

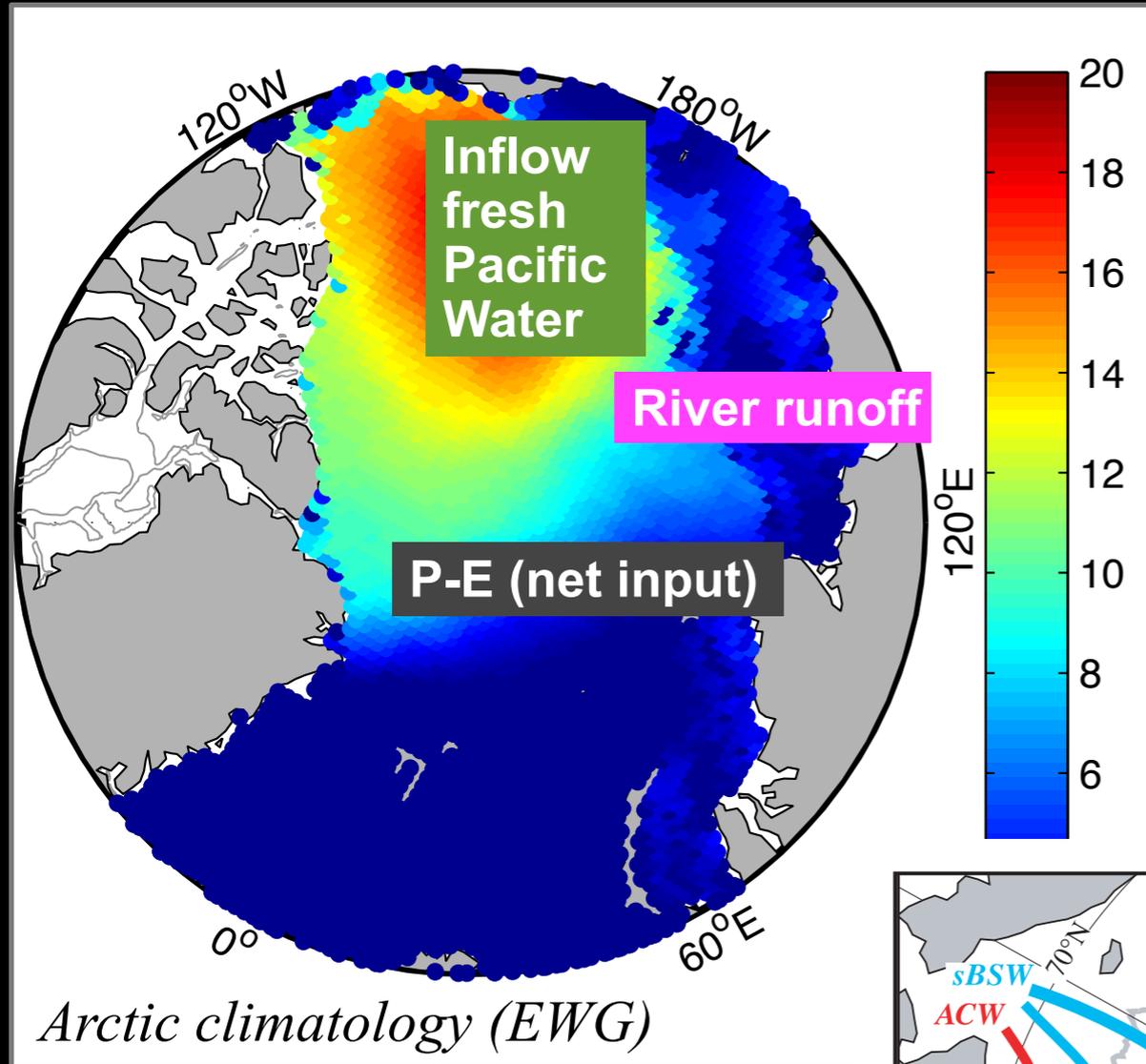
Recent changes in the freshwater composition east of Greenland



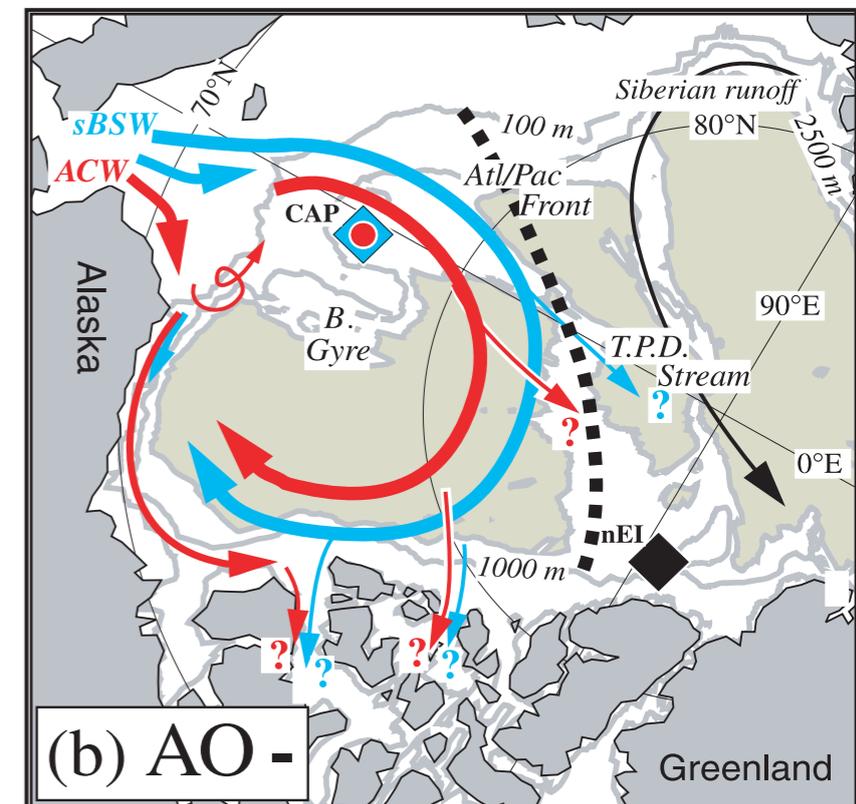
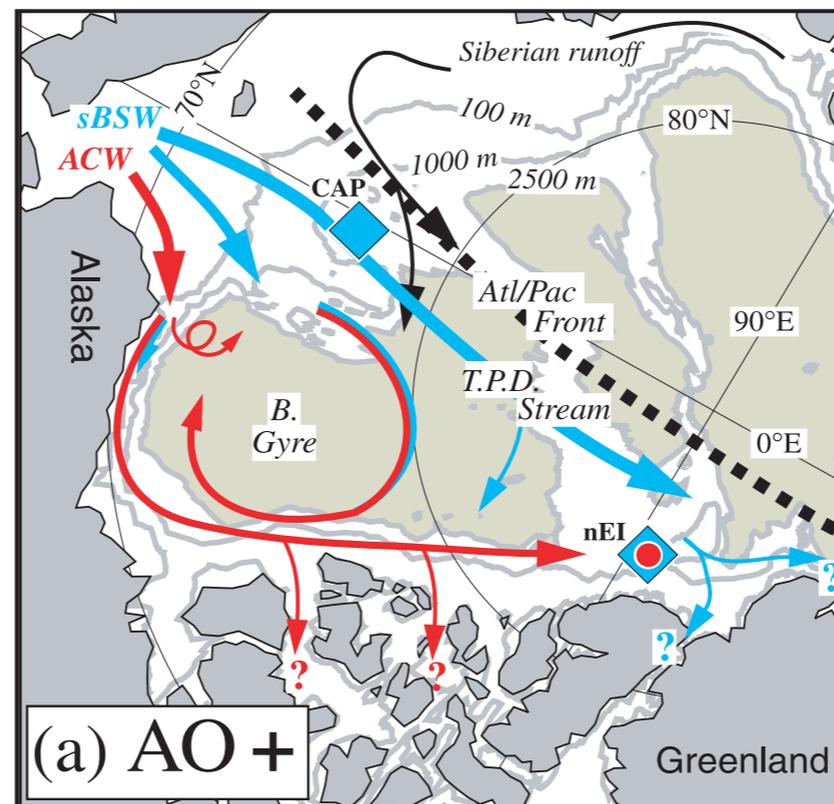
Laura de Steur (NPI/NIOZ) - ASOF meeting 16-17 March 2015

De Steur, Pickart, Torres, and Valdimarsson, accepted in GRL March 2015

Pacific Water in the Arctic



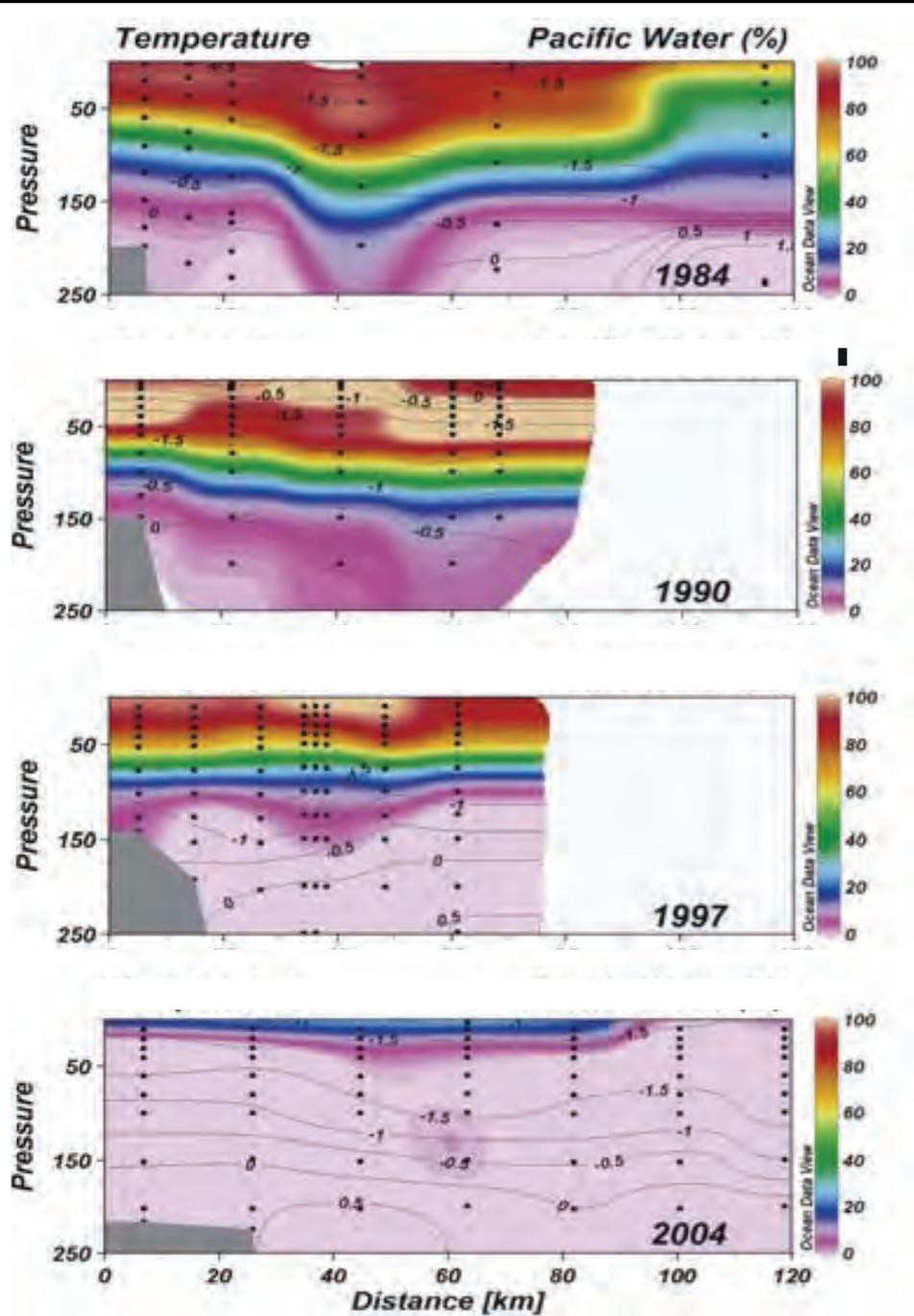
- ★ Significant contribution to halocline and freshwater content in CB
- ★ Nutrient rich
- ★ Short circuit from Pacific to Atlantic
- ★ Front varies between Lomonosov and Mendeyelev Ridge



Steele et al., 2004

Pacific Water in the East Greenland Current

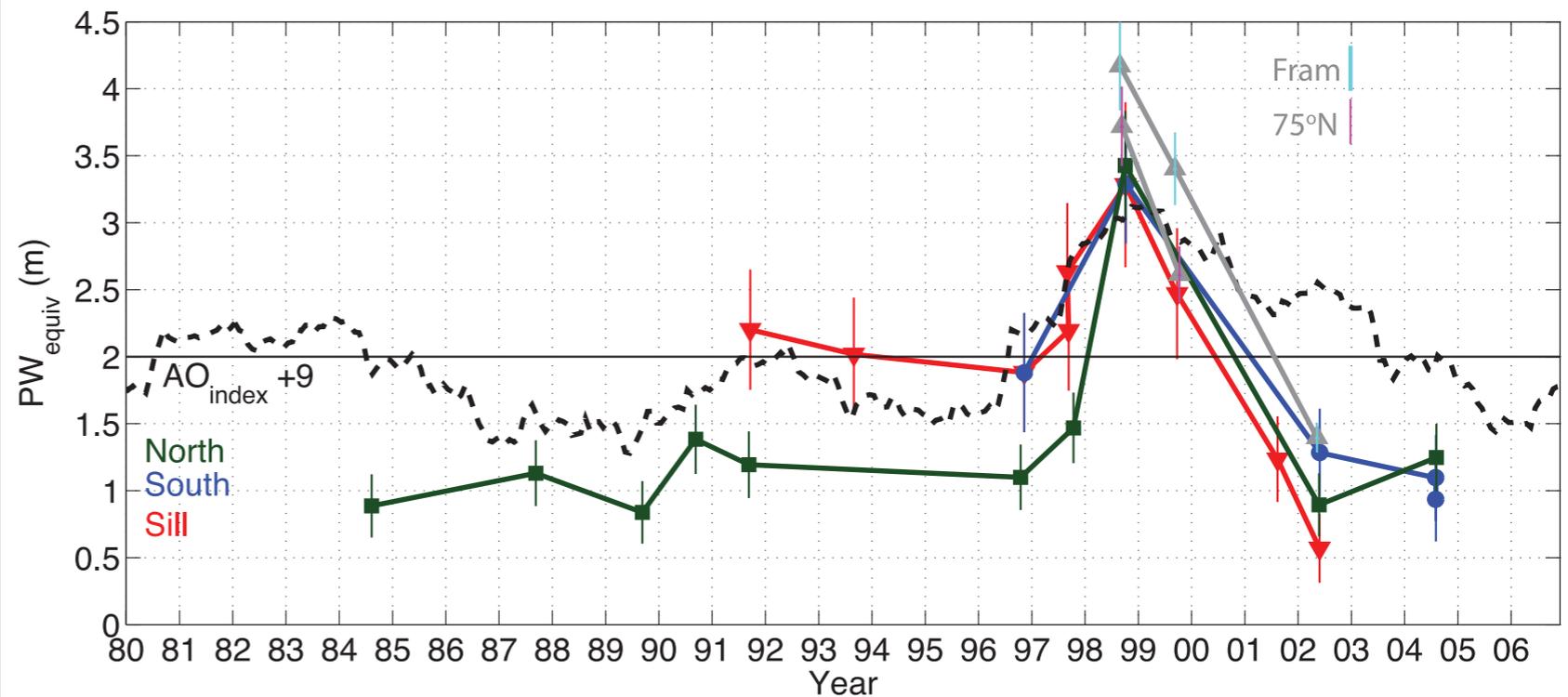
Fram Strait



Falck et al. (2005)

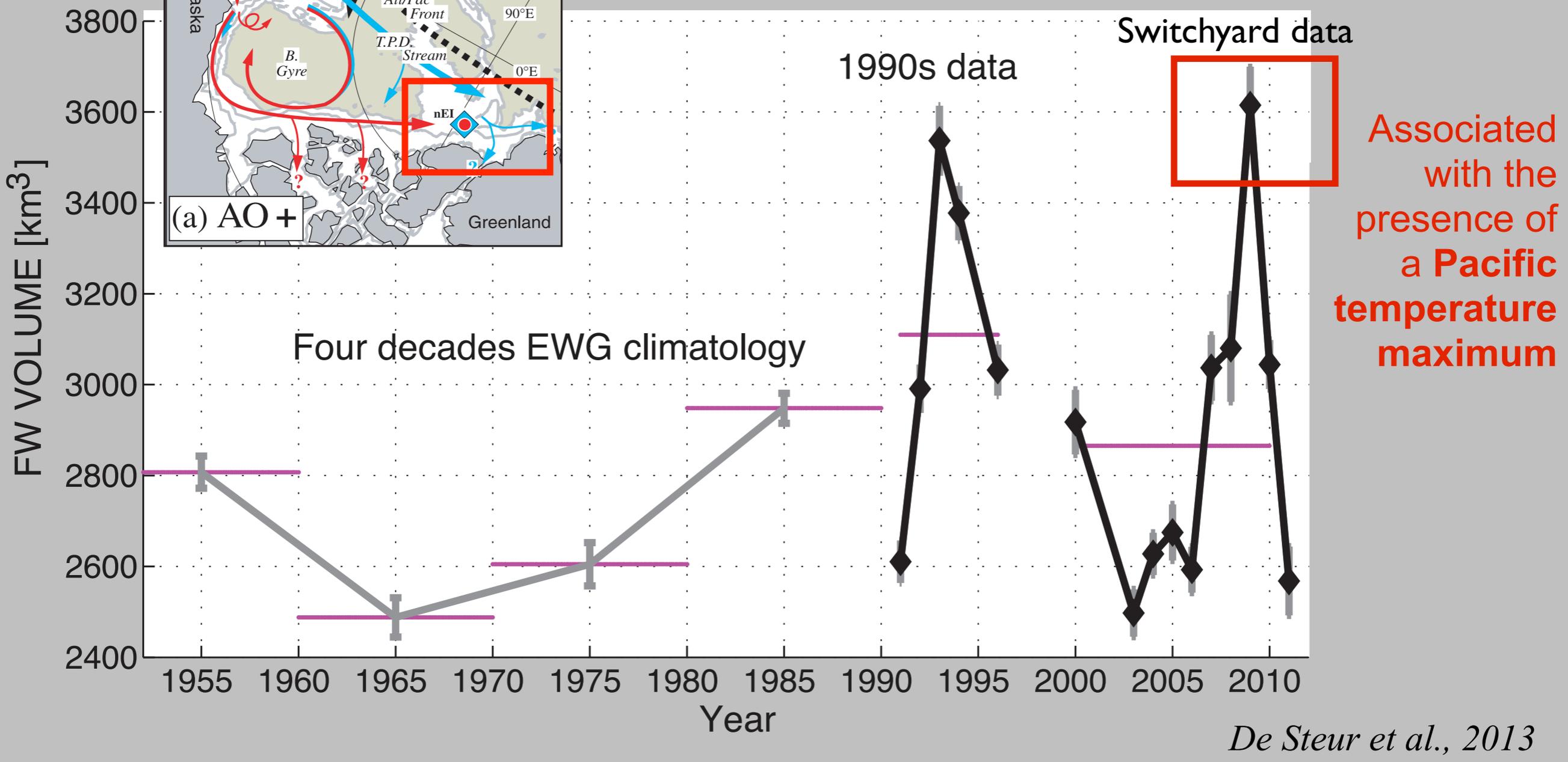
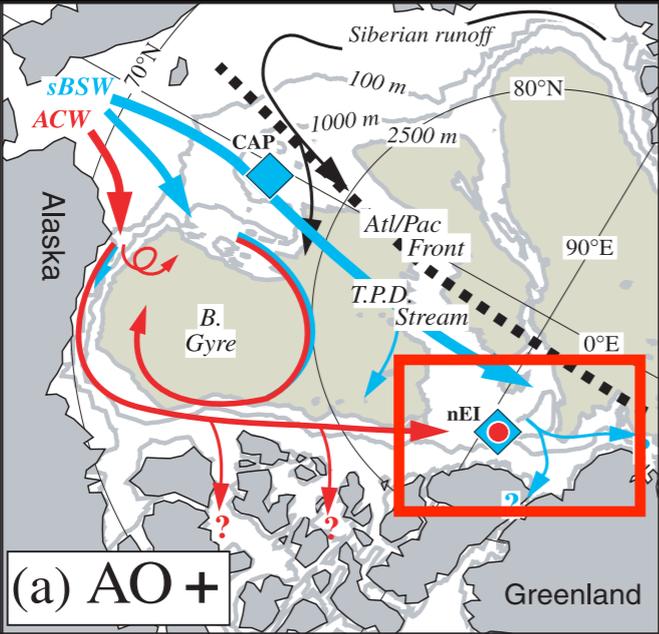
- ★ Intermittent presence: observed in 1980s and 1990s, absent since 1998
- ★ First seen again in Fram Strait 2011

Denmark Strait



Sutherland et al. (2009)

FW content in the Lincoln Sea (north of Greenland)

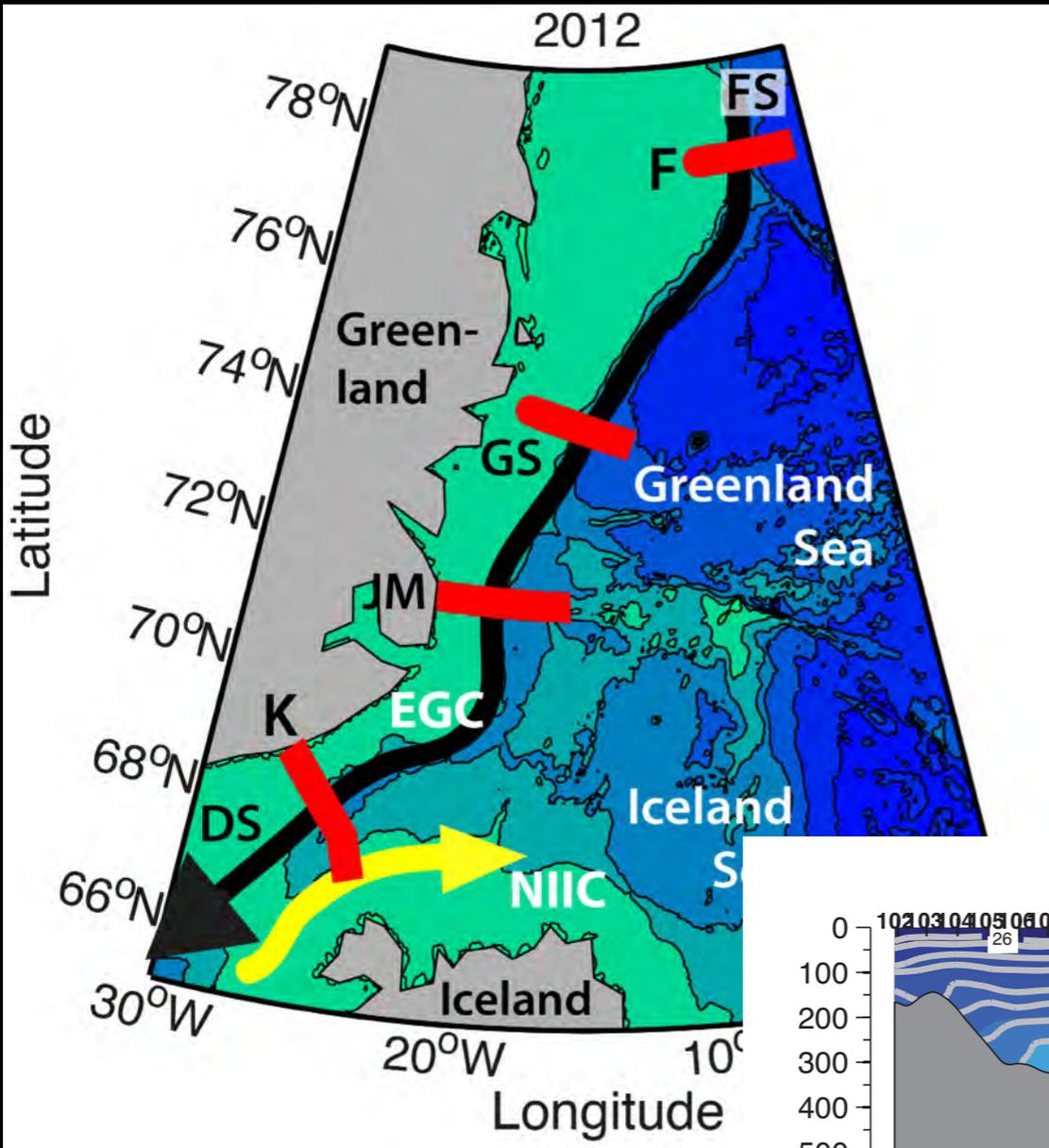


FW volume anomaly of ~1100 km³: all released by 2011

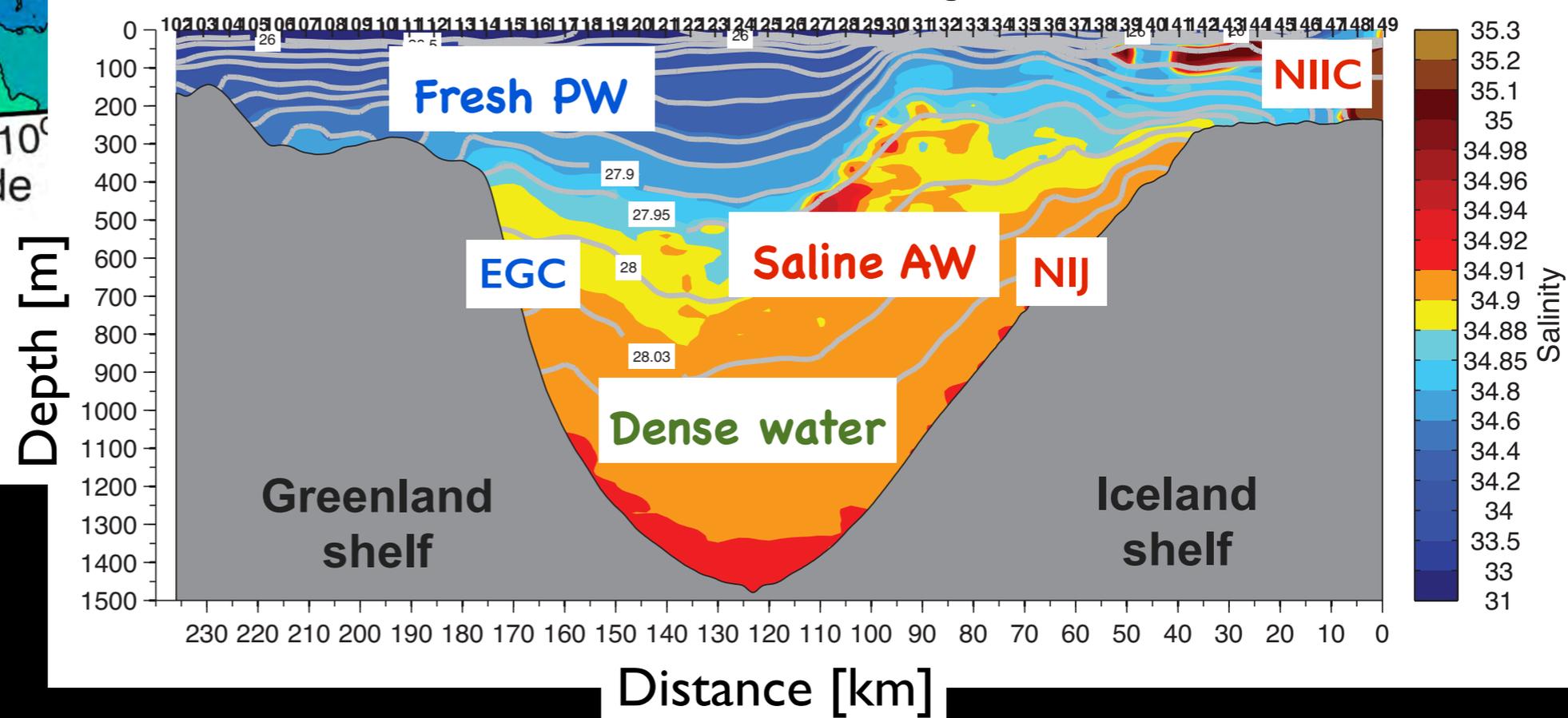
De Steur et al., 2013

Data and methods

- 4 sections across the EGC in 2012
- Kögur section in 2011, 2012, 2013
 - CTD + LADCP data
 - Tracer data: $\delta^{18}O$, nitrate, phosphate @ 5, 20, 50, 75, 100, 150, 200, 300 m



Salinity at the Kögur line



4 sections in 2012:

K = Kögur

JM = Jan Mayen

GS = Greenland Sea

F = Fram Strait

Determine the *fractions* of Pacific Water (PW), Sea-Ice Melt (SIM) and Meteoric Water (MW) to FW:

$$f_{PW} = (PO_4^M - PO_4^{AW}) / (PO_4^{PW} - PO_4^{AW})$$

$$f_{AW} + f_{SIM} + f_{MW} = 1 - f_{PW}$$

$$O^{18}_{AW} \cdot f_{AW} + O^{18}_{SIM} \cdot f_{SIM} + O^{18}_{MW} \cdot f_{MW} = O^{18}_M - O^{18}_{PW} \cdot f_{PW}$$

$$S_{AW} \cdot f_{AW} + S_{SIM} \cdot f_{SIM} + S_{MW} \cdot f_{MW} = S_M - S_{PW} \cdot f_{PW}$$

Where M = measured. Choices for End-Member Values are:

At and north
of Kögur

| Source | End-member values |
|-----------------|---|
| Atlantic Water: | $S_{AW} = 34.9, O^{18}_{AW} = 0.35\text{‰}$ |
| Pacific Water: | $S_{PW} = 32.0, O^{18}_{PW} = -1.3\text{‰}$ |
| Sea-ice melt: | $S_{SIM} = 4, O^{18}_{SIM} = 0.5\text{‰}$ |
| Meteoric Water: | $S_{MW} = 0, O^{18}_{MW} = -18.4\text{‰}$ |

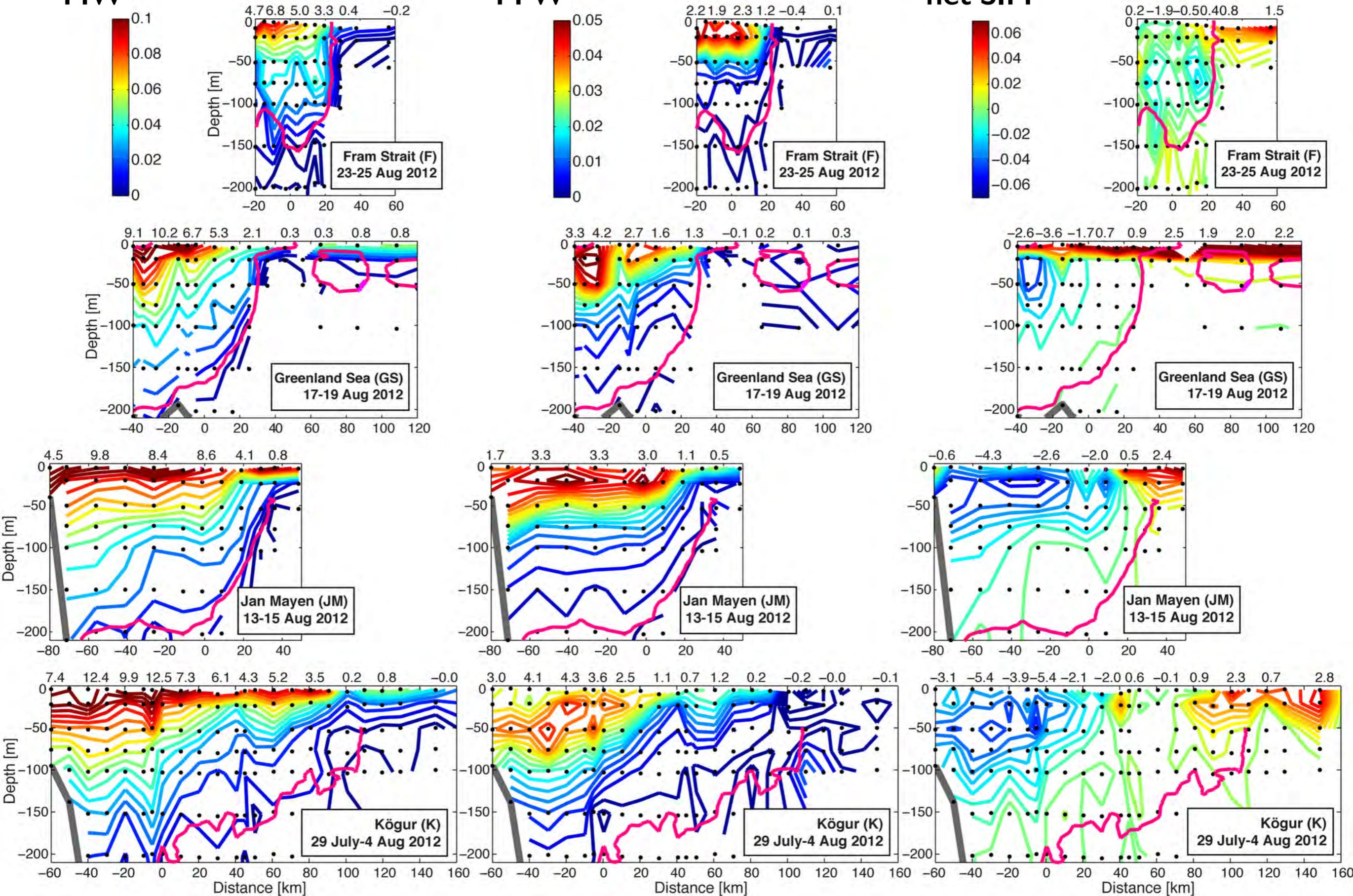
Freshwater fractions 2012

East Greenland Polar Front (EGPF) — 0.5°C isotherm

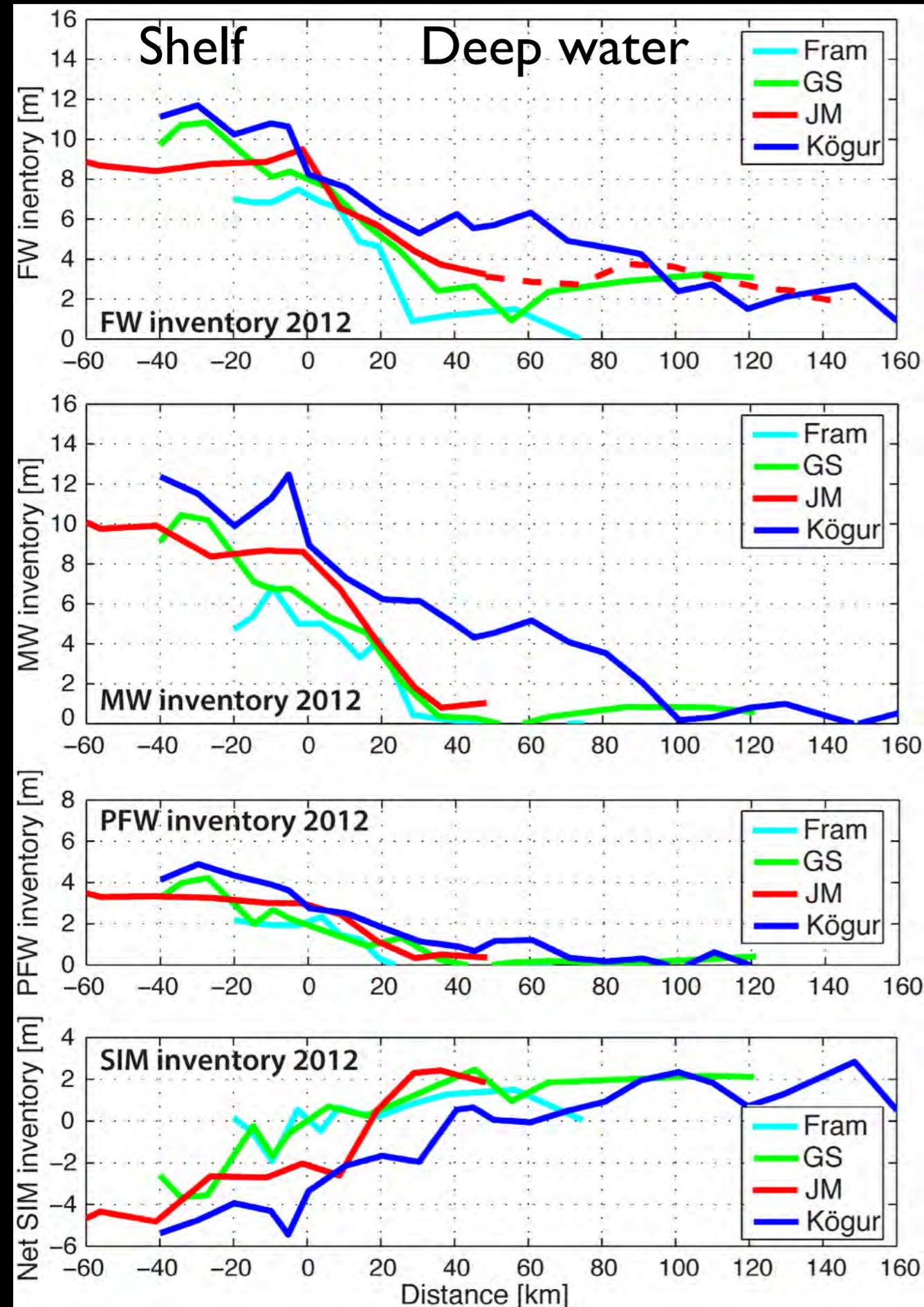
MW

PFW

net SIM



4 sections across the EGC in 2012

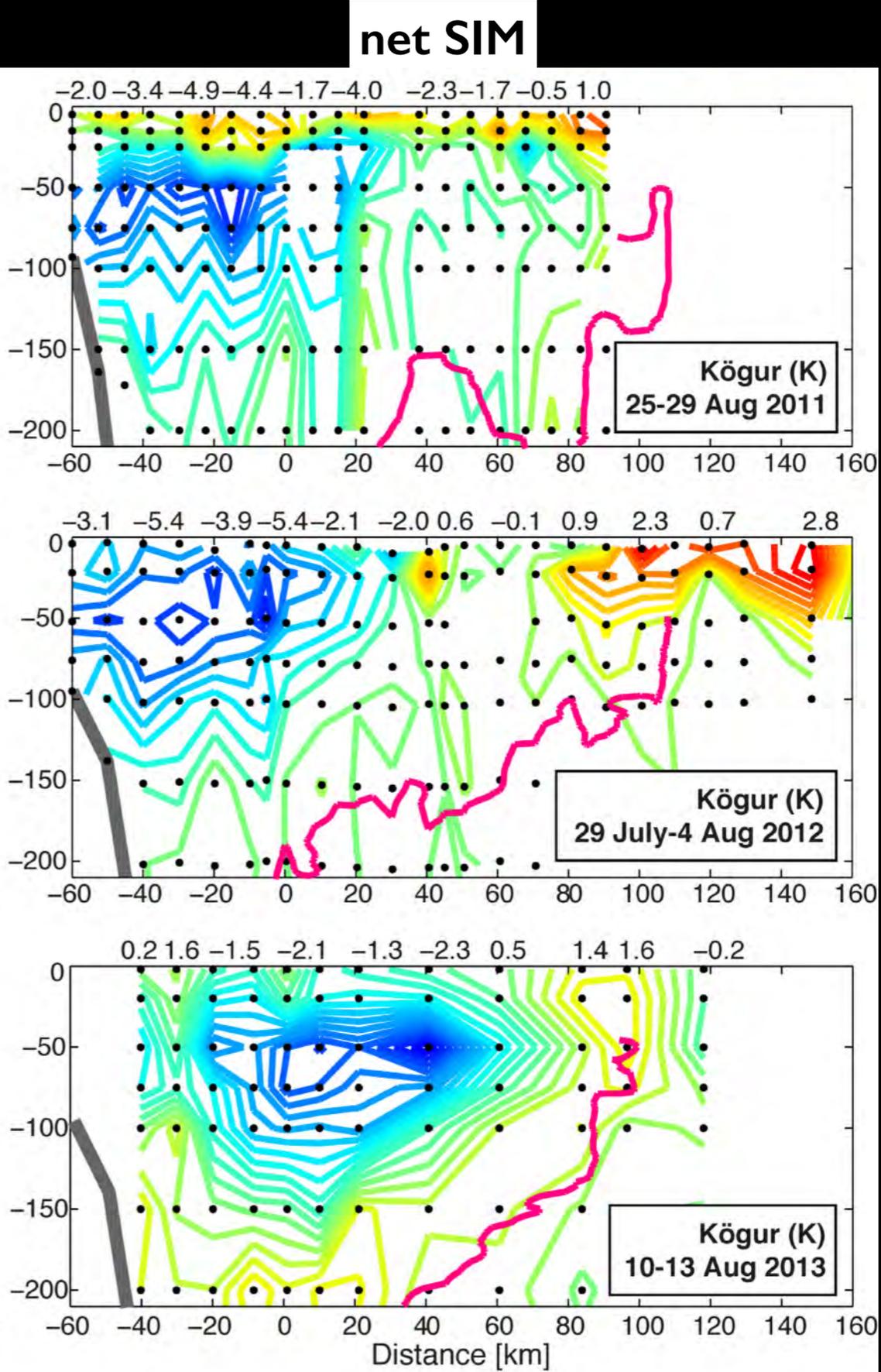
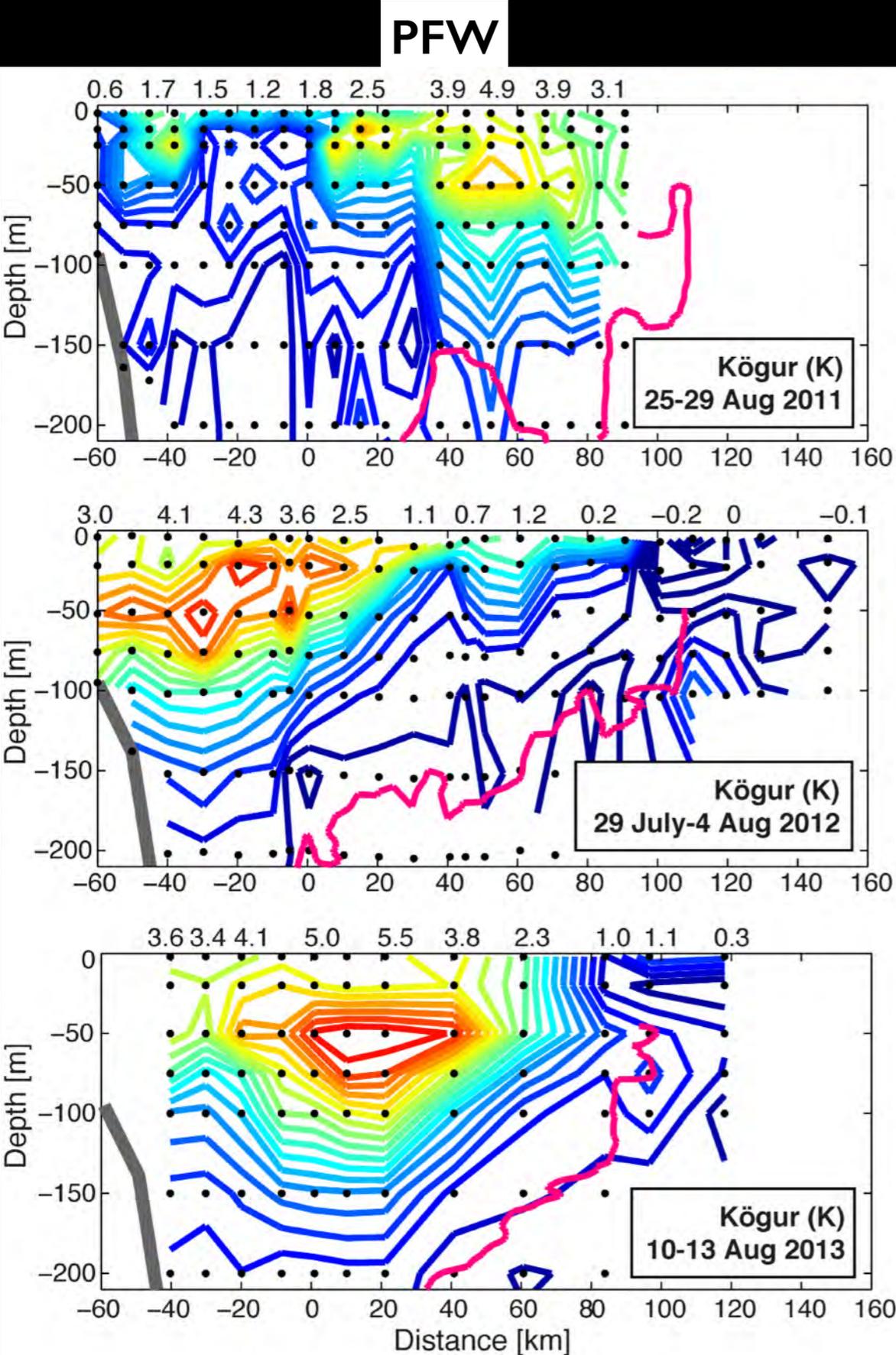


- Largest amount of FW on Kögur
- Largest amount of MW on Kögur, where MW dominates off slope

- Significant amounts of PFW
- PFW present off slope at Kögur

- Negative SIM (brine) on shelf
- Positive SIM east of the EGPF

Freshwater fractions @ Kögur 2011-2013

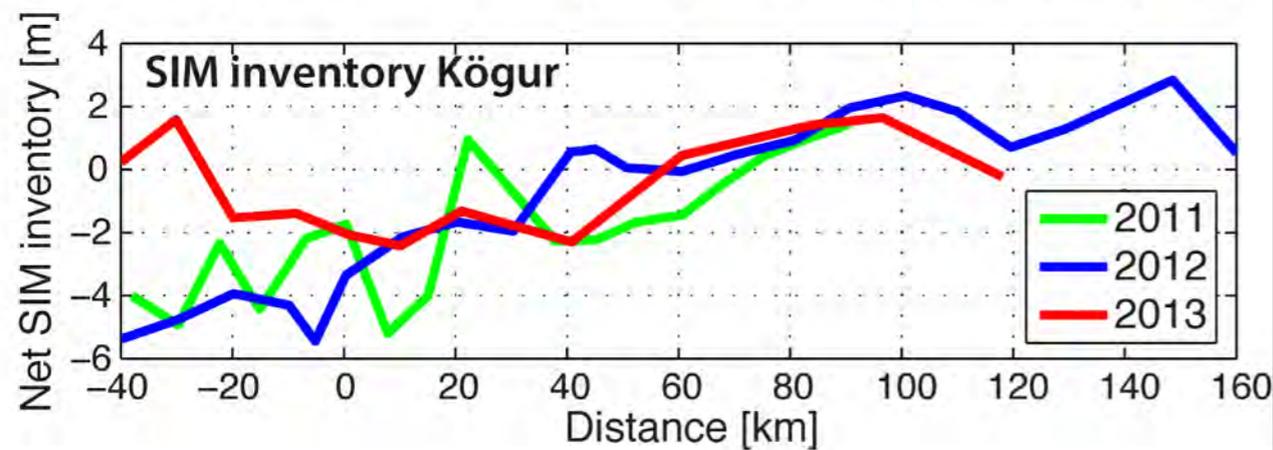
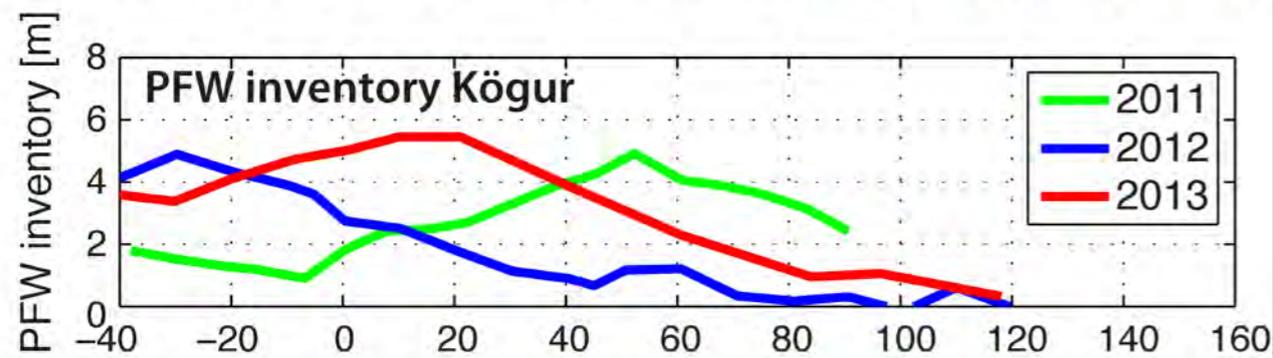
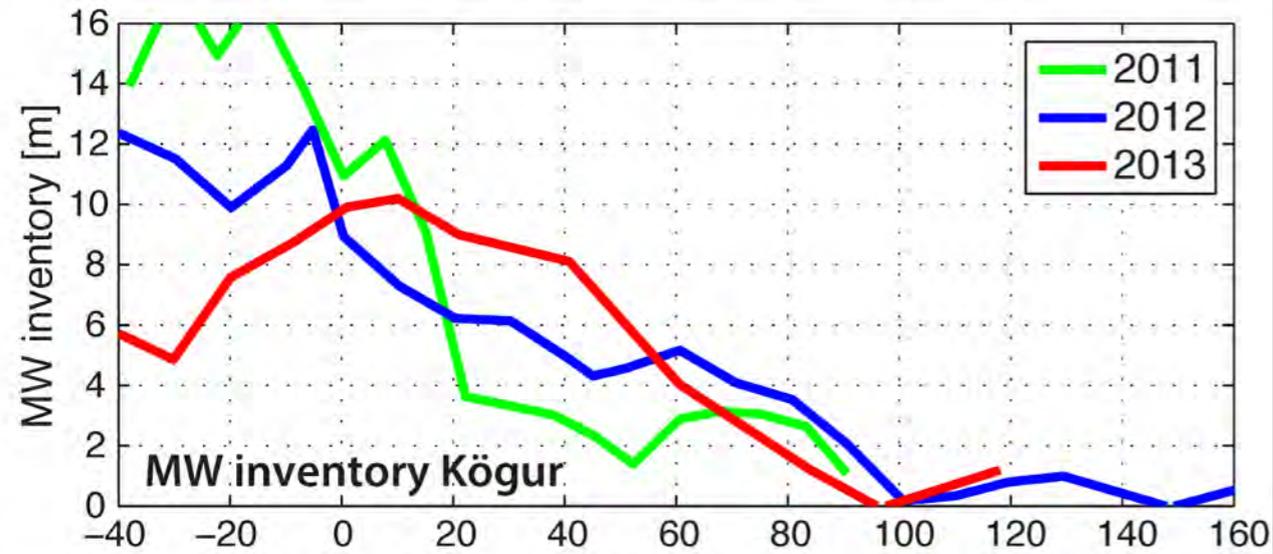
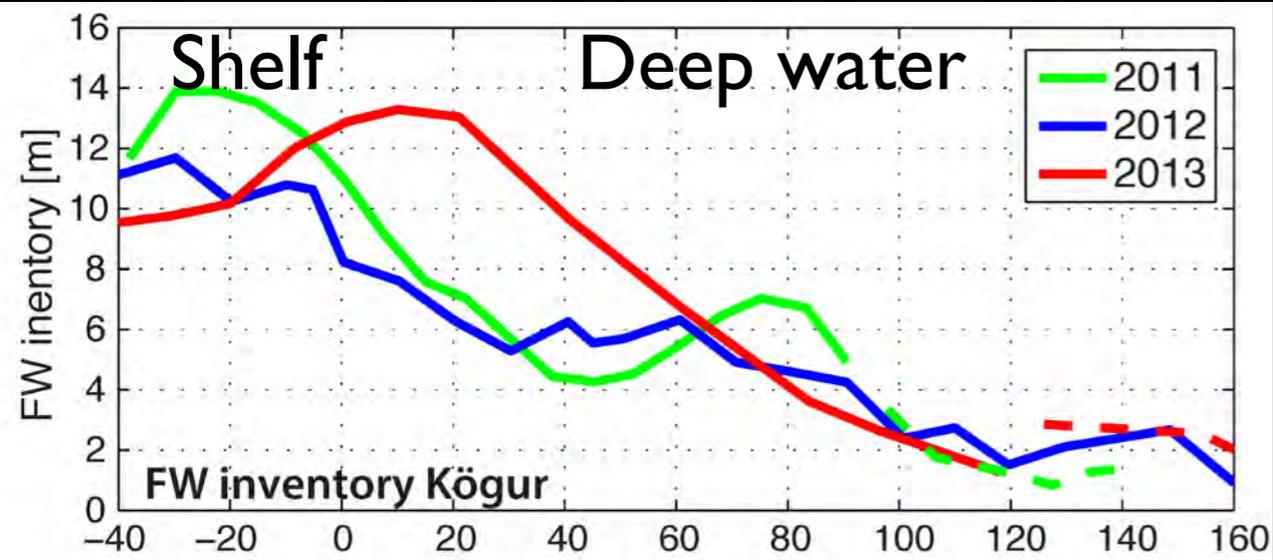


2011

2012

2013

3 occupations of Kögur 2011-2013:



- FW was largest in 2013 while MW fraction was smallest
- Large interannual variability

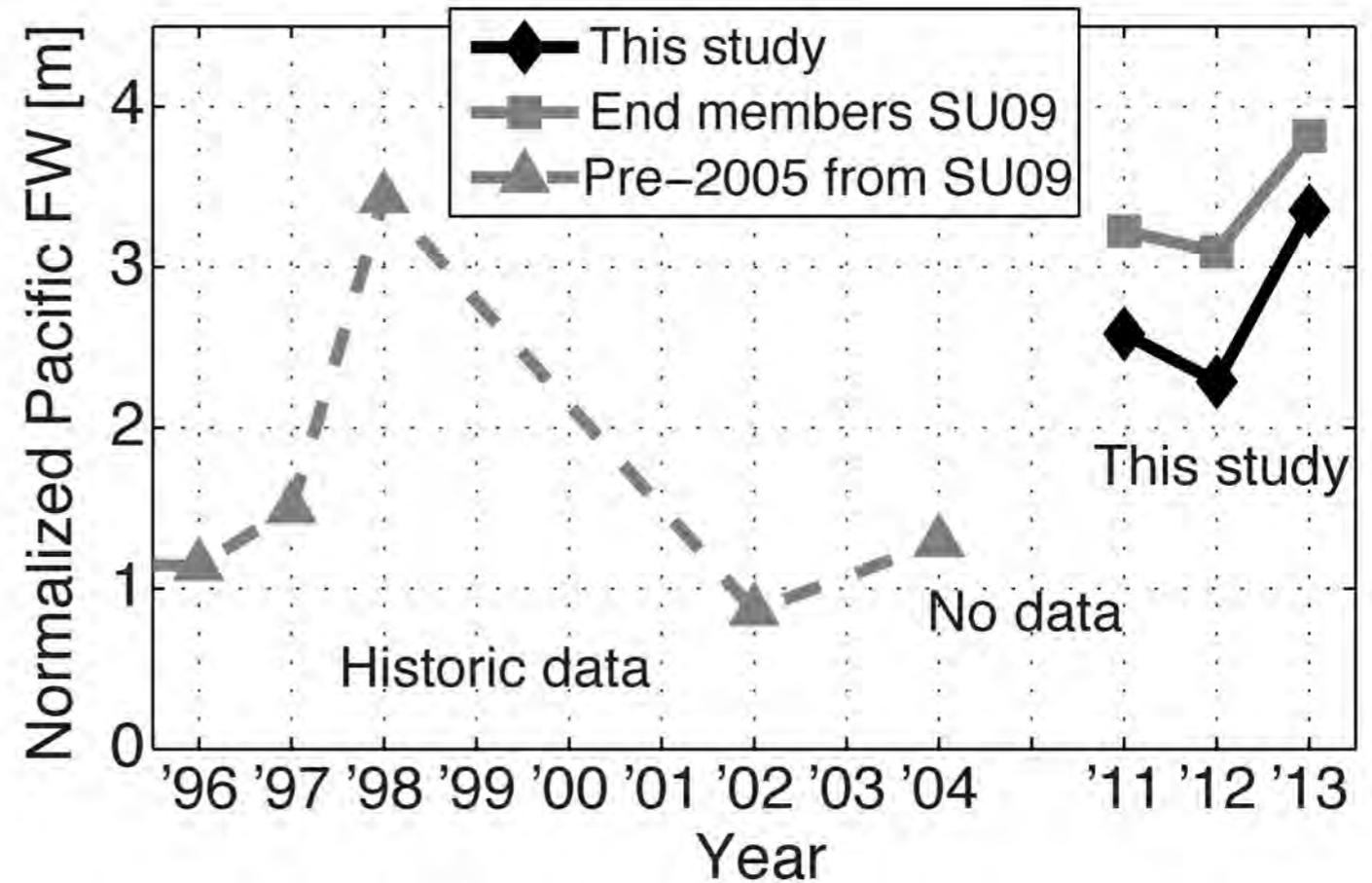
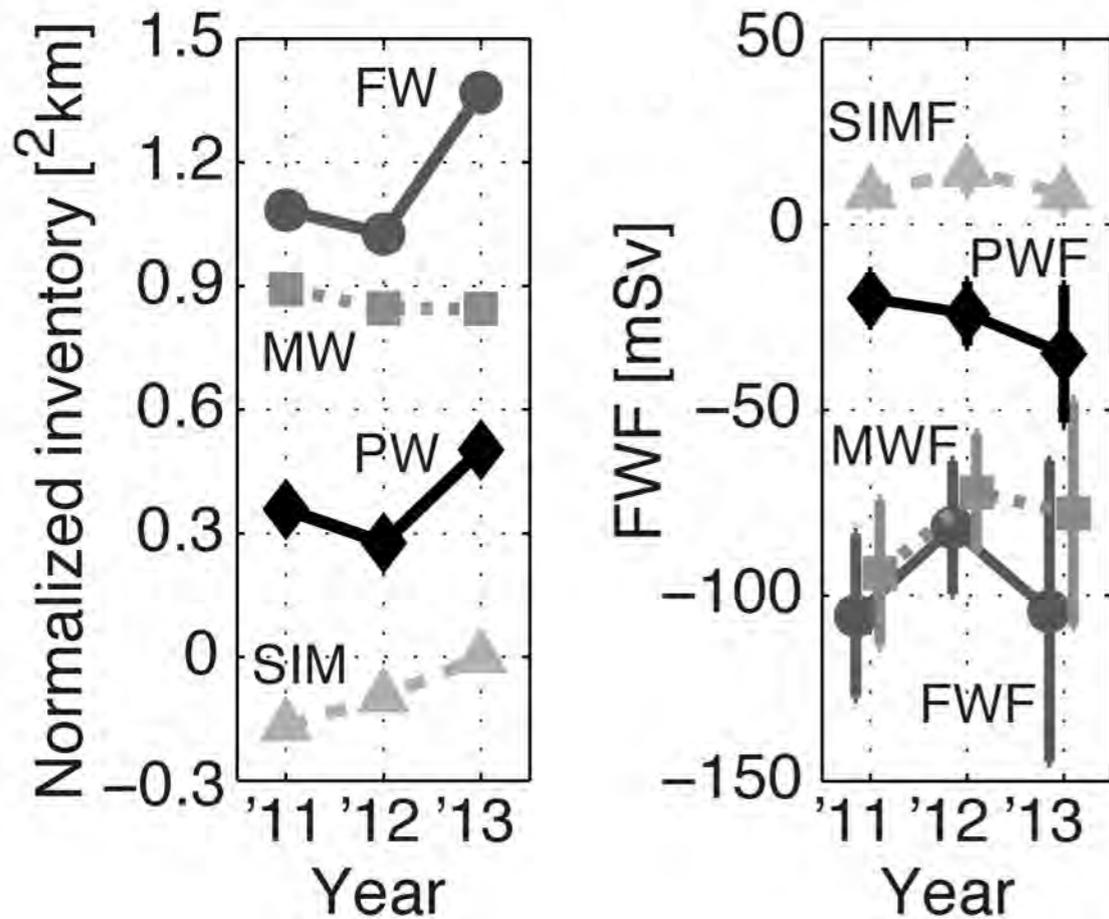
- PW present in all 3 years; PW was weakest in 2011

- Brine dominates shelf break EGC
- Positive SIM is always present east of the EGPC

Integral values on 150 km distance

Inventories & fluxes

Pacific Freshwater



- ★ Zero net SIM in 2013
- ★ PWF contributed 1/3 to the FWF in 2013

Elevated amounts of Pacific freshwater observed in 2011-2013 with a maximum in 2013: as large as last seen in 1998

Reduction of eastward
flow PW shelfbreak jet

More PW
inflow

1980s

1990s

Post 2004

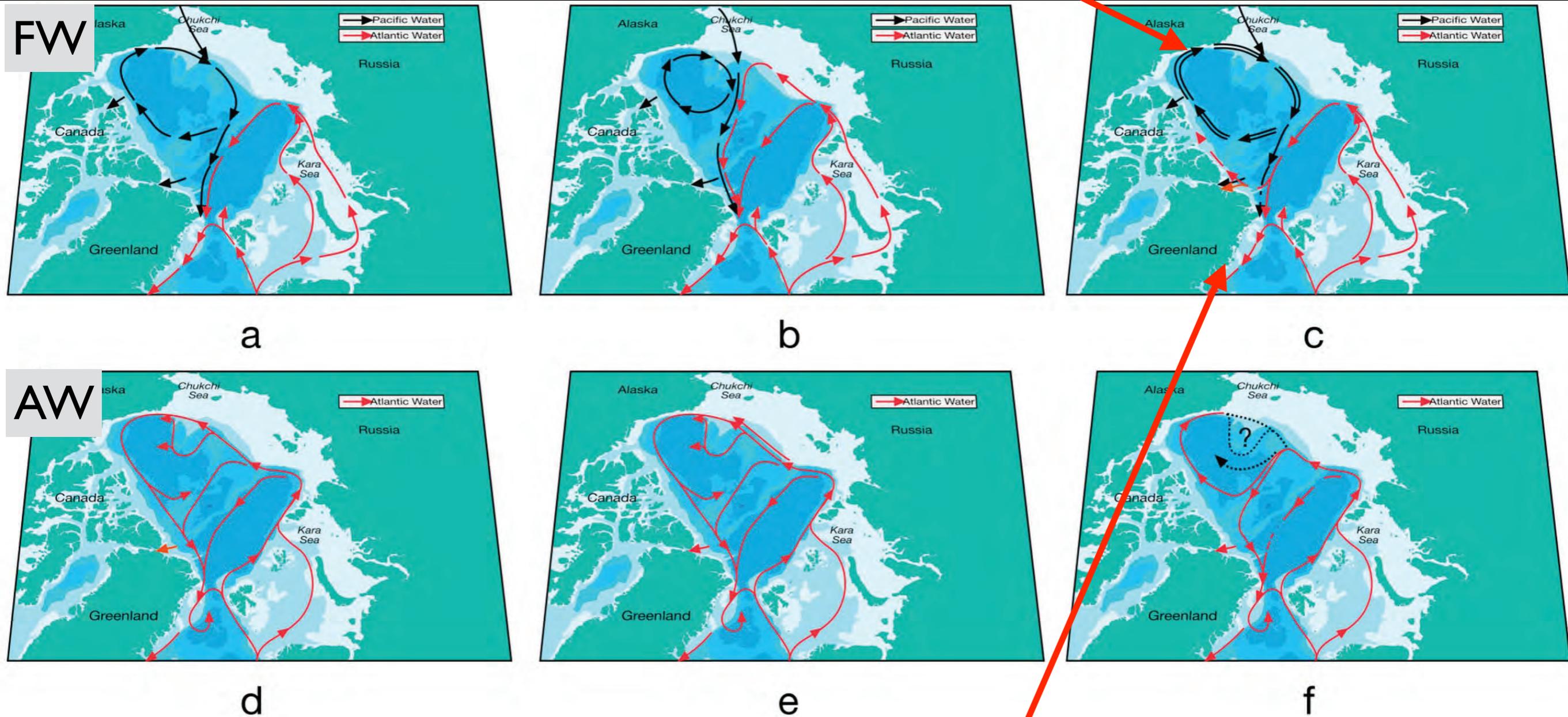


Figure from Karcher et al., 2012

Leading to more PW
(with a time lag xx?)



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