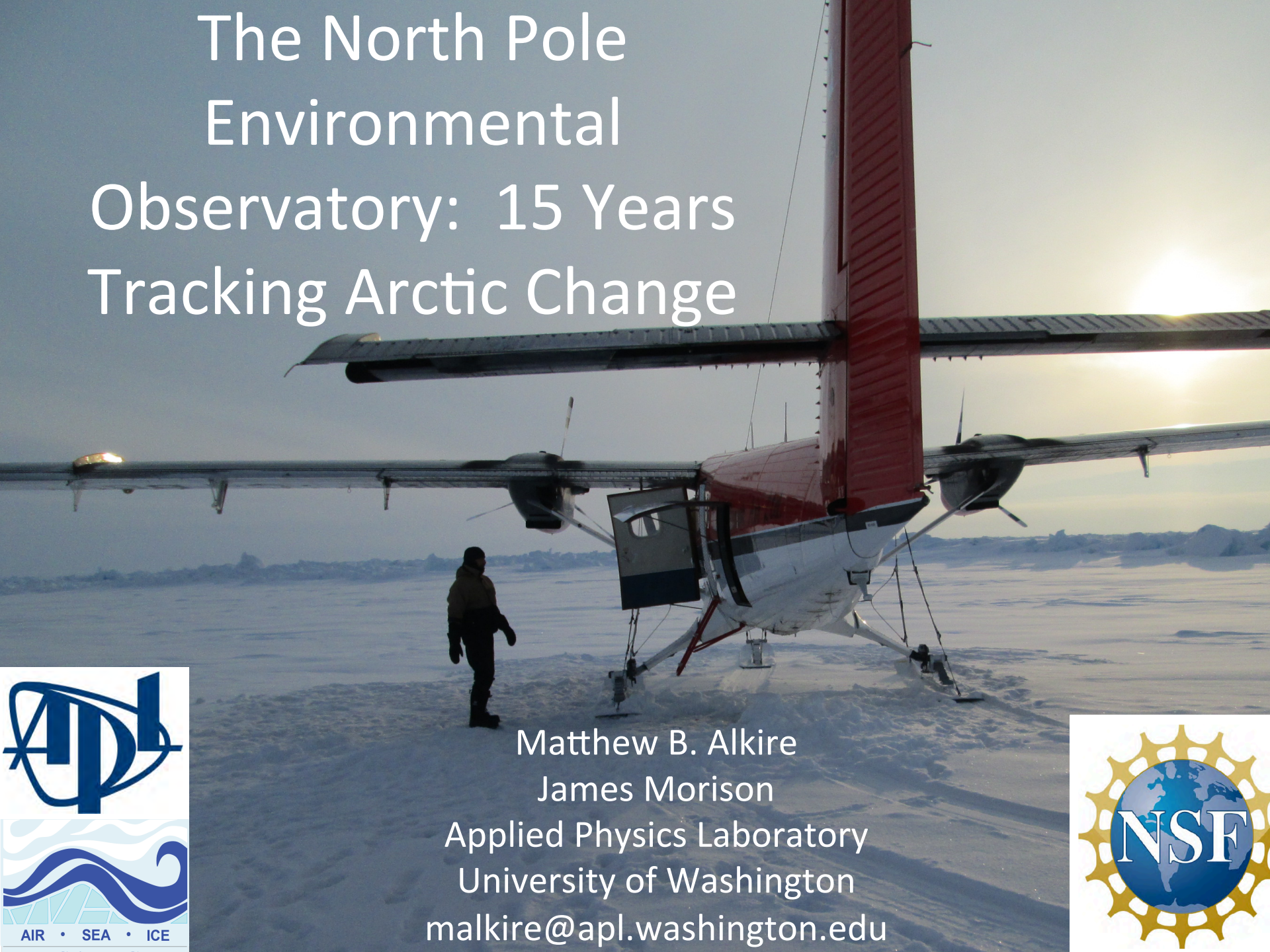
The North Pole Environmental Observatory: 15 Years Tracking Arctic Change



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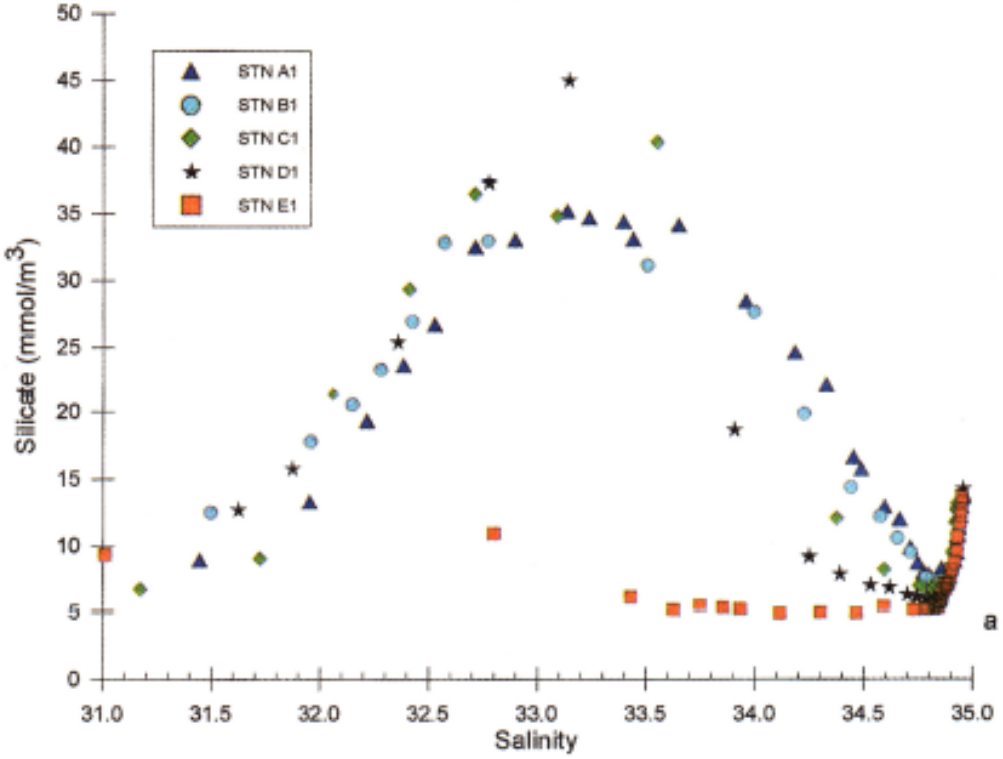
AIR • SEA • ICE

NSF



"The reason for the breakdown of frontal structure over one ridge, its reestablishment over another, and the attendant change in interbasin circulation requires further investigation." **– McLaughlin et al. (1996)**

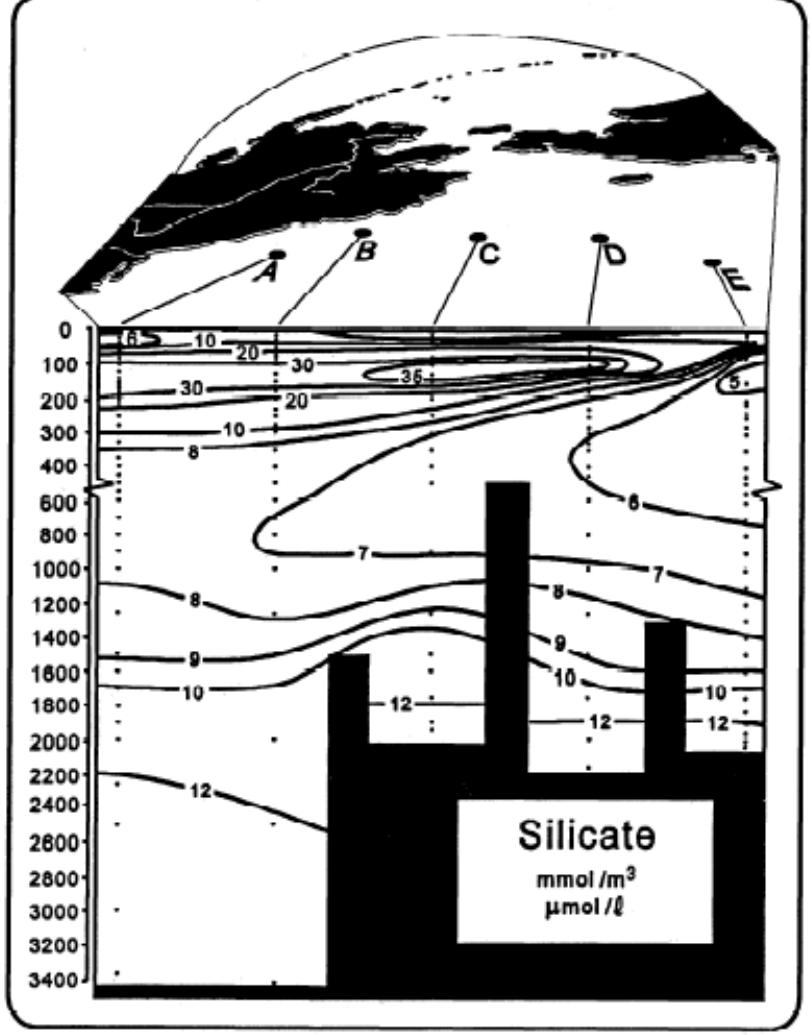


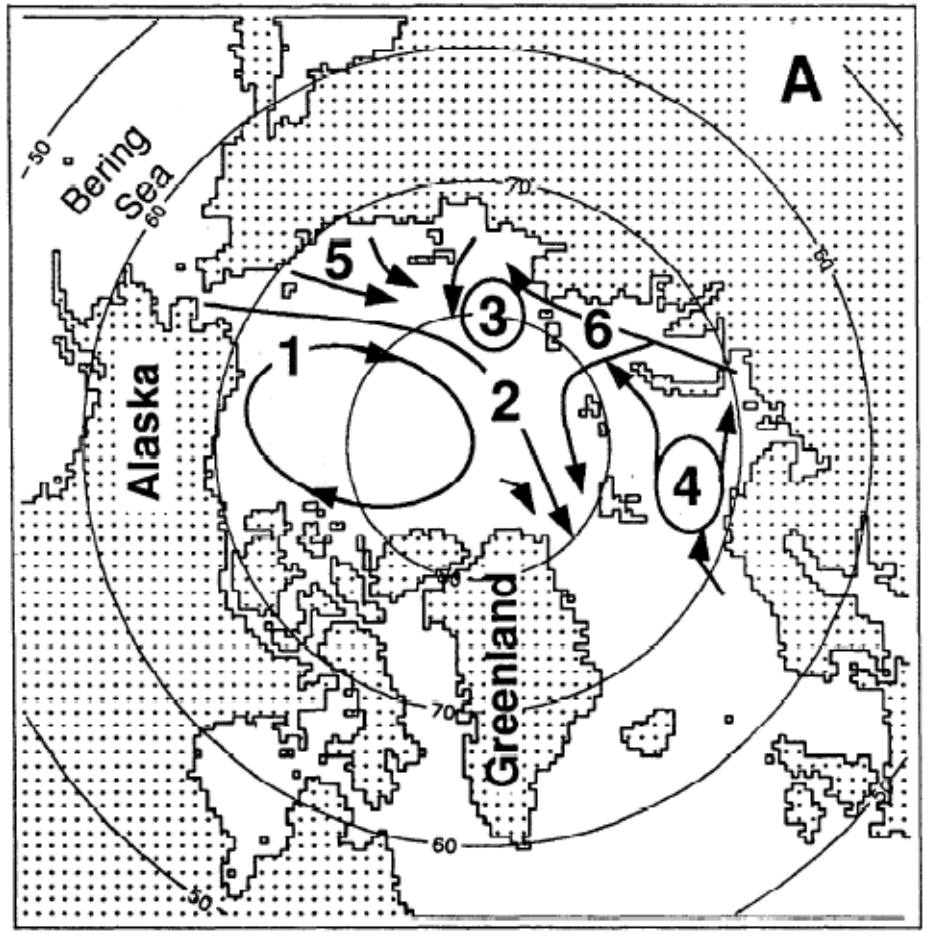
Figure 5. Section of silicate across the southern Canadian Basin.

"Whether or not this perturbation represents an episodic event analogous to the so-called 'great salinity anomaly' that issued low salinity water from the Arctic into the North Atlantic, or a longer-term transition from one stable water mass structure to another remains to be seen." – **Carmack et al. (1995)**

McLaughlin et al., 1996

ANTI-CYCLONIC MODE

CYCLONIC MODE



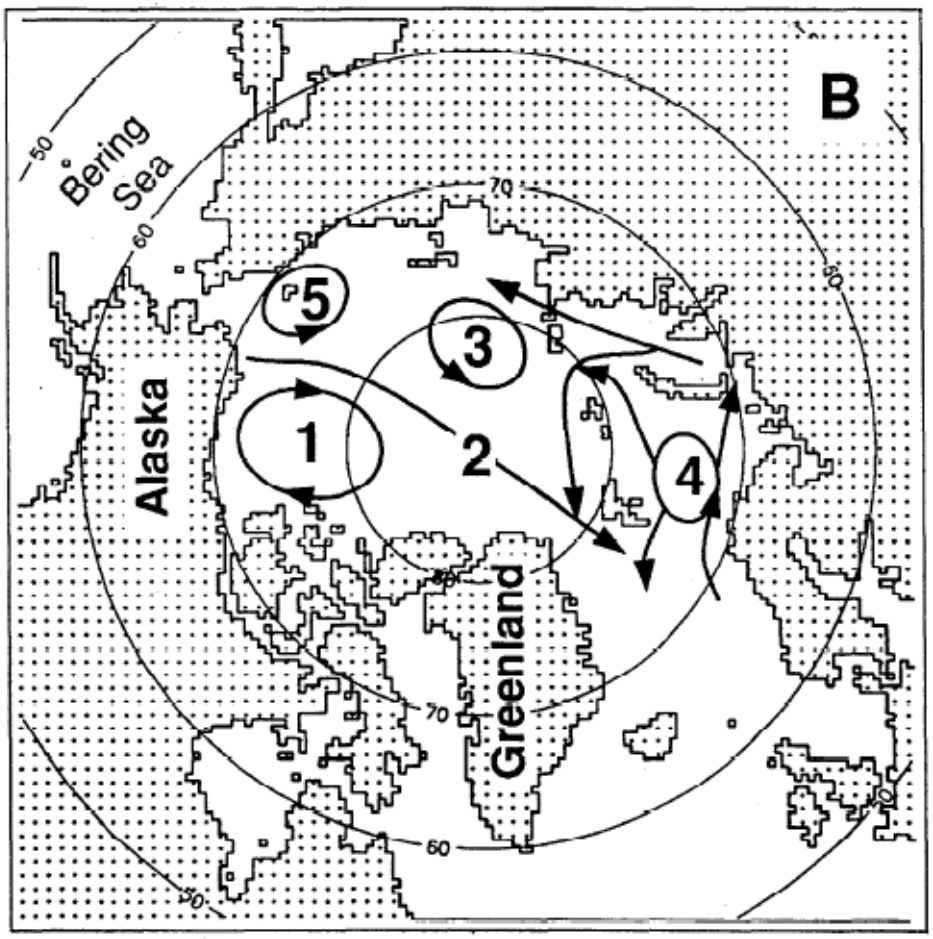
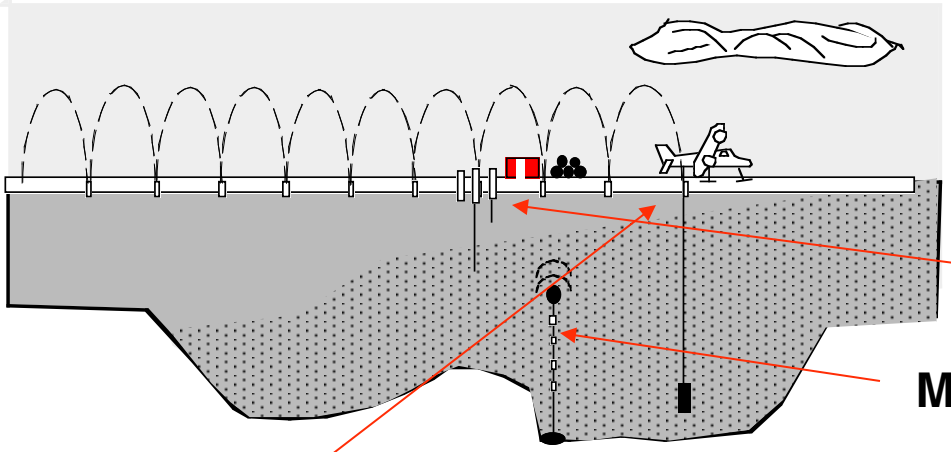


Figure 4. Regimes of surface currents and ice drift in the Arctic Ocean redrawn from *Sokolov* [1962]. (a) Type A circulation, corresponding to prevailing Arctic High atmospheric pressure; (b) Type B circulation, corresponding to prevailing Icelandic Low atmospheric pressure. Numbered features are 1, Beaufort Gyre; 2, Transarctic Drift Current; 3, Laptev Sea cyclonic circulation; 4, Barents Sea currents; 5, East Siberian Sea circulation; and 6, Kara Sea coastal flow.

Proshutinksy & Johnson (1997)

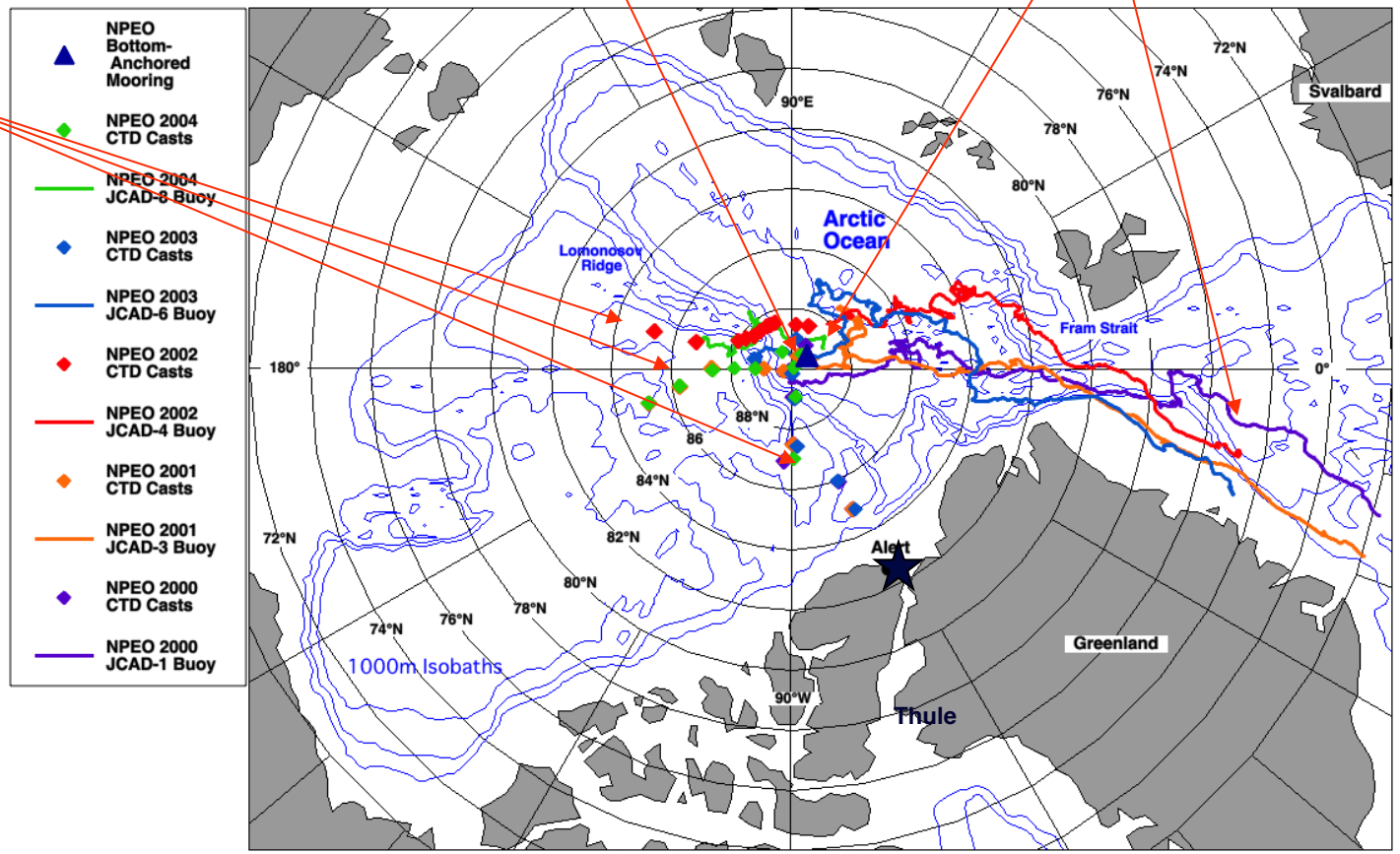
NPEO includes:

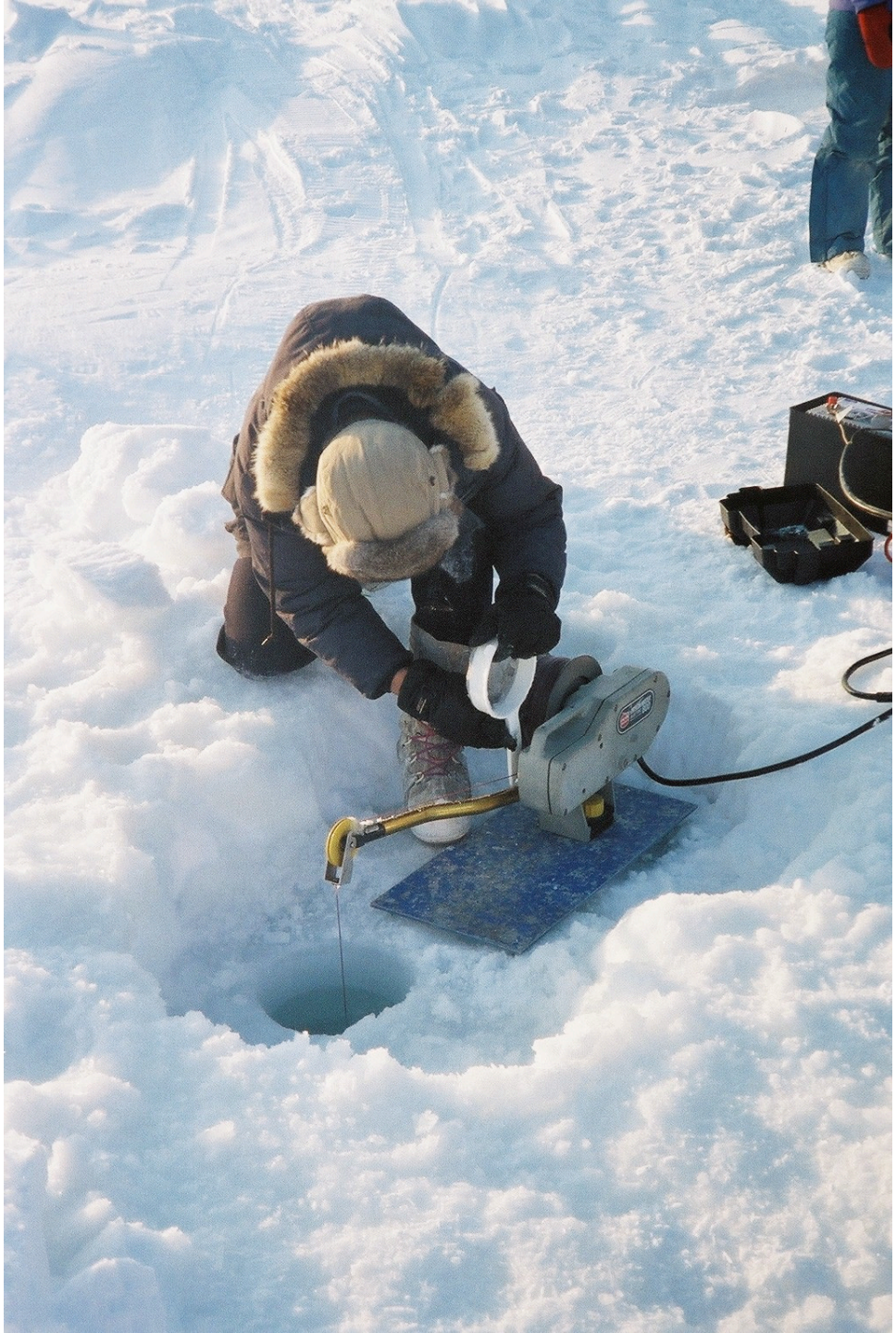


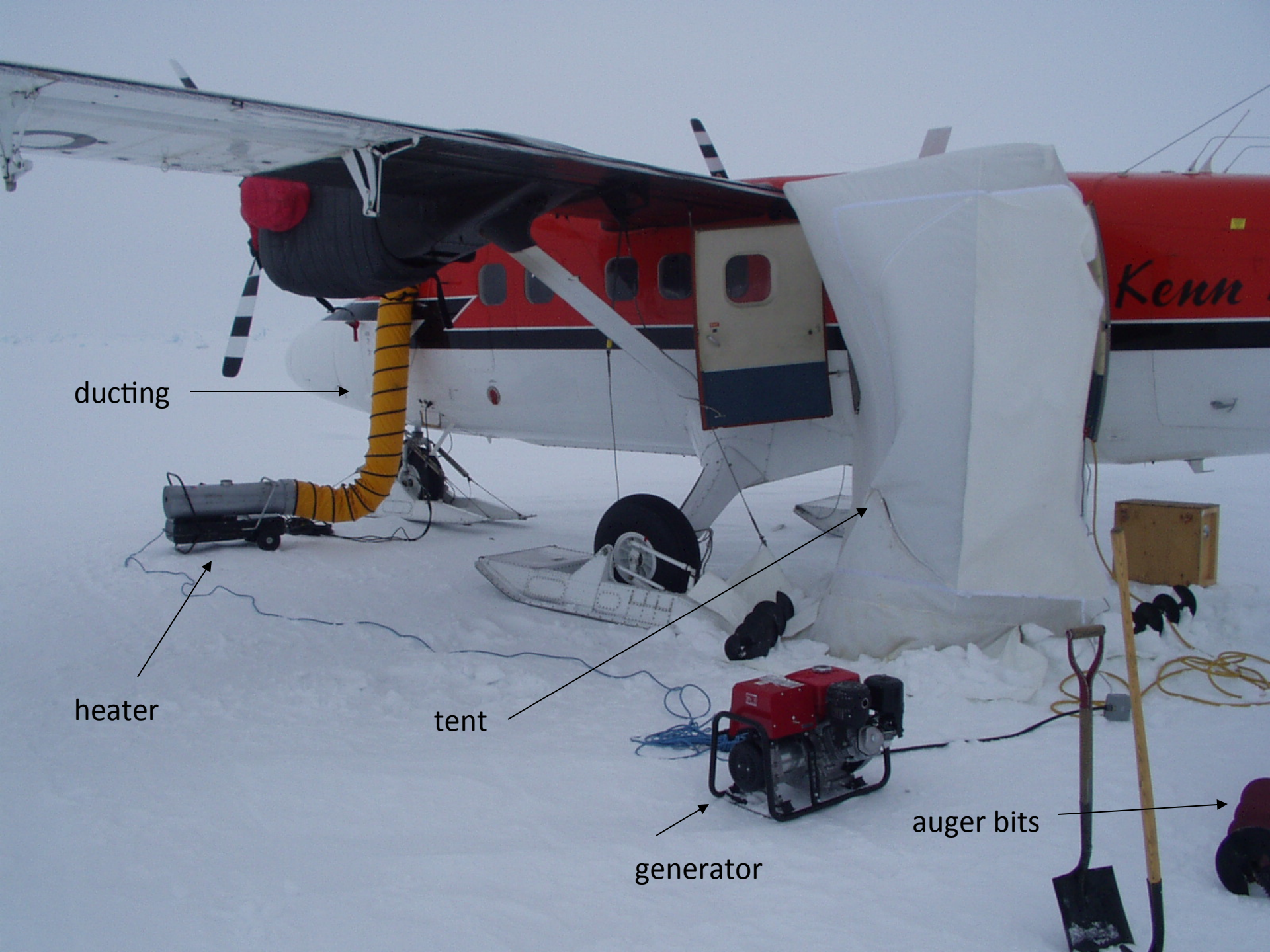
Mooring

Automated Drifting Stations

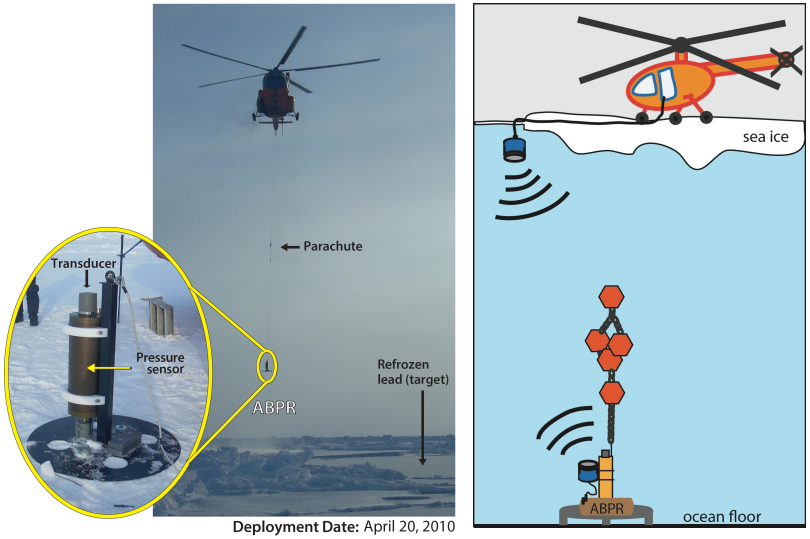
Airborne Hydro Sections





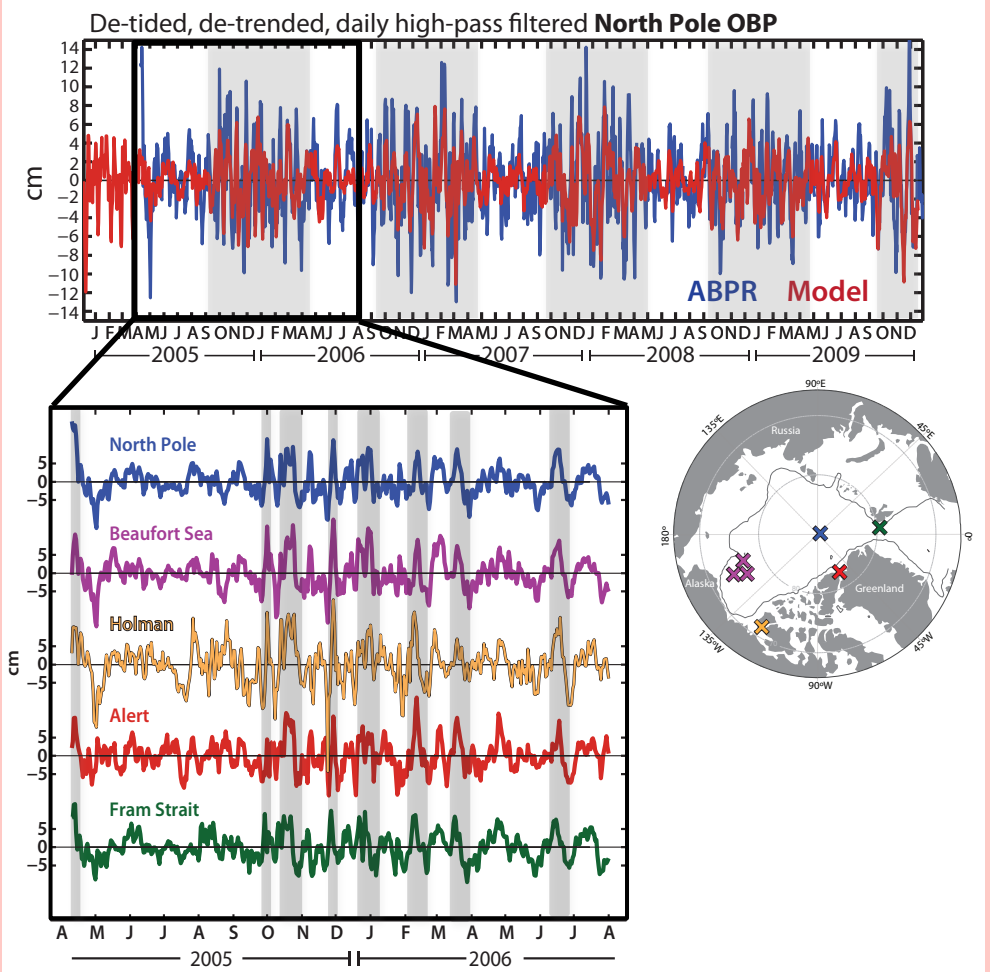

ducting
heater
tent
generator
auger bits

Arctic Bottom Pressure Recorder (ABPR)



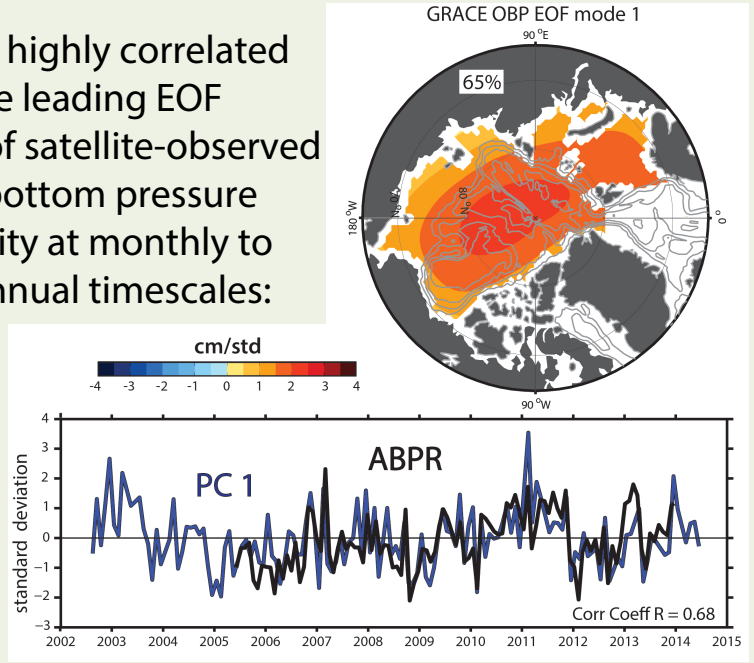
Peralta-Ferriz et al., 2014, MTS

Wintertime sub-monthly mode of Arctic Ocean mass variability and its associated ocean circulation patterns.

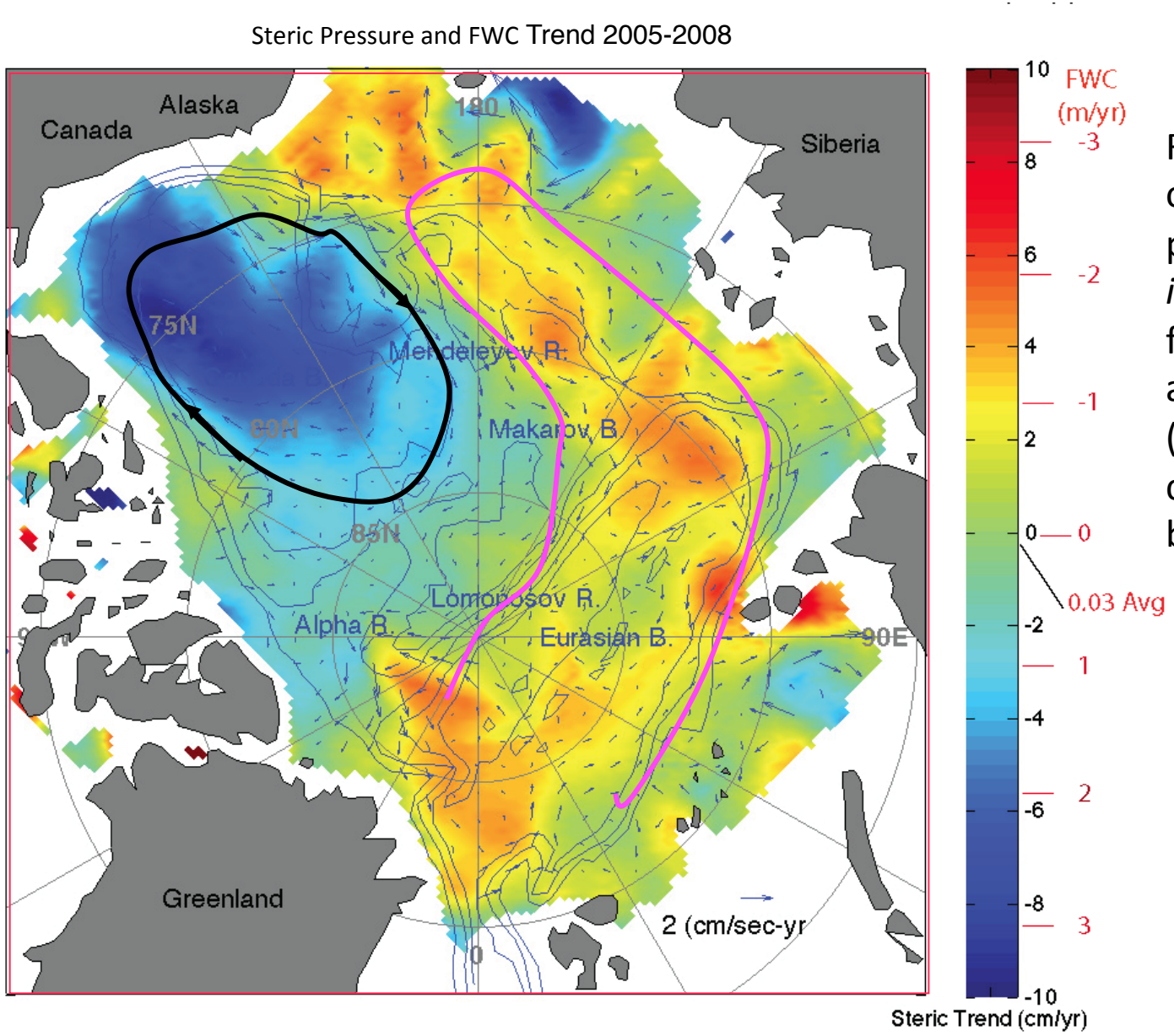


Peralta-Ferriz et al., 2011, GRL

ABPR is highly correlated with the leading EOF mode of satellite-observed Arctic bottom pressure variability at monthly to inter-annual timescales:



Peralta-Ferriz et al., 2014, J. Climate

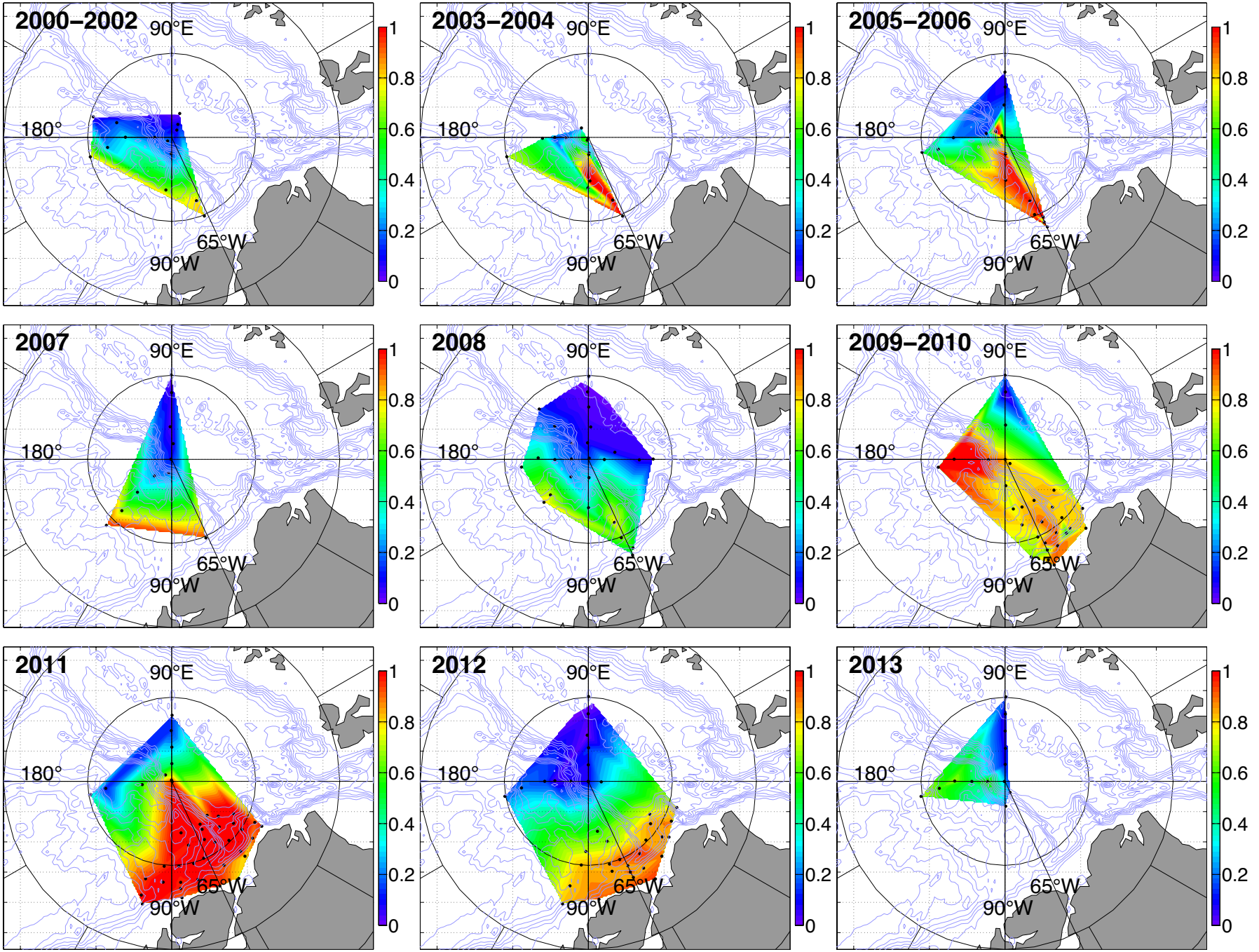


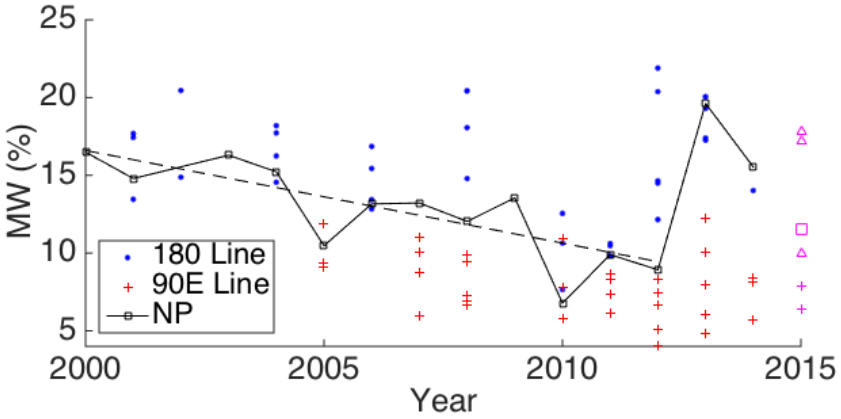
Remote sensing offers an Arctic-wide picture but requires *in-situ* observations for both calibration and additional insight (such as freshwater composition – provided by chemistry)

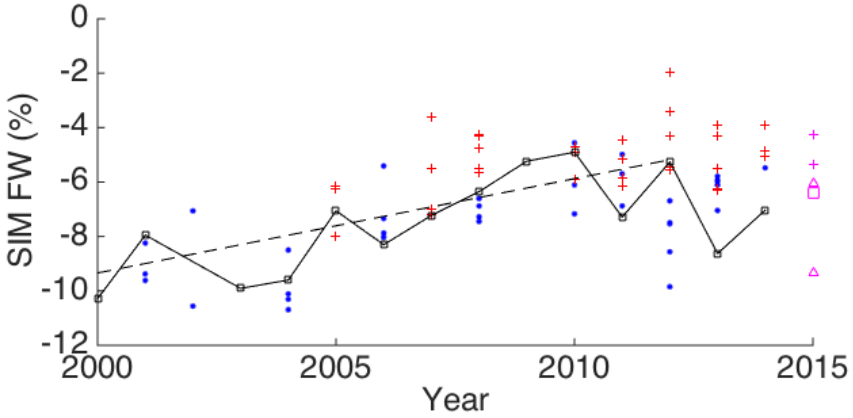
Morison et al. (2012)

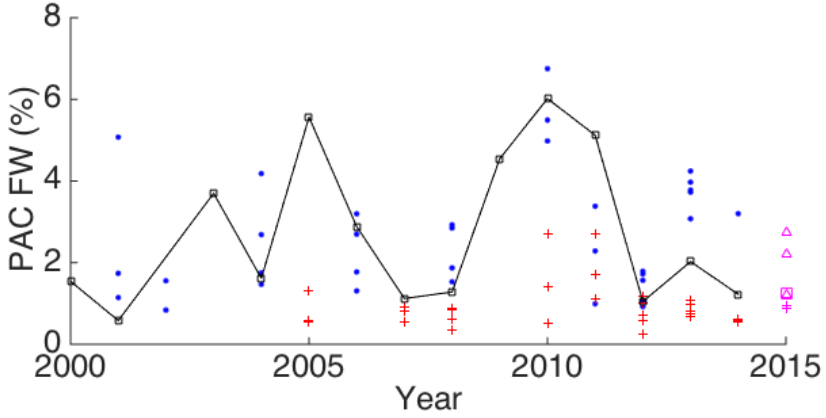
Pacific Water Fraction at 20m

NPEO-Switchyard 2000-2013

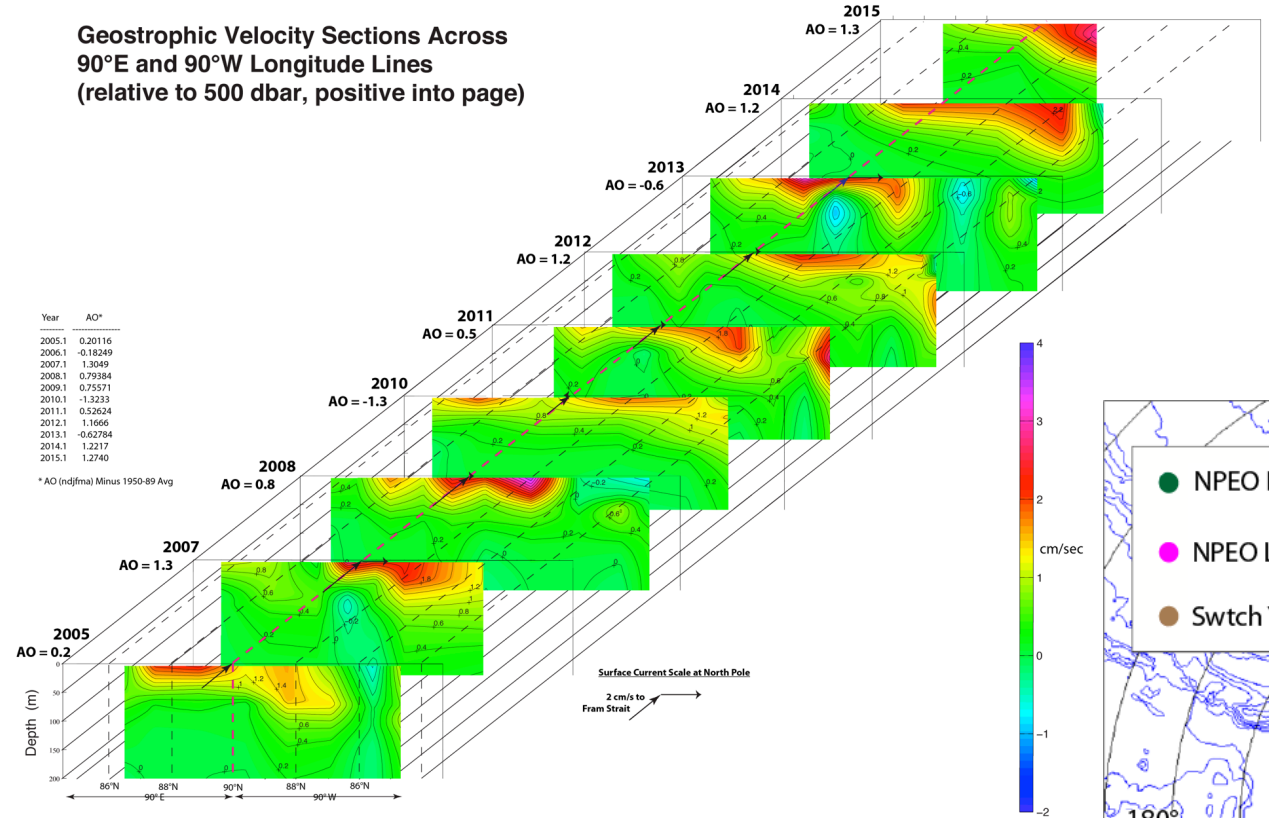


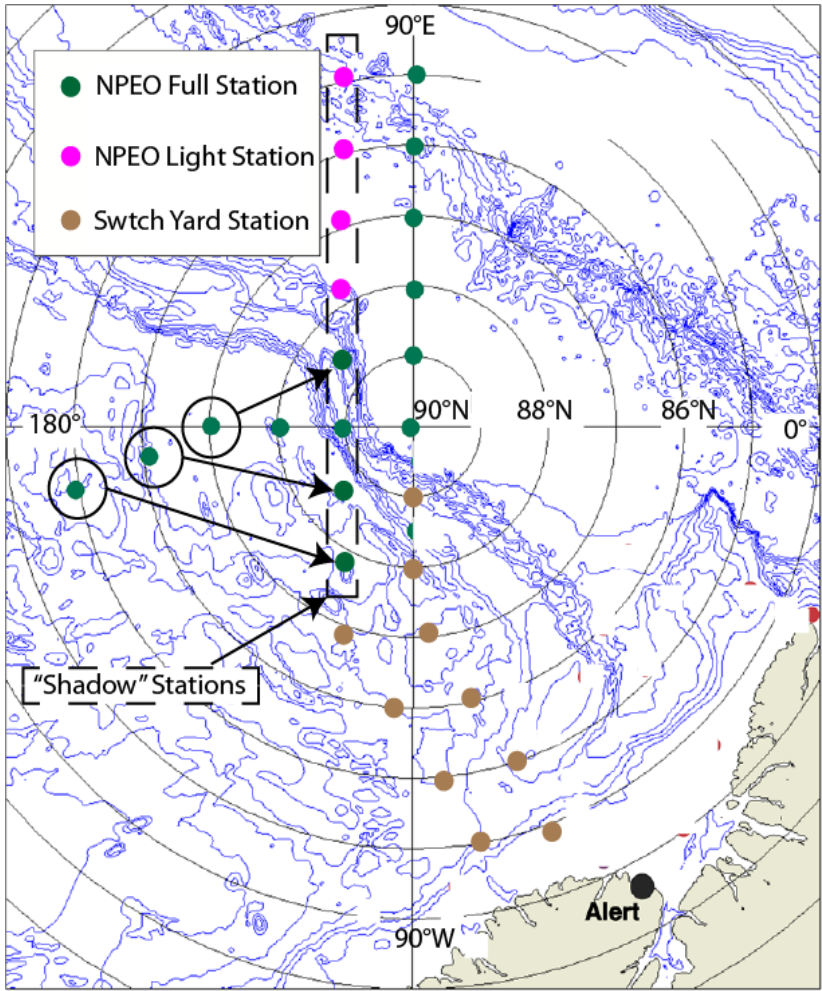




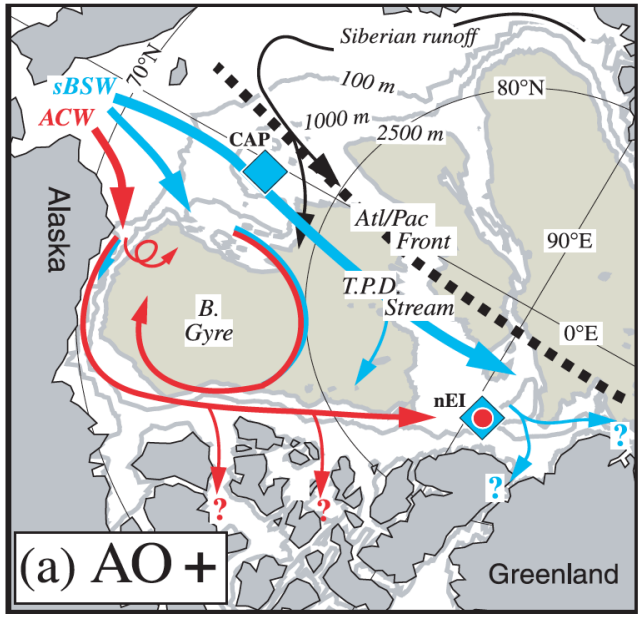


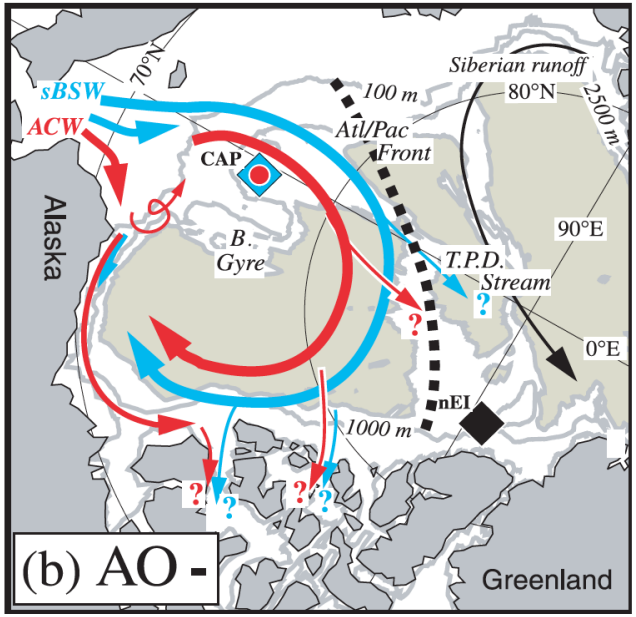
Long-term decline in meteoric water nearly balanced by increase in sea-ice meltwater





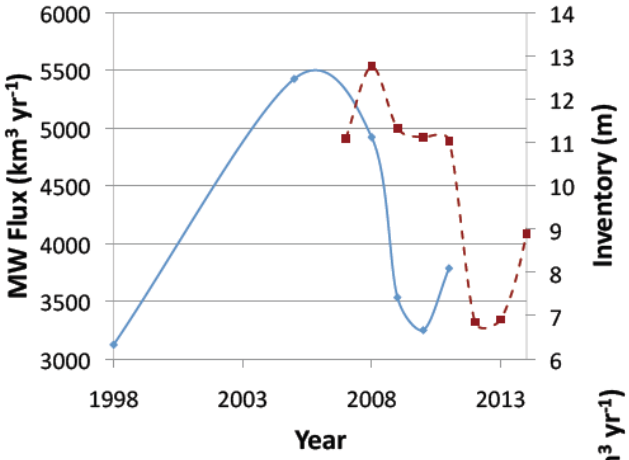
A focus on estimating the fluxes of freshwater and its components associated with the Transpolar Drift will allow for a more quantitative comparison with Fram Strait





Do the Fram Strait and NPEO time series agree?

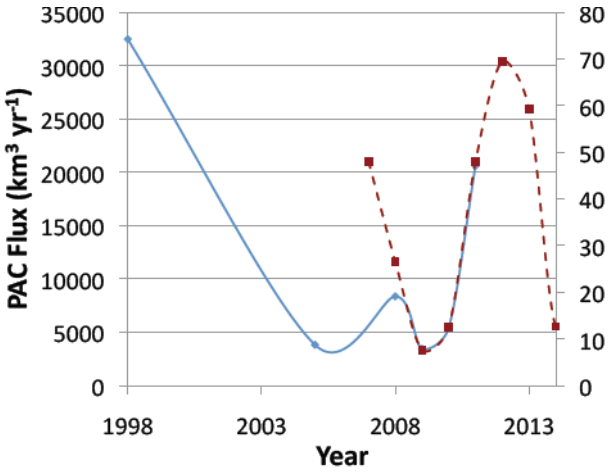
If not, why not?

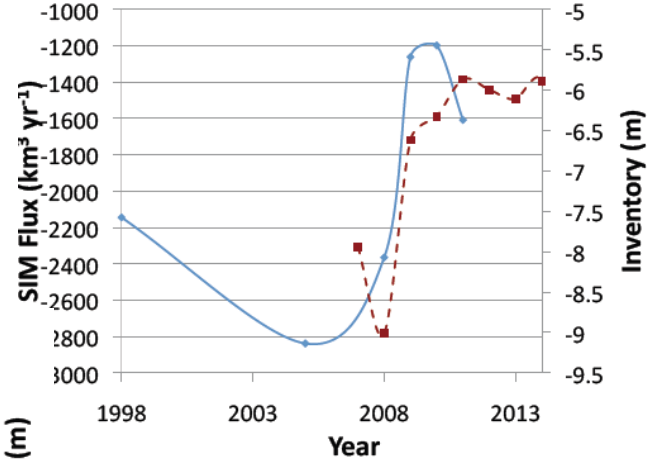


North Pole inventories

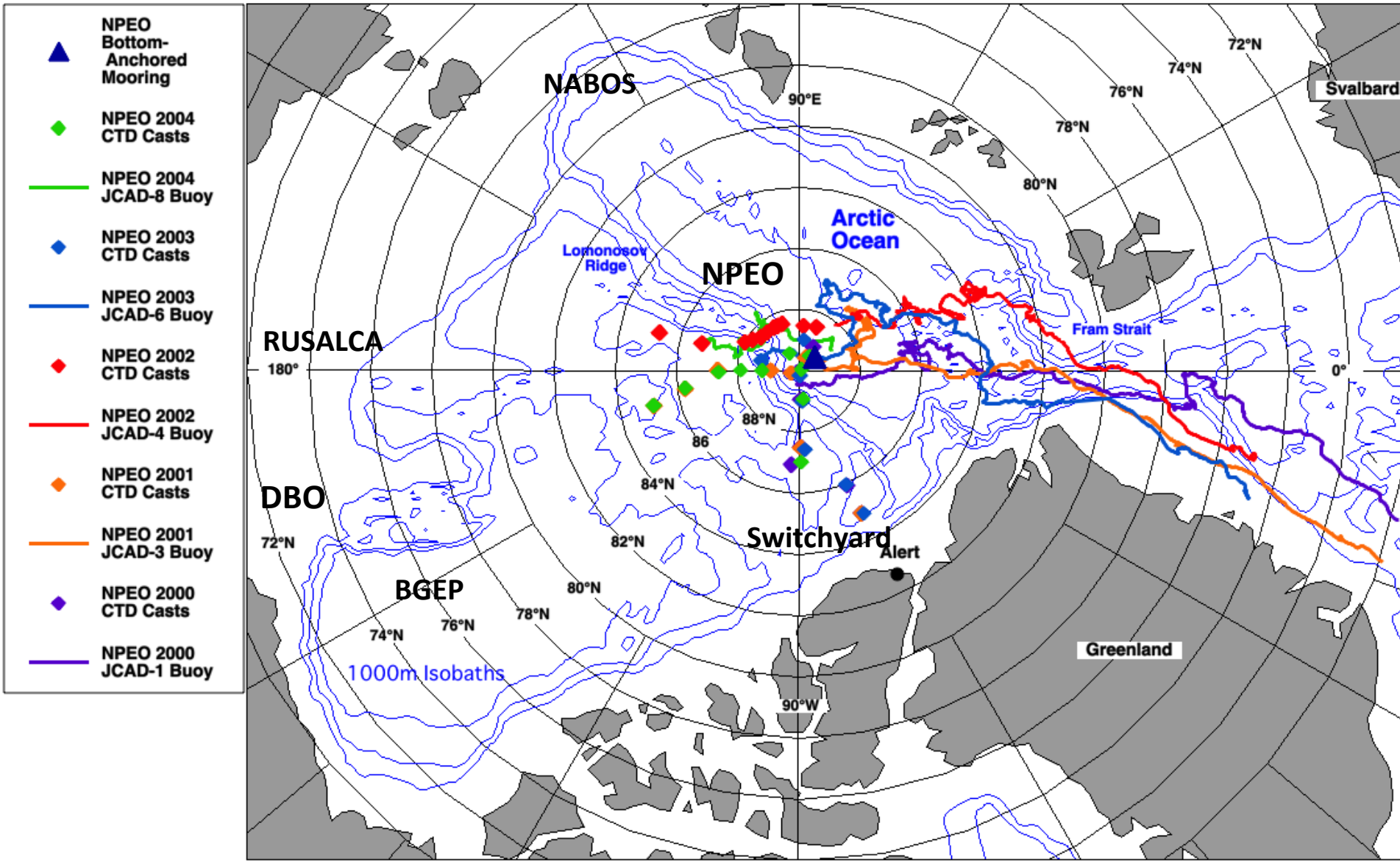
vs.

Fram Strait fluxes (Rabe et al., 2013)





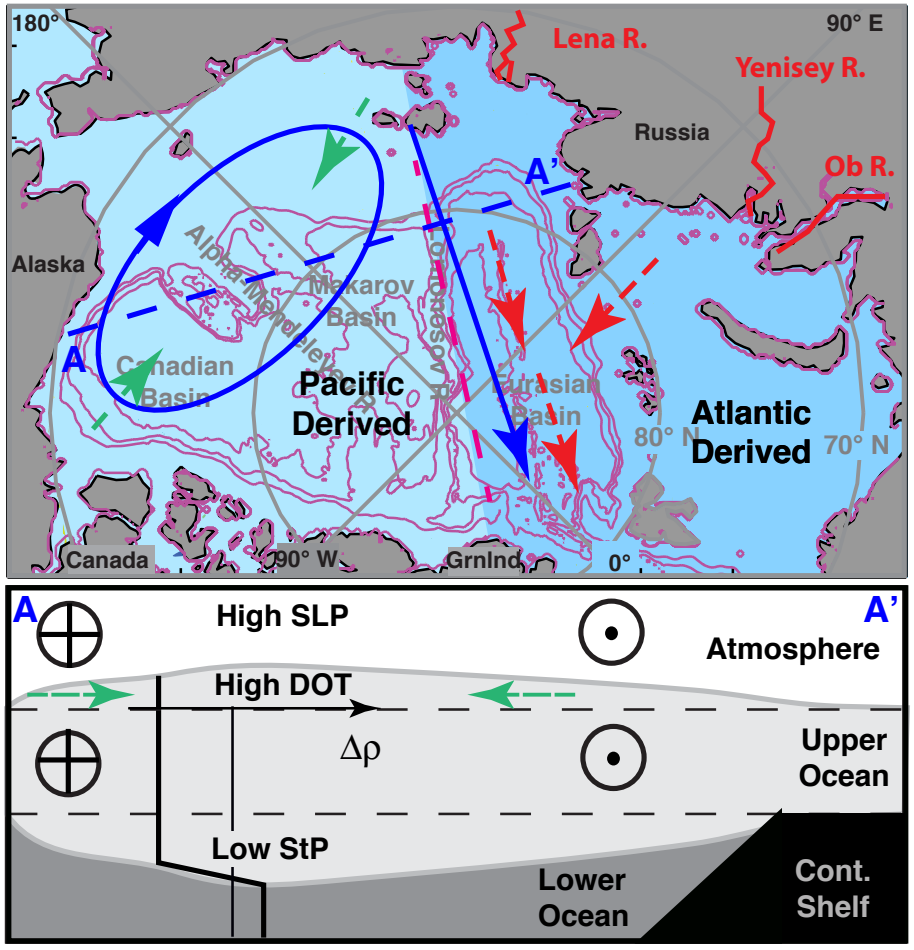
Steele et al. (2004);
Alkire et al. (2014)

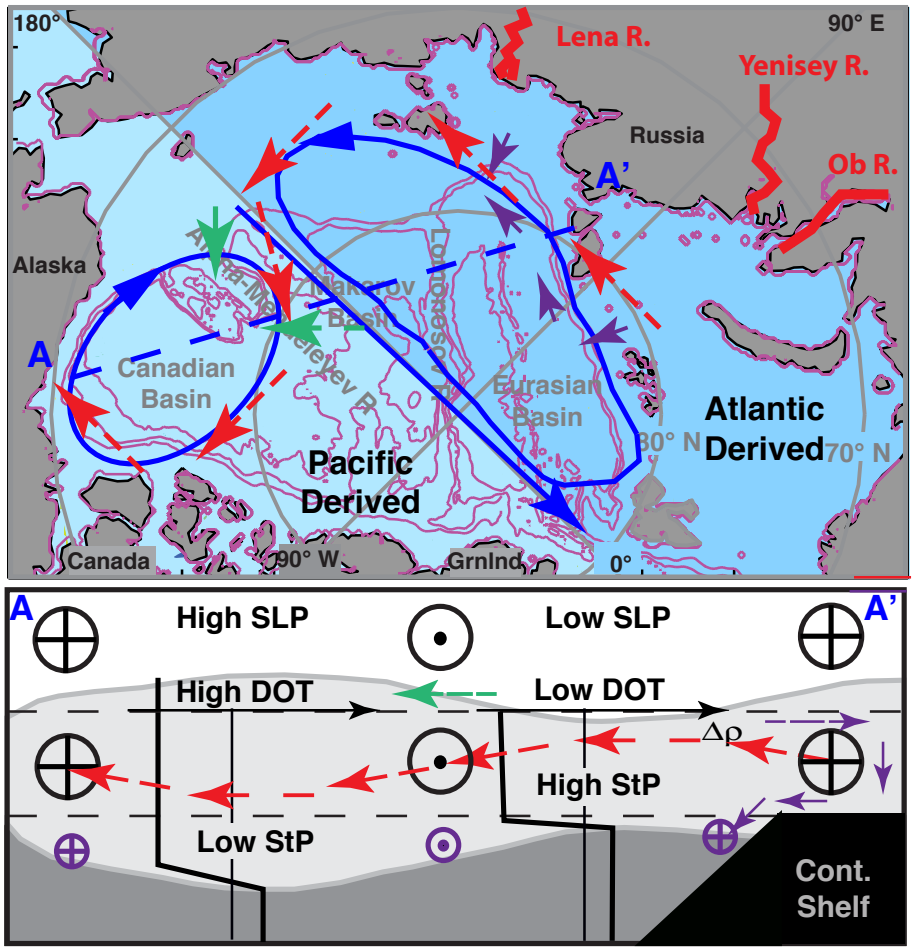

NPEO Bottom-Anchored Mooring
NPEO 2004 CTD Casts
NPEO 2004 JCAD-8 Buoy
NPEO 2003 CTD Casts
NPEO 2003 JCAD-6 Buoy
NPEO 2002 CTD Casts
NPEO 2002 JCAD-4 Buoy
NPEO 2001 CTD Casts
NPEO 2001 JCAD-3 Buoy
NPEO 2000 CTD Casts
NPEO 2000 JCAD-1 Buoy
NABOS
RUSALCA
DBO
BGEP
NPEO
Arctic Ocean
Lomonosov Ridge
Fram Strait
Switchyard
Alert
Greenland
Svalbard
1000m Isobaths
90°E
180°
0°
90°W
72°N
74°N
76°N
78°N
80°N
82°N
84°N
86
88°N

SUMMARY

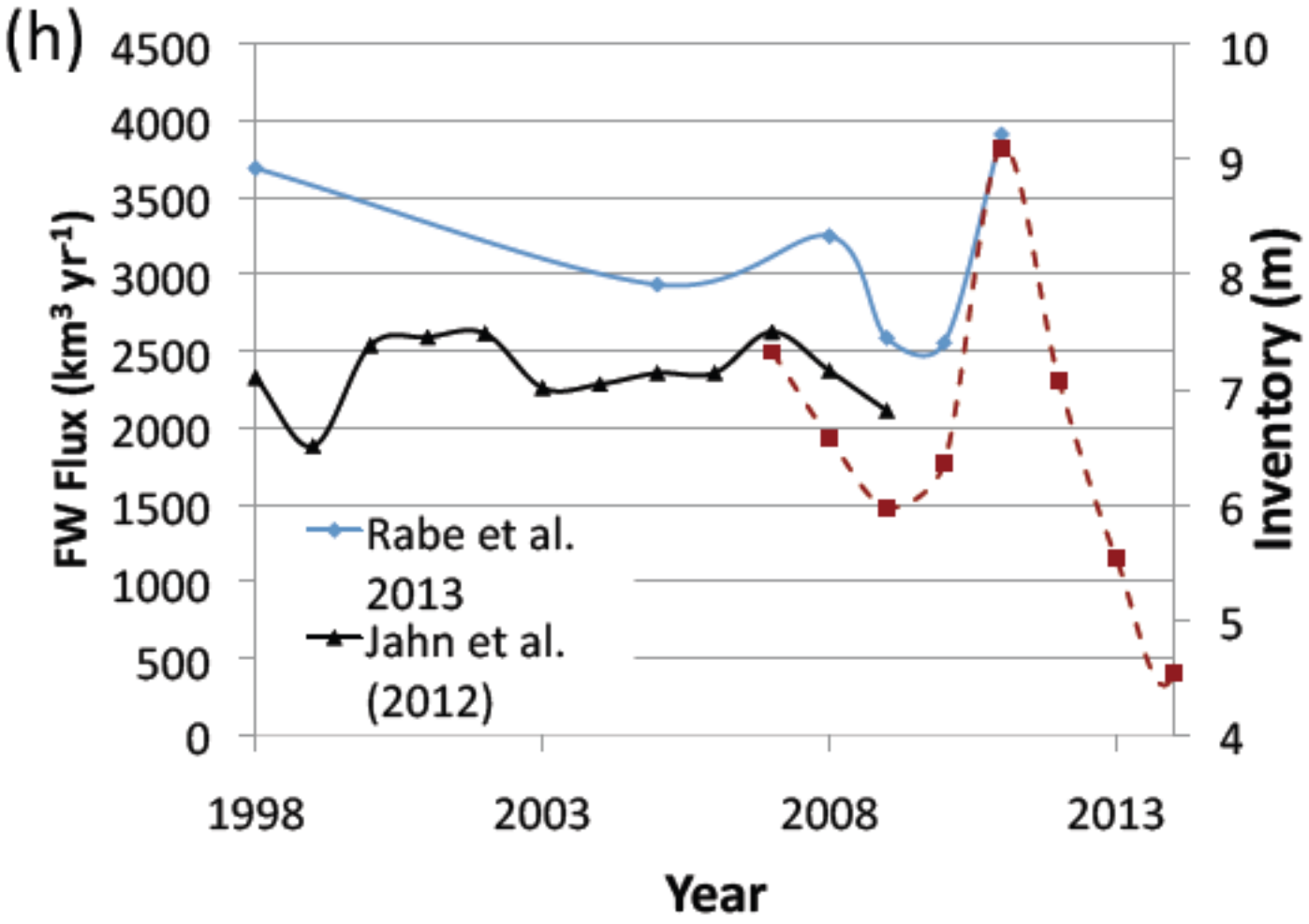
- Taken together, AON programs have the ability to yield pan-Arctic understanding of ongoing change
- As one of these programs, NPEO has provided key data from the Central Arctic
- Moving forward, we hope to continue NPEO by expanding carbon measurements and shifting focus to better quantify freshwater fluxes associated with the Transpolar Drift

INDEX





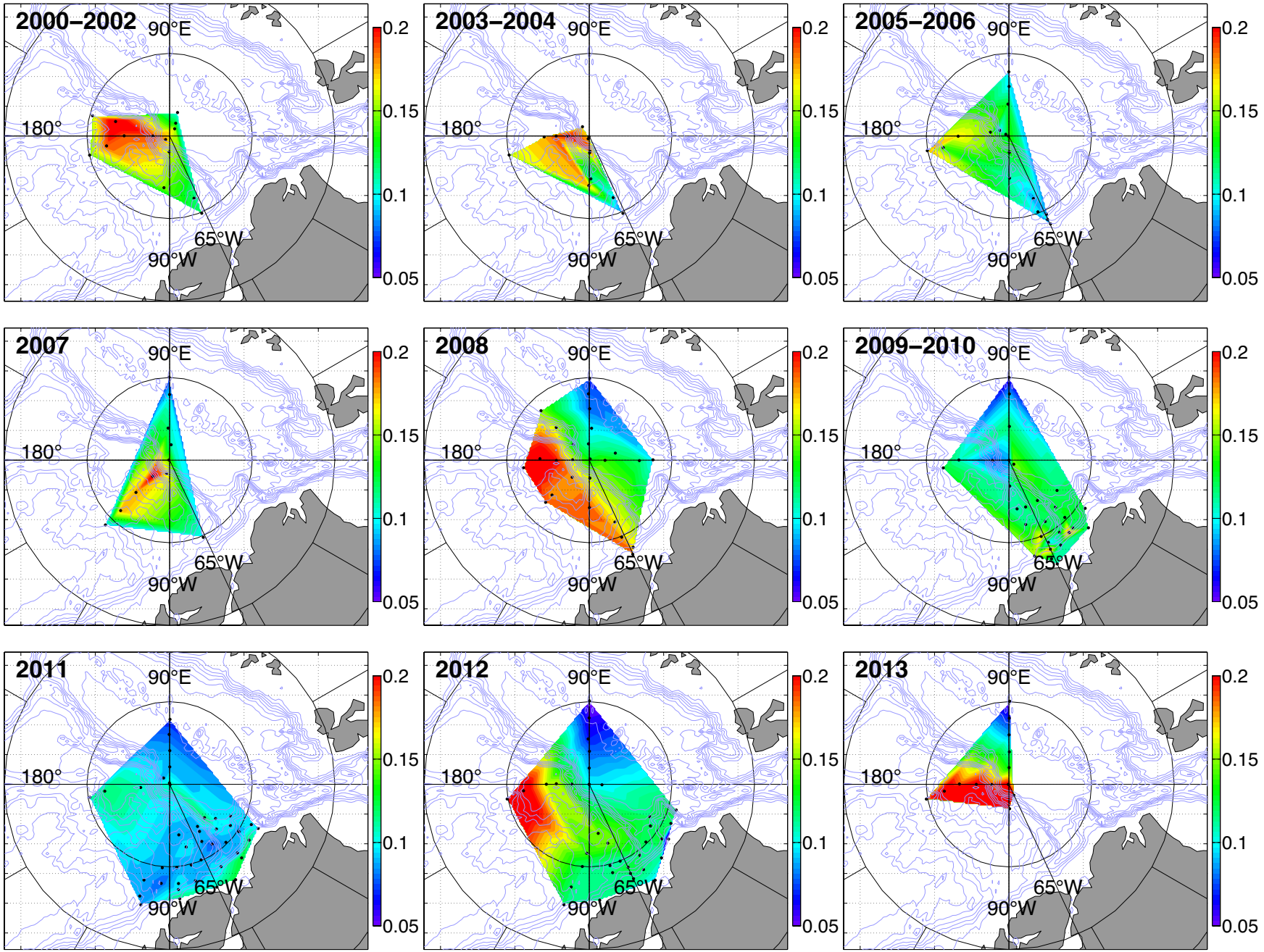
Morison et al. (2012)



North Pole inventories vs. fluxes reported in Rabe et al. (2013) & Jahn et al. (2012)
The inventories were advanced by 2 years for maximum correlations with Fram Strait fluxes

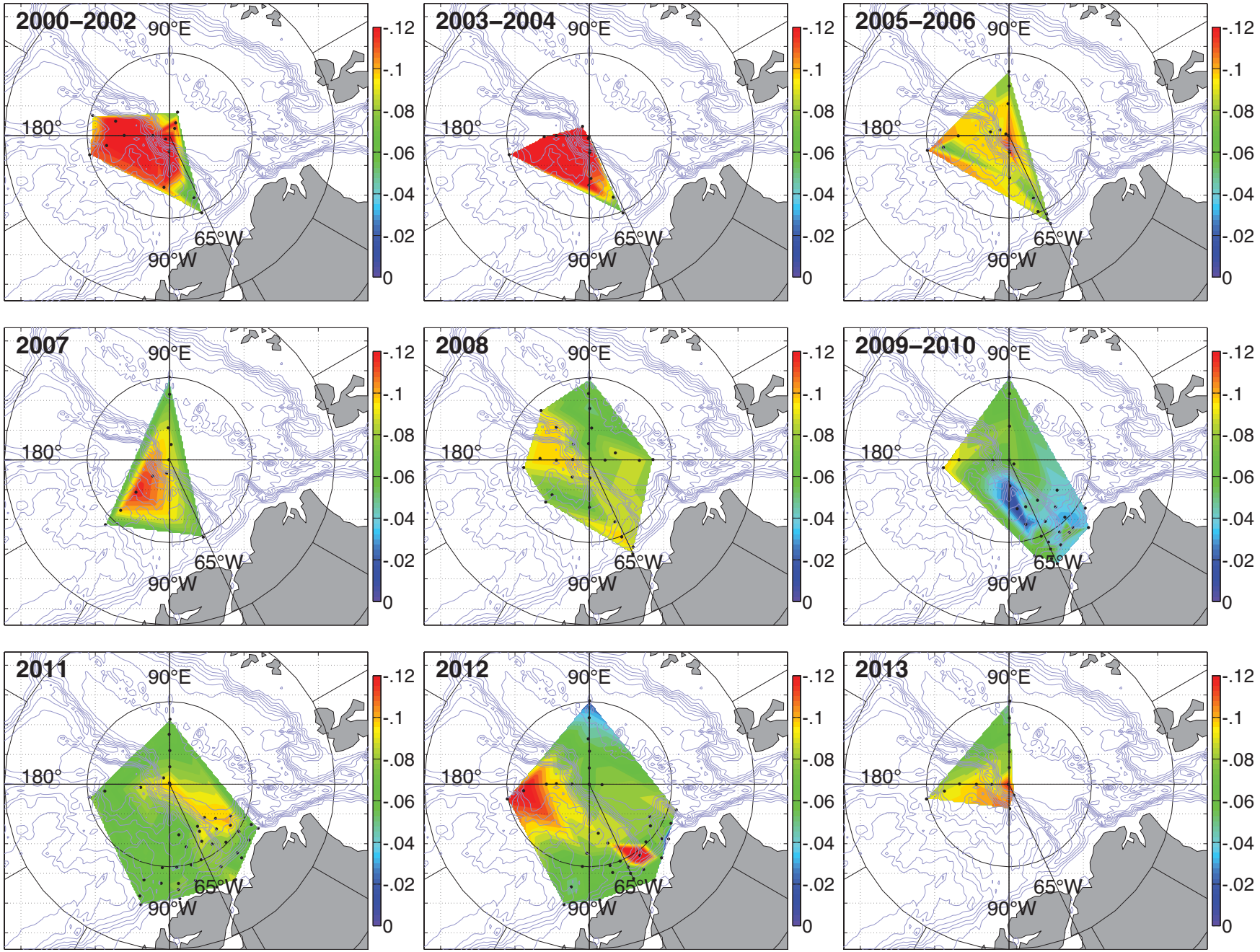
Meteoric Water Fraction at 20m

NPEO-Switchyard 2000-2013



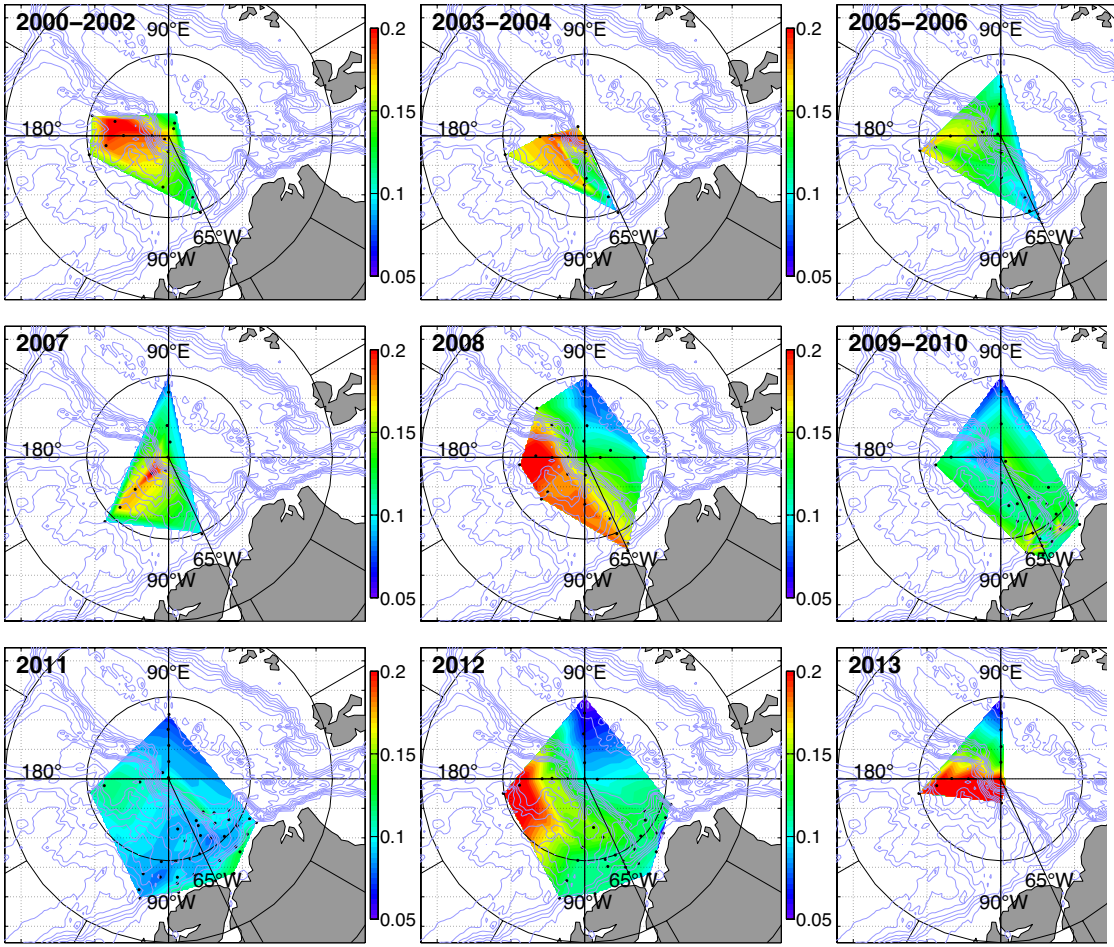
Net Sea-Ice Meltwater Fraction at 20m

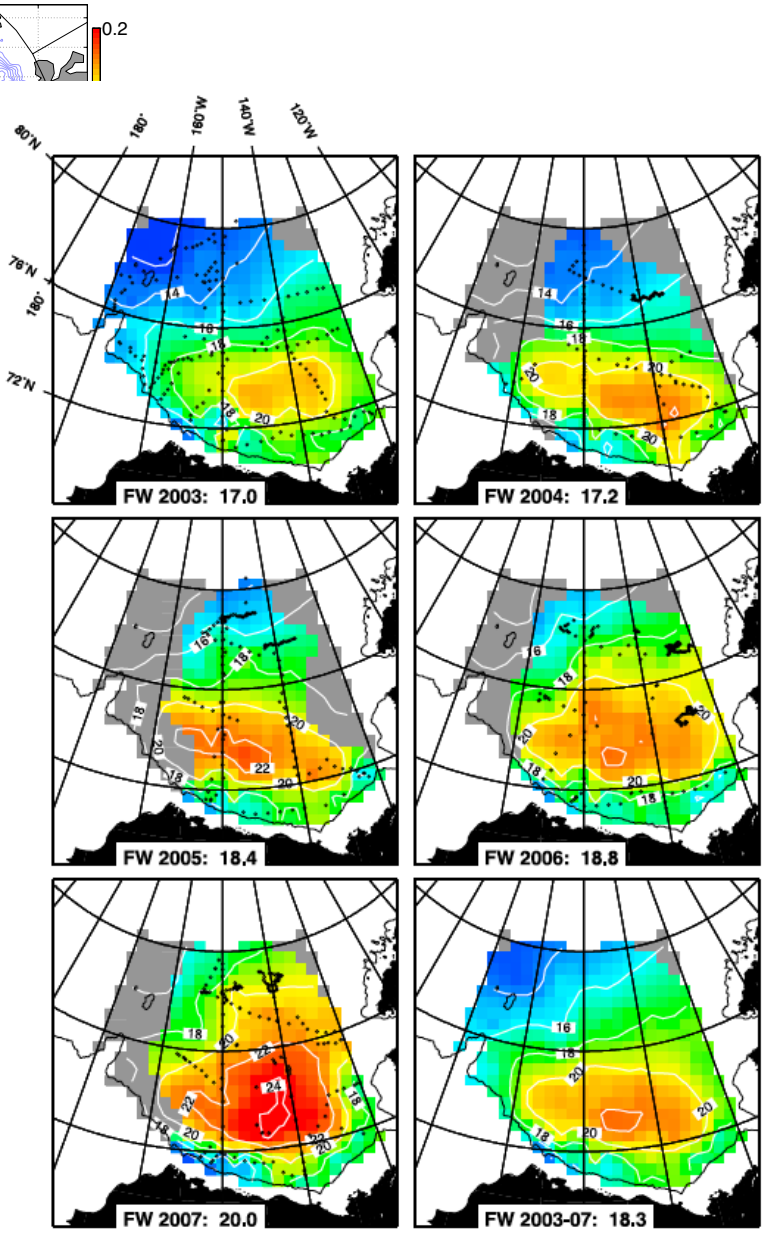
NPEO-Switchyard 2000-2013



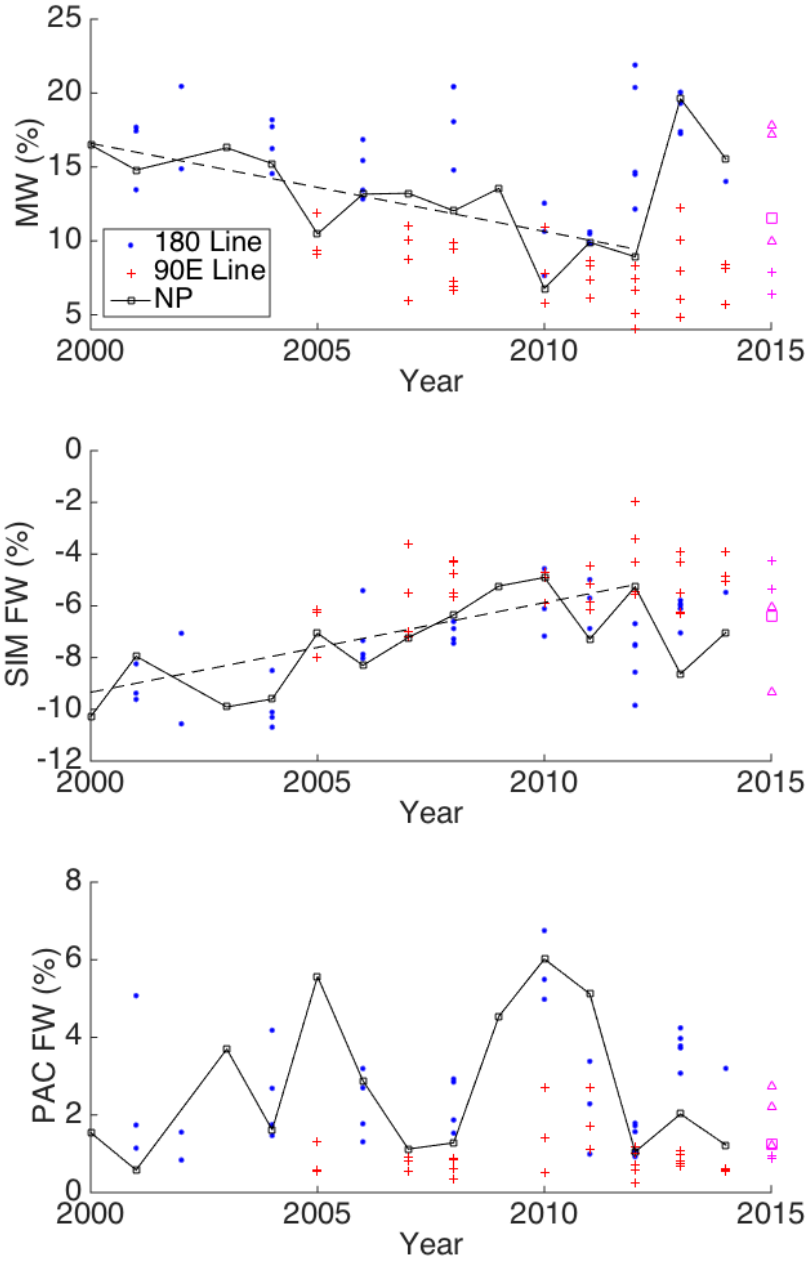
Meteoric Water Fraction at 20m

NPEO-Switchyard 2000-2013



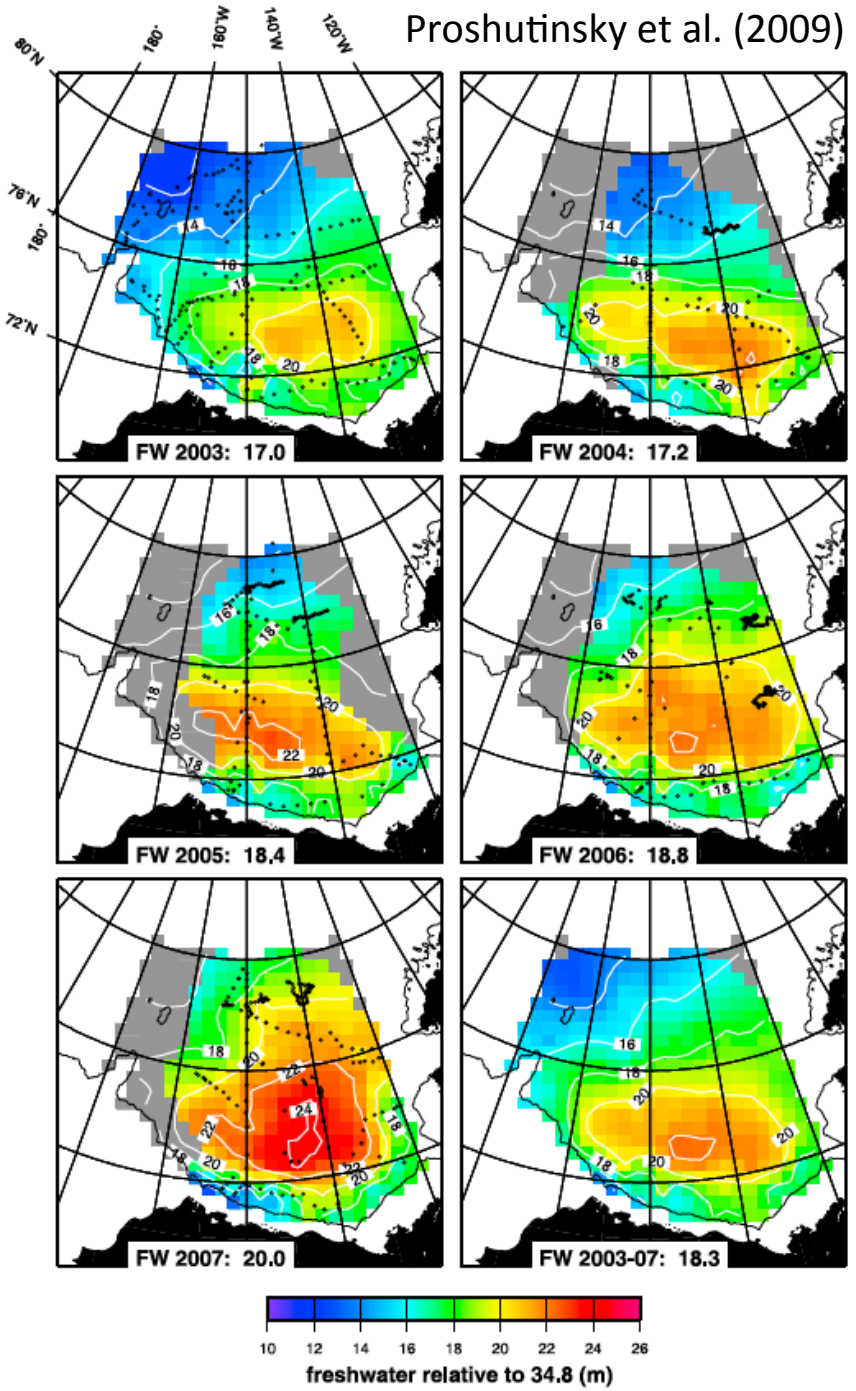


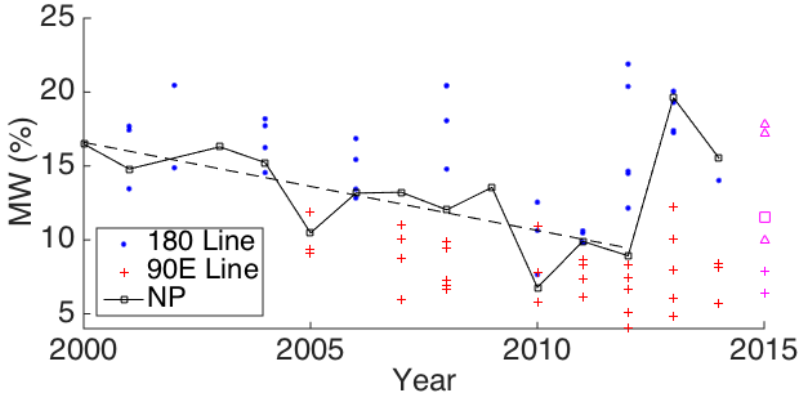
Alkire et al. (2015); Proshutinsky et al. (2009)

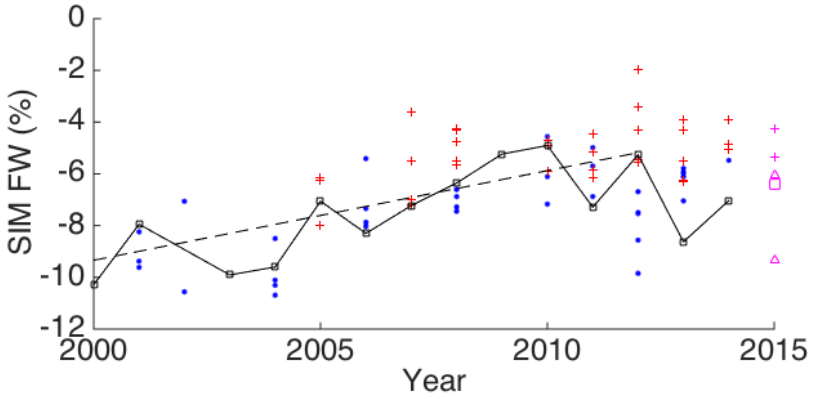


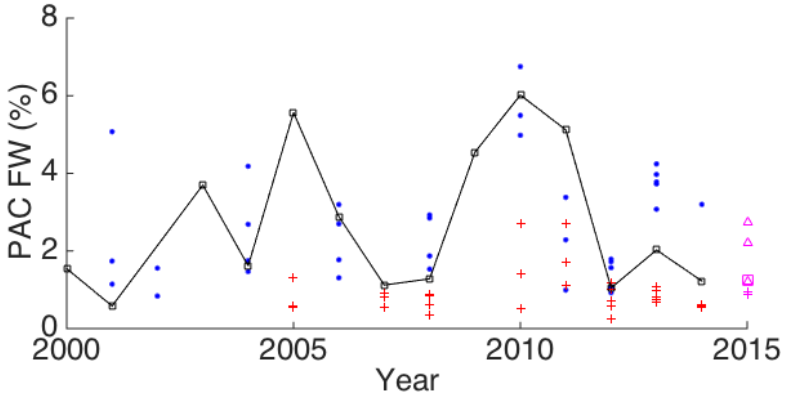
Alkire et al. (2015)

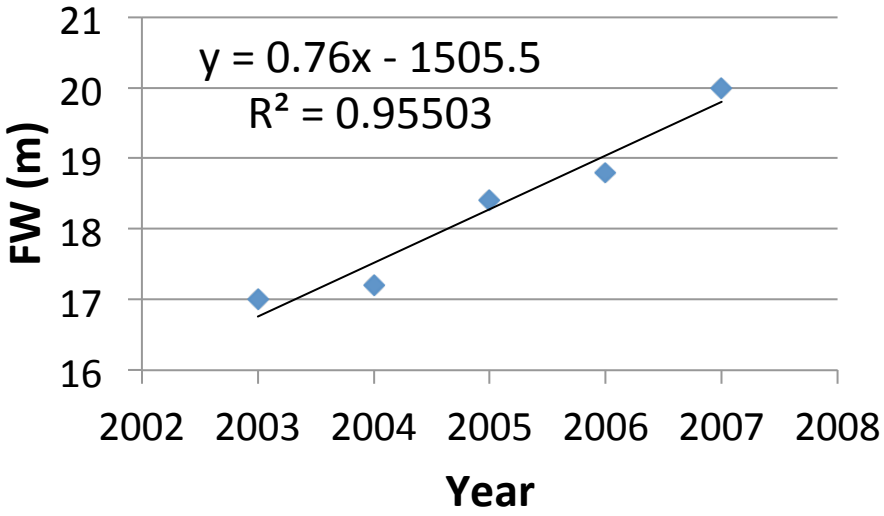
Proshutinsky et al. (2009)





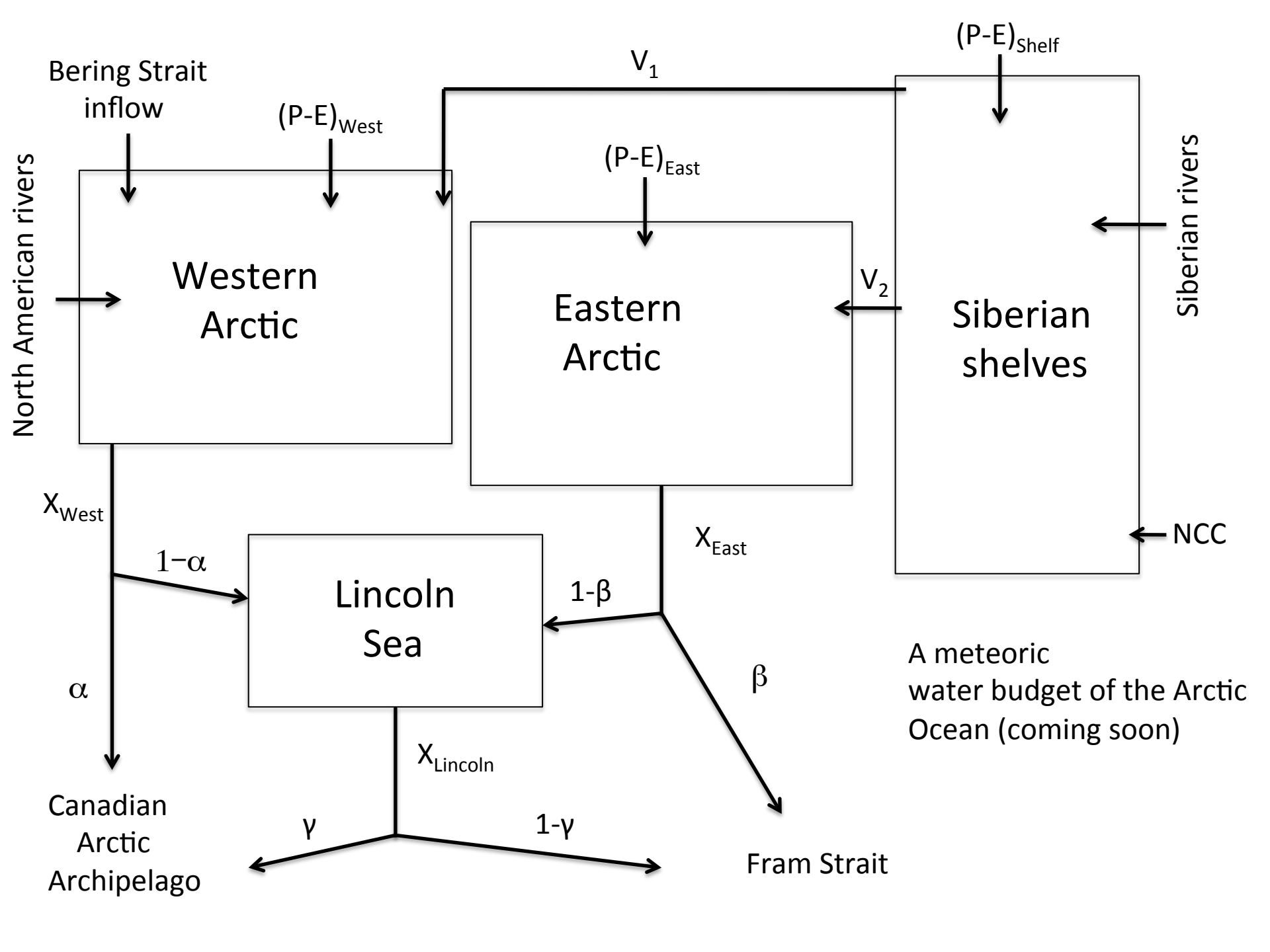






While freshwater in Canada Basin increased meteoric water in the Central Arctic decreased

Alkire et al. (2015); Proshutinsky et al. (2009)


Bering Strait inflow
(P-E)West
V1
(P-E)Shelf
North American rivers
(P-E)East
Siberian rivers
Western Arctic
Eastern Arctic
V2
Siberian shelves
XWest
XEast
NCC
1−α
1-β
Lincoln Sea
α
β
A meteoric water budget of the Arctic Ocean (coming soon)
XLincoln
Canadian Arctic Archipelago
γ
1-γ
Fram Strait