What are capabilities and gaps in ongoing and planned in-situ observational programs?

Ignatius Rigor
and Participants of the
International Arctic Buoy Programme (IABP)

June 2022
The IABP maintains the fundamental Arctic Observing Network observing ice/ocean circulation, surface meteorology, and oceanography.
Seasonal Ice Zone Reconnaissance Surveys (SIZRS)

Deployments during SIZRS flights with the US Coast Guard. IABP Buoys are typically deployed with AXCTD/AXCPs flying northward, while dropsondes are deployed on the way home.
Sea Ice Drift

(a) 1979

(b) 1994

Scale: 2 cm/s = →

Rigor et al., 2002
Sea Ice Drift Changes w/ Arctic Oscillation

(c) Low Index

(d) High Index

Rigor et al., 2002
IABP Buoys Reporting in November 2021

Multisensor Analyzed Sea Ice Extent
03 NOV 2021  DOY 307
Multisensor Analyzed Sea Ice Extent
23 JUN 2022  DOY 174

IABP Buoys Reporting in June 2022
Impact of observations from Arctic drifting buoys on the reanalysis of surface fields

Inoue et al., 2009
Our In Situ Observations Miss the Fundamental Mode Of Circulation Change

Percent chance of finding an IABP buoy in a 250-km square based on buoy tracks from 2001 to 2021

- The probability contours roughly align with EOF1 contours.
- The odds of finding a buoy inside EOF1’s dominant feature are < 10%.
- The odds of finding a buoy inside the Beaufort Sea are 30-60%.
- 20 years of looking for the keys to circulation change under the Beaufort Gyre lamp post
Our In Situ Observations Miss the Fundamental Mode Of Circulation Change
US-IABP / AARI Collaboration

- Russian Ice breakers Akademik Fedorov, and Mikhail Somov.
- Deploy Marlin Yug buoys
  - 12 Ice Balls (GPS, SLP, Ts)
  - 8 Ice Balls w/ ice thermistor strings
KV Svalbard – NERSC CAATEX & AMOS
November, 2020

• 2 clusters of Ice Balls and boxes of wooden boats from Float Your Boat outreach projects of USCG, NERSC, APL/UW, were deployed in August (not shown on map).

• 10 SVP-Bs (from CGC Healy) were deployed along Northern Sea Route, Chukchi and Beaufort seas.

• 3rd Ice Ball and boxes of wooden boats were deployed at SIO-1 (from CGC Healy)

• 4th Ice Ball and wooden boats will be deployed where Nansen’s Fram was set in the ice 125 years ago.
Objective: Service moorings, CTD Surveys, and deploy autonomous and ice-based assets.

Chief Scientist: Igor Polyakov <ivpolyakov@alaska.edu>

Buoys:
- N AXIB
- N ITP
- N SIMB3
- N Ice Balls
- N Etc.
RV Polarstern, Aug-Sep. 2023
PS138; Project: ARCWATCH 1 (GPF 20-1_029)

• Disciplines: Sea Ice including physics, cryo-pelagic and cryo-benthic coupling; Chemical and Physical Oceanography; Marine Biology, including Ocean Optics, Planktology, Sedimentology, Biogeochemistry, Microbiology, and Benthology; Marine Technology.

• Chief Scientist Antje Boetius
  <Antje.Boetius@awi.de>

• Buoys:
  • N AXIB
  • N ITP
  • N SIMB3
  • N Ice Balls
  • N Etc.
RV Polarstern, Aug-Sep. 2024
PS143; Project: ARCWATCH-2 (GPF 20-2_070)

- Disciplines: Chemical Oceanography; Physical Oceanography; Pelagic, Benthic and Sea-ice Biology; Sea-ice Physics.

- Chief Scientist: Walter Geibert <walter.geibert@awi.de>

- Buoys:
  - N AXIB
  - N ITP
  - N SIMB3
  - N Ice Balls
  - N Etc.
ICE-PPR Buoy Deployment Plans
July – August 2022

Leads: John Woods, Ignatius Rigor

- ICE-PPR coordinates defense assets from Arctic countries to support research.
- Drop Locations will be determined by
  a) Current state of buoy array
  b) Sea Ice and Weather conditions
- METOC/Imagery Support can be coordinated with USA/CAN/DEN Ops Centers
- Science Team interested to be engaged with Flight Crew for coordination

Priority 1 may take multiple flights for proper seeding
Hydrographic surveys and buoy deployments using long range aircraft can yield snapshot sections through the change sensitive regions, e.g.,

Seasonal Ice Zone Reconnaissance Surveys (SIZRS) aboard US Coast Guard C-130s makes monthly summer AXCTD, AXCP, and dropsonde sections and deploys buoys across the Beaufort Sea SIZ.

International Cooperative Engagement Program for Polar Research (ICE-PPR) uses C-130s from 7 partner nations to deploy buoys and expendable probes.
IABP Deployment Plans 2023+

Multisensor Analyzed Sea Ice Extent
23 JUN 2022  DOY 174
SUMMARY

• Many of the changes in Arctic Climate are centered in the Eurasian Sector of the Arctic Ocean, and
• Changes in ice/ocean circulation quickly transport buoys away
• Logistics have always been sparse, but will be even sparser given the Ukrainian/Russian War.
• Efforts to find new options are also hampered by the war.
• Enormous spatial gap in logistics for sustaining in situ AON
ICE-PPR Resolute, Alert, Thule
July 2021 (TBD)

- **2020 RCAF/ECCC**
- **Buoys:**
  - 2 ICEXAIR
  - 4 AXIBs
  - 12 SVP-AD
  - Lots of Ice Trackers
  - Lots of Ice Trackers w/ Barometers
  - N UpTempOs
- **Flight 1:** Resolute - Canadian High Arctic – Alert (SVP-AD and Ice Trackers)
- **Flight 2:** Alert - Eurasian Arctic – Alert (AXIB and SVP-AD)
- **Flight 3:** Alert – Ice Island Tagging – Resolute (SVP-AD and Ice Trackers)
ICE-PPR Plans 2022

- CA DND
  Inuvik/Tuktoyaktuk/Sachs Harbor, February (canceled)
- USIABP UTQ, Mar. 28–Apr. 7
- RCAF High Arctic, June/July
- HMCS Harry DeWolf (JACO cruise NW of Thule), July
- USAF Eurasian Basin, TBD
Seasonal Ice Zone Reconnaissance Surveys
SIZRS August 2022 Deployments

Color contours show the most significant pattern of sea surface height variability from US-Russian hydrography 1950-89 and satellite altimetry 2004-2019. The center of maximum variability and circulation is the blue area in the Makarov Basin. The proposed SIZRS USCG C-130J flight (red line) would be the first section of hydrographic measurements across this critical region since the 1993 cruise of the USS PARGO.
2022 Deployments: **29 Buoys**
- 1 APL/UW Dynamic Ocean Topography (DOT) buoys
- 6 USIABP Ice Balls
- 3 ASL Ice Trackers
- 6 ASL Ice Deformation Array (Periph Buoys)
- 1 ASL Sidekick Webcam
- 12 JAMSTEC buoys
  - 6 Ice Trackers
  - 5 Ice Balls
  - 1 SideKick
  - 1 WARM-like Buoy
USIABP Utqiagvik, Alaska
April 2022 Deployments

- 1 Cluster with...
  - 1 Light and Ice Mass Balance (LIMB) buoy
  - 1 Sidekick Webcam
  - 1 Ice Ball
  - Wooden Boat from www.floatboat.org
- 1 Pacific Gyre Ice Ball
- 2 APL/UW Ice Pelicans
- 3 Pacific Gyre Ice Trackers
- 4 UMD Trackers
International Ocean Drilling Program (IODP)
August – September 2022

- Objective: 900m sediment core
- Chief Scientists:
  - Ruediger Stein <ruediger.stein@awi.de>, and
  - Kristen St. John <stjohnke@jmu.edu>.
- Buoys:
  - N Ice Ball
  - N SVP-B
Ice Bergs and MY floes near Utqiagvik, Alaska

- As of May 25, 2021 ice bergs, MY floes, and landfast ice are not moving.
- Deployed 7 buoys at cluster of bergs north-northeast of NARL (bottom right).
- Deployed 5 buoys at loose cluster of bergs and MY floes north of Pt. Barrow (top right).
- Deployed 1 buoy on MY floe near Perch (NNW of NARL).
- Deployed 5 buoys at "Wyatt" (1 LIMB, 1 SK, 1 IP, 2 IC).
- Deployed 3 buoys at "Coco" (1 LIMB, 1 IB, 1 IC).
- Deployed 3 Ice Trackers on bergs in landfast ice east of Utqiagvik (blue arrows overlaid on Radarsat image in upper left).
END