000	0.00
22	Fisheries and Oceans Canada_Canadian Coast Guard		Van Inlet	Van Inlet	CCG Communication sites	-132.541944	53.252222	0.00
23	Fisheries and Oceans Canada_Canadian Coast Guard		Calvert Island	Calvert Island	CCG Communication sites	-128.011944	51.589167	0.00
24	Fisheries and Oceans Canada_Canadian Coast Guard		Amphitrite Point	Amphitrite Point	CCG Communication sites	-125.540278	48.925278	0.00
25	Fisheries and Oceans Canada_Canadian Coast Guard		Eliza Dome	Eliza Dome	CCG Communication sites	-127.120278	49.873333	0.00
26	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Ozzard	Mount Ozzard	CCG Communication sites	-125.491667	48.959444	0.00
27	Fisheries and Oceans Canada_Canadian Coast Guard		Port Alberni	Port Alberni	CCG Communication sites	-124.811944	49.218611	0.00
28	Fisheries and Oceans Canada_Canadian Coast Guard		Estevan Point	Estevan Point	CCG Communication sites	-126.533333	49.383056	0.00
29	Fisheries and Oceans Canada_Canadian Coast Guard		Nootka	Nootka	CCG Communication sites	-126.614444	49.593333	0.00
30	Fisheries and Oceans Canada_Canadian Coast Guard		Holberg	Holberg	CCG Communication sites	-128.126111	50.640000	0.00
31	Fisheries and Oceans Canada_Canadian Coast Guard		Vancouver	Vancouver	CCG Communication sites	-123.112222	49.284722	0.00
32	Fisheries and Oceans Canada_Canadian Coast Guard		Watts Point (Howe Sound)	Watts Point (Howe Sound)	CCG Communication sites	-123.210000	49.648333	0.00
33	Fisheries and Oceans Canada_Canadian Coast Guard		Annacis Island	Annacis Island	CCG Communication sites	-122.919167	49.193056	0.00
34	Fisheries and Oceans Canada_Canadian Coast Guard		Bowen Island	Bowen Island	CCG Communication sites	-123.386944	49.344722	0.00
35	Fisheries and Oceans Canada_Canadian Coast Guard		Gabriola Island	Gabriola Island	CCG Communication sites	-123.843056	49.153056	0.00
36	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Newton	Mount Newton	CCG Communication sites	-123.443056	48.613333	0.00
37	Fisheries and Oceans Canada_Canadian Coast Guard		Mount Helmcken	Mount Helmcken	CCG Communication sites	-123.571389	48.401944	0.00
38	Canadian Hydrographic Service		7120 Victoria	7120 Victoria	CHS PWLN	-123.370706	48.424261	0.00
39	Canadian Hydrographic Service		7277 Patricia Bay	7277 Patricia Bay	CHS PWLN	-123.451650	48.653600	0.00
40	Canadian Hydrographic Service		7654 New Westminster	7654 New Westminster	CHS PWLN	-122.910000	49.200000	0.00
41	Canadian Hydrographic Service		7735 Vancouver	7735 Vancouver	CHS PWLN	-123.109988	49.287145	0.00
42	Canadian Hydrographic Service		7786 Sandy Cove	7786 Sandy Cove	CHS PWLN	-123.232889	49.339889	0.00
43	Canadian Hydrographic Service		7795 Point Atkinson	7795 Point Atkinson	CHS PWLN	-123.253822	49.337440	0.00
44	Canadian Hydrographic Service		8074 Campbell River	8074 Campbell River	CHS PWLN	-125.247333	50.042317	0.00
45	Canadian Hydrographic Service		8408 Port Hardy	8408 Port Hardy	CHS PWLN	-127.489017	50.722383	0.00
46	Canadian Hydrographic Service		8545 Bamfield	8545 Bamfield	CHS PWLN	-125.136044	48.836013	0.00
47	Canadian Hydrographic Service		8575 Port Alberni	8575 Port Alberni	CHS PWLN	-124.813444	49.225182	0.00
48	Canadian Hydrographic Service		8615 Tofino	8615 Tofino	CHS PWLN	-125.912596	49.153530	0.00
49	Canadian Hydrographic Service		8735 Winter Harbour	8735 Winter Harbour	CHS PWLN	-128.029000	50.513000	0.00
50	Canadian Hydrographic Service		8976 Bella Bella	8976 Bella Bella	CHS PWLN	-128.141827	52.163215	0.00
51	Canadian Hydrographic Service		9354 Prince Rupert	9354 Prince Rupert	CHS PWLN	-130.324322	54.317167	0.00
52	Canadian Hydrographic Service		9850 Queen Charlotte	9850 Queen Charlotte	CHS PWLN	-132.071700	53.252017	0.00
53	Canadian Hydrographic Service		9958 Henslung Cove	9958 Henslung Cove	CHS PWLN	-133.005403	54.189836	0.00
54	Canadian Hydrographic Service		7592 Roberts Bank	7592 Roberts Bank	CHS WL Proposed/Planned	-123.166667	49.016667	0.00
55	Canadian Hydrographic Service		7594 Sand Heads	7594 Sand Heads	CHS WL Proposed/Planned	-123.300000	49.105772	0.00
56	Canadian Hydrographic Service		7607 Steveston	7607 Steveston	CHS WL Proposed/Planned	-123.177192	49.122959	0.00
57	Canadian Hydrographic Service		7610 Woodward's Landing	7610 Woodward's Landing	CHS WL Proposed/Planned	-123.075778	49.124661	0.00
58	Canadian Hydrographic Service		7723 First Narrows - East	7723 First Narrows - East	CHS WL Proposed/Planned	-123.127692	49.312531	0.00
59	Canadian Hydrographic Service		7745 Second Narrows	7745 Second Narrows	CHS WL Proposed/Planned	-123.024944	49.293111	0.00
60	Canadian Hydrographic Service		7755 Port Moody	7755 Port Moody	CHS WL Proposed/Planned	-122.865833	49.287700	0.00
61	Canadian Hydrographic Service		9078 Moore Islands	9078 Moore Islands	CHS WL Proposed/Planned	-129.407008	52.672264	0.00
62	Canadian Hydrographic Service		9130 Hartley Bay	9130 Hartley Bay	CHS WL Proposed/Planned	-129.241382	53.423795	0.00
63	Canadian Hydrographic Service		9140 Kitimat	9140 Kitimat	CHS WL Proposed/Planned	-128.696017	53.988600	0.00
64	Canadian Hydrographic Service		9227 Bonilla Island	9227 Bonilla Island	CHS WL Proposed/Planned	-130.636329	53.493347	0.00
65	Canadian Hydrographic Service		7455 Chemainus	7455 Chemainus	CHS WL Highly Desired/Proposed	-123.714350	48.925800	0.00
66	Canadian Hydrographic Service		7810 Squamish	7810 Squamish	CHS WL Highly Desired/Proposed	-123.171096	49.683501	0.00
67	Canadian Hydrographic Service		7965 Comox	7965 Comox	CHS WL Highly Desired/Proposed	-124.929165	49.671051	0.00
68	Canadian Hydrographic Service		9475 Stewart	9475 Stewart	CHS WL Highly Desired/Proposed	-130.010383	55.917000	0.00
69	Canadian Hydrographic Service		9059 McInnes Island	9059 McInnes Island	CHS WL Highly Desired/Proposed	-128.716808	52.249701	0.00
70	Canadian Hydrographic Service		9713 Rose Harbour	9713 Rose Harbour	CHS WL Highly Desired/Proposed	-131.083934	52.148947	0.00
71	Canadian Hydrographic Service		4100 Second Narrows Curr	4100 Second Narrows Currents	Current Sensors Installed	-123.024556	49.294053	0.00
72	Canadian Hydrographic Service		8560 Fairview Terminal Cu	8560 Fairview Terminal Current	Current Sensors Installed	-130.360389	54.282764	0.00
73	Canadian Hydrographic Service		4010 First Narrows East Cu	4010 First Narrows East Current	Currents Proposed/Planned	-123.127692	49.312531	0.00
74	Canadian Hydrographic Service		4900 Campbell River Curre	4900 Campbell River Currents	Currents Proposed/Planned	-125.287092	50.076478	0.00
75	Canadian Hydrographic Service		8540 Kitimat Terminal Cur	8540 Kitimat Terminal Currents	Currents Proposed/Planned	-128.680167	53.992394	0.00
76	Canadian Hydrographic Service		3900 Delta Port Currents	3900 Delta Port Currents	Currents Highly Desired/Proposed	-123.163647	49.010014	0.00
77	Canadian Hydrographic Service		4150 Squamish Terminal C	4150 Squamish Terminal Curren	Currents Highly Desired/Proposed	-123.172822	49.682197	0.00
78	Canadian Hydrographic Service		6600 Port McNeill Current	6600 Port McNeill Currents	Currents Highly Desired/Proposed	-127.147411	50.610403	0.00
79	Canadian Hydrographic Service		8570 Stewart Terminal Cur	8570 Stewart Terminal Currents	Currents Highly Desired/Proposed	-130.005600	55.914339	0.00
80	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	Hydrophone	-126.050292	48.316640	982.40
81	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	Video Camera	-126.050123	48.316788	984.00
82	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	ADCP 2 MHz	-126.050247	48.316795	981.00
83	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	Imaging Rotary Sonar	-126.050247	48.316795	981.00
84	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	ADCP 600 kHz	-126.050163	48.316762	985.00
85	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	ADCP 75 kHz	-126.050125	48.316743	985.00
86	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	CTD	-126.050217	48.316517	985.00
87	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonAxis	Oxygen Sensor	-126.050217	48.316517	985.00
88	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	Fluorometer FLNTU	-126.058022	48.314925	899.50
89	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	CTD	-126.058007	48.314872	896.10
90	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	Video Camera	-126.058007	48.314872	896.10
91	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	Multibeam Non-rotating Sonar	-126.058222	48.314882	896.00
92	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	Oxygen Sensor	-126.058355	48.314775	895.00
93	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidEast	Microbial Sensor	-126.057992	48.314933	899.50
94	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	ADCP 150 kHz	-126.058958	48.315007	890.00
95	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	Video Camera	-126.058672	48.315070	895.00
96	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	ADCP 2 MHz	-126.058790	48.315108	892.00
97	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	Imaging Rotary Sonar	-126.058958	48.315007	890.00
98	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	Plankton Pump	-126.059080	48.314962	892.00
99	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CanyonMidWest	Sediment Trap	-126.058709	48.314991	890.00
100	Ocean Networks Canada	NEPTUNE	Barkley Canyon	CoralCliff1	ADCP 2 MHz	-126.062125	48.309823	824.00
101	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate	Oxygen Sensor	-126.065635	48.312075	871.00
102	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate	Imaging Rotary Sonar	-126.066360	48.312158	865.00
103	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate	Temperature Array	-126.848082	48.670620	858.00
104	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Wally_Benthic Crawler	-126.131055	48.354958	455.00
105	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Current Meter	-126.066120	48.311980	867.00
106	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Methane Sensor	-126.066120	48.311980	867.00
107	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Turbidity Meter	-126.066120	48.311980	867.00
108	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	CTD	-126.065882	48.311940	871.00
109	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Fluorometer	-126.065882	48.311940	871.00
110	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Sediment Micro-Profiler	-126.065882	48.311940	871.00
111	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	ADCP 2 MHz	-126.065378	48.311743	860.00
112	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Fluorometer FLNTU	-126.065378	48.311743	860.00
113	Ocean Networks Canada	NEPTUNE	Barkley Canyon	Hydrate_Wally	Video Camera	-126.065378	48.311743	860.00
114	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Accelerometer	-126.175182	48.427533	396.00
115	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Broadband Seismometer	-126.175182	48.427533	396.00
116	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	BPR	-126.174817	48.427275	397.70
117	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	CTD	-126.174723	48.427350	395.00
118	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Oxygen Sensor	-126.174723	48.427350	395.00

119	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Hydrophone	-126.174660	48.427530	396.50
120	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	ADCP 75 kHz	-126.174578	48.427457	396.00
121	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Imaging Rotary Sonar	-126.174908	48.427027	392.00
122	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	ADCP 2 MHz	-126.174645	48.427025	395.90
123	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	ADCP 600 kHz	-126.174400	48.427067	392.00
124	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Video Camera	-126.174452	48.427042	394.00
125	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope	Sediment Trap	-126.174250	48.427100	394.00
126	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Hydrophone	-126.174132	48.427387	0.00
127	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	ADCP 400 kHz	-126.174155	48.427382	0.00
128	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	CO2 Sensor	-126.174155	48.427382	0.00
129	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	CTD	-126.174155	48.427382	0.00
130	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Echosounder, Bioacoustic	-126.174155	48.427382	0.00
131	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Fluorometer CDOM	-126.174155	48.427382	0.00
132	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Fluorometer FLNTU	-126.174155	48.427382	0.00
133	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Nitrate sensor	-126.174155	48.427382	0.00
134	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Oxygen Sensor	-126.174155	48.427382	0.00
135	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Radiometer	-126.174155	48.427382	0.00
136	Ocean Networks Canada	NEPTUNE	Barkley Canyon	UpperSlope_Vetical Profiling Sy	Vertical Profiler Instrument Package	-126.174155	48.427382	0.00
137	Ocean Networks Canada	NEPTUNE	Boundary Pass	JDFM-BNDYP_Mooring	ADCP 2 MHz	-123.040217	48.766300	223.00
138	Ocean Networks Canada	NEPTUNE	Boundary Pass	JDFM-BNDYP_Mooring	CTD	-123.040217	48.766300	223.00
139	Ocean Networks Canada	NEPTUNE	Boundary Pass	JDFM-BNDYP_Mooring	Oxygen Sensor	-123.040217	48.766300	223.00
140	Ocean Networks Canada	NEPTUNE	Boundary Pass	JDFM-BNDYP_Mooring	Current Meter	-123.039217	48.766366	220.00
141	Ocean Networks Canada	NEPTUNE	British Columbia Lower Fra	CODAR_SensingArea	Marine Radar System	-123.300000	49.120000	0.00
142	Ocean Networks Canada	NEPTUNE	British Columbia Lower Fra	Iona_ShoreStation	AIS Receiver	-123.205482	49.216063	0.00
143	Ocean Networks Canada	NEPTUNE	British Columbia Lower Fra	Iona_ShoreStation	Meteorological Station	-123.205482	49.216063	0.00
144	Ocean Networks Canada	NEPTUNE	British Columbia Lower Fra	WestshoreCoalTerminal	Piezometer	-123.167833	49.016058	0.00
145	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	BPR	-125.281117	48.813945	100.00
146	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	Hydrophone	-125.281950	48.813750	105.00
147	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	ADCP 300 kHz	-125.280000	48.813667	95.00
148	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	CTD	-125.280983	48.813850	98.00
149	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	Echosounder, Bioacoustic	-125.280983	48.813850	98.00
150	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	Oxygen Sensor	-125.280983	48.813850	98.00
151	Ocean Networks Canada	NEPTUNE	Folger Passage	Deep	Video Camera	-125.281078	48.813218	100.00
152	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	ADCP 2 MHz	-125.281500	48.808292	25.00
153	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	ADCP 600 kHz	-125.281500	48.808292	25.00
154	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Radiometer	-125.281500	48.808292	25.00
155	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	3D Camera	-125.281500	48.808292	25.00
156	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	CTD	-125.281500	48.808292	25.00
157	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Current Meter	-125.281500	48.808292	25.00
158	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Fluorometer FLNTU	-125.281500	48.808292	25.00
159	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Oxygen Sensor	-125.281500	48.808292	25.00
160	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Radiometer	-125.281500	48.808292	25.00
161	Ocean Networks Canada	NEPTUNE	Folger Passage	Pinnacle	Video Camera	-125.281500	48.808292	25.00
162	Ocean Networks Canada	VENUS	Mill Bay	Brentwood	Meteorological Station	-123.552100	48.653100	-5.00
163	Ocean Networks Canada	VENUS	Mill Bay	Brentwood	Video Camera	-123.552100	48.653100	6.00
164	Ocean Networks Canada	VENUS	Mill Bay	Brentwood	Water Quality Monitor	-123.552100	48.653100	6.00
165	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	3D_Camera	3D Camera	-123.486405	48.650733	102.00
166	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Bottom Boundary Layer	ADCP 1 MHz	-123.486120	48.650535	96.00
167	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Bottom Boundary Layer	ADCP 600 kHz	-123.486120	48.650535	96.00
168	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Bottom Boundary Layer	Fluorometer FLNTU	-123.486120	48.650535	96.00
169	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Bottom Boundary Layer	Particle Analyzer	-123.486120	48.650535	96.00
170	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	CTD	-123.498883	48.622283	0.00
171	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Fluorometer FLNTU	-123.498883	48.622283	0.00
172	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Oxygen Sensor	-123.498883	48.622283	0.00
173	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Transmissometer	-123.498883	48.622283	0.00
174	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Air Temperature and Humidity Sensor	-123.498883	48.622283	0.00
175	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Barometric Pressure Sensor	-123.498883	48.622283	0.00
176	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Camera System	-123.498883	48.622283	0.00
177	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Echosounder, Bioacoustic	-123.498883	48.622283	0.00
178	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Meteorological Station	-123.498883	48.622283	0.00
179	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Profiling Winch	-123.498883	48.622283	0.00
180	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Buoy Profilng System	Wind Monitoring System	-123.498883	48.622283	0.00
181	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Nitrate sensor	-123.487492	48.650737	102.00
182	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Camera System	-123.485705	48.650417	95.00
183	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Turbidity Meter	-123.487200	48.651400	92.00
184	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Hydrophone	-123.485555	48.649937	94.00
185	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Ifremer Tempo Mini site	Video Camera	-123.486073	48.650478	98.00
186	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Ocean Tech. Test Bed	CO2 Sensor	-123.475783	48.649500	23.00
187	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	ADCP 300 kHz	-123.503677	48.685917	94.00
188	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	CTD	-123.499466	48.688550	80.00
189	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Oxygen Sensor	-123.499466	48.688550	80.00
190	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	ADCP 300 kHz	-123.486022	48.651320	98.00
191	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	CTD	-123.486008	48.651198	98.00
192	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Transmissometer	-123.486008	48.651198	98.00
193	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	ADCP 75 kHz	-123.486142	48.651203	96.00
194	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Current Meter	-123.479067	48.651387	96.00
195	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Echosounder, Bioacoustic	-123.479067	48.651387	96.00
196	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Gas Tension Device	-123.479067	48.651387	96.00
197	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Oxygen Sensor	-123.479067	48.651387	96.00
198	Ocean Networks Canada	VENUS	Saanich Inlet Central Node	Saanich Inlet Central Node	Sediment Trap	-123.479067	48.651387	96.00
199	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	ADCP 1 MHz	-123.426507	49.040078	300.00
200	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	ADCP 300 kHz	-123.426507	49.040078	300.00
201	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	ADCP 600 kHz	-123.426507	49.040078	300.00
202	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Hydrophone	-123.000000	49.000000	300.00
203	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Oxygen Sensor	-123.425487	49.040038	297.00
204	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Turbidity Meter	-123.425487	49.040038	297.00
205	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Particle Analyzer	-123.425723	49.040017	300.00
206	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	ADCP 150 kHz	-123.425717	49.039987	300.00
207	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	CTD	-123.425717	49.039987	300.00
208	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Echosounder, Bioacoustic	-123.425717	49.039987	300.00
209	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Current Meter	-123.425852	49.039887	300.00
210	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Sediment Trap	-123.425852	49.039887	300.00
211	Ocean Networks Canada	VENUS	Strait of Georgia Central N	Strait of Georgia Central Node	Camera System	-123.426017	49.039748	300.00
212	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	ADCP 600 kHz	-123.339465	49.080522	142.00
213	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Particle Analyzer	-123.339633	49.080750	149.00
214	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Turbidity Meter	-123.339633	49.080750	149.00
215	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Profiling Sonar	-123.339545	49.080637	148.00
216	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	ADCP 300 kHz	-123.329720	49.084950	110.00
217	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	CTD	-123.329720	49.084950	110.00
218	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Echosounder, Bioacoustic	-123.329720	49.084950	110.00
219	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Fluorometer FLNTU	-123.329720	49.084950	110.00
220	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Imaging Rotary Sonar	-123.329720	49.084950	110.00
221	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Particle Analyzer	-123.329720	49.084950	110.00
222	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Profiling Sonar	-123.329720	49.084950	110.00
223	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Current Meter	-123.329645	49.084928	100.00
224	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	ADCP 1 MHz	-123.329883	49.084907	108.00
225	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Camera System	-123.329883	49.084907	108.00
226	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Turbidity Meter	-123.329883	49.084907	108.00
227	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Accelerometer	-123.340652	49.080880	150.00
228	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Pressure Gauge	-123.340652	49.080880	150.00
229	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Temperature Sensor	-123.340652	49.080880	150.00
230	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Fluorometer FLNTU	-123.340688	49.080758	146.00
231	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Temperature Array	-123.340688	49.080758	146.00
232	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Sound Source	-123.340277	49.080995	146.00
233	Ocean Networks Canada	VENUS	Strait of Georgia Delta Noc	Strait of Georgia Delta Node	Hydrophone	-123.340547	49.080970	143.00
234	Ocean Networks Canada	VENUS	Strait of Georgia East Nod	Strait of Georgia East Node	Fluorometer FLNTU	-123.319157	49.091192	41.00
235	Ocean Networks Canada	VENUS	Strait of Georgia East Nod	Strait of Georgia East Node	Imaging Rotary Sonar	-123.319157	49.091192	41.00
236	Ocean Networks Canada	VENUS	Strait of Georgia East Nod	Strait of Georgia East Node	Profiling Sonar	-123.319157	49.091192	41.00
237	Ocean Networks Canada	VENUS	Strait of Georgia East Nod	Strait of Georgia East Node	ADCP 600 kHz	-123.319070	49.091222	40.00

238	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	CTD	-123.319070	49.091222	40.00
239	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Hydrophone	-123.329208	49.084163	108.00
240	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	ADCP 300 kHz	-123.329110	49.084220	108.00
241	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Camera System	-123.329110	49.084220	108.00
242	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	CTD	-123.329110	49.084220	108.00
243	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Current Meter	-123.329110	49.084220	108.00
244	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Echosounder, Bioacoustic	-123.329110	49.084220	108.00
245	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Fluorometer FLNTU	-123.329110	49.084220	108.00
246	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Imaging Rotary Sonar	-123.329110	49.084220	108.00
247	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Pressure Gauge	-123.329110	49.084220	108.00
248	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Profiling Sonar	-123.329110	49.084220	108.00
249	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Hydrophone	-123.000000	48.000000	100.00
250	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Hydrophone	-123.000000	49.000000	170.00
251	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Multibeam Non-rotating Sonar	-123.316782	49.042623	166.00
252	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Temperature Array	-123.316782	49.042623	166.00
253	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Temperature-Depth Logger	-123.317755	49.042513	172.00
254	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Particle Analyzer	-123.317585	49.041895	169.00
255	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Transmissometer	-123.317585	49.041895	169.00
256	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Camera System	-123.317732	49.042248	170.00
257	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	CTD	-123.314683	49.039633	168.00
258	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Oxygen Sensor	-123.314683	49.039633	168.00
259	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Echosounder, Bioacoustic	-123.316837	49.043160	170.00
260	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Current Meter	-123.316777	49.043192	170.00
261	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	ADCP 150 kHz	-123.316833	49.042685	165.00
262	Ocean Networks Canada	VENUS	Strait of Georgia East Node	Strait of Georgia East Node	Turbidity Meter	-123.316833	49.042685	165.00
263	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	ADCP 2 MHz	-123.391200	48.300167	112.00
264	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	CTD	-123.390944	48.300556	112.00
265	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Current Meter	-123.390944	48.300556	112.00
266	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Oxygen Sensor	-123.390944	48.300556	112.00
267	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	ADCP 2 MHz	-123.408900	48.401000	56.00
268	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	CTD	-123.408778	48.401222	62.00
269	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Current Meter	-123.408778	48.401222	62.00
270	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Oxygen Sensor	-123.408778	48.401222	62.00
271	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	CTD	-124.212817	48.360667	175.00
272	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Current Meter	-124.212817	48.360667	175.00
273	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Oxygen Sensor	-124.212817	48.360667	175.00
274	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	CTD	-124.749117	48.508133	226.00
275	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Current Meter	-124.749117	48.508133	226.00
276	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	Oxygen Sensor	-124.749117	48.508133	226.00
277	Ocean Networks Canada	VENUS	Strait of Juan de Fuca	Strait of Juan de Fuca_Mooring	ADCP 2 MHz	-124.750083	48.508333	225.00
278	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Holberg	Accelerometer	-128.135000	50.640000	-620.00
279	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Kyuquot	Meteorological Station	-127.373566	50.032883	-42.00
280	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Kyuquot	Accelerometer	-127.374467	50.032850	-39.00
281	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Nootka	Accelerometer	-126.617000	49.592000	-16.00
282	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	PortAlberni_ShoreStation	Shore Station	-124.808300	49.218300	-30.00
283	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	PortAlice	Meteorological Station	-127.486500	50.428550	-29.00
284	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	PortAlice	Accelerometer	-127.486500	50.428550	-29.00
285	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Tahsis	Accelerometer	-126.651167	49.926850	-8.00
286	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	WossLake	Meteorological Station	-126.601950	50.213267	-166.00
287	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	WossLake	Accelerometer	-126.601883	50.213367	-165.00
288	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Zeballos	Meteorological Station	-126.850617	49.989683	-16.00
289	Ocean Networks Canada	SMART OCEANS B	Vancouver Island	Zeballos	Accelerometer	-126.850617	49.989683	-16.00
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Air Temperature and Humidity Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Barometric Pressure Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Oxygen Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Temperature Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Thermosalinograph	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Turbidity, Chlorophyll and Fluorescence	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Horseshoe Bay - De	Wind Monitoring System	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Air Temperature and Humidity Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Barometric Pressure Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Oxygen Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Pyranometer	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Pyrgeometer	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Temperature Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Thermosalinograph	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Turbidity, Chlorophyll and Fluorescence	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Duke F	Wind Monitoring System	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Air Temperature and Humidity Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Barometric Pressure Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Oxygen Sensor	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Thermosalinograph	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Turbidity, Chlorophyll and Fluorescence	MOBILE	MOBILE	3.000000
See route on ma	Ocean Networks Canada	VENUS	Strait of Georgia	BC_Ferries_Tsawwassen-Swartz	Wind Monitoring System	MOBILE	MOBILE	3.000000
	Pacific Salmon Foundation	VENUS	Strait of Georgia	Salish Sea Marine Survival Proje	CTD	MOBILE	MOBILE	Full Water Coumn
	Pacific Salmon Foundation	VENUS	Strait of Georgia	Salish Sea Marine Survival Proje	Fluorometer	MOBILE	MOBILE	Full Water Coumn
	Pacific Salmon Foundation	VENUS	Strait of Georgia	Salish Sea Marine Survival Proje	Oxygen Sensor	MOBILE	MOBILE	Full Water Coumn

Coastal observing technical groups, meetings, workshops

Categories:

A) Working Groups (Ocean Networks Canada):

ONC Working Groups (WG) represent a focussed forum intended to serve a research community interested in a particular aspect of the observatory. Thus, WGs are composed of research scientists (external to ONC) and relevant ONC Science, Data, and Operations staff. The subject of a WG may be defined on the basis of: i) space or a particular environment (*e.g*., Barkley Canyon & Slope WG; Endeavour WG; Saanich Inlet WG); or ii) a particular instrument or installation (*e.g*. CORK 1346A Tiltmeter WG; Gliders WG; Ferry Installations WG); or iii) the physical observatory (*e.g*. Infrastructure and Cables WG). WGs may be permanent or disbanded once a particular issue has been resolved. Below is the current list of ONC WGs:

1. **Saanich Inlet**: Low oxygen environments, Benthic Ecology, Forensics, Computer Vision, Water Column Processes
2. **Strait of Georgia**: Estuaries, Biological & Physical Oceanography, Slope stability, Forensics
3. **Endeavour**: Hydrothermal Vents (Benthic Ecology), Seismology, Tsunamis, Circulation, Photogrammetry
4. **Barkley Canyon & Slope**: Gas Hydrates **-** Biology, Benthic Ecology, Canyon and Slope Dynamics, Water Column processes
5. **Folger Passage**: Benthic Habitats, Wave Dynamics, Computer Vision
6. **CORK 1364A Tiltmeter**: Seafloor Geodesy
7. **Arctic**: Benthic Habitats, Ice Dynamics, Phytoplankton Dynamics
8. **Gliders**: Physical & Biological Oceanography
9. **Ferry Installations**: Physical & Biological Oceanography
10. **Infrastructure and Cables**: Engineering and Technology
11. **Sea State**: Sea State, Wave modelling, Current Modelling, Physical Oceanography
12. **Community Science**: Community Observatories, Community Science, Citizen Science
13. **Maritime Domain Awareness**: Marine Traffic, Marine safety, Marine Mammal Collision, Radar data
14. **Tsunami**: Tsunami, Bottom Pressure Recorders, Source Modelling, GPS Tsunami Detection, Tsunami Wave Propagation, Bathymetry Fusion, WERA, CODAR
15. **INDEEP**: Benthic Ecology (ecosystem function and climate change)
16. **Hydrophones**: Marine Mammals, Noise Pollution
17. **Gas Hydrates**: Gas Hydrates Dynamics

B) Selected Workshops/Meetings (2014–2015)

1. State of the Physical, Biological and Selected Fishery Resources of Pacific Canadian Marine Ecosystems in 2014. Institute of Ocean Sciences, Sidney, BC, Canada. March 10–11, 2015 (Fisheries and Oceans Canada)
2. Line P Workshop. Institute of Ocean Sciences, Sidney, BC, Canada. March 3, 2015 (Fisheries and Oceans Canada)
3. BC Coastal Marine Sciences 2015: A Roadmap to 2020. Victoria, BC, Canada. February 16–17, 2015 (Ocean Networks Canada)
4. Multidisciplinary Observatories in Vent Ecosystems (MOVE) Workshop. IFREMER. Brest, France. November 24–27, 2014 (IFREMER and Ocean Networks Canada)
5. Hakai Research Exchange. Sidney, BC, Canada. October 24, 2014 (University of Victoria Faculty of Social Sciences and Faculty of Law)
6. Computer Vision for Analysis of Underwater Imagery. Stockholm, Sweden. August 24, 2014.
7. BC Hydrophone Network Workshop. Vancouver, BC, Canada. June 16, 2014 (Ocean Networks Canada, Vancouver Aquarium)
8. ONC-INDEEP Partnership Development Workshop. Victoria, BC, Canada. April 23–25, 2014 (Ocean Networks Canada)
9. Tsunami Detection Workshop. Port Alberni, BC, Canada. March 27–28, 2014 (Ocean Networks Canada)
10. Ocean Gliders Canada Workshop. Montreal, QC, Canada. March 24–25, 2014 (MEOPAR)
11. Strait of Georgia Oceanography Workshop. Vancouver, BC, Canada. January 15–16, 2014 (University of British Columbia, Ocean Networks Canada)

Report from USA

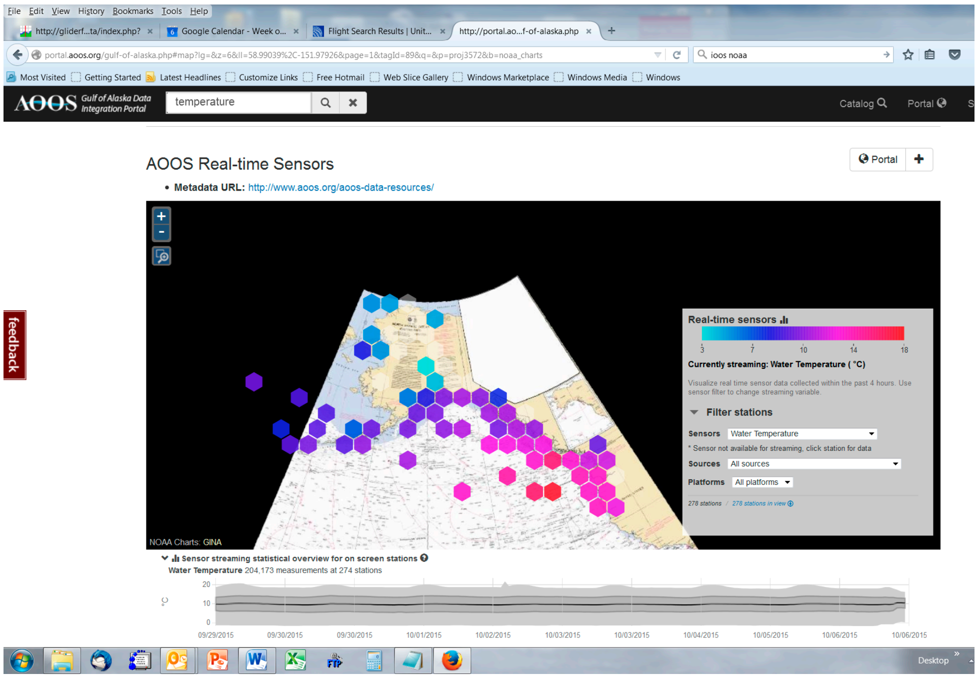
U.S. Pacific coastal ocean observing

United States west coast coastal ocean observing is coordinated through the U.S. National Oceanic and Atmospheric Administration's (NOAA) Integrated Ocean Observing System (IOOS). The famous CalCOFI (California Cooperative Oceanic Fisheries Investigation) lines are occupied in the central and southern California Current. The Newport Hydrographic Line (44° 39.1′N) has been occupied off Oregon since the 1960s. A coast-wide wave monitoring and prediction system is run by the Coastal Data Information Program (CDIP).

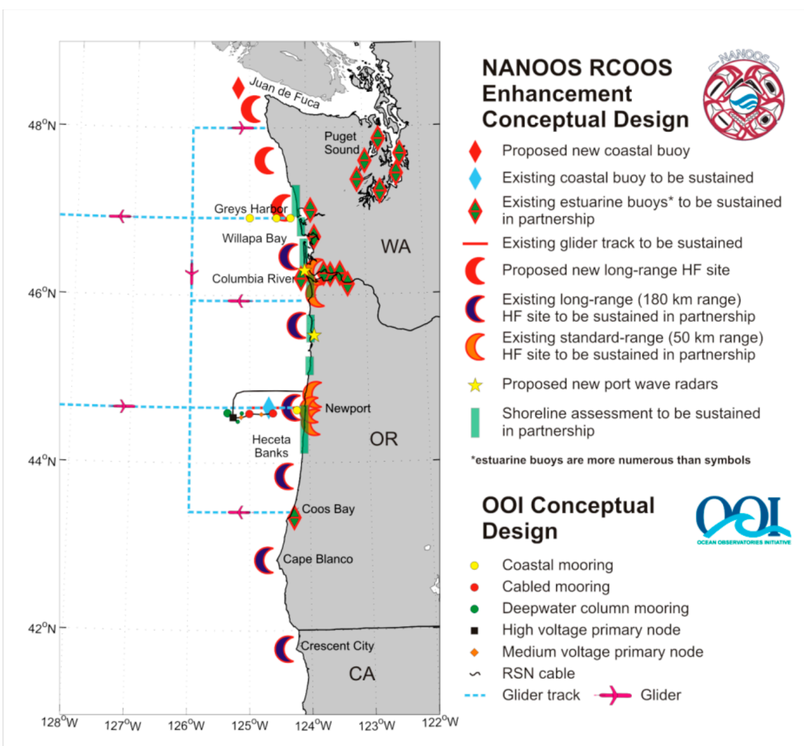
In the Pacific, there are five U.S. IOOS regional ocean observing associations (see map below):

- Alaska Ocean Observing System (AOOS)
- Northwest Association of Networked Ocean Observing Systems (NANOOS)
- Central and Northern California Coastal Ocean Observing System (CeNCOOS)
- Southern California Coastal Ocean Observing System (SCCOOS)
- Pacific Islands Region (PacIOOS)

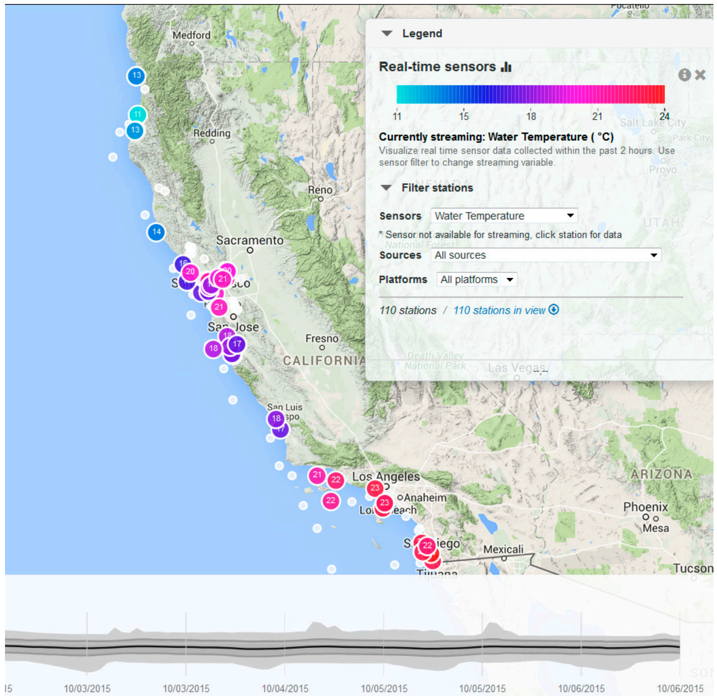
Below are some maps of ocean observing assets for each U.S. IOOS regional association on the U.S. Pacific west coast:



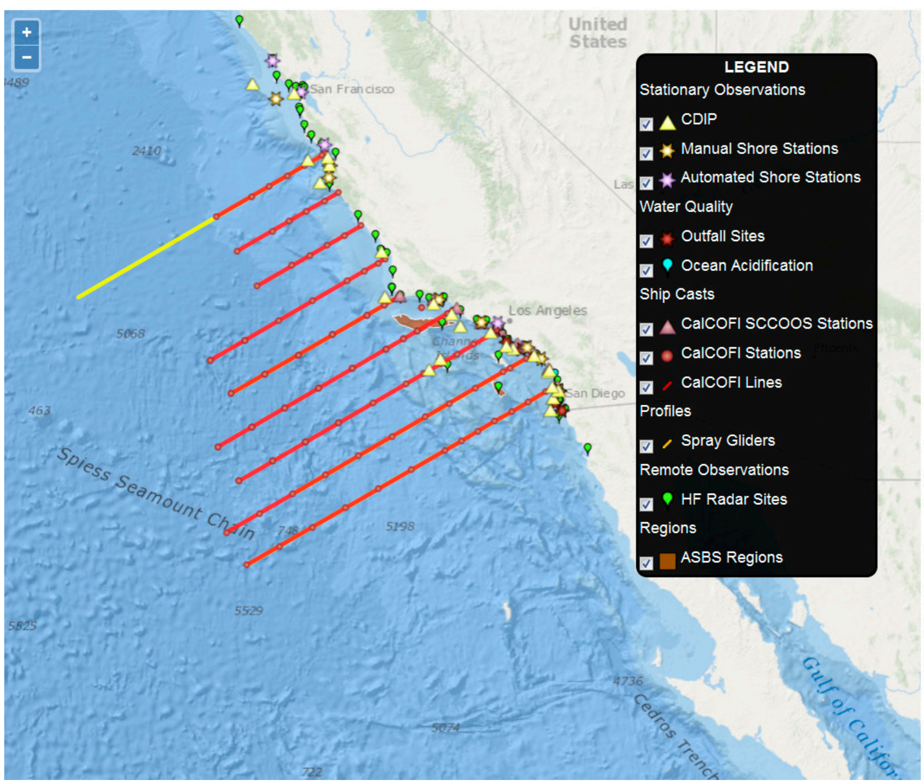
An example of real-time temperature coverage for [AOOS](#).



A conceptual design map for [NANOOS](#) coastal ocean observing.

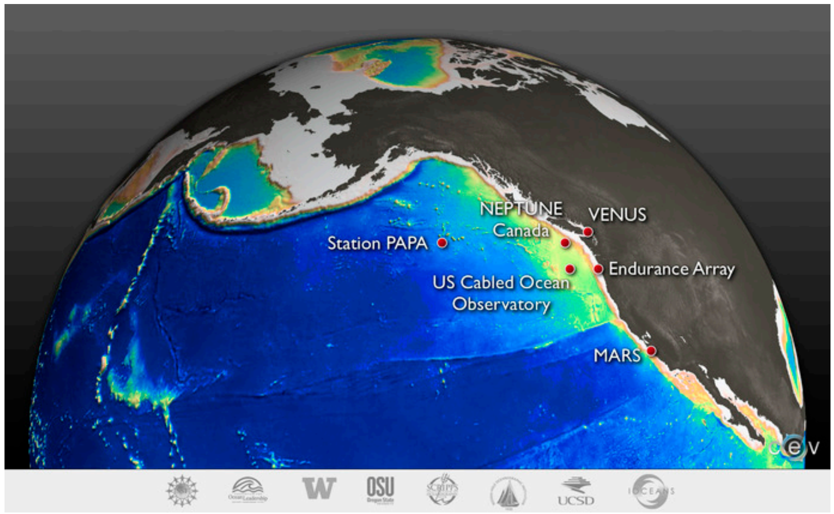


Example of real-time temperature measurements from [CeNCOOS](#).

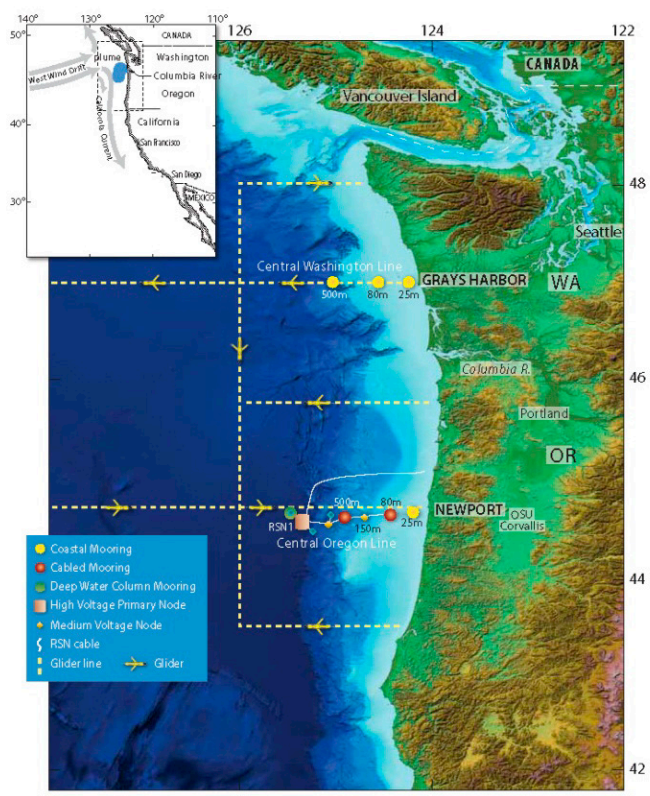


The [SCCOOS](#) observing system including the CalCOFI lines and some [CDIP](#) wave stations.

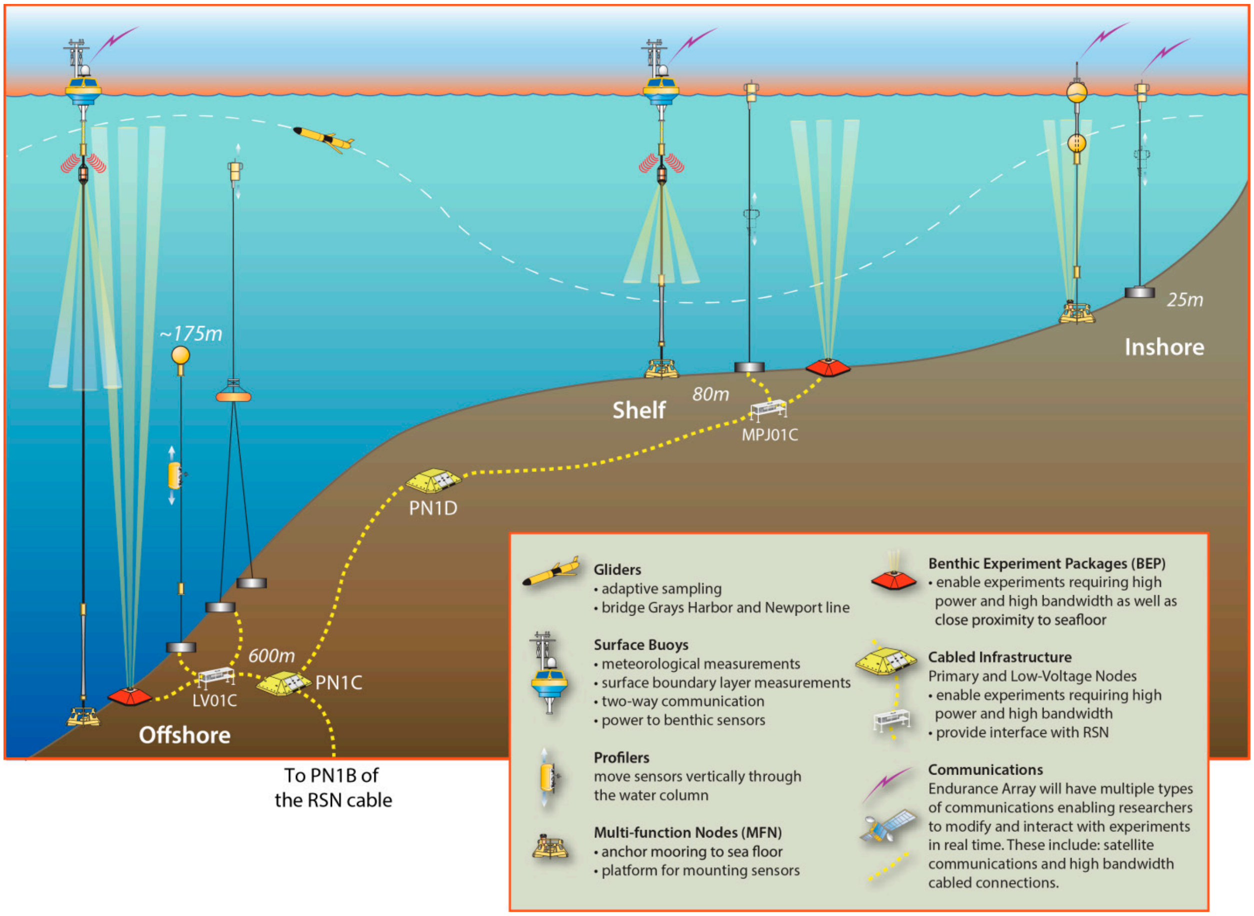
The U.S. National Foundation has funded the Ocean Observatories Initiative (OOI, oceanobservatories.org) that is just finishing construction off the coasts of Oregon and Washington. [The OOI also has instruments at Station PAPA in the Gulf of Alaska but that is not a coastal location.] The OOI cabled sensor array complements the Canadian cabled ocean observing arrays called NEPTUNE Canada and VENUS. The OOI Endurance Array focuses on the coastal ocean off Oregon and Washington.



Ocean observatories in the Northeast Pacific Ocean.



The OOI Endurance Array.



A detailed cross-section of the OOI Endurance Array off central Oregon.

Best practices

NOAA's "Alliance for Coastal Technologies" (ACT) is an important partner working with both the federal and regional ocean observing organizations within U.S. IOOS. ACT is a NOAA-funded partnership of research institutions, resource managers, and private sector companies that supports the development and adoption of effective and reliable sensors and platforms. ACT is also committed to providing the information required to select the most appropriate tools for studying and monitoring coastal environments. http://www.act-us.info/

Quality Assurance of Real Time Ocean Data, QARTOD: As part of the U.S. IOOS Data Management and Communication (DMAC) core services, the U.S. IOOS Program Office supports QARTOD. QARTOD has issued many manuals for real-time quality control of various data types including in-situ currents, temperature, salinities, dissolved oxygen, ocean optics, water level, winds, and dissolved nutrients. These manuals are living documents that reflects the state-of-the-art quality control (QC) testing procedures for real-time observations. They are written for the experienced operator but also provide examples for those who are just entering the field. The manuals and more about QARTOD can be found at http://www.ioos.noaa.gov/qartod/welcome.html

Coastal observing technical groups, meetings, workshops

See list of U.S. IOOS regional associations above.

Report from the People's Republic of China

China coastal observation system

The State Oceanic Administration (SOA) of the People's Republic of China, together with the Chinese Academy of Science, several Universities and municipal governments of some coastal cities have established a coastal ocean observation system based on different measurement means, such as satellites, floats, shore-based observation stations, mooring systems, radars and observation vessels (Fig. 1).

Figure 1: Different observation means

- For satellite data, one side we download data from international sources such as Windscat, Radarsat, Landsat and so on; on the other side we launch new satellites, which are more suitable for observing China coastal areas such as HY-1, HY-2, HY-3 and GFOSAT.
- For floats, we deployed more than 20 stations along the China coastal line and are planning to deploy more in the future.
- For shore-based observation stations, we have already 121 stations distributed in different China coastal provinces and important islands.
- For mooring stations, until now, this technology has not been widely used in all China coastal areas for monitoring because of strong fishing activities but the National Marine Environment Monitoring Center, (NMEMC), SOA developed a set of seabed platform observation systems against complex seabed and environment conditions of China coastal areas aiming at obtaining continuous, high-quality ocean data for environment protection and relevant researches (Fig. 2). NMEMC has sensors such as ADCP and CTD successfully mounted to these systems to observe ocean current, wave, depth, temperature and salinity data, and we have also designed enough space allowing for geochemistry sensors. Up to July 2015, these systems have been already deployed 72 times in the Bohai Sea and northern Yellow Sea for different environment protection and research projects. They were very reliable, all deployed systems have been retrieved, and 87% of them have been retrieved successfully at the first try (Fig. 3). Data obtained through these systems further our understanding on different ocean processes of the Bohai Sea and northern Yellow Sea.

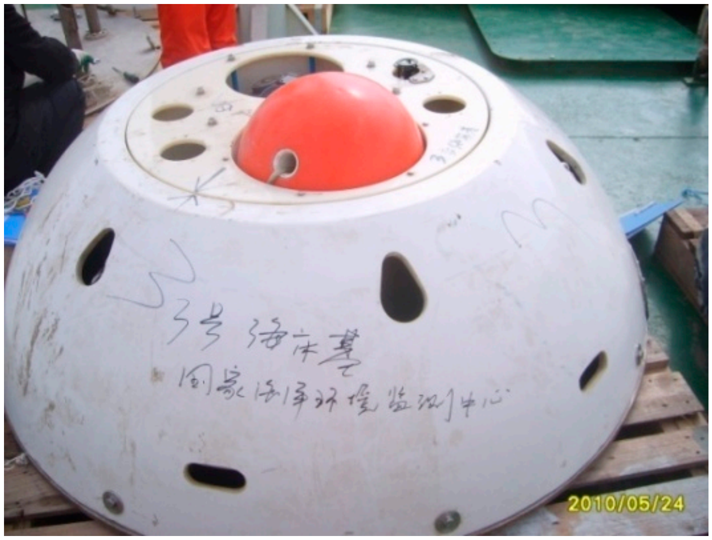


Figure 2: The seabed platform observation system

Figure 3: Retrieval of the seabed platform observation system

- For radar observations, SOA has installed 10 high-frequency short-wave radar stations along the China coast to monitor ocean currents and waves for disaster early-warning, 28 x-ray radar stations to measure ocean waves, and 1 radar station to monitor sea ice in the Liaodong Bay of the Bohai Sea.
- The data obtained are used for different purposes. We established a data distribution system (GTS data system) between SOA and the National Meteorological Information Center for weather forecasting and ocean disaster early-warning. For monitoring, we established the ocean observation system monitoring platform, which can give visual feedback of the coastal environment conditions (Fig. 4).

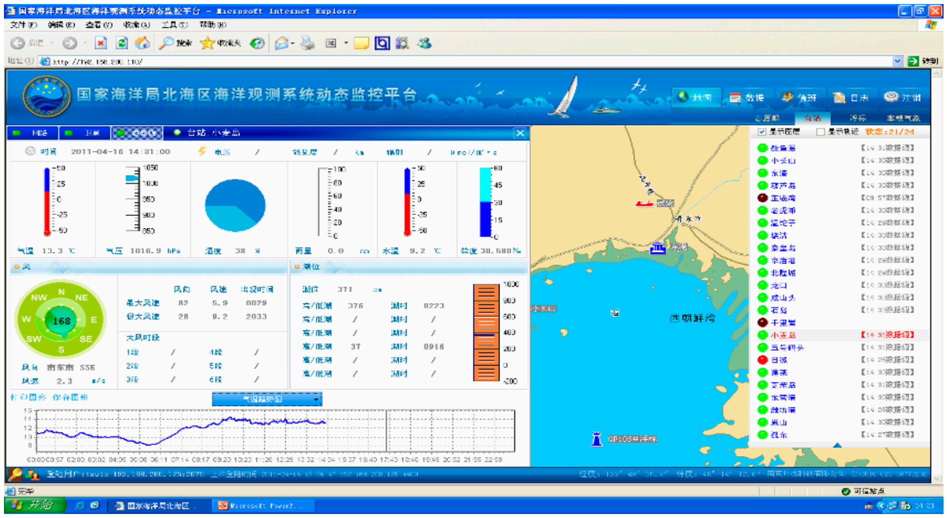


Figure 4: A snapshot of the ocean observation system monitoring platform

Observation data processing system

We explored a new mode of marine environmental monitoring data integration service platform, which produces innovations in many aspects, such as monitoring data processing technology research, database construction, system key technology development, application and extension. These achievements promoted the information level of marine environmental monitoring management and service.

A marine environmental monitoring data processing standard specification was established, which can unify the monitoring data processing technology and procedure.

We researched and established a series of marine environmental monitoring data processing methods,which include data quality control method, and data processing technology procedure. The monitoring data standardization method contains standardization of marine environmental monitoring area name and code, station number, parameter name and unit. The data quality control method includes repeated data checking, logic examination, number range checking, off-group points checking and biological species Chinese-name and Latin-name checking. Based on these methods, we proposed a set of marine environmental monitoring data processing procedure which contains data standardization, data checking and data output.

A marine environmental monitoring data processing system was developed, which can guarantee the monitoring data quality.

In order to quicken the processing speed of masses of data and improve monitoring data quality, we developed the “marine environmental monitoring data processing system” based on a set of data processing methods. This system is able to successfully achieve functions of data reading and combination, data standardization, dataset quality control and assessment production execution.

A marine environmental monitoring data submission system was researched, which can improve transmission efficiency of monitoring data.

The “marine environmental monitoring data submission system” we designed can upload data, check data, and import data to a database. These procedures can be operated on one platform, which greatly heighten the transmission efficiency of monitoring data. According to the present characteristics of the national, sea region and coastal province network system, we put forward a “piecewise transplantation” construction concept, which helps us solve the problem of system application in institutions at all levels. The advantage of this concept is time-saving. This system brings great convenience to upload batch files, transform batch files, checkout batch data and import them into a database.

A monitoring database and management system was constructed, which can achieve central management of national monitoring data and information.

Based on massive marine environmental monitoring datasets and monitoring items, we established a marine environmental monitoring database, which can realize central management, storage, sharing, communion and use of marine data. We designed database tables of monitoring task, monitoring station, monitoring area and monitoring institution for basic information. Meanwhile, we designed 38 database tables for monitoring items, such as marine water quality, marine sediment, marine biological quality, phytoplankton, zooplankton, benthos, intertidal benthos, fish eggs, larval fish, marine atmosphere, *etc*. The database meets the storage demand of various monitoring task data. At the same time, based on a relational database, we built a marine environmental monitoring database management system. The management system offers help to solve a large number of marine environmental monitoring materials. Also, it provides functions of importing original data and checking repeated data. Furthermore, this database management system also can examine the marine engineering environment survey materials by contrasting them with monitoring data.

Various assessment products are designed, which can enrich applications of monitoring data.

We did a lot of work on production technology, and made different products for most of the tasks and monitoring items. Various assessment products and statistical products were exhibited on our platform. We provide abundant products for users via our platform, and submit them to related oceanic institutions regularly every year.

Suggestion

There are abundant resources and expertise in the member countries of AP-NPCOOS, so we should take the opportunity to strengthen the framework of the panel. We should enhance communication and cooperation with each other, innovate the oceanic data administration system, improve the technology and the product quality by training the talent and promoting the competitiveness of AP-NPCOOS member countries in the whole world.

Report from the Republic of Korea

Questions to consider for our AP-NPCOOS Annual Meeting

- What are "best practices" for coastal ocean observing platforms, sensors and sensor calibration, data quality control, user interfaces to data and information products, data delivery to users, data archiving? (Term of Reference #1)
  - *Intercomparison of data, Unifying standard data format, Maintain a data portal and mirror sites*

- How can AP-NPCOOS advise/assist FUTURE? (Term of Reference #3) FUTURE is the PICES Scientific Program "Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems" (http://pices.int/members/scientific_programs/FUTURE/FUTURE-main.aspx)
  - *Within TCODE and MONITOR's activity for FUTURE, AP-NPOOS can assist researches in relation to understanding climatic impacts on coastal marine ecosystem in selected regions.*

- What is relationship of AP-NPCOOS and CREAMS? And MONITOR? And TCODE?
  - *At the moment, CREAMS concerns mainly with EAST(East Asian Seas Time-series) I (for the East/Japan Sea) & II (for the Yellow and East China Seas). There is a close relationship in long-term time series measurements in the coastal zone in these Seas.*

- How might AP-NPCOOS advise/assist PICES in preparation of the North Pacific Ecosystem Status Report (http://pices.int/projects/npesr/default.aspx)? (Term of Reference #3)
  - *Summarizing the oceanic changes in the coastal region.*

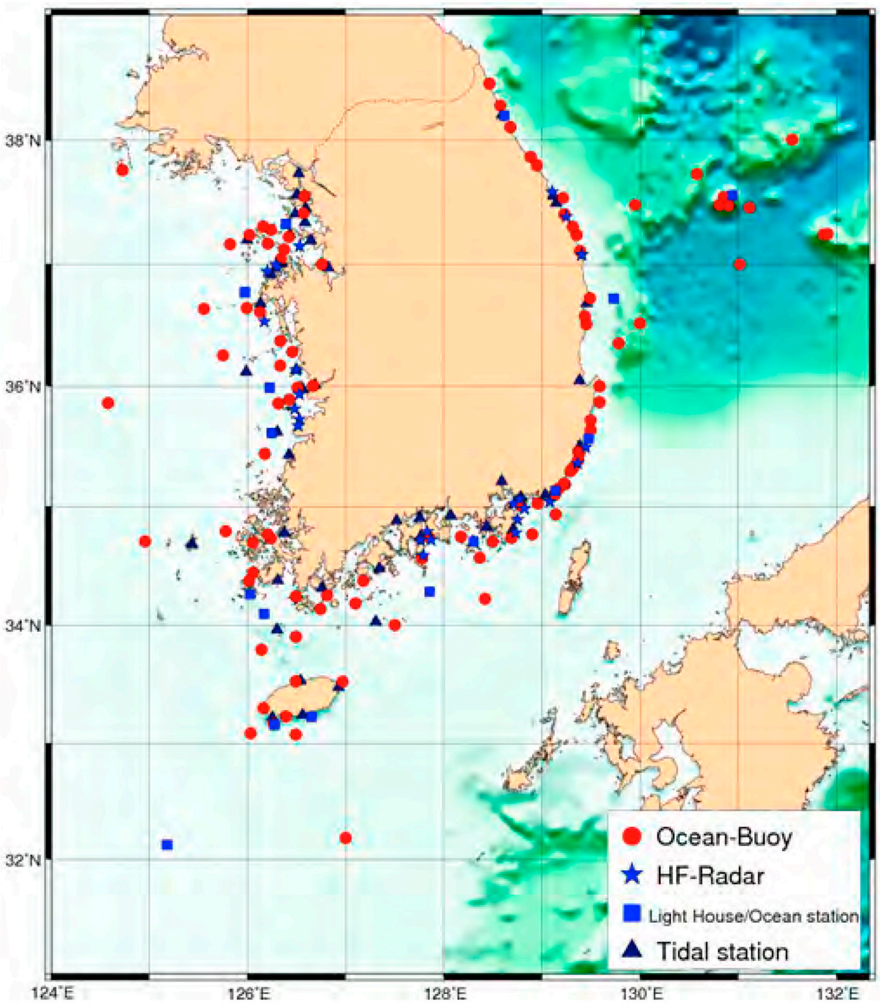
- How might AP-NPCOOS relate to global programs like GOOS, Argo, Pogo, etc? It might be helpful to visit the GOOS page (http://www.ioc-goos.org/). (Term of Reference #3)
  - *It is related to global programs from a functional point of view. All the programs has the same final goal, 'understating the changing ocean'.*

- What are the motivations and applications for your country's coastal ocean observing (e.g., fisheries, shipping, aquaculture, etc.)?
  - *Shipping (sea level, coastal current), fisheries (water properties), weather forecasting (waves), environmental monitoring (near nuclear power plant, reclamation project), climate related study (changes in ecosystem), etc.*

- What is unique to AP-NPCOOS that is not being covered elsewhere in PICES or internationally? For example, AP-NPCOOS is definitely "coastal," but what about other unique aspects?
  - *High resolution monitoring of (climate)change (especially, sea level)*

- What open-ocean observing assets are most relevant to your coastal issues and how are they linked into your coastal ocean observing systems? If they are not lined in efficiently, how might that be done?
  - *Climate change (sea level rise and warming trend) is clear connecting link between open-ocean observing and coastal observation systems.*

Korea coastal observation system



Coastal observing technical groups, meetings, workshops

Korean Ocean Monitoring Forum : Jae Hak Lee (jhlee@kiost.ac.kr).

AP-NPCOOS Endnote 4

Proposal for a ½-day Workshop on
"*Delivering quality multi-parameter data from the coastal ocean*" at PICES-2016

Convenors: Akash Sastri (Canada, AP-NPCOOS), Chuanxi Xing (China, AP-NPCOOS)

The coastal ocean is a region with important fisheries and other ecosystem benefits, while at the same time being subject to human pressures. In order to assess coastal marine ecosystem status and changes, including any long-term trends, high-quality observations of a variety of physical, chemical and biological variables must be made and sustained. The quality of these observations depends on sensor choice, pre-deployment sensor preparation and calibration, platform and sensor deployment, post-deployment sensor calibration and data processing and dissemination. We invite contributions that deal with all aspects of delivering high-quality data from the coastal ocean, in particular techniques for measuring biogeochemical parameters (oxygen, nutrients, chlorophyll) and mitigating biofouling and sensor drift.

Proposal for a 1-day Topic Session on
"*Understanding the changing coastal ocean: advances and challenges in multi-parameter observations*" at PICES-2016

Convenors: Vyacheslav B. Lobanov (Russia, AP-NPCOOS, MONITOR), Matthew Baker (USA, NPRB), Sung Yong Kim (Korea, KAIST), John Barth (USA, OSU)

Potential co-sponsors: MONITOR, TCODE, (POC/BIO)

Major changes in coastal ocean ecosystems occur across the North Pacific and its marginal seas on a variety of time scales, from weeks to years. Examples include warming events associated with low (*e.g.*, El Niño) and high latitude ("warm blob") forcing, and coastal hypoxia influenced by both natural and anthropogenic forcing. These major changes involve physical, chemical, and biological processes and their interaction. Sustained, high-quality, multi-parameter coastal observations are required to discern changes from normal seasonal patterns and to detect long-term trends. We invite contributions that address the role of coastal ocean observations in advancing our understanding of these major physical-biological changes in North Pacific coastal oceans. These may include techniques for sustaining multi-sensor time series and the use of new measurement platforms, as well as new measurements and understanding of regional interactions and coastal-deep ocean interactions at various areas of PICES region. Subsequent discussion will facilitate an exchange on how major regional phenomena (*e.g.*, ENSO, anomalous warming) are expressed at localized scales, best practices and new approaches in observational techniques, and regional comparisons.