Basin-scale Events to Coastal Impacts (BECI): An Ocean Intelligence System for a Changing World

Workshop 3:
Technology and tools for monitoring and synthesis

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Sensors and platforms

- **Sensor – The device that makes the measurement of a quantity closely related to what you really care about.**
  - **Thermometer, hydrophone, nutrient analyzer, various optical sensors, etc.**
- **Platform – the device that delivers the sensor where you want to make the measurement and gets the data home.**
  - **Ship, glider, satellite, autonomous powered vehicle, drone, etc.**
- **Power requirements, data transmission needs, and other logistical constraints can limit the use of some sensors on some platforms.**
  - **You can’t always get what you want.**

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- Ac r – ASL Victoria BC
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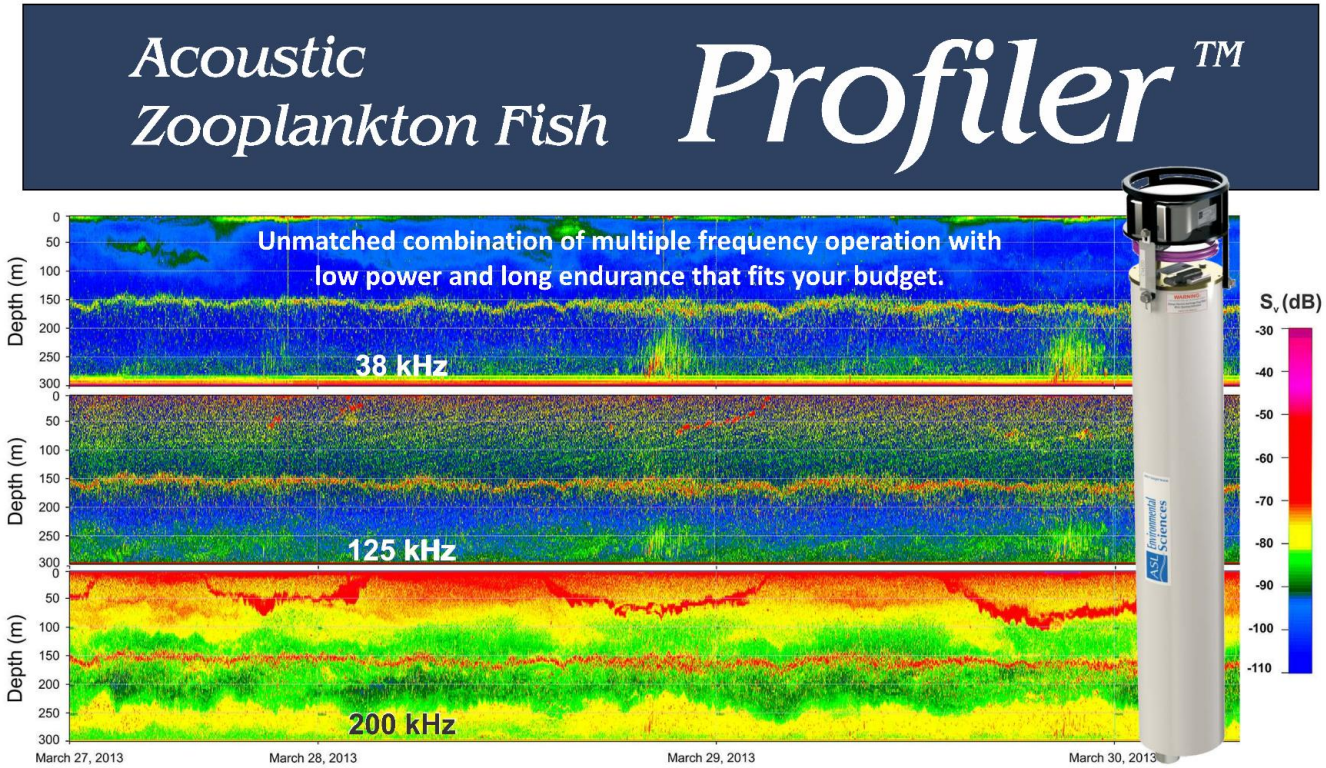
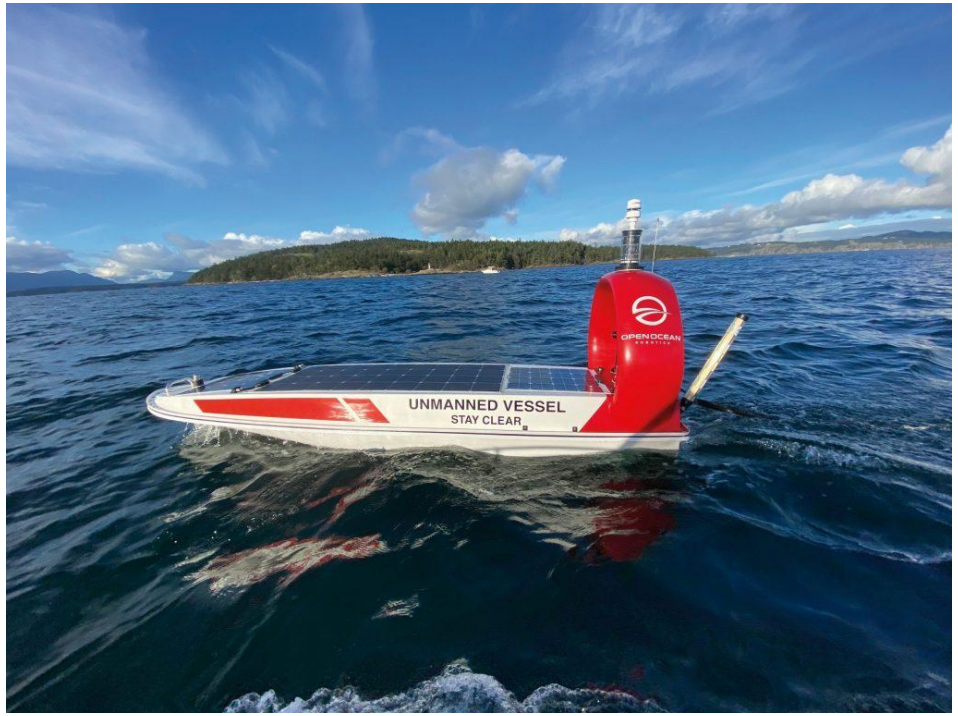
  - d their prey with 1 instrument?



Applications

The Acoustic Zooplankton Fish *Profiler*™ can monitor the presence and abundance of zooplankton and fish

For shelf and coastal applications



Replace the Argo floats with moored profilers. For many shelf applications you may be able to use gliders.

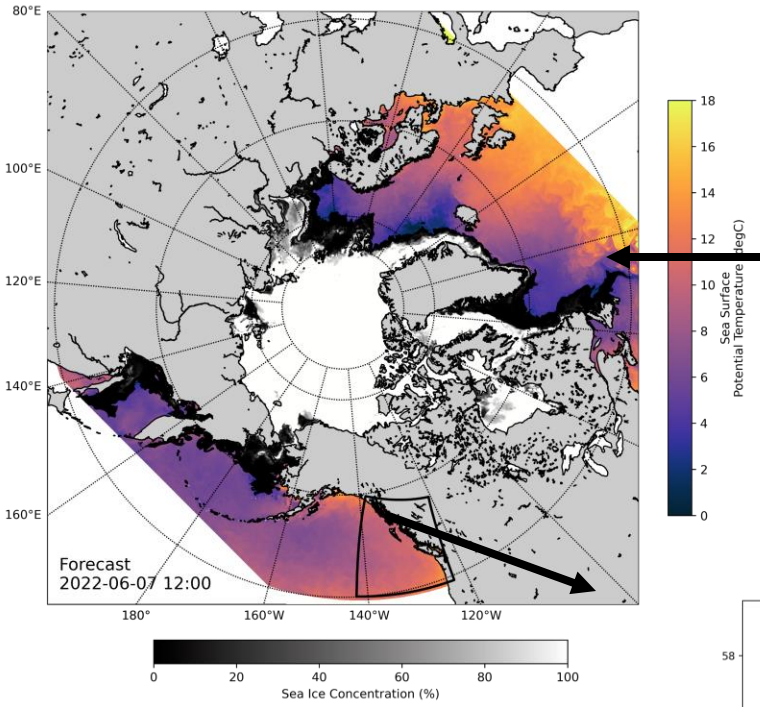
Autonomous surface vessel
Open Ocean Robotics – Data Xplorer
Vessel is smart enough to get out of the way of other vessels.
Openoceanrobotics.com

Moored profiler.
Multi-Electronique Viking buoy
http://www.multi-electronique.com

Forecast models: Basin and shelf scales

GoC Operational Ocean Forecasting

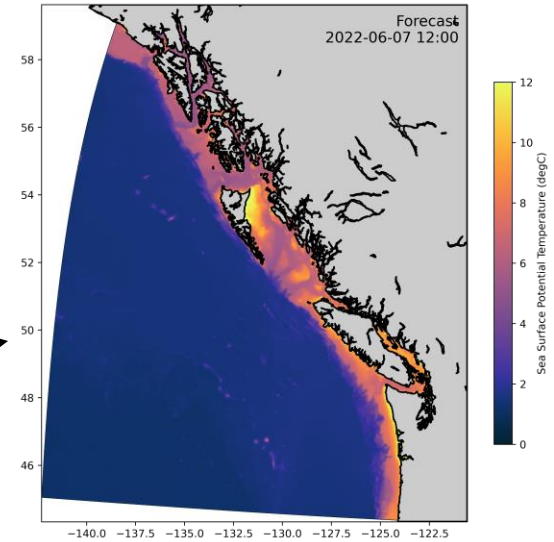
	RIOPS	CIOPS-W
Domain	Pan-Canadian (Pacific, Arctic, & Atlantic)	West Coast Canada (Pacific)
Spatial Resolution	1/12th degree (~7-8km)	1/36th degree (~2.5km)
Forecast	84 hours	48 hours
Sea Ice	Yes	No



Regional Ice-Ocean Prediction System (RIOPS)

- Both systems run forecasts 4x per day, plus daily hindcast
- Available data: water levels (hourly); currents (hourly surface, daily 3D); temperature and salinity (hourly surface, daily 3D); sea ice concentration & velocity (RIOPS only, hourly)
- Data available at: dd.meteo.gc.ca/model_riops & dd.meteo.gc.ca/model_ciops/west & navigator.oceansdata.ca/public

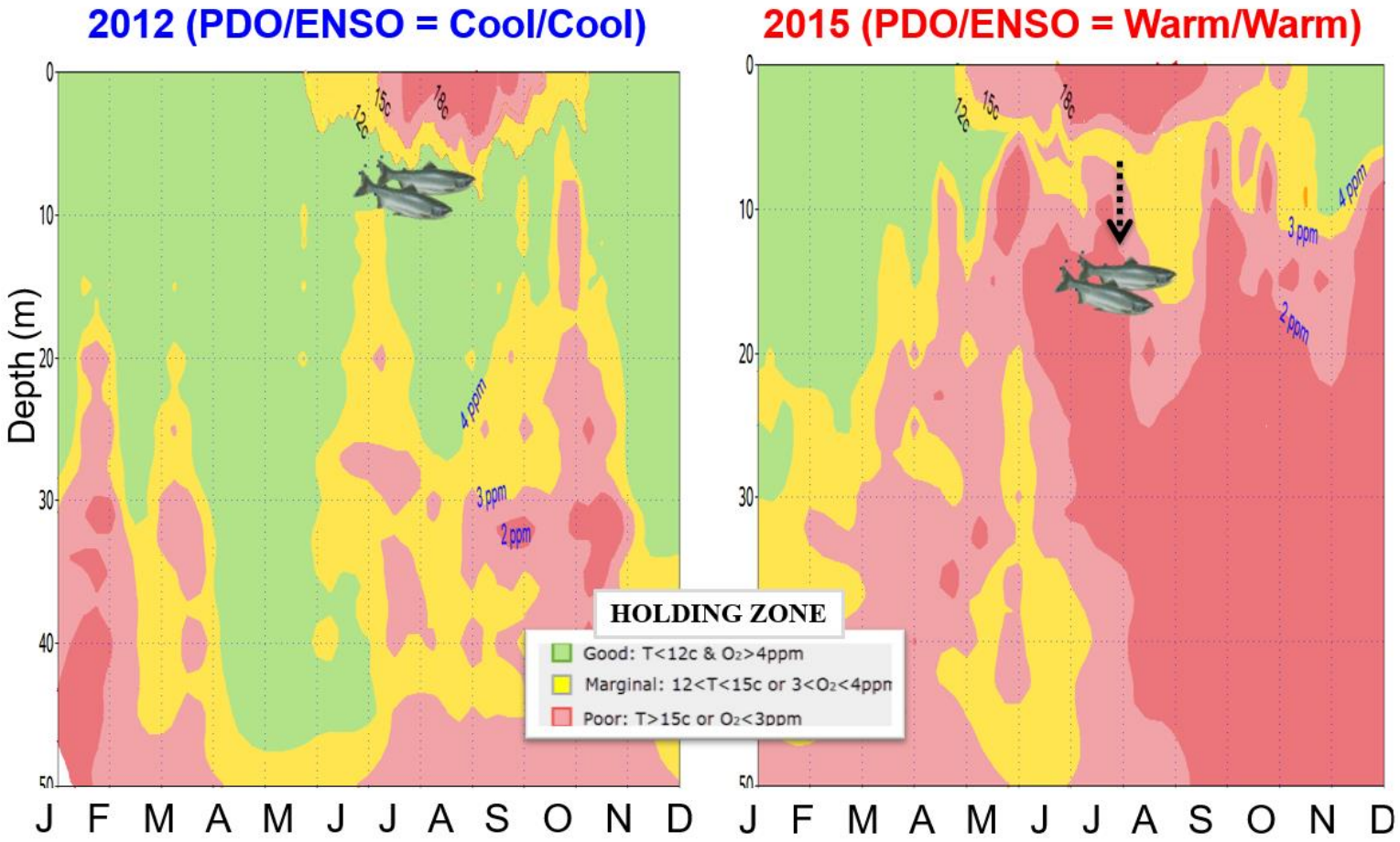
Coastal Ice-Ocean Prediction System - West (CIOPS-W)



Forecast models: Basin and shelf scales

- **Many countries have operational ocean forecast models that are useful for the north Pacific.**
- **Given that they assimilate Argo float data, the temperature, salinity, and upper ocean stratification are generally credible.**
- **There are numerous quasi-operational models that simulate basic biogeochemical variables and lower trophic levels.**
- **There must be numerous ways these models can be used to provide value to BECI for operational decision making.**
- **For years, Canada has combined modelled currents, SST, and winds, with statistical models to provide estimates of return timing for Fraser River sockeye and to predict whether the returning fish will go inside or outside of Vancouver Island on their way to the Fraser River.**

Temp-Oxy Conditions: Holding Zone



Hyatt and Stiff (unpub.)

Alberni Inlet - west coast of Vancouver Island.

The plot shows both temperature (near the surface) and oxygen (at depth).

They are coloured by their effect on salmon condition.

- **Green – good**
- **Yellow – marginal**
- **Red – bad**

- **There is room for the fish when PDF and ENSO are both in cool phase.**
- **There is not much room for fish when PDO and ENSO are both in warm phase.**

Forecast models: River temperature and flow.

- **Warm river water has become a major issue for salmon survival in BC.**
- **There is a quasi-operational temperature and flow model for the Fraser River.**
- **There should be one for all the major rivers.**
- **These are not complicated models.**
- **They do require a network of temperature gauges and field work to establish water height versus discharge relationships.**
- **The atmospheric forcing data is available.**

Constraints

- **An acoustic sensors like the AZFP produces a substantial data stream. The user needs to have the technical capacity to absorb it and use it.**
- **I don’t know what the power constraints are for AZFP use on a glider (mission lifetime). But it has been done.**
- **Optical satellite sensors (SST, chl-a, others) are useful but very limited by cloud cover and fog in the northeast Pacific Ocean.**
  - **The beautiful cloud free and gap free images you see involve a lot of interpolation in space and time. There is often less than 1 measurement per week at any given location.**
- **Ocean circulation models produce massive data streams that require infrastructure and people to deal with.**

Summary

- **Ocean circulation models**
  - **Basin scale**
  - **Inlet scale**
  - **River scale**
- **Observing salmon, their prey, and their environment**
  - **Acoustic Zooplankton and Fish Sampler (AZFP)**
  - **Biogeochemical Argo floats.**
  - **Moored profilers**
  - **Automous surface vehicles.**
- **Warning: The things I presented are unlikely to reduce the need for ship time**

The Task

- **We request that you present around five slides over 10 minutes that summarize your understanding of technology and tools that can be applied to monitor and study physical, chemical and biological ocean conditions and their relation to fish distribution and productivity.**
- **We are particularly interested in the application of autonomous vehicles (gliders/sail drones) and remote sensing tools that can reduce reliance on expensive ship-based sampling to study ocean conditions and the application of technologies like acoustic tags, hydroacoustics, eDNA and otolith microchemistry that can improve our understanding where fish are in space and time in the ocean.**

Warning: The things I will present are unlikely to reduce the need for ship time