The Southeastern and Northeastern Beaufort Sea Marine Observatories

ArcticNet and IMG-Golder
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The Southeastern and Northeastern Beaufort Sea Marine Observatories

Major goal:

- Collect multi-year and continuous data on ocean circulation, sea ice and biogeochemical fluxes at the local and regional scale to help decision makers, regulators and stakeholders address potential issues related to development in the Beaufort Sea.

Objectives:

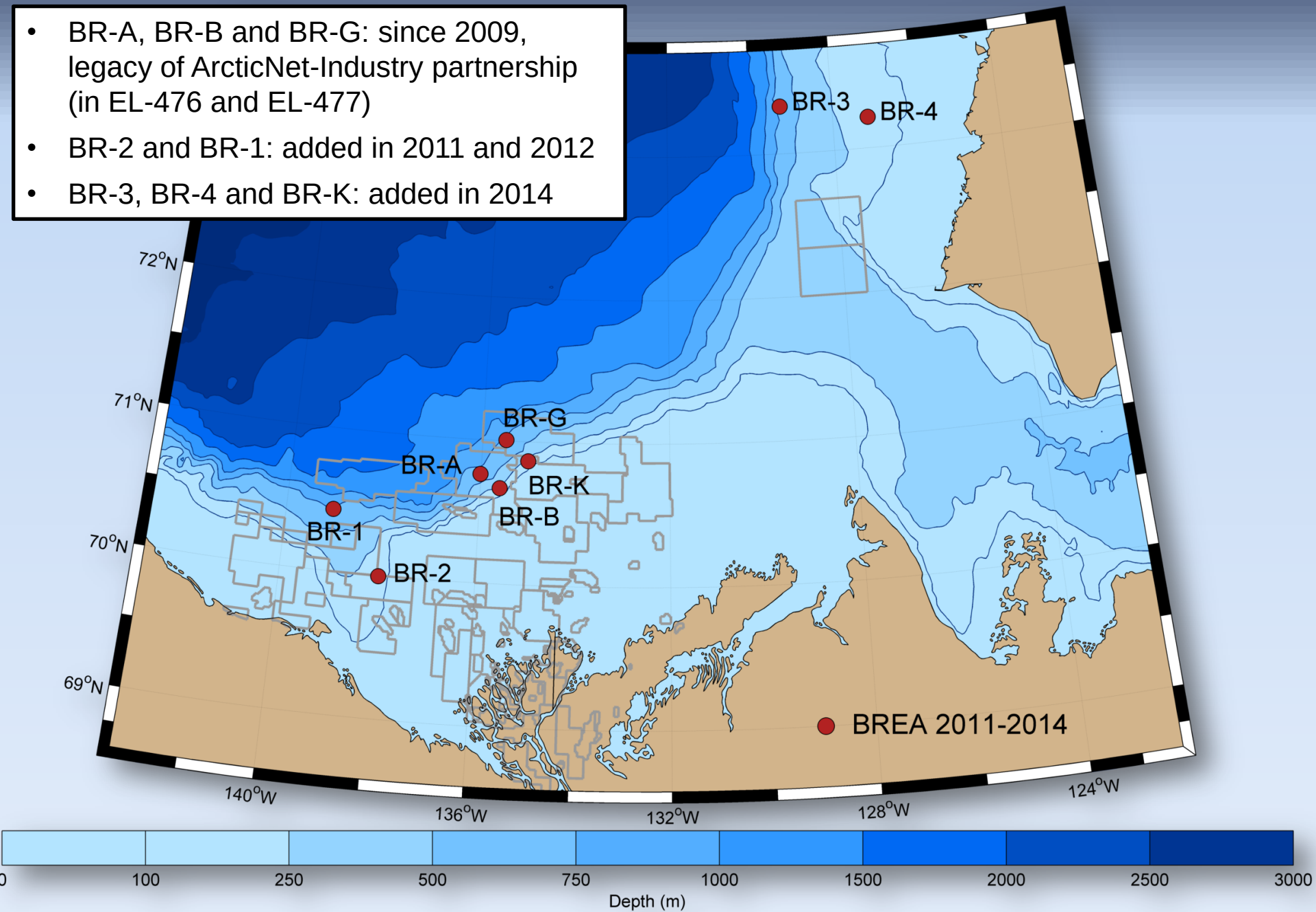
- Maintain and extend existing time-series in and around O&G leases and fill important data gaps in the Beaufort Sea;
- Quantify the along-shelf and across-shelf variability in ocean circulation and related water mass assemblage and properties;
- Quantify the annual movement and thickness distribution of sea-ice, with a special emphasis on heavy, thick multi-year ice;
- Quantify the seasonal and annual variability of particulate matter fluxes at the shelf edge and over the mid-slope.

Approach:

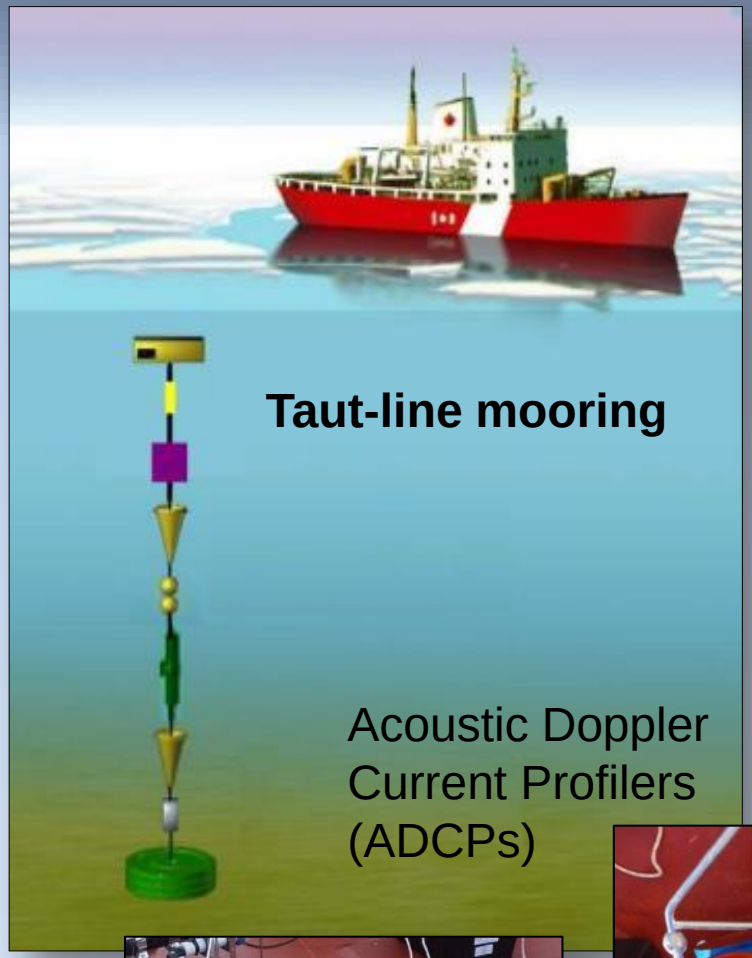
- Deployment of moored oceanographic observatories equipped with state-of-the-art instruments at three key locations: (1) Mackenzie Trough, (2) Central shelf/slope at EL-476 and EL-477, and (3) Northwest of Banks Island.

Southern and Northeastern Beaufort Sea Observatory

- BR-A, BR-B and BR-G: since 2009, legacy of ArcticNet-Industry partnership (in EL-476 and EL-477)
- BR-2 and BR-1: added in 2011 and 2012
- BR-3, BR-4 and BR-K: added in 2014



BREA mooring instrumentation and data collection

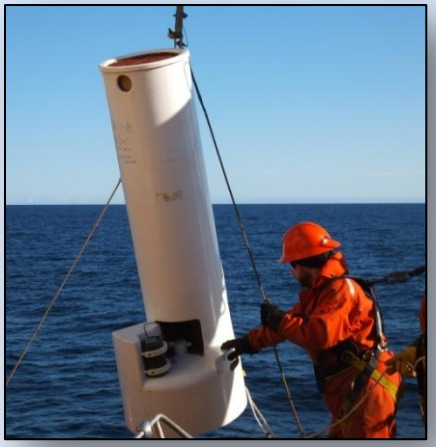


Ice draft and motion profilers

Releases and current-meters

Salinity, temperature loggers

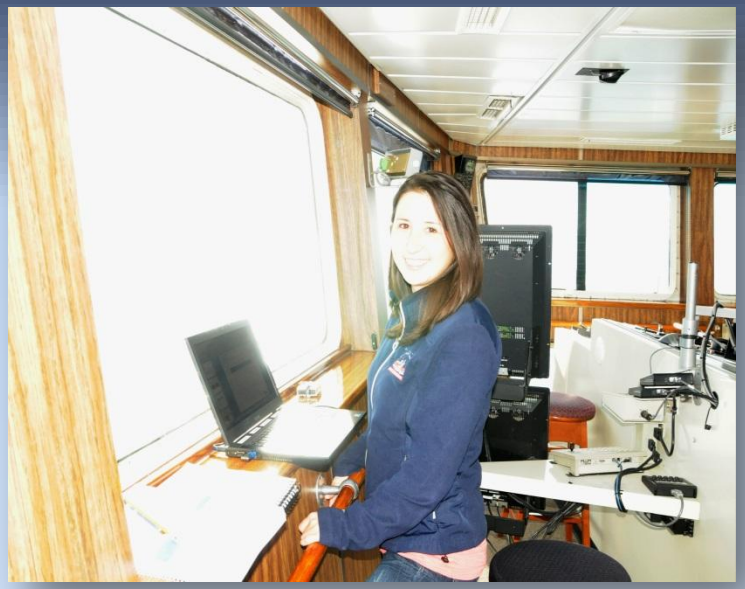
Sediment traps

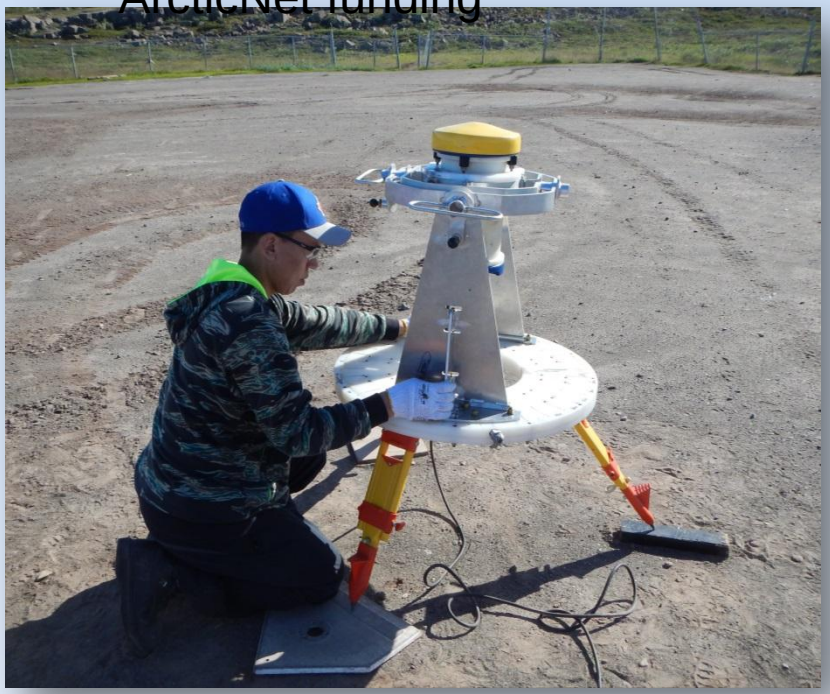


Laser Particle-size analyzer

Community engagement and consultation

- Involvement of Inuvialuit as Marine Wildlife Observers and Field Assistants during expeditions onboard the *CCGS Amundsen* in 2011, 2013 and 2014
  - Gather baseline data on the occurrence of marine wildlife in the Beaufort Sea
  - Skill--providing opportunity and employment through Inuvialuit--owned IMG-Golder Corporation supported by ArcticNet funding

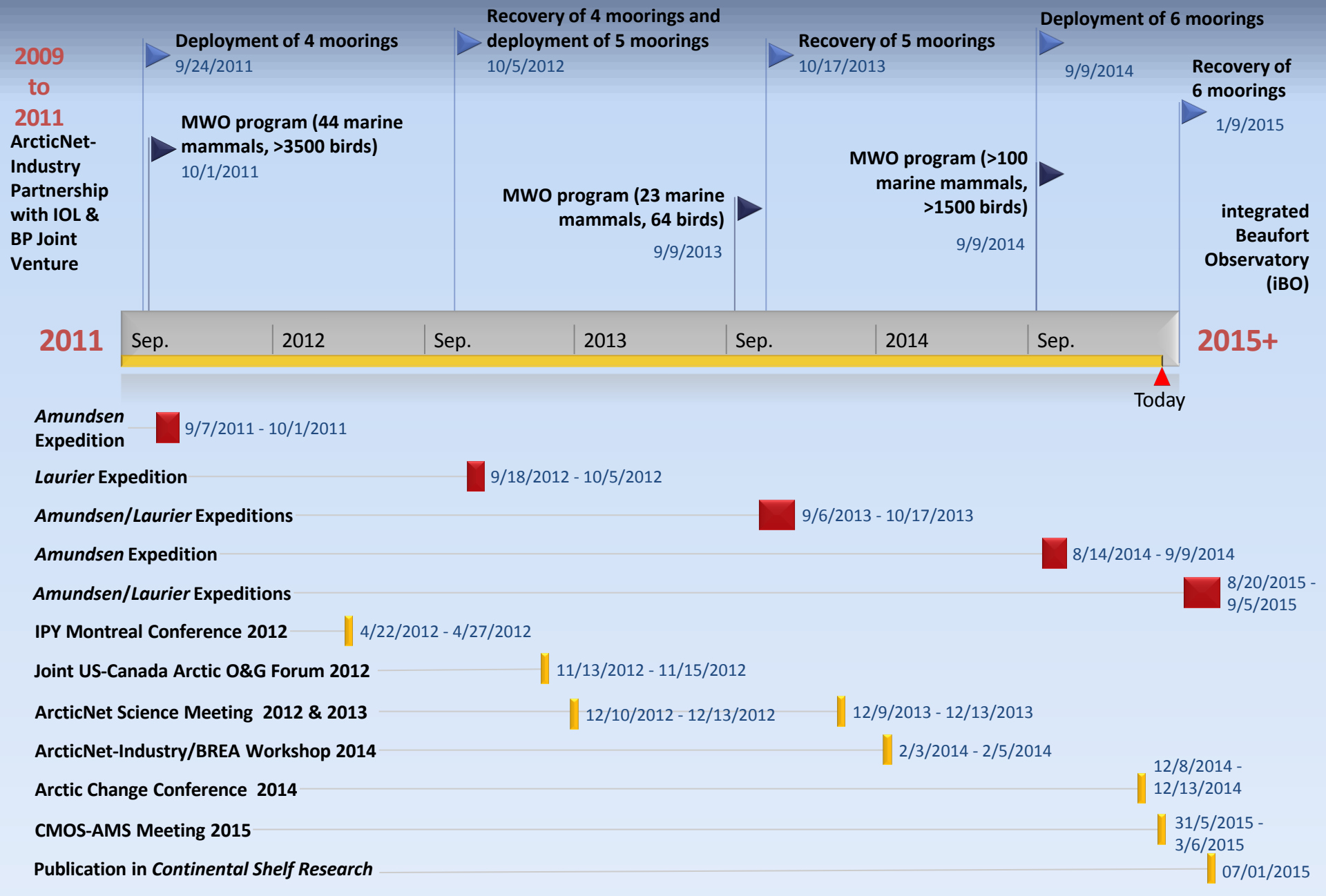




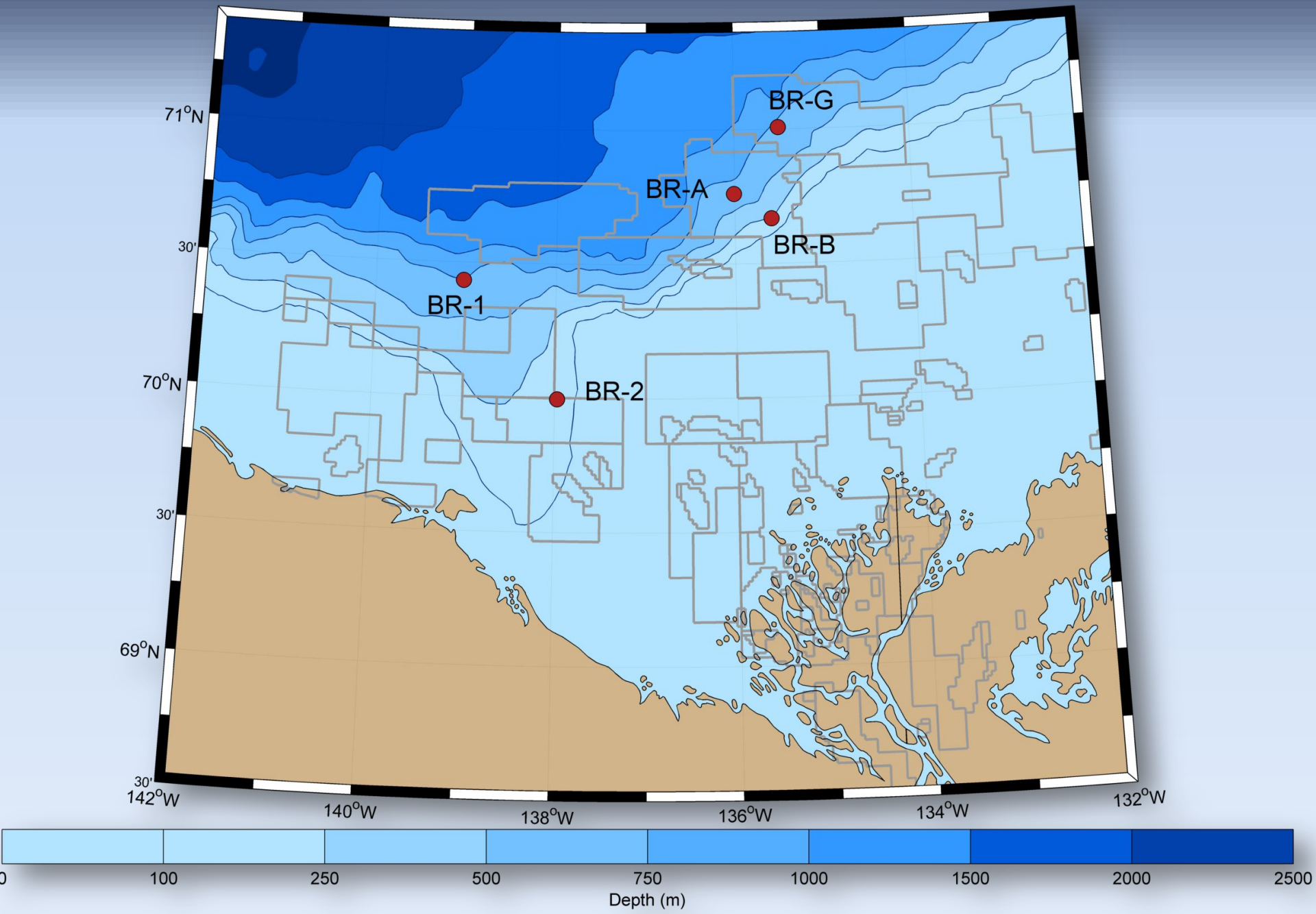
ArcticNet - IMG-Golder MWO Program

- IMG-Golder: Inuvialuit environmental consulting company, jointly owned by Inuvialuit business partners (majority shareholders) and Golder (approximately 100 employees since 2001)
- Since 2009, 12 MWOs were trained and 8 where employed on different surveys in the Beaufort Sea, including through substantial funding from the ArcticNet and BREA programs
- Cruise operations carried out on the *CCGS Amundsen* were focused on marine mammal and seabird sightings according to standard industry protocols

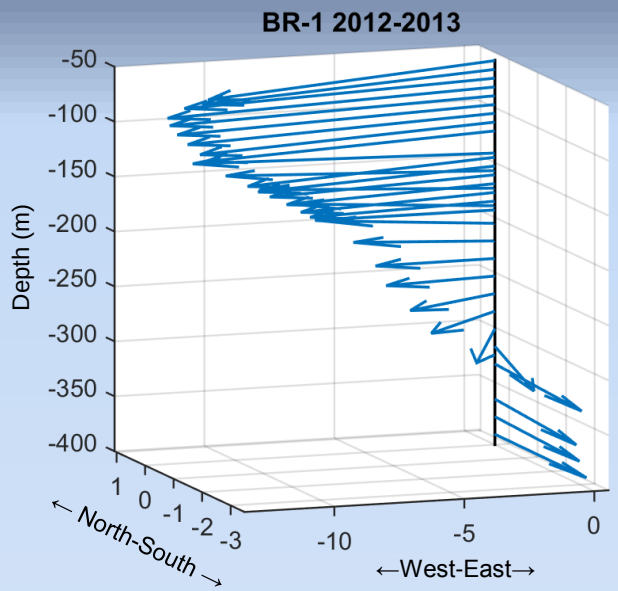
Milestones: Fieldwork (Moorings & Wildlife Observations) and Communications

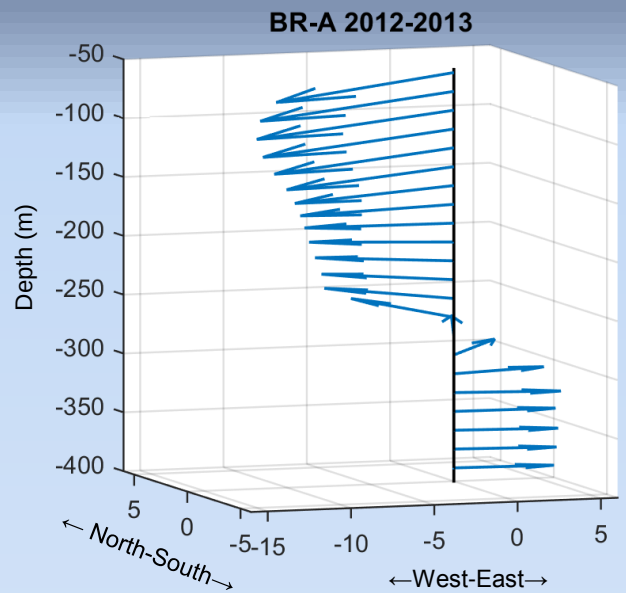


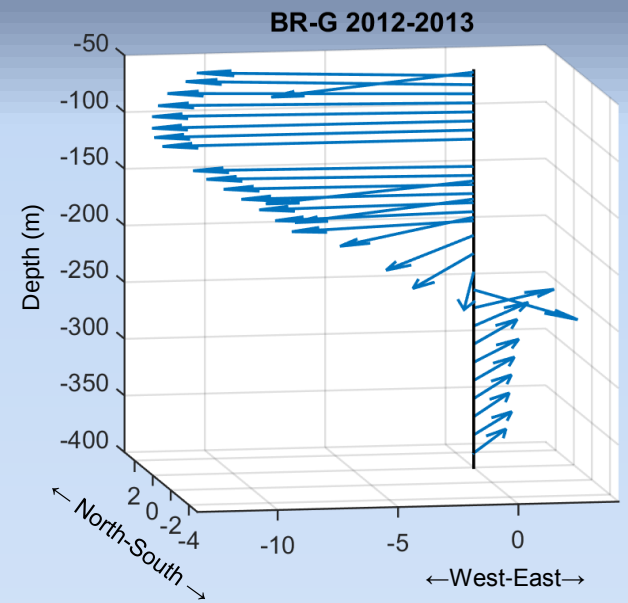
Salient results from BREA observatory, with a focus on 2012-2013

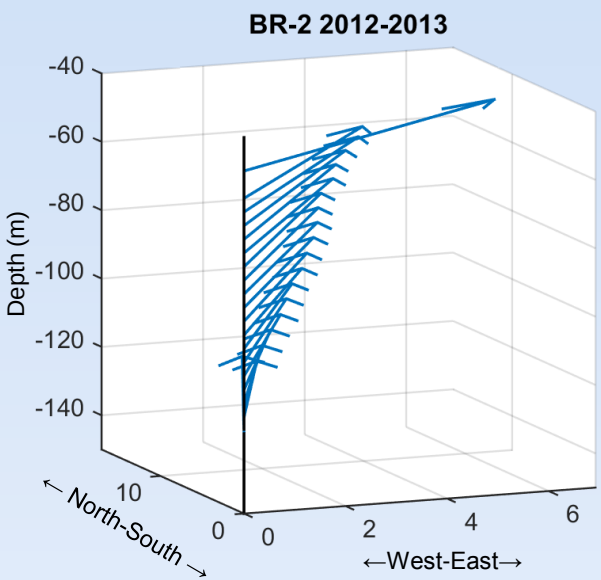


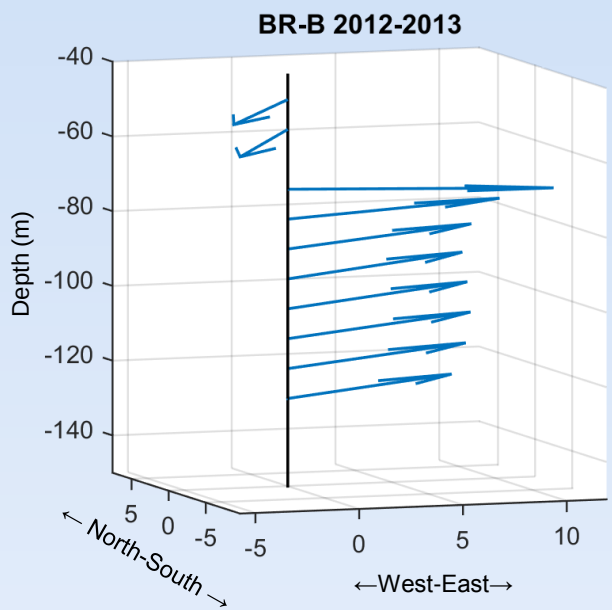
Mean ocean circulation at BREA mooring pairs over 2012-2013









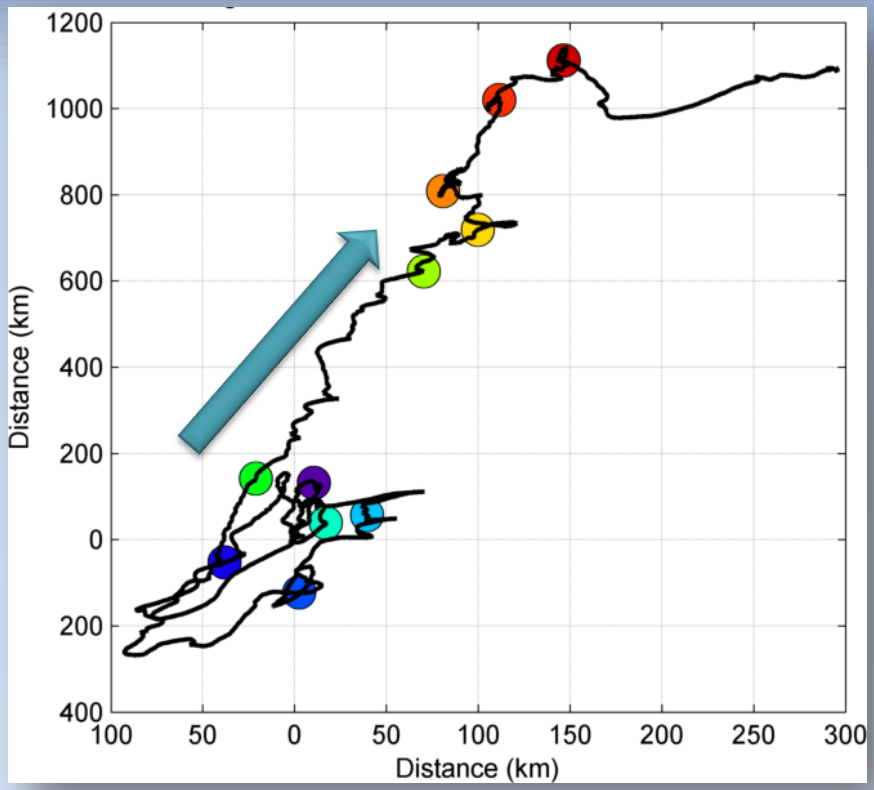


All speed units in cm/s

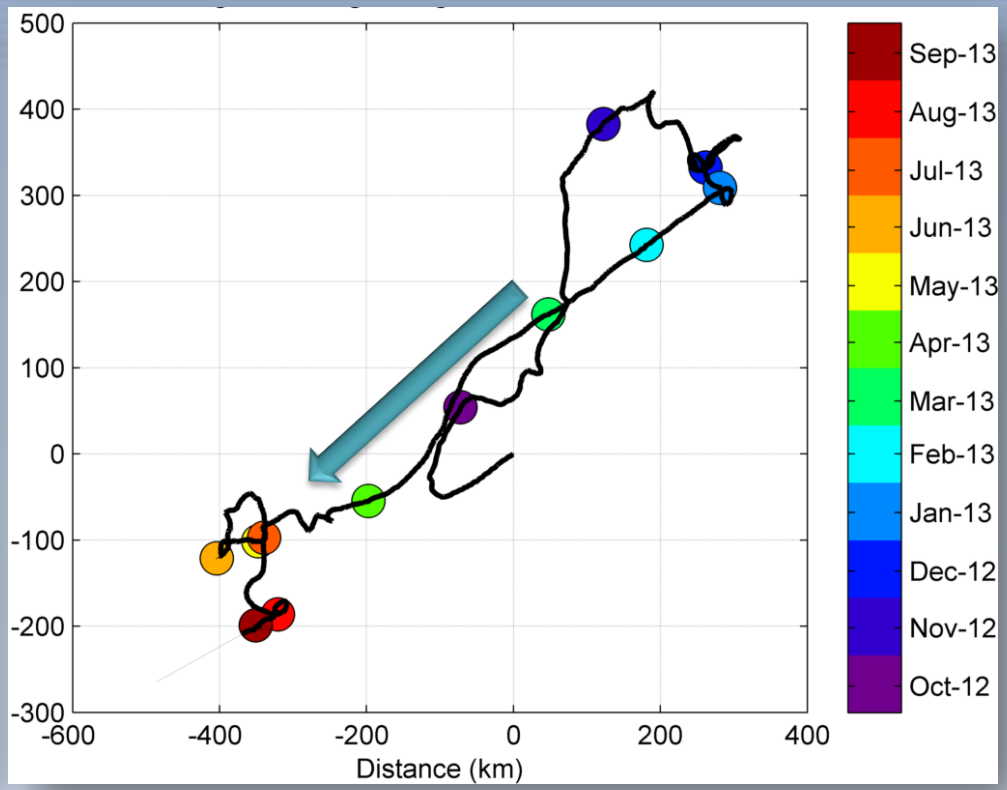
- Offshore, upper ~200-m influenced by westward Beaufort Gyre
- Boundary current below 300-m (Atlantic waters)
- Northeastward shelf-break jet on the upper slope within the ~70 to 140 m interval depth

Short-term variability, flow reversals and current surges (examples)

BR-2 (Mackenzie Trough) - 100 m



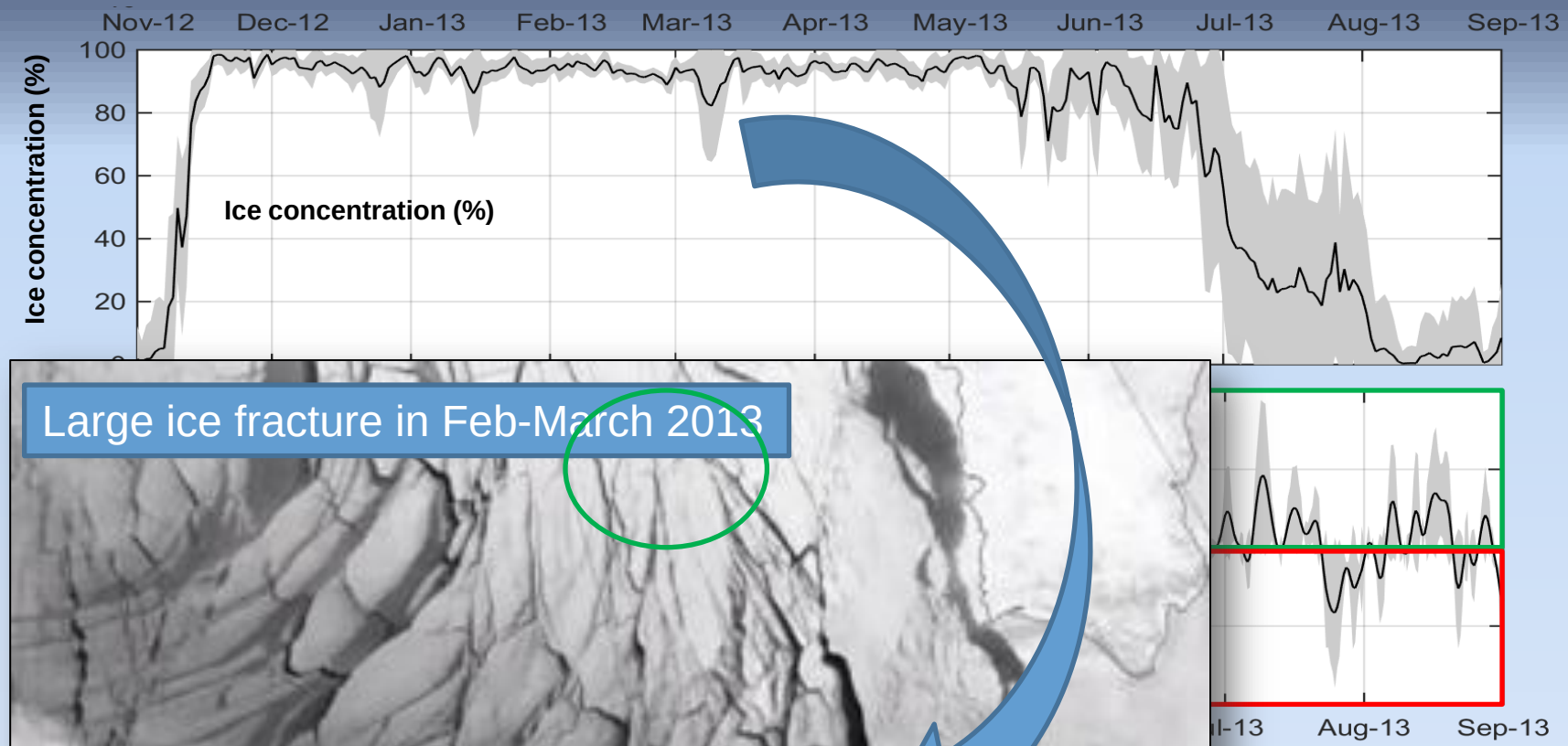
BR-G (EL-477 offshore) - 100 m

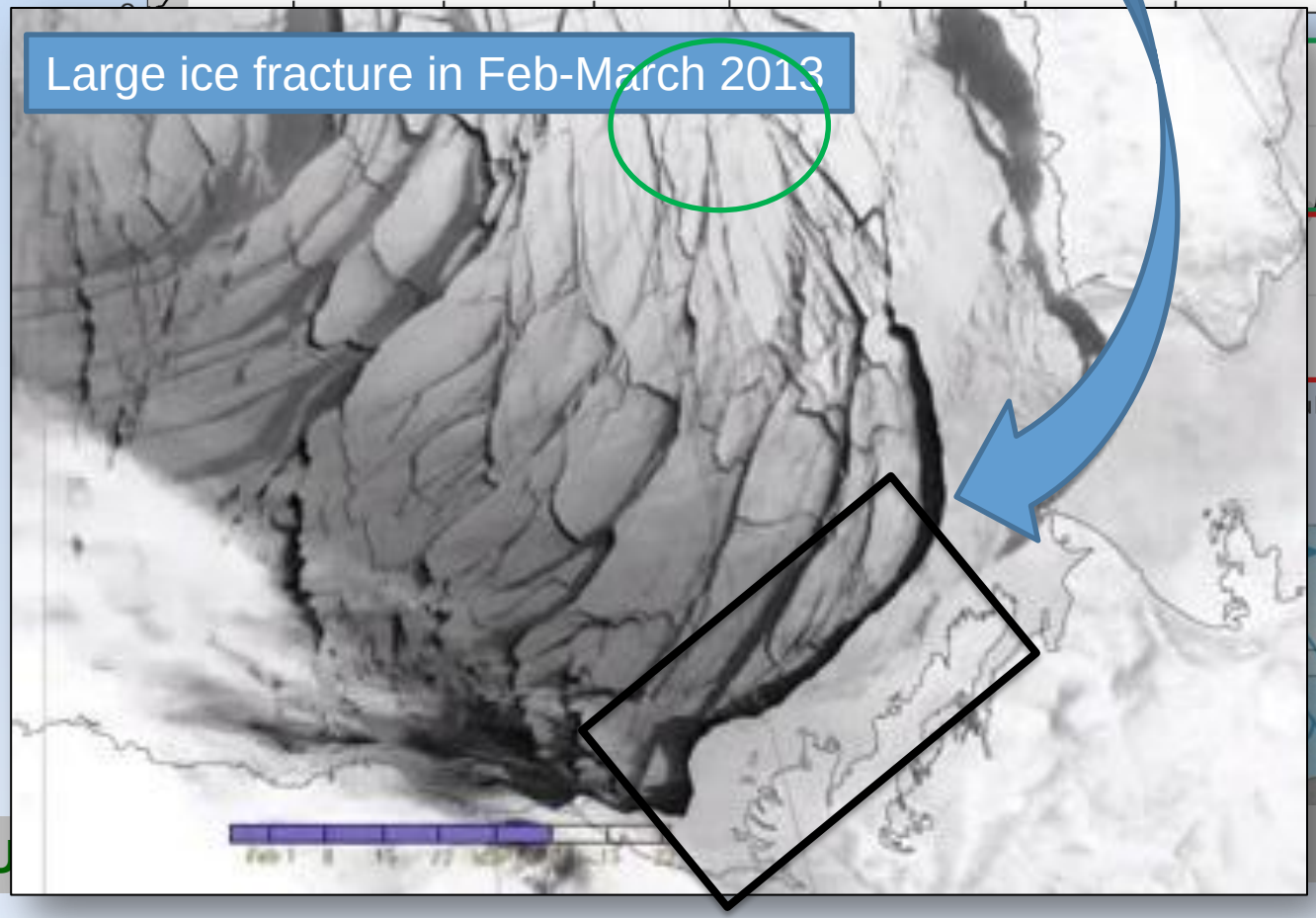


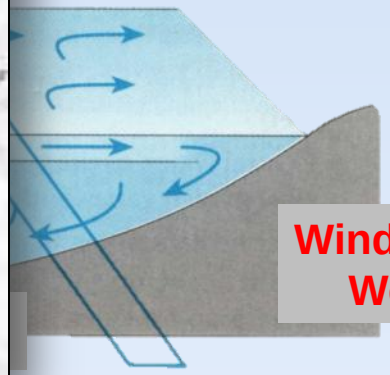
- Net flow: northeast
- Marked reversals in the fall 2012
- Variability (eddies and shear)
- Pulse displacement of ~500-km **to the northeast** over March 2013 (shelf-break jet pattern)

- Net flow: west-southwest
- Long-loop reversal in the fall 2012
- Smoother (less shear and variability)
- Pulse displacement of ~300-km **to the southwest** over March 2013 (Beaufort Gyre pattern)

Ice and wind conditions over 2012-2013



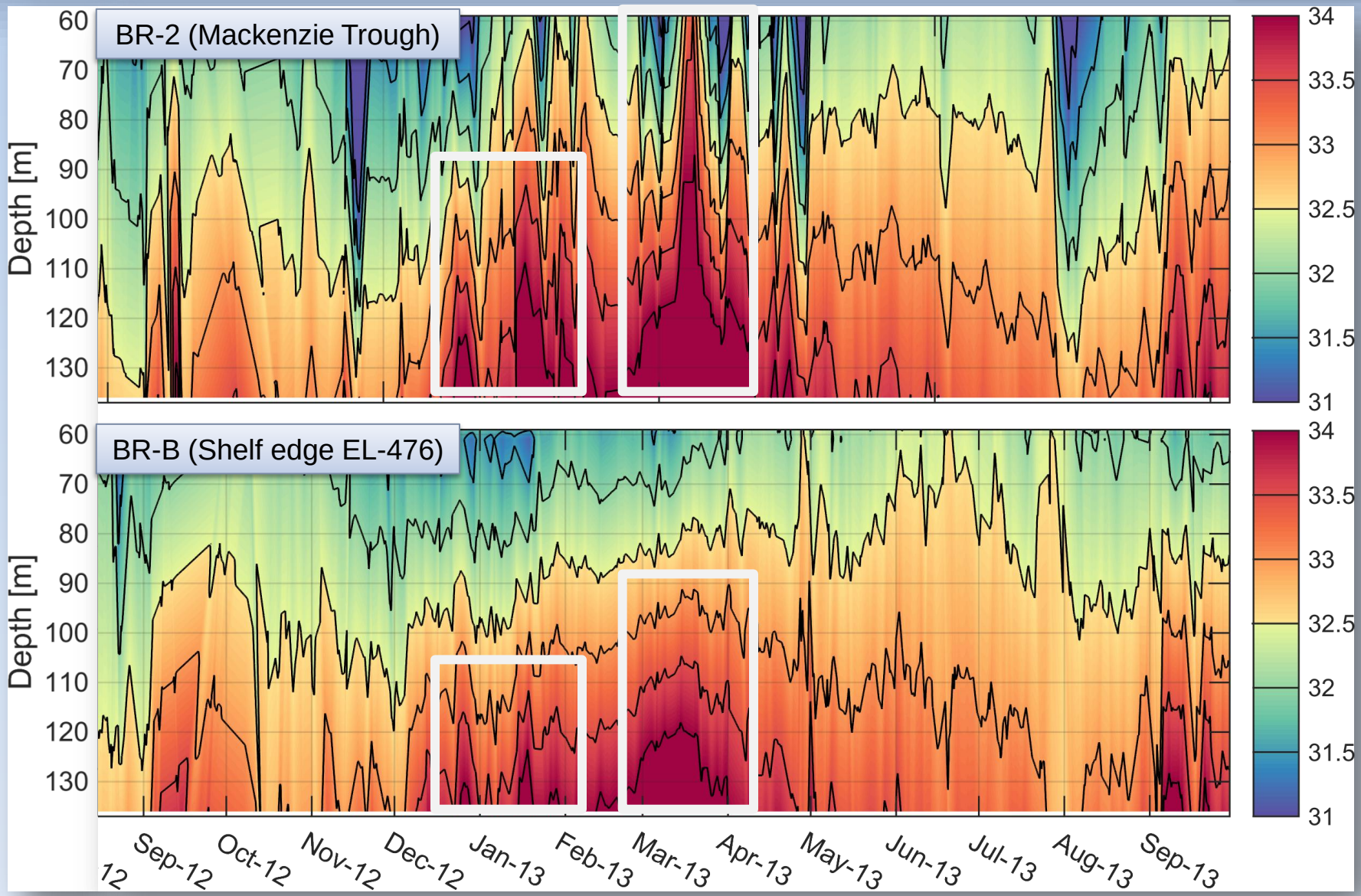




Wind from West

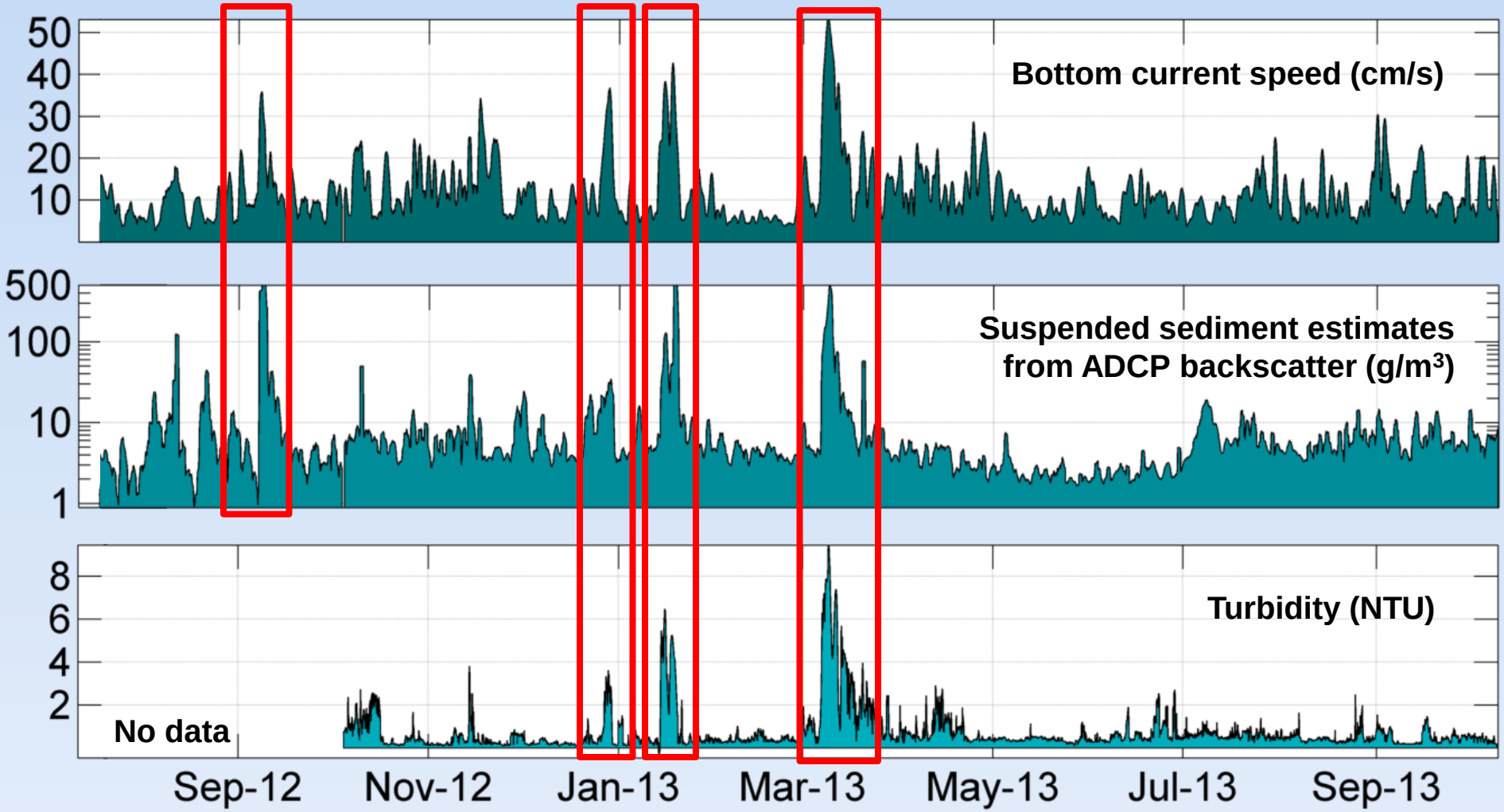
Evidence for large-scale upwelling at the shelf edge in winter 2013

Stronger in Mackenzie Canyon; peaks in late Dec, mid-Jan and mid-March



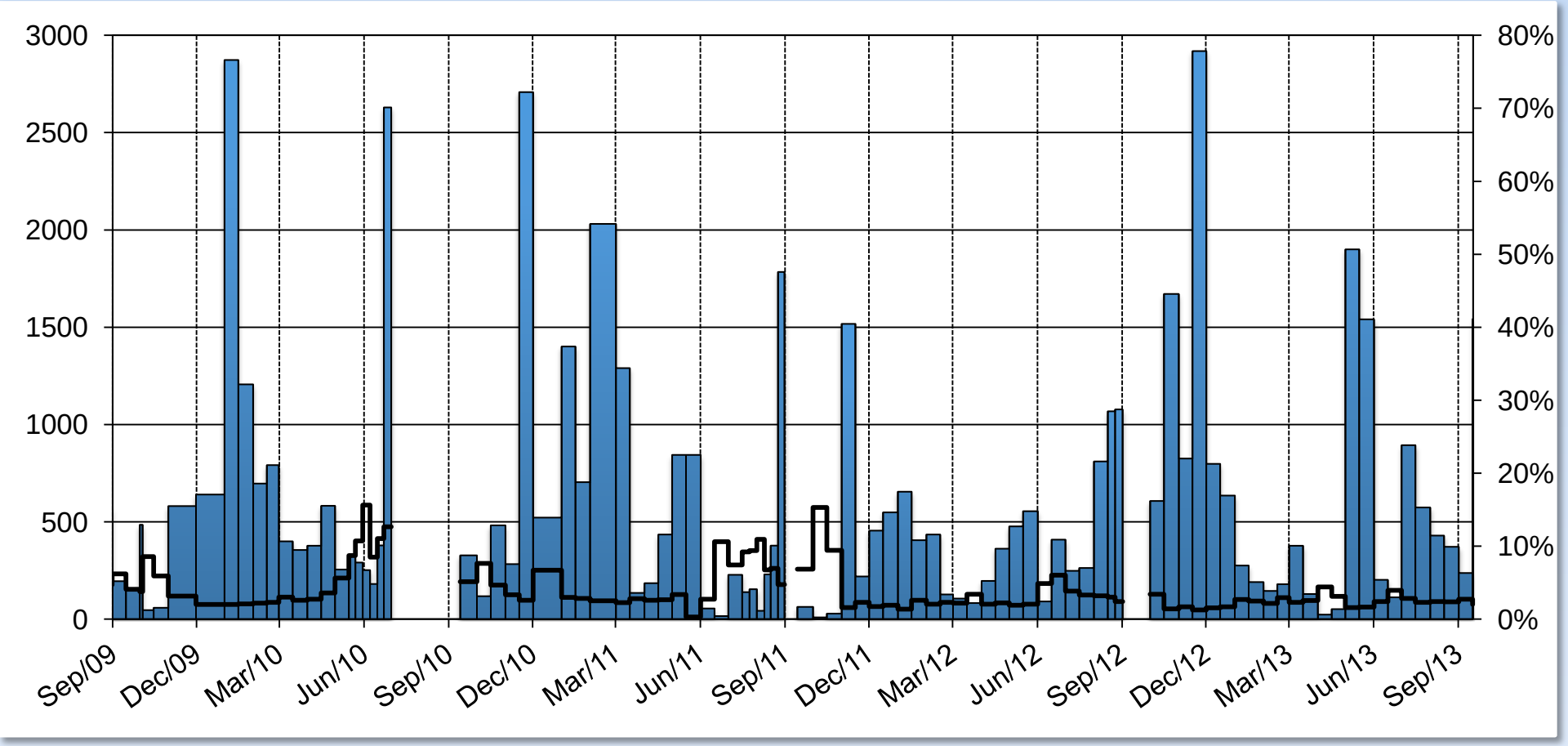
Near-bottom processes at the edge of the Mackenzie Canyon (BR-2)

- Current surges in the shelf-break jet as a result of wind and/or ice motion exceed erosion thresholds and result in suspended sediment transport at the shelf edge
- In winter 2013, such events were driven by a sustained upwelling regime; a similar event occurred in September 2012 when the Beaufort Sea was ice free



4-year time series (2009-2013) of particulate matter fluxes over the slope at (BR-A - 180 m depth - EL-460)

- Rich and Integrated dataset: illustrates strong inter-annual variability and coupling between meteorological & oceanographic forcings and sediment transport



Conclusions

Community relevance:

- Engagement, seasonal employment, training and technical skills.

Industry relevance:

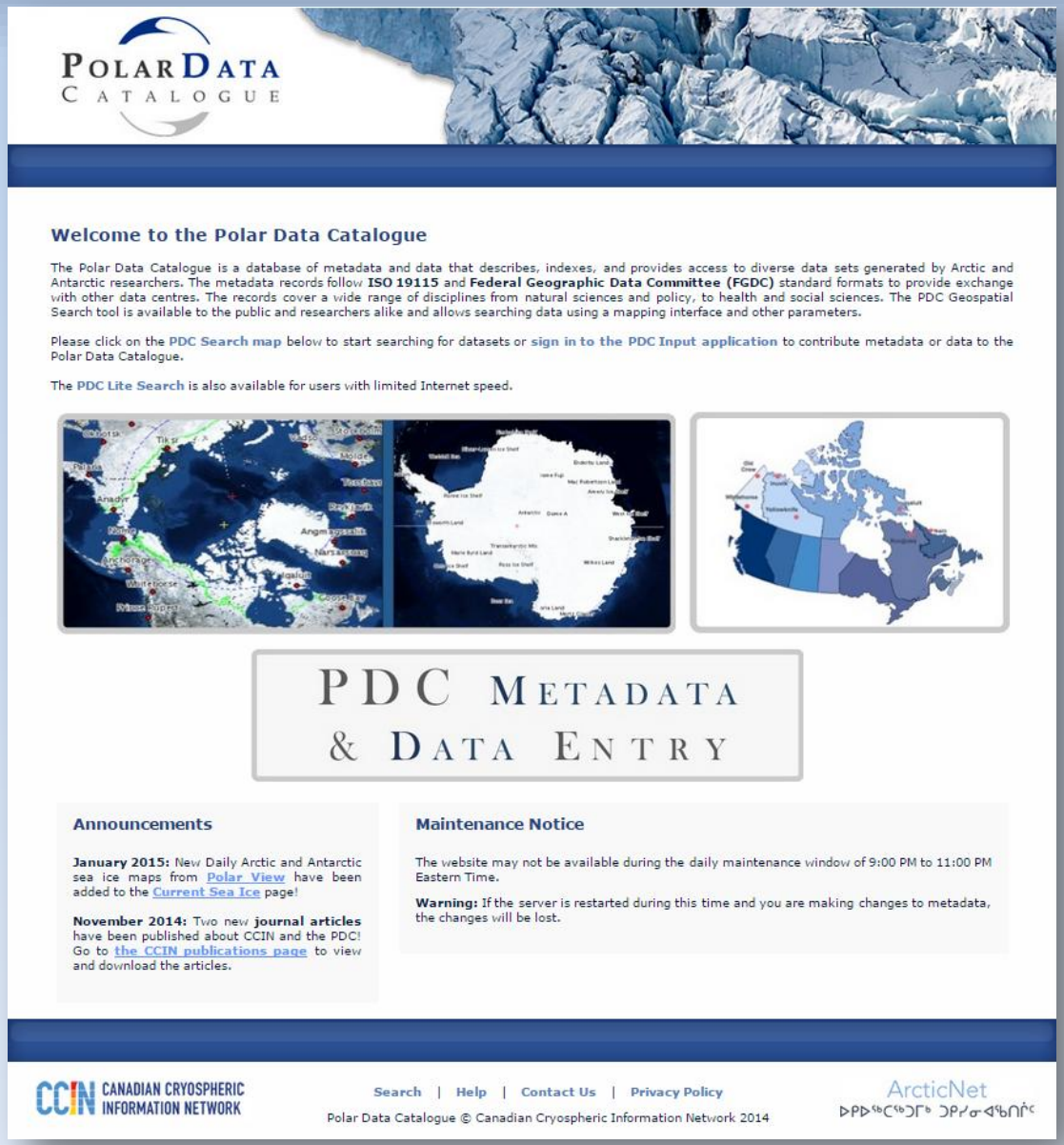
- Impact of storms and ice thickness and motion on ocean circulation and sediment mobilization (structure design);
- Frequency and intensity of upwelling-downwelling events, mesoscale eddy activity (oil spill trajectory);
- Calibration and validation of atmosphere-ice-ocean coupled models and marine forecasts (operations at sea).

Scientific relevance:

- System wide perspective; continuous time series and into iBO;
- Rich and illustrative dataset revealing strong spatial, seasonal, and inter-annual variability of oceanographic processes;
- Evidence for tight coupling between atmospheric, sea ice and ocean processes including sediment transport and biogeochemical fluxes.

S/NE Beaufort Observatory dataset, status and data availability

https://www.polardata.ca/



- All BREA mooring data will be uploaded to the PDC by the end of February 2015
- Fully QA/QC'ed, available in Text and Matlab format with complete meta-data
- For more information, contact:

Keith.Levesque@arcticnet.ulaval.ca

ArcticNet
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Thank you! Questions?

Special thanks to the ArcticNet & IMG-Golder BREA Team:

ArcticNet

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