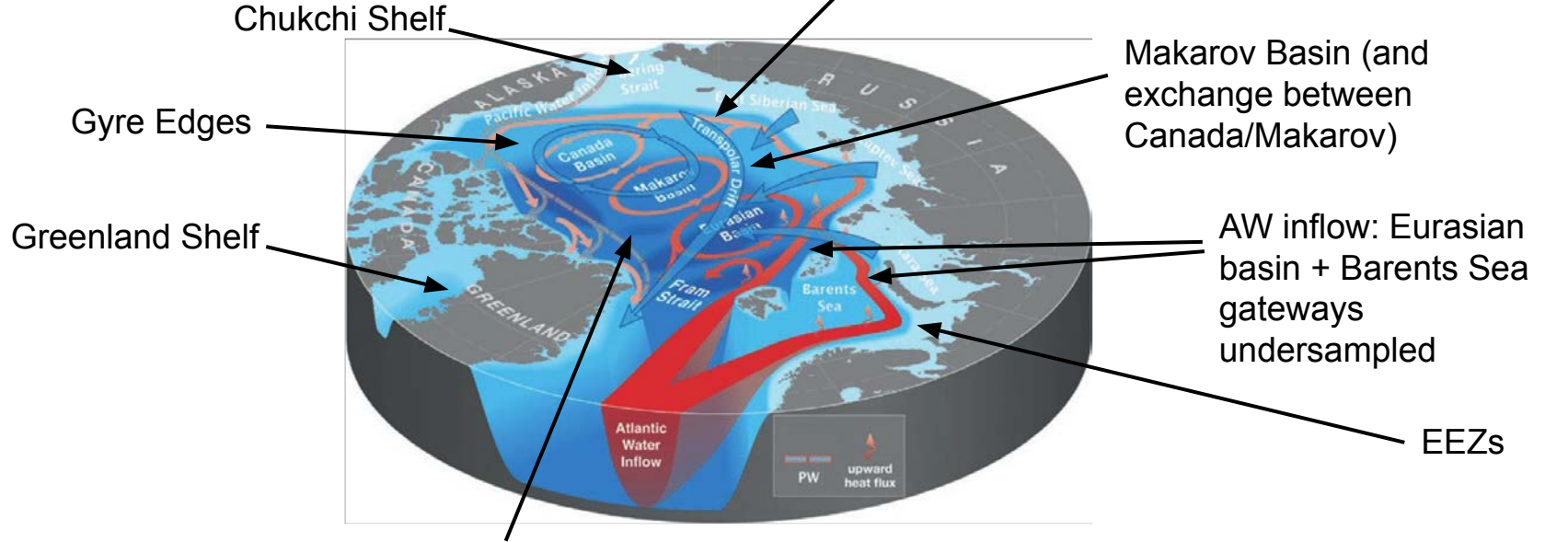


# Breakout Group 2: Observations

How can we use observational systems to understand a changing Arctic?

# Existing Spatial and Temporal Biases and Gaps



**Temporally: ship and aircraft observations constrained in winter**

Carmack et al. 2015

**Hard to measure: BGC, trace metals, turbulence, fluxes, air temperature, snow**

# Type of Observations to Fill Gaps

ITPs with BGC sensors

Acoustic tomography (basin-wide, regional)

Gliders + nav moorings

Argo/Deep Argo (ice)

Saildrones

Submarines: historic + modern (largely classified 🤖)

Bottom pressure sensors (have limitations)

Drifter campaigns—insert in Arctic inflows?

Trans-Arctic cruise (Healy 2023)

More sustained moorings

Aircraft opportunities

AX-CTDs

Tourism cruise opportunities

River influx data

Tidal gauges

Variability/statistics as well as means

# Capabilities/Limitations of Remote Sensing

## Capabilities

- Good estimates sea ice motion over the whole Arctic, SSH, ice roughness, etc.
- SWOT will provide good measurements of geostrophic surface currents
  - ICESat-2 provides this too
- PACE will provide BGC/SST
- Sentinel provides (gridded) ice motion maps
- Future satellites will sample Arctic 3x/day, starting 2025 or 2026

## Limitations

- Sea ice limits estimates of wind and other parameters below sea ice.
- Cannot measure air pressure, nor temperature and salinity just under the ocean/ice surface.
- After SMOS/SMAP perish, no plans from NASA/ESA for another SSS mission
- Understanding of thin ice impacts on satellite-derived SSS/SST
- Separation of steric/non-steric SSH
- Tidal models on shelves and in fjords and geoids need improvement for high-resolution applications

# Blending In Situ/Remote Sensing Data

- Optimal Interpolation may have higher correlations to observations, but numerical models may be more dynamically consistent.
- Blending data introduces errors and many times the original observations may be more useful.
  - Data assimilation relies on assumptions about length and timescales, needs to be applied with care and understanding of where data was/wasn't assimilated
- Role for data assimilation and high-resolution modeling in helping leverage sparse observations, determine optimal observational sampling, and provide situational awareness
- Co-located bottom pressure + acoustic tomography on satellite tracks (SSH and SSS) could maximize data usefulness
- SSH buoys + SSH satellite measurements allow for better confidence

# Overcoming degradation of relations with Russia

- Leverage ice breakers from other countries to plan or extend cruises into the Eurasian Arctic (bring topic up with Arctic Icebreaker Coordinating Committee, Pacific Arctic Group, IARPC?).
- Can “SCICEX” be revived to take measurements and deploy instruments?
- Relying more on models and satellites to fill gaps on the Russian side
- Autonomous vehicles that can be steered into spatial gaps: gliders, floats, saildrones
- Ocean currents may be more efficient than ice for moving drifters along important flow pathways (Argo)
- Multinational collaboration can potentially help ease data gaps resulting from US/Russia relations