

Dramatic weakening of the Pacific water boundary current in the Beaufort Sea during the first decade of the 2000s

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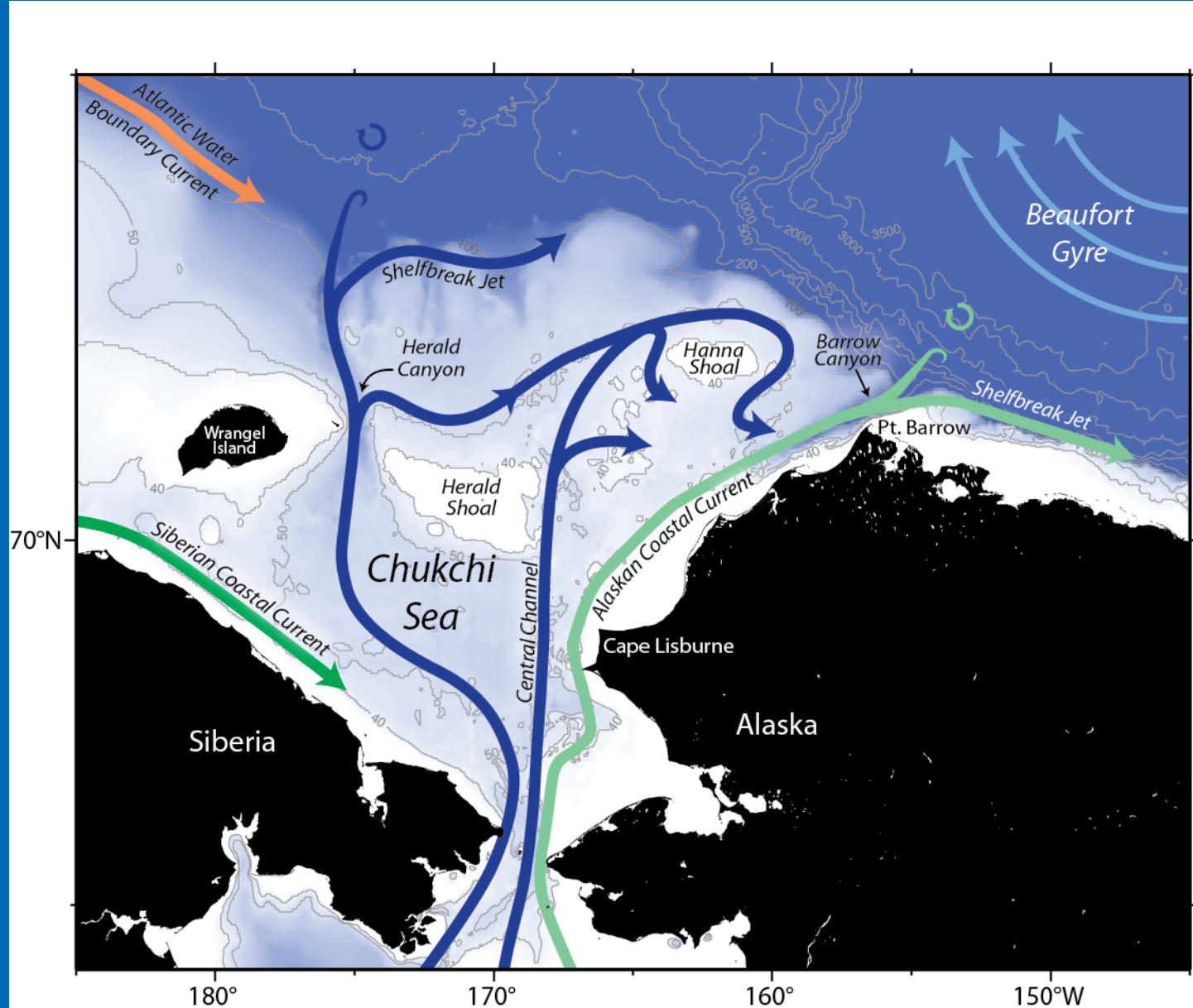
S. Roberts, T.J. Weingartner, H. Statscewich

University of Alaska

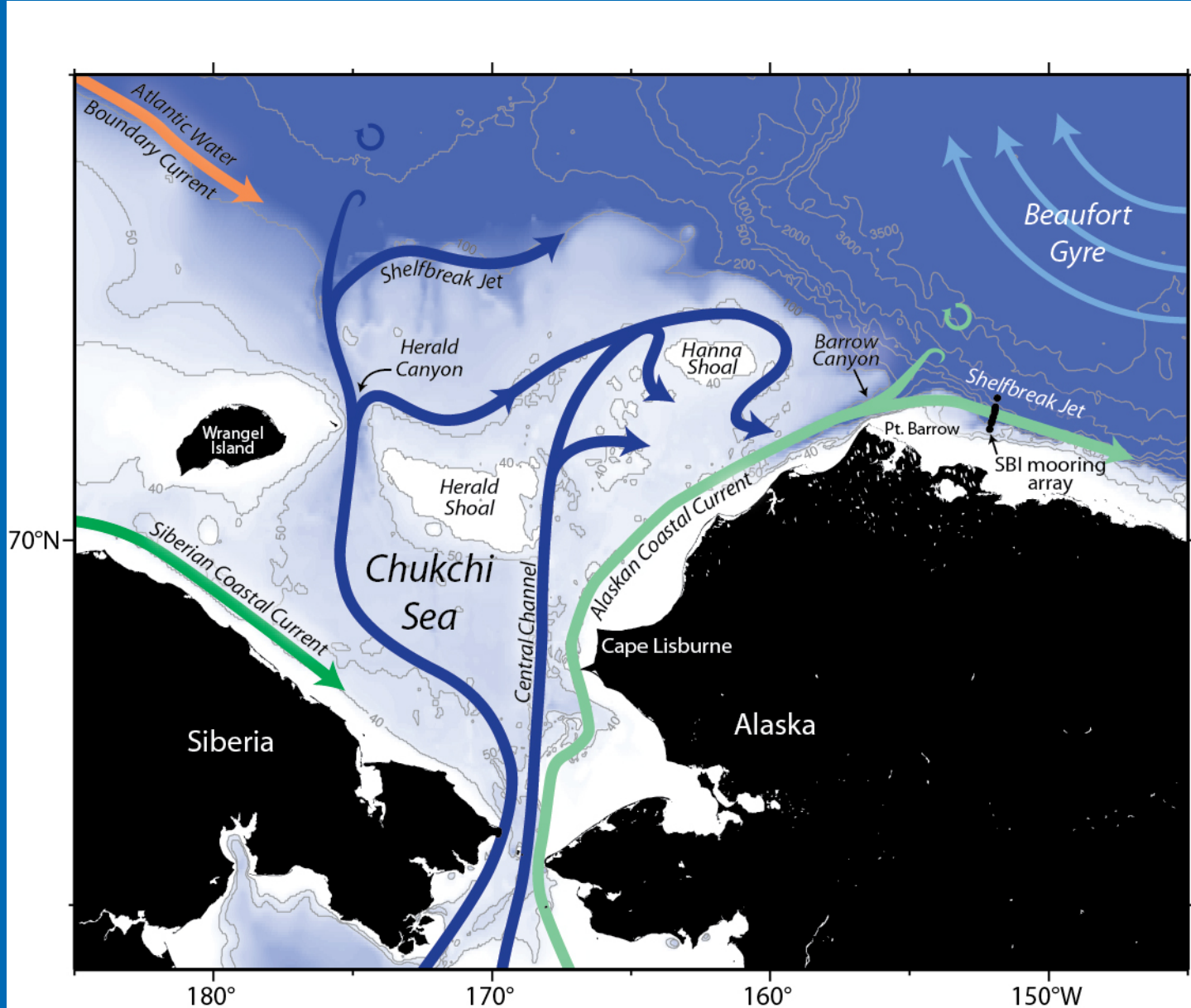
Outline

- I. Overview of the circulation in Chukchi/Beaufort Seas
- II. Seasonal to interannual variability of the boundary current
- III. Causes and ramifications of the pronounced changes

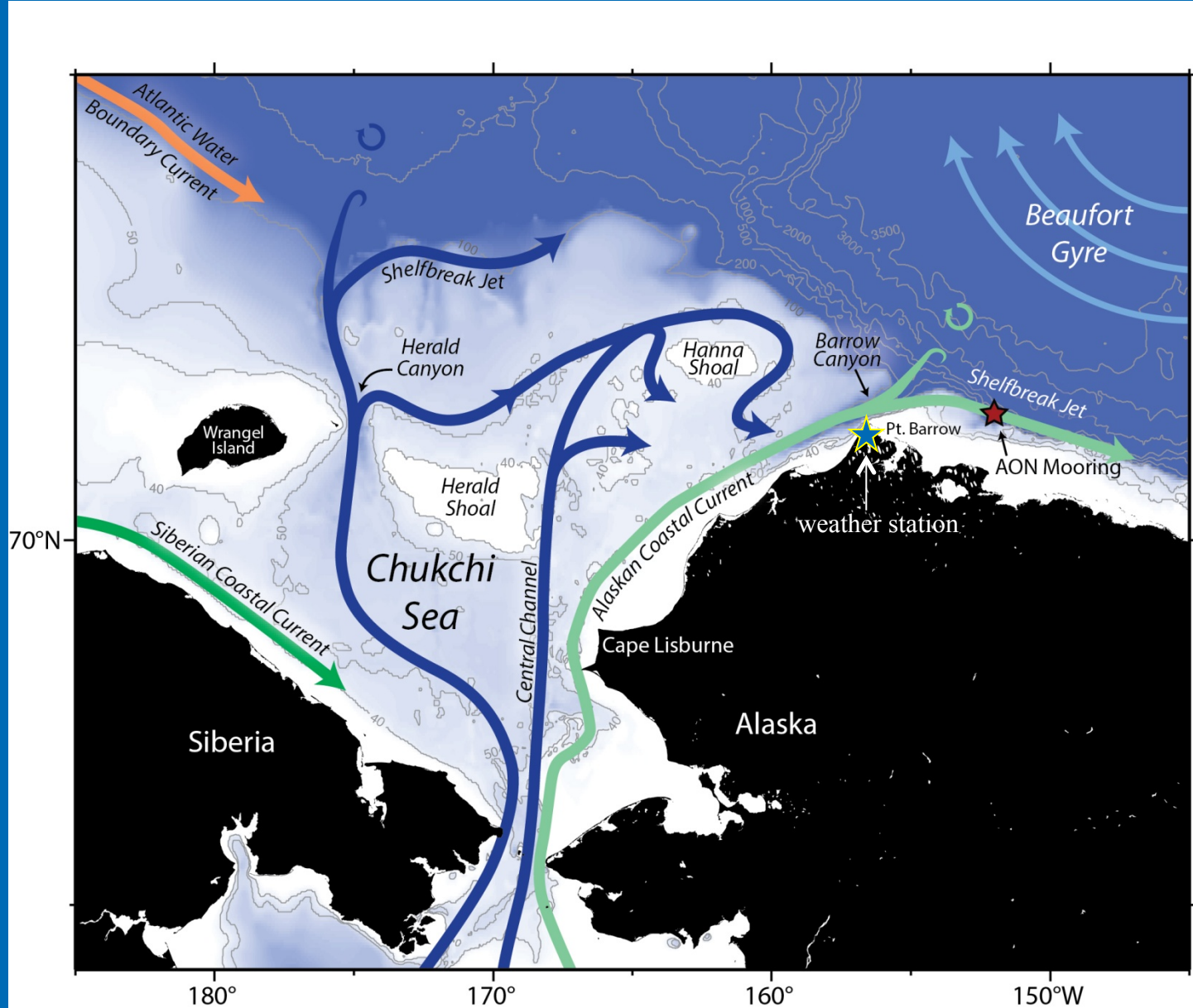
Pacific water inflow to the Arctic



Pacific water inflow to the Arctic

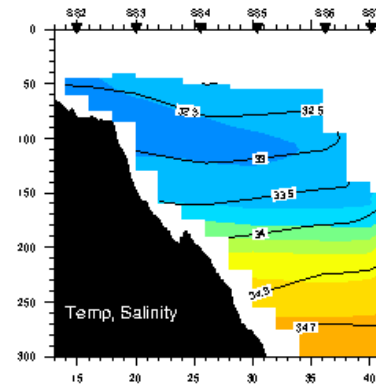
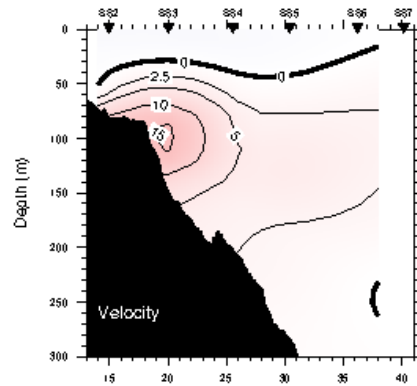


Pacific water inflow to the Arctic

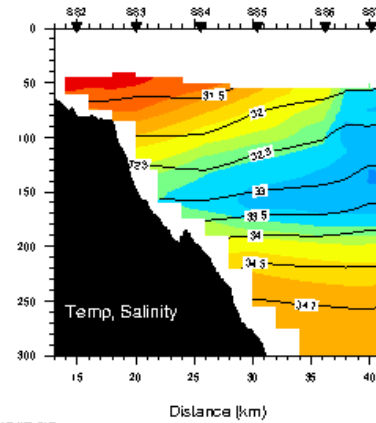
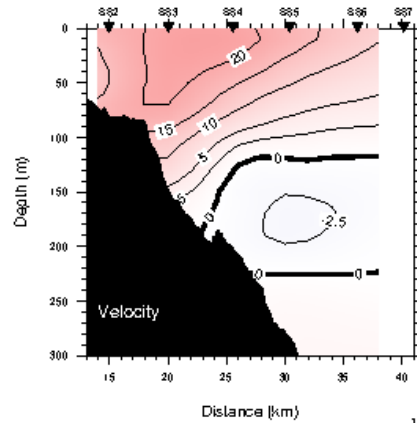


Pacific water boundary current (or Beaufort shelfbreak jet)

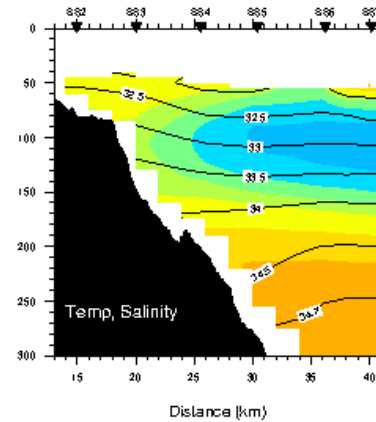
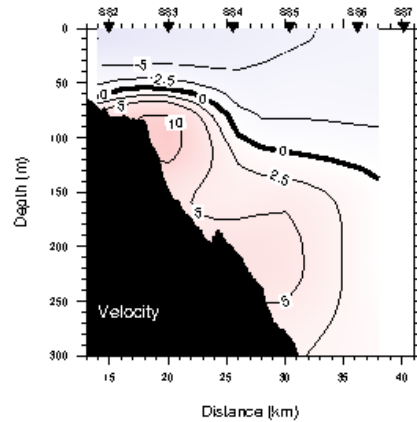
Spring Average



Summer Average

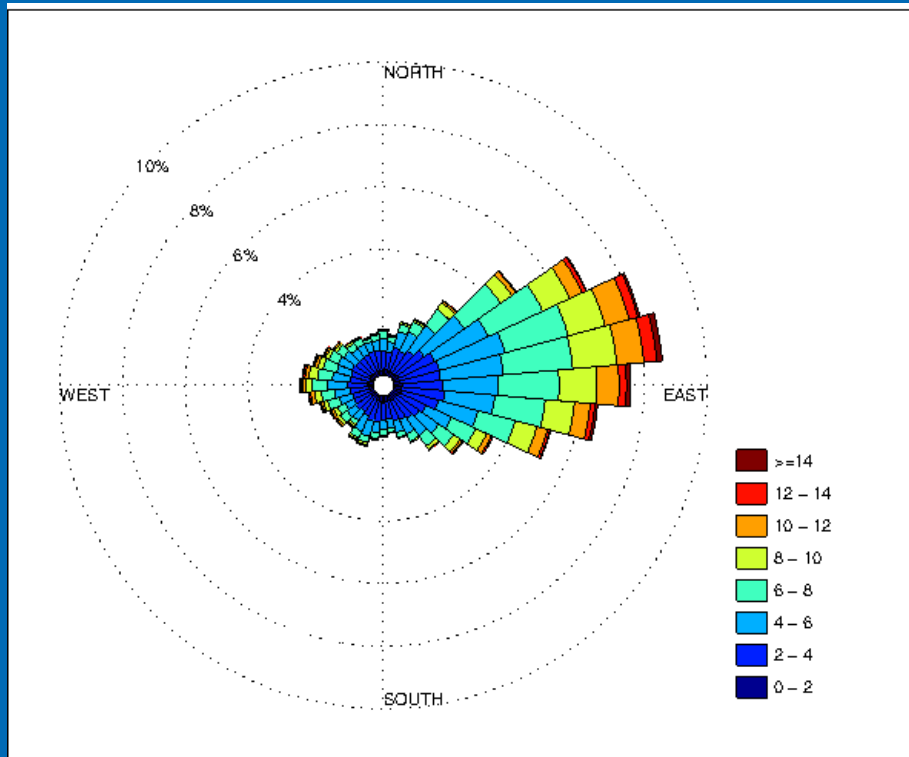


Winter Average



viewer is
looking west

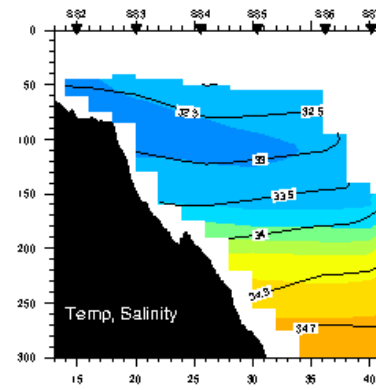
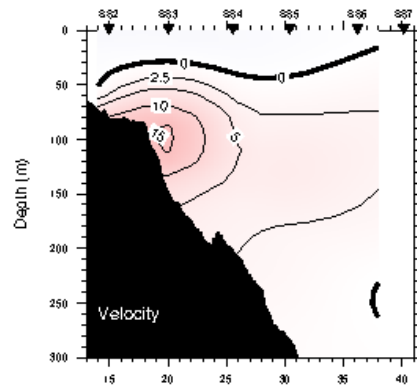
The predominant wind direction in the Beaufort Sea is easterly



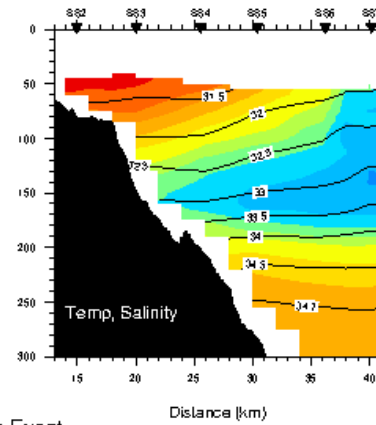
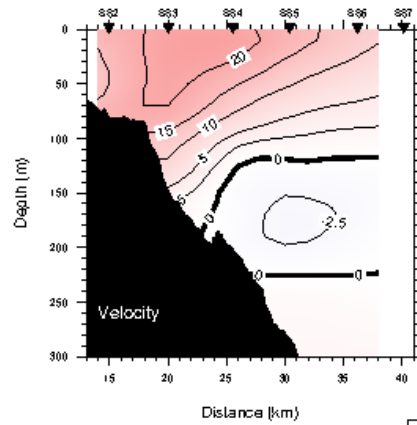
10-m wind rose from the Met station in Pt. Barrow, AK

Pacific water boundary current

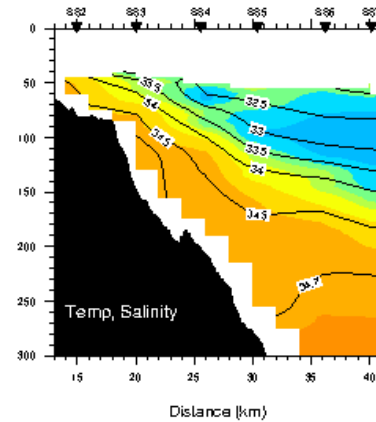
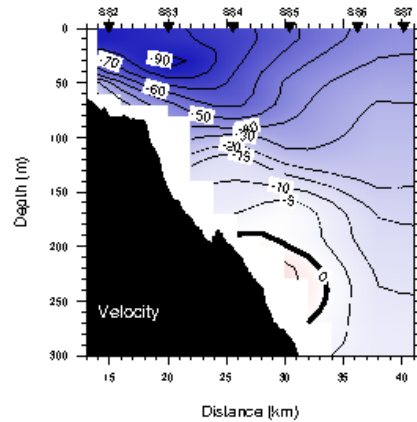
Spring Average



Summer Average



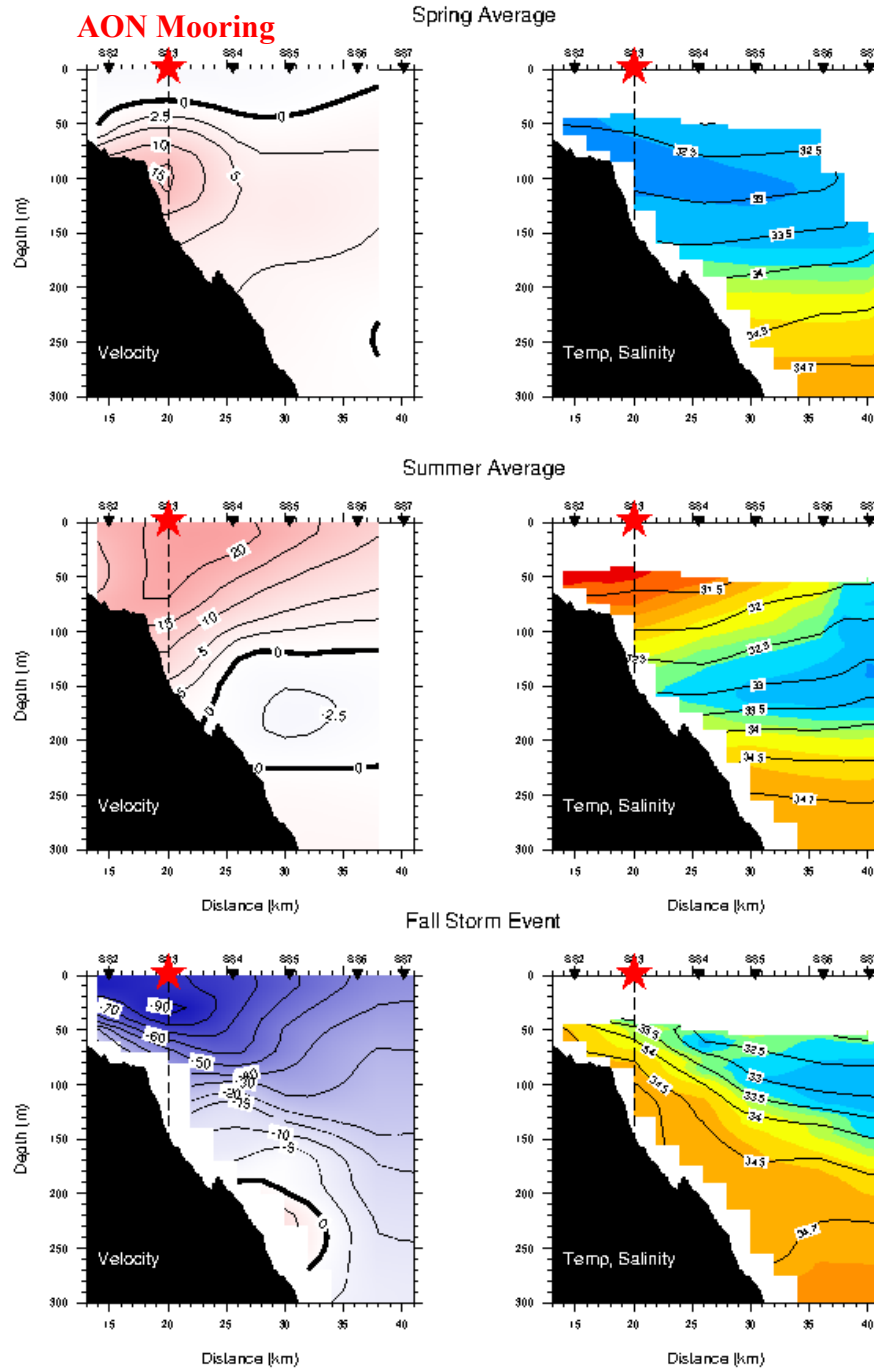
Fall Storm Event



viewer is looking west

fall storm event

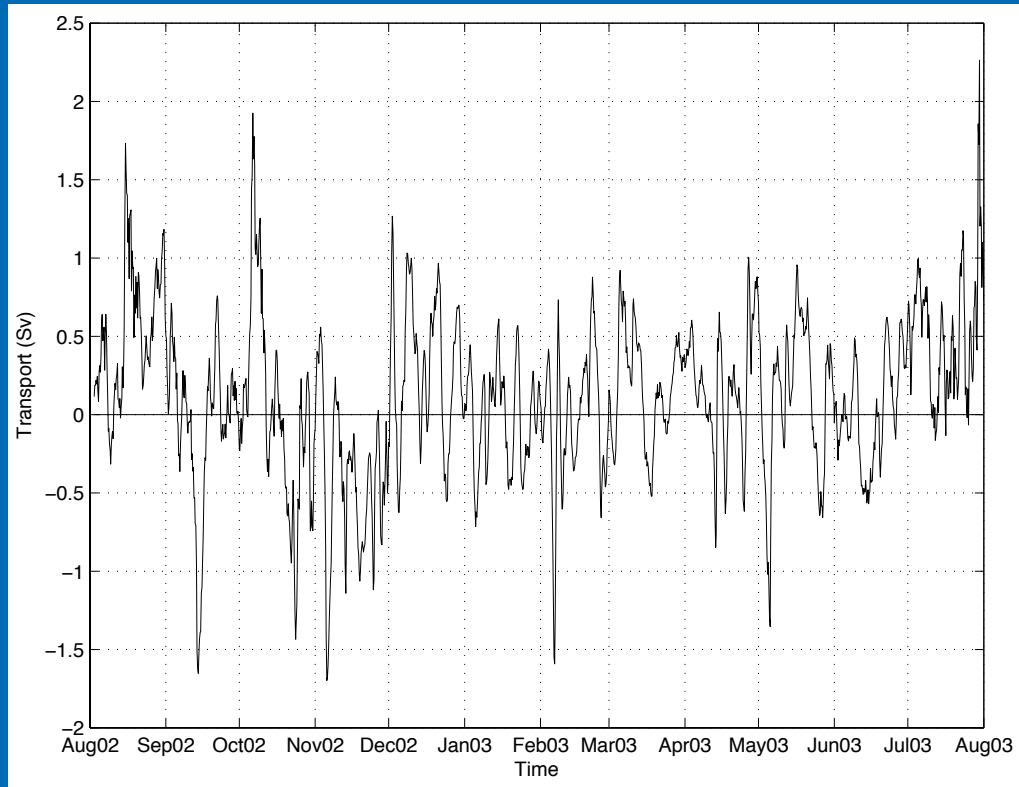
Pacific water boundary current



viewer is looking west

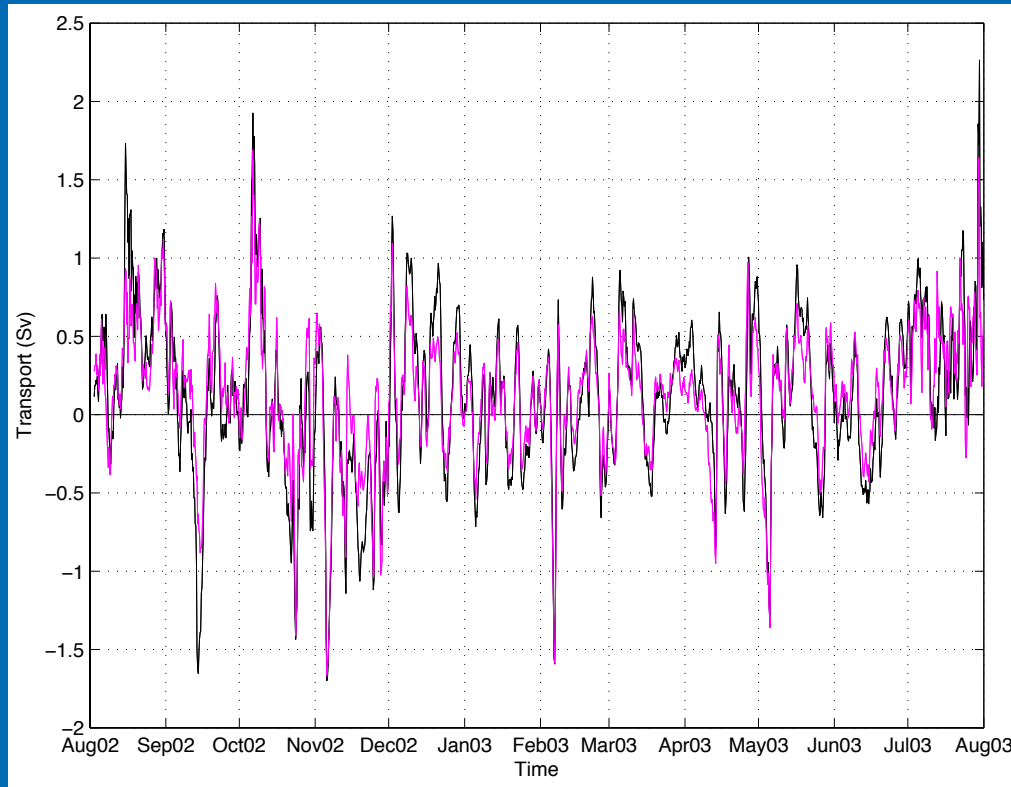
fall storm event

Transport of Pacific Water: 2002–3



full array

Transport of Pacific Water: 2002–3

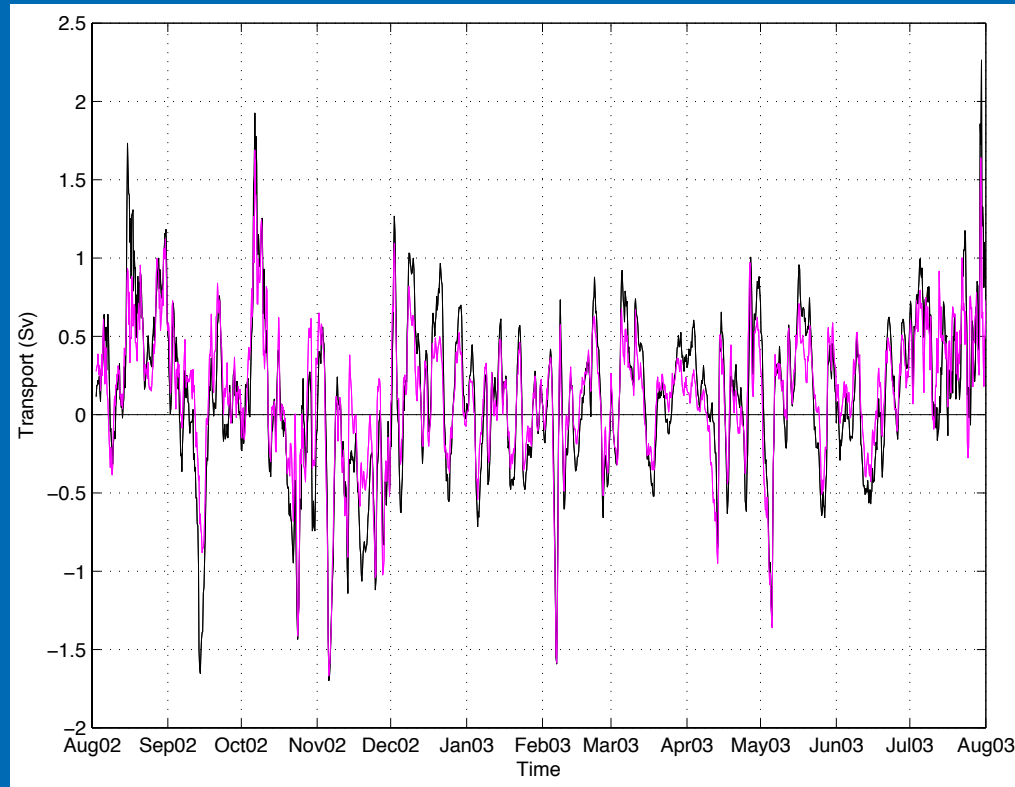


$r = .92$

full array —————

single mooring proxy —————

Transport of Pacific Water: 2002–3



Data from:

2002-2004 SBI
2005-2006 WHOI
2008-2014 AON

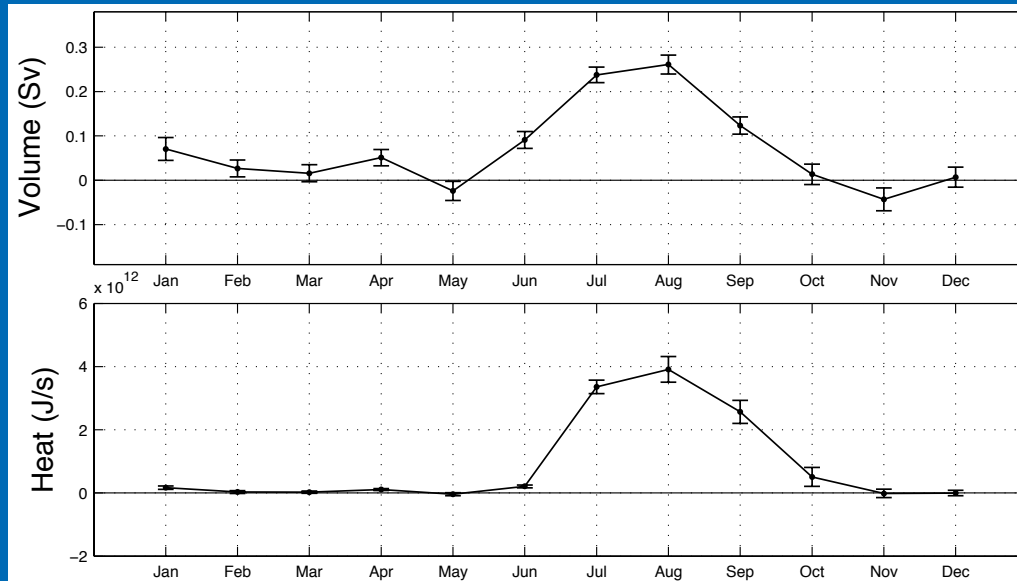
9 years total

full array —————

single mooring proxy —————

Seasonal to interannual variability

Seasonal variation in transport

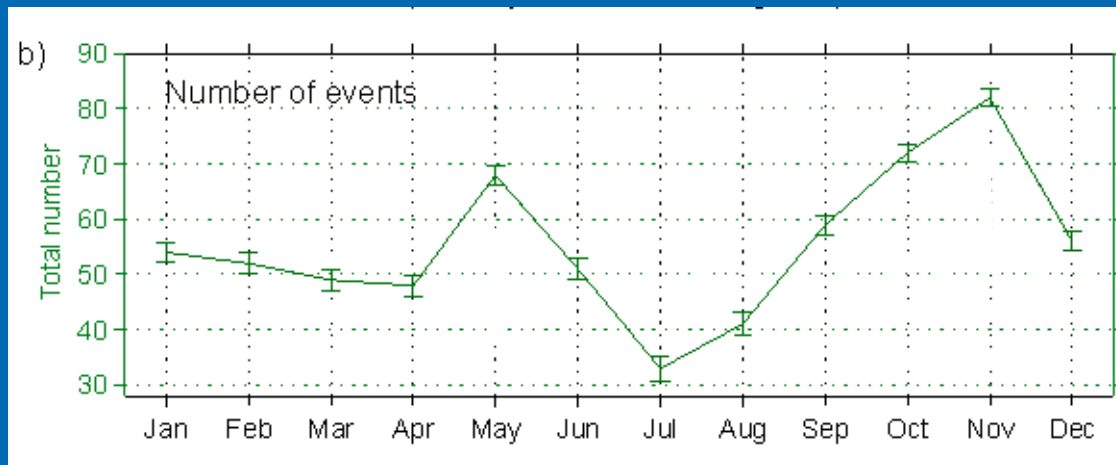


volume transport

heat transport

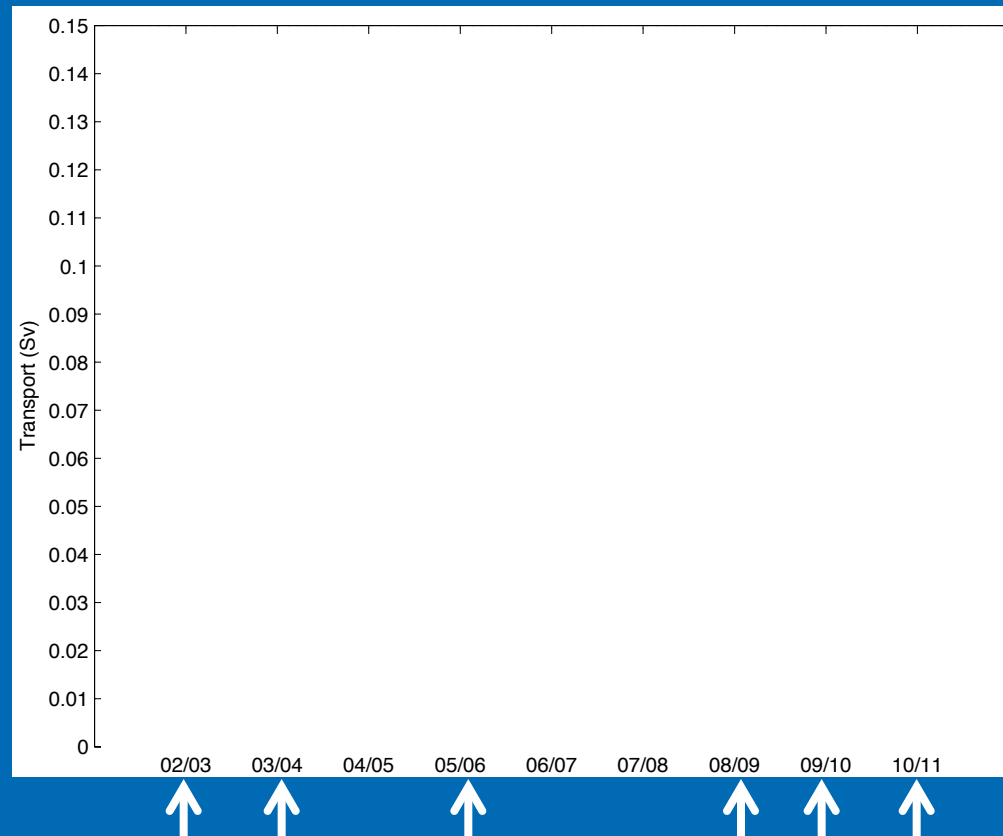
Most of the transport of the current, and nearly all of the heat flux, occurs in the summer months

Number of upwelling events using a Pt. Barrow wind proxy

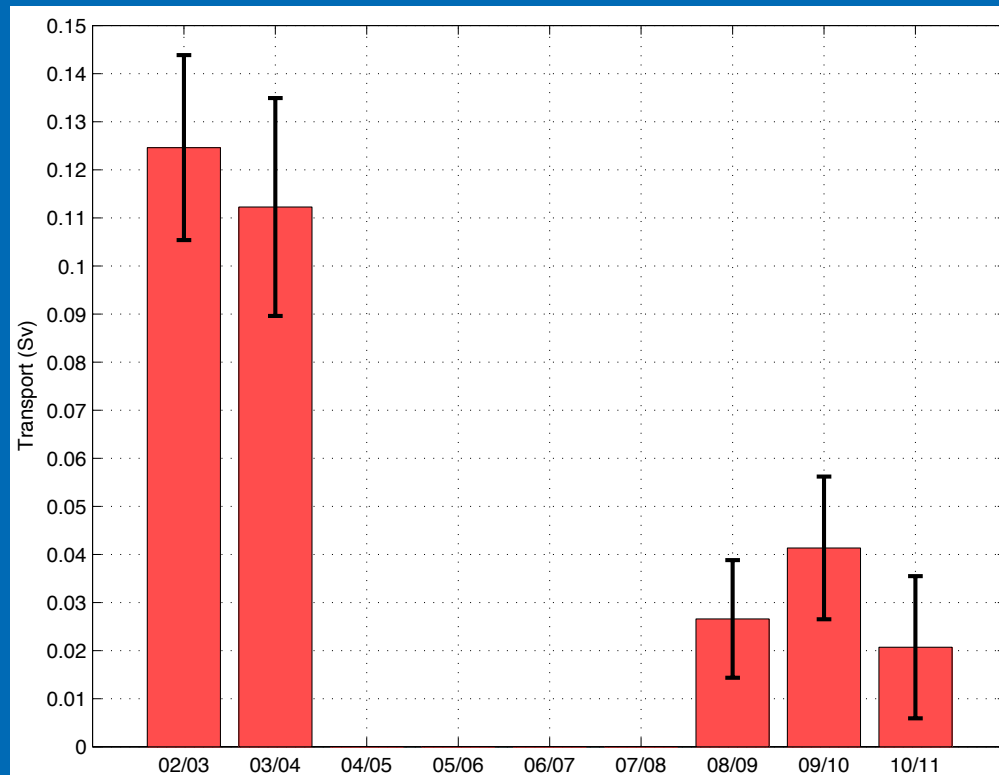


Pickart et al. (2013)

Interannual variation in transport

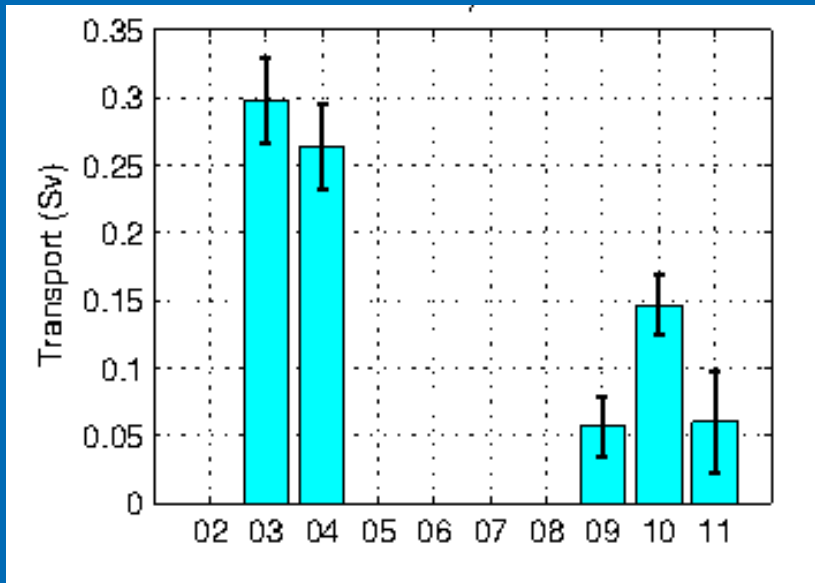


Interannual variation in transport



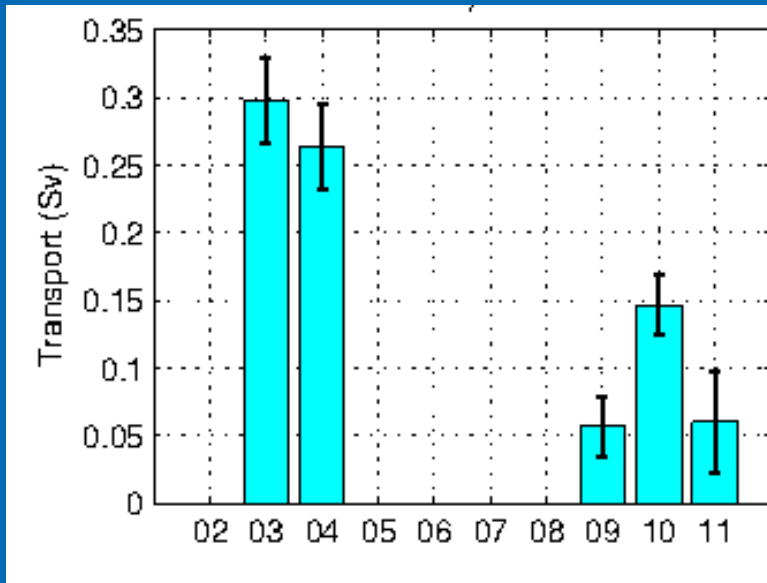
The boundary current has diminished in transport by more than 80% over the last decade, even though the Bering Strait inflow has increased by 50%

Interannual variation in transport

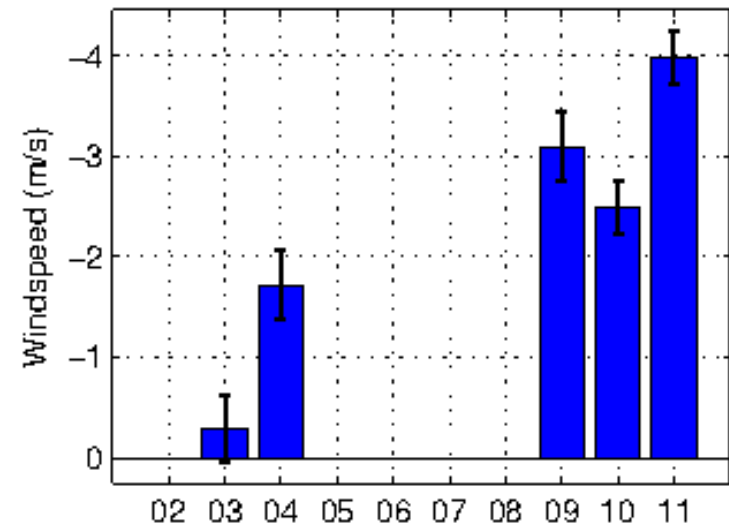


Transport during summer (JJA)

Interannual variation in transport



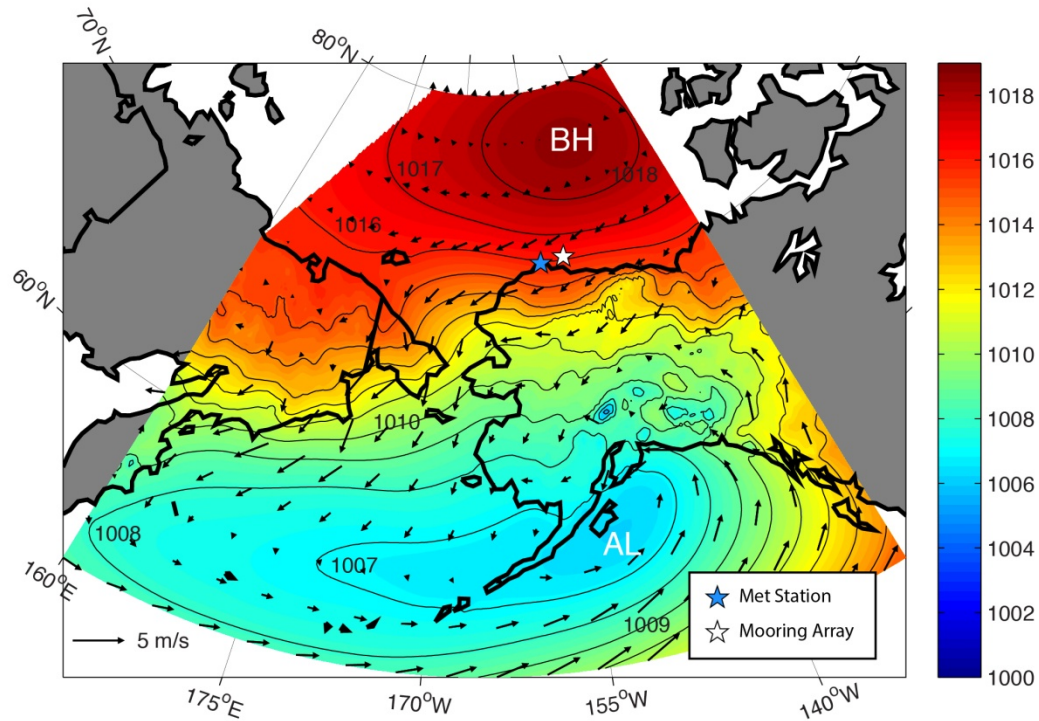
Transport during summer (JJA)



Pt. Barrow alongcoast winds during summer

Enhanced summertime easterly winds are the cause of the transport drop

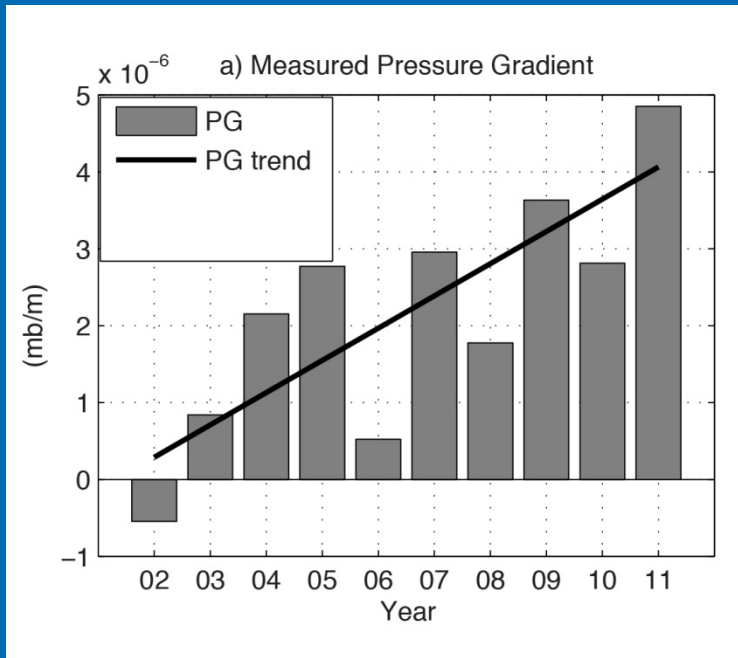
Two atmospheric Centers of Action



BH = Beaufort High

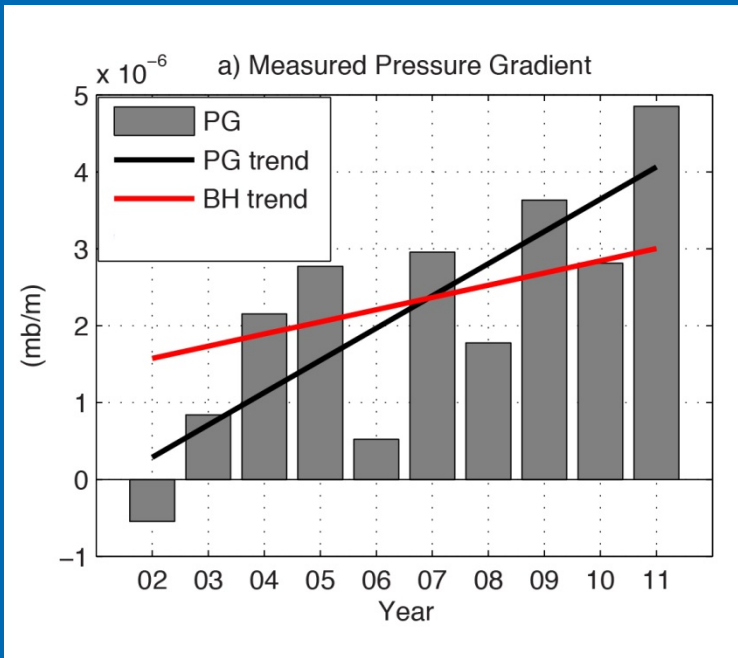
AL = Aleutian Low

Beaufort High versus Aleutian Low



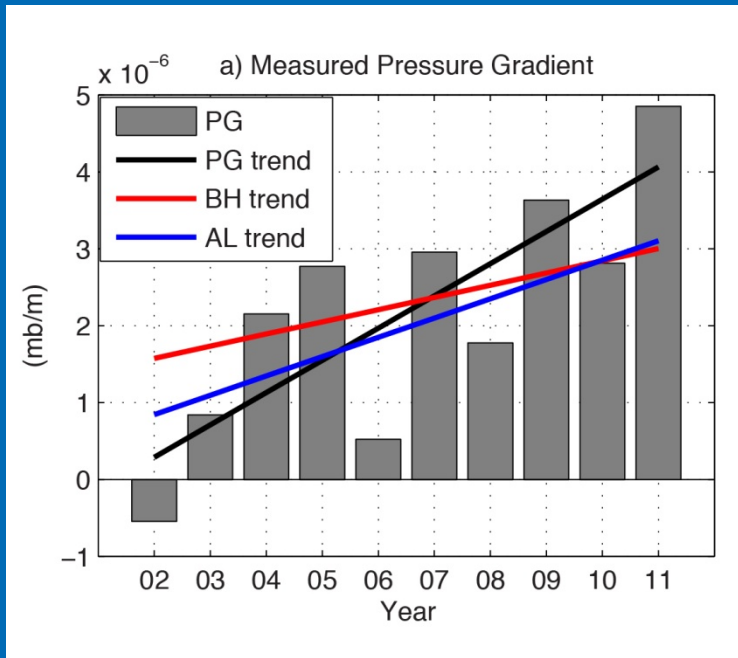
Sea level pressure gradient

Beaufort High versus Aleutian Low



Sea level pressure gradient

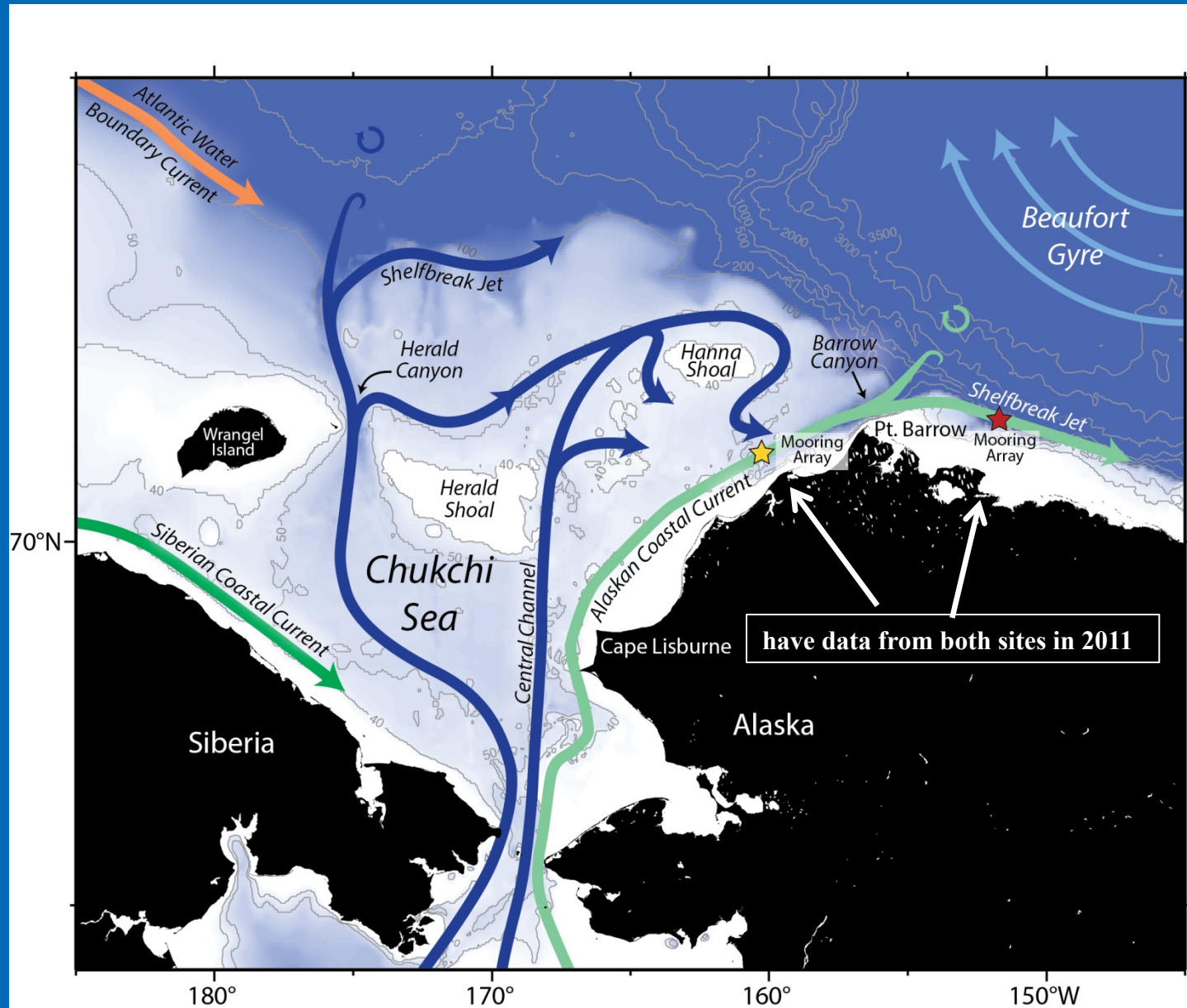
Beaufort High versus Aleutian Low



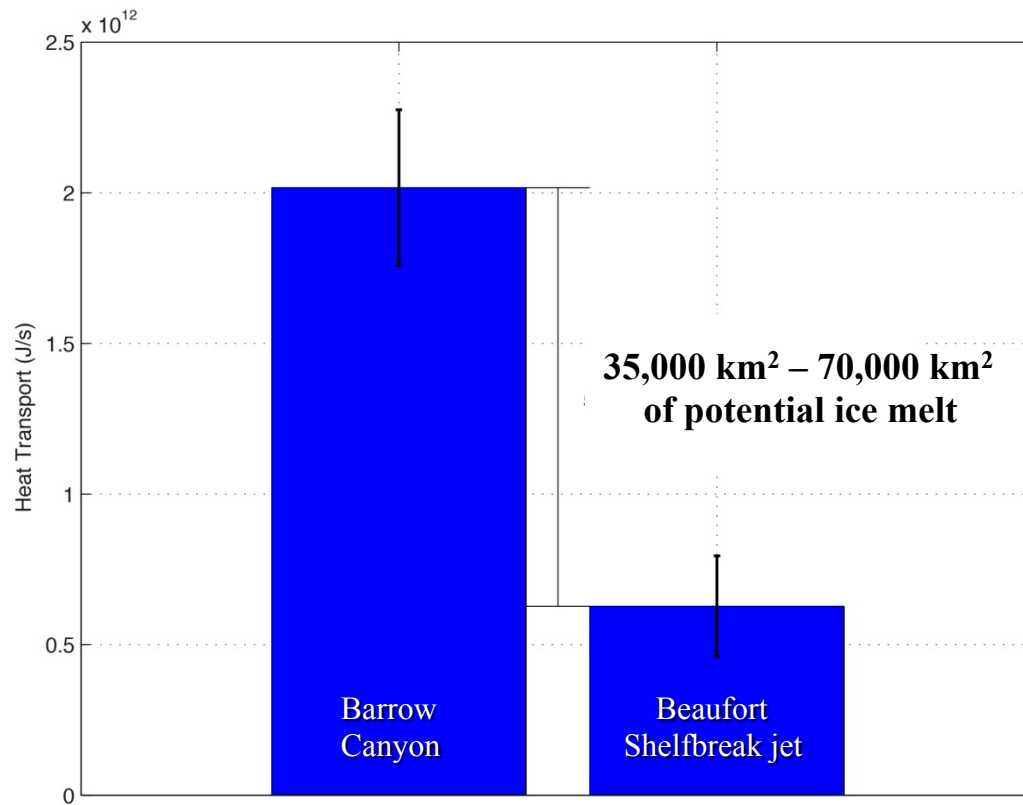
Sea level pressure gradient

**Ramifications of the reduction
in boundary current transport**

Where does the water (and heat) go?



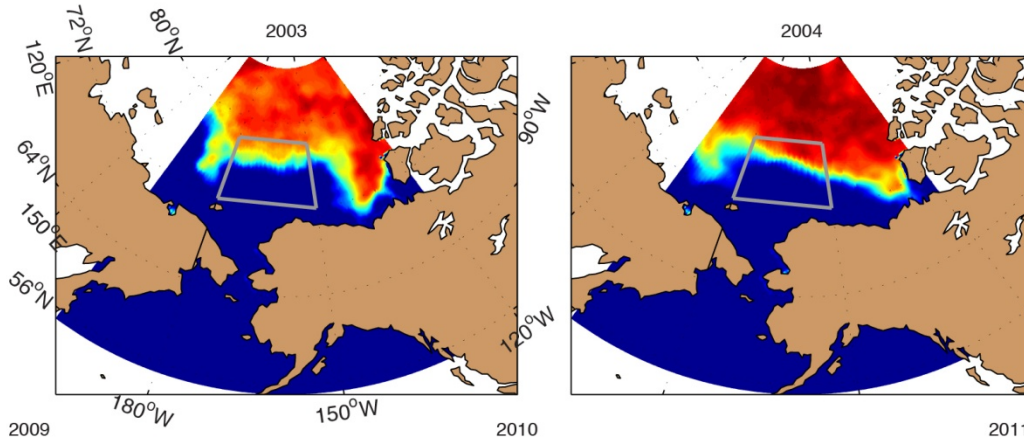
Where does the water (and heat) go?



Average heat flux at each site for summer 2011

Where does the water (and heat) go?

AVHRR-AMSR

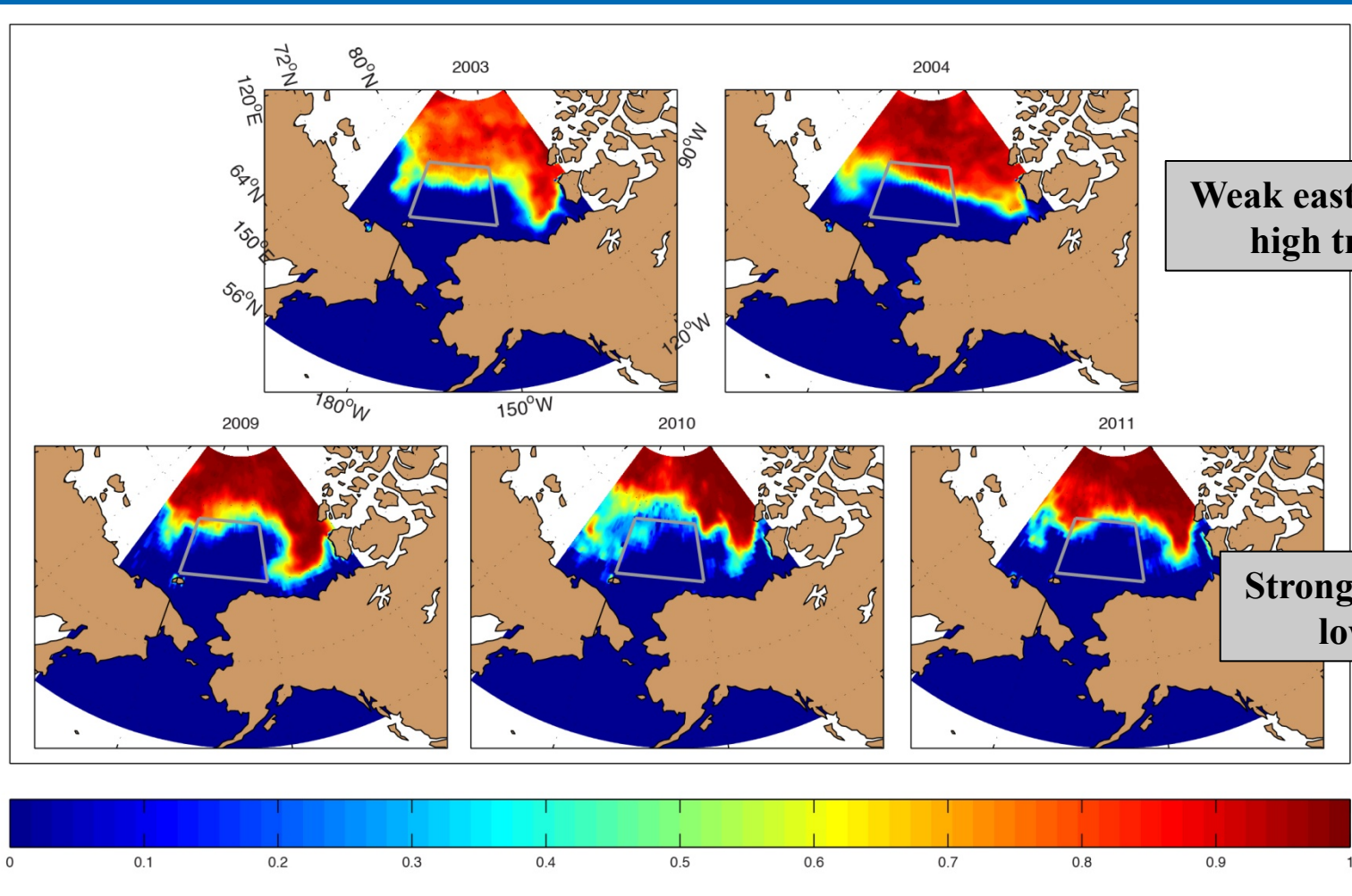


**Weak easterly winds /
high transport**

Sea-ice concentration in late-September 2011

Where does the water (and heat) go?

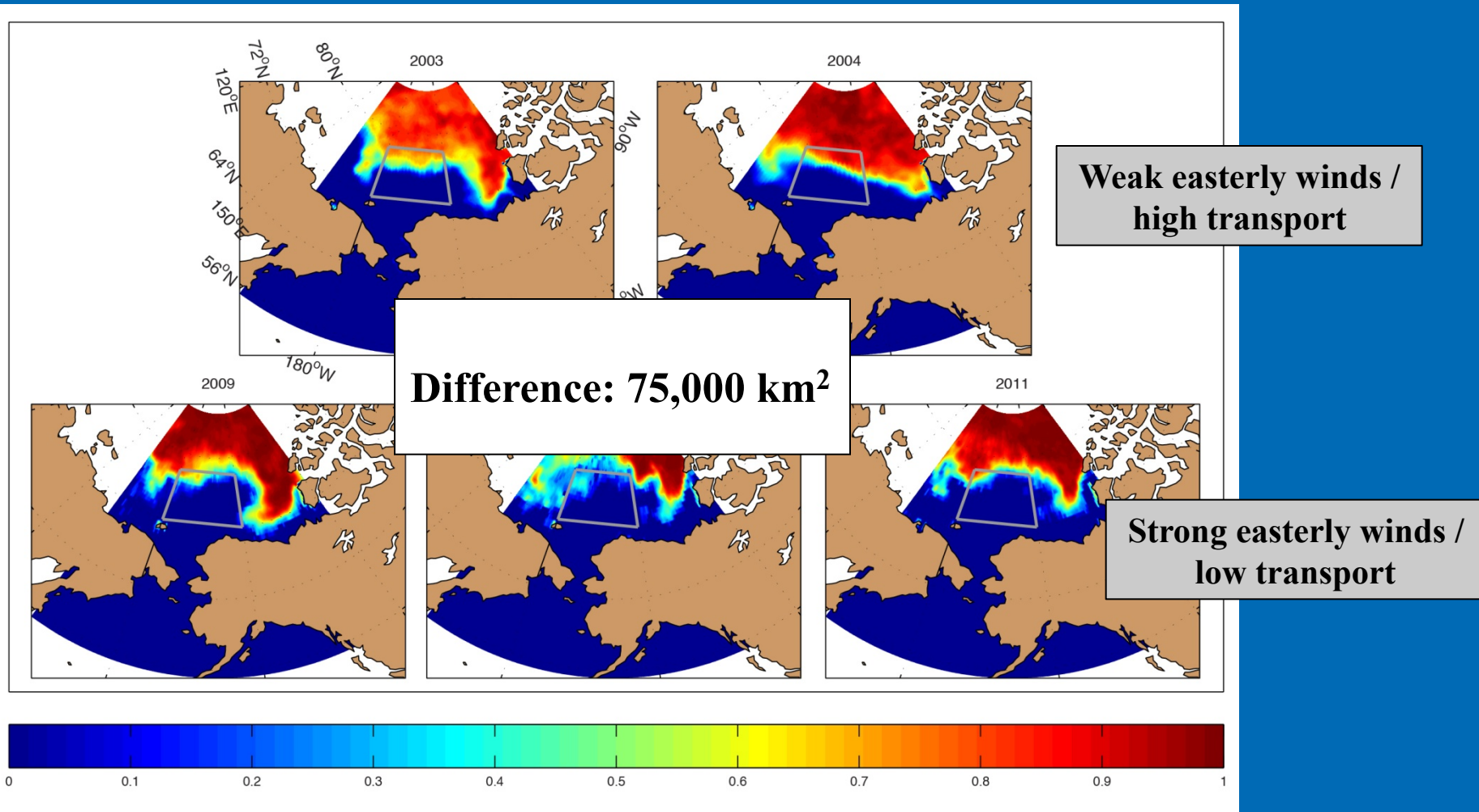
AVHRR-AMSR



Sea-ice concentration in late-September 2011

Where does the water (and heat) go?

AVHRR-AMSR

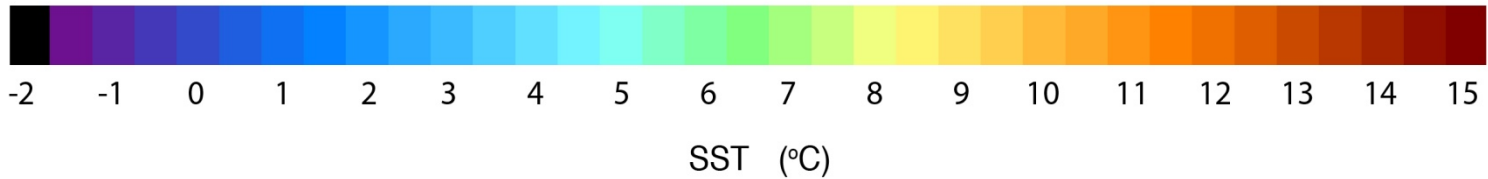
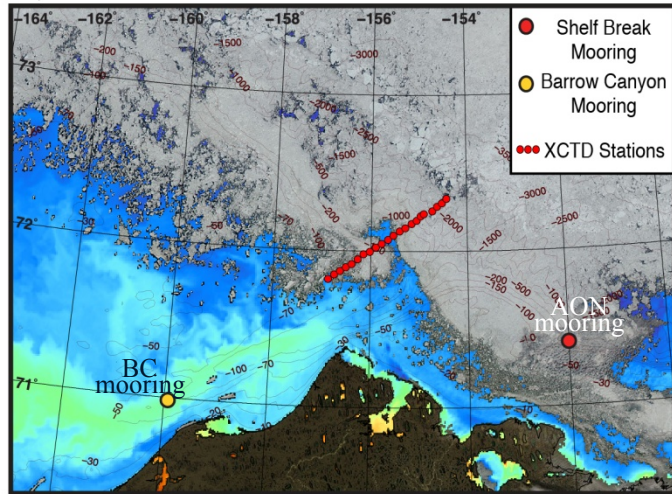


Sea-ice concentration in late-September 2011

How does the water (and heat) leave Barrow Canyon?

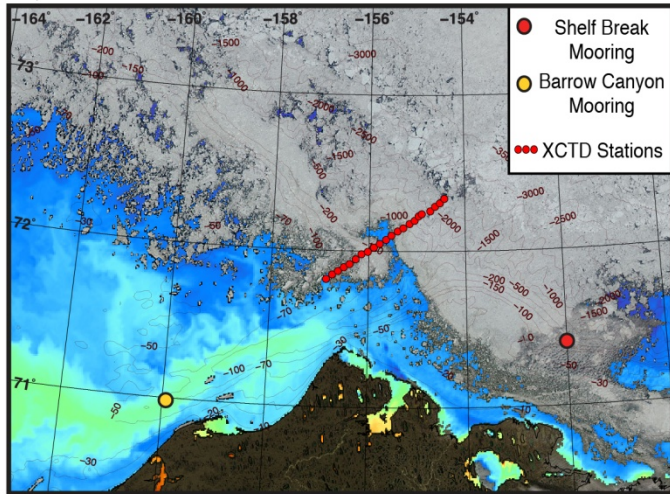
Easterly wind event summer 2011

a July 10, 2011

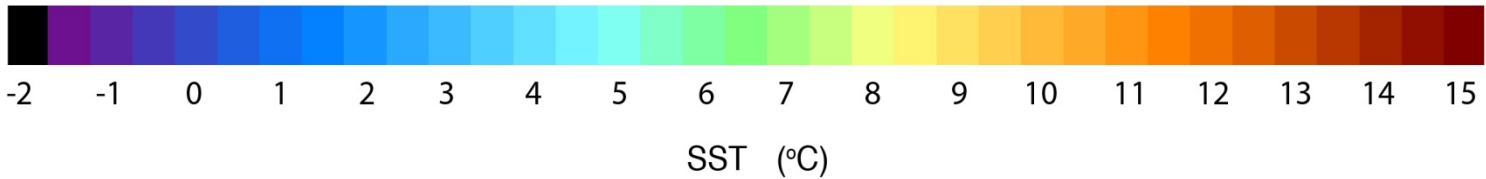
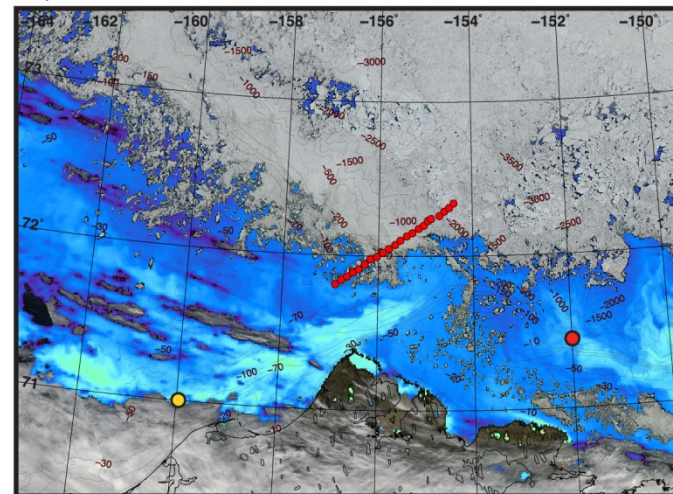


Easterly wind event summer 2011

a July 10, 2011

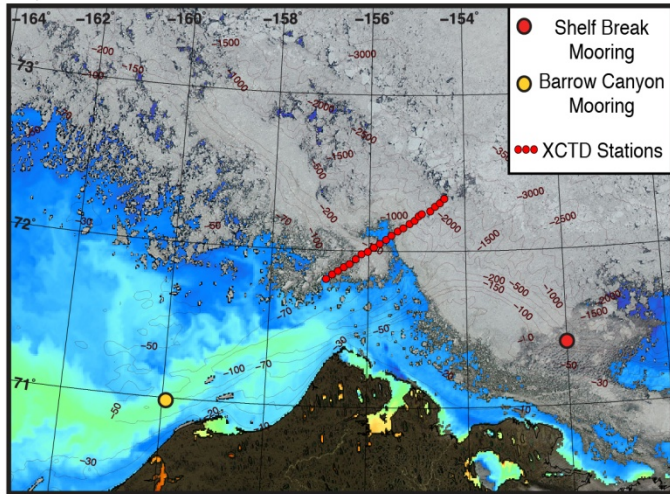


b July 14, 2011

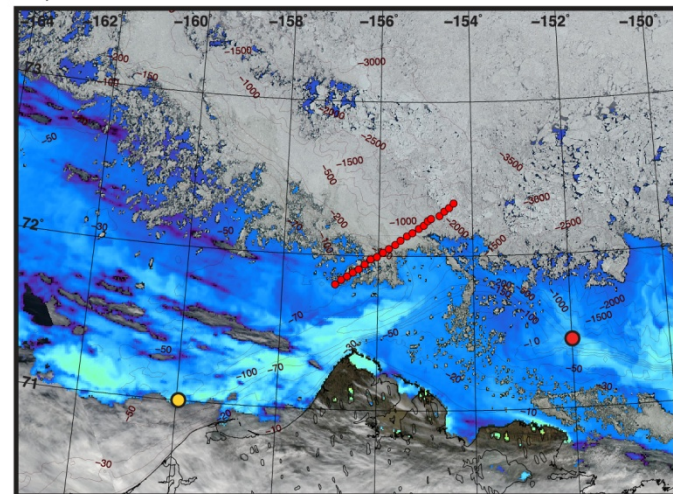


Easterly wind event summer 2011

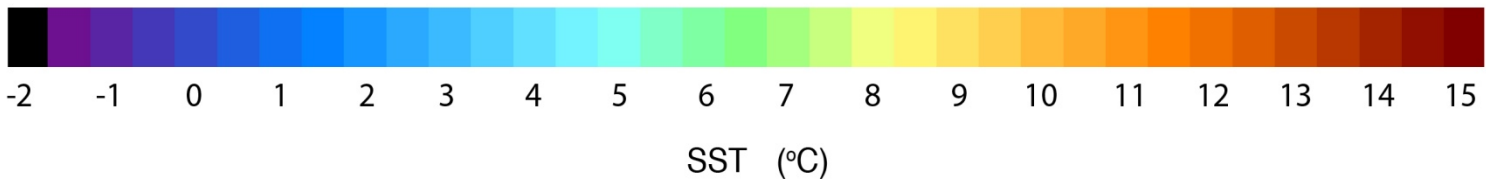
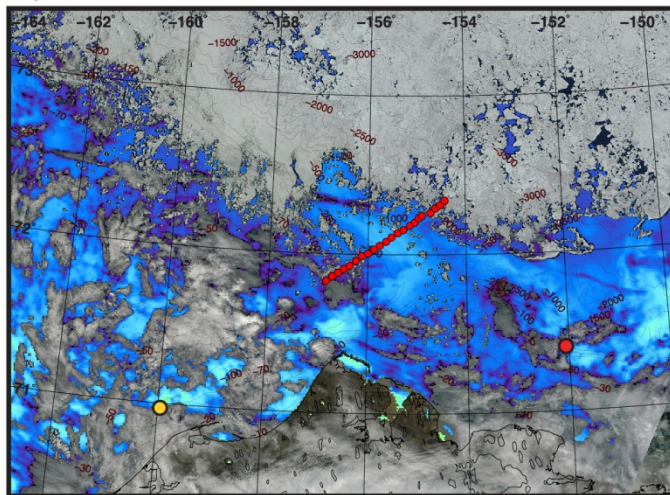
a July 10, 2011



b July 14, 2011

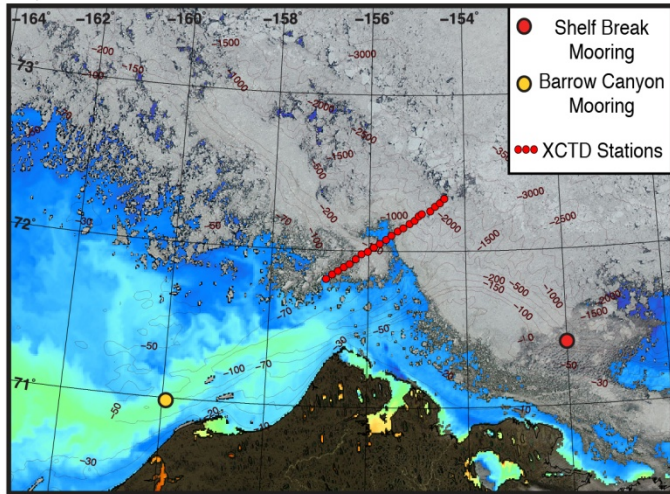


c July 16, 2011

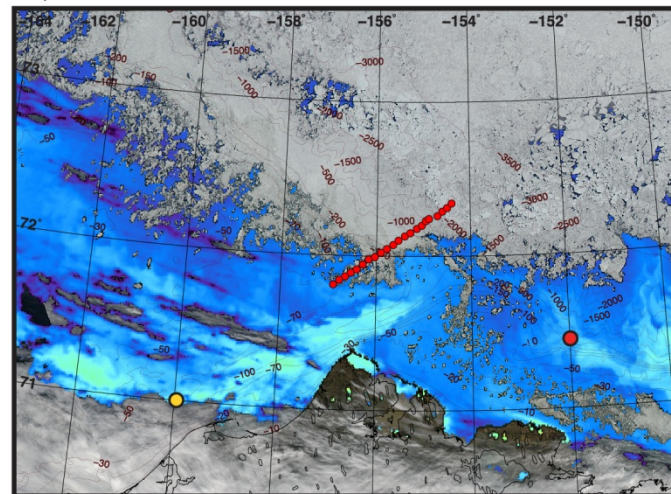


Easterly wind event summer 2011

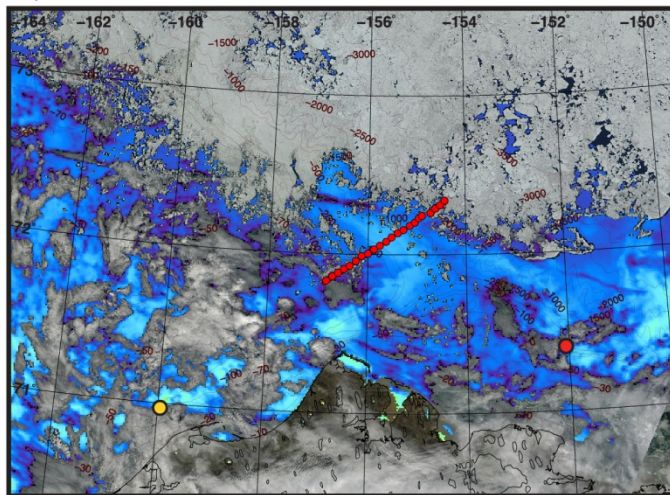
a July 10, 2011



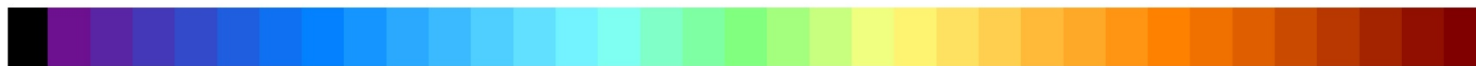
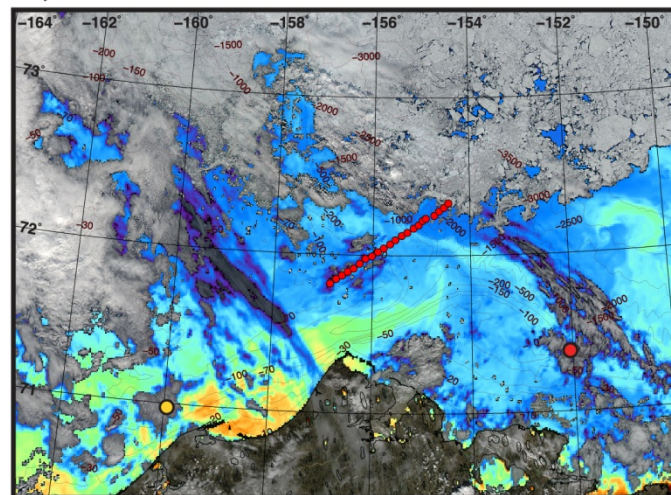
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c July 16, 2011

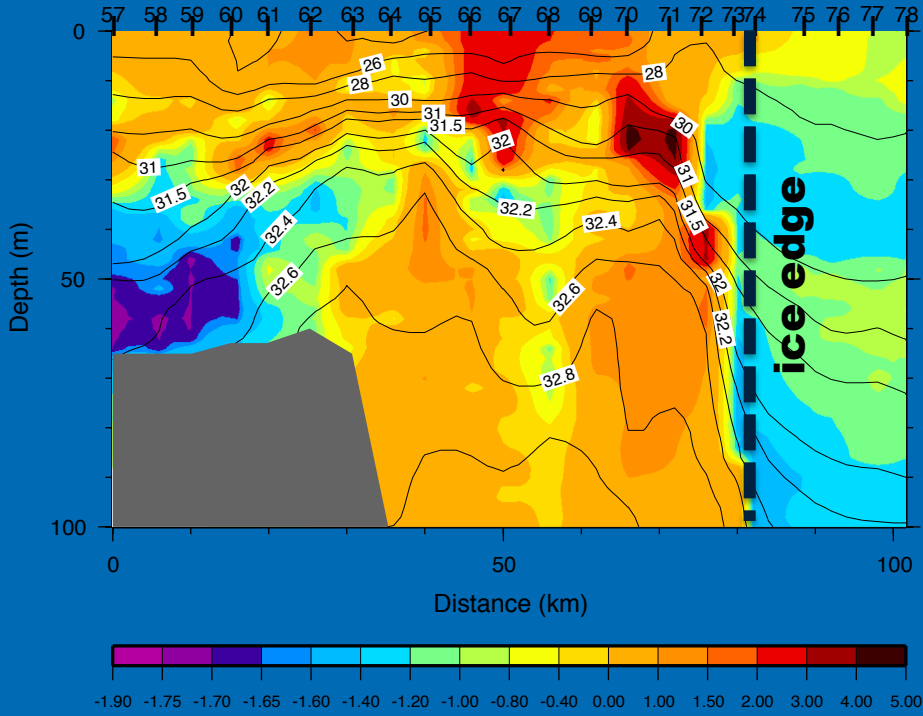


d July 19, 2011



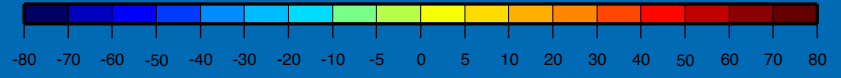
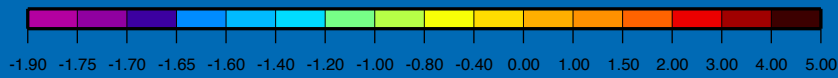
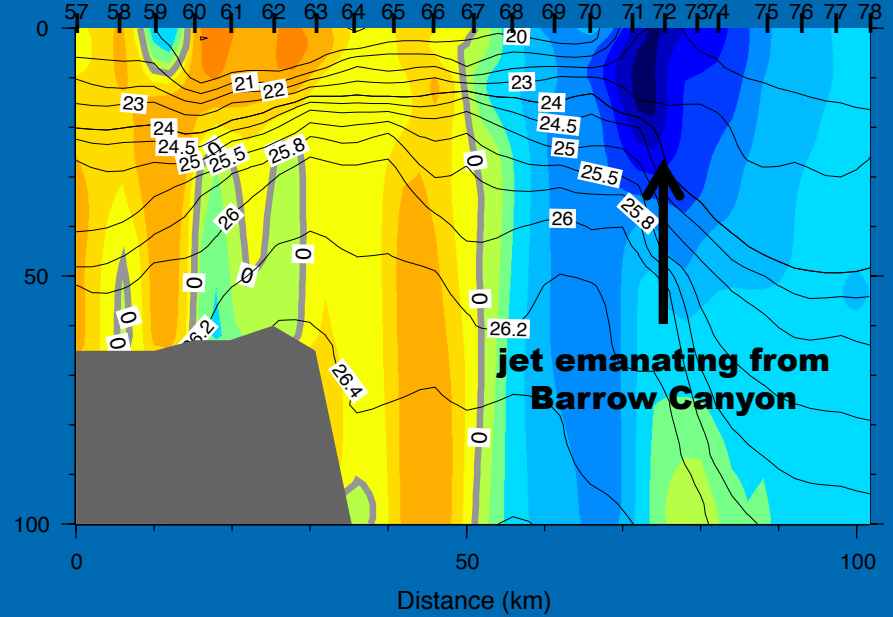
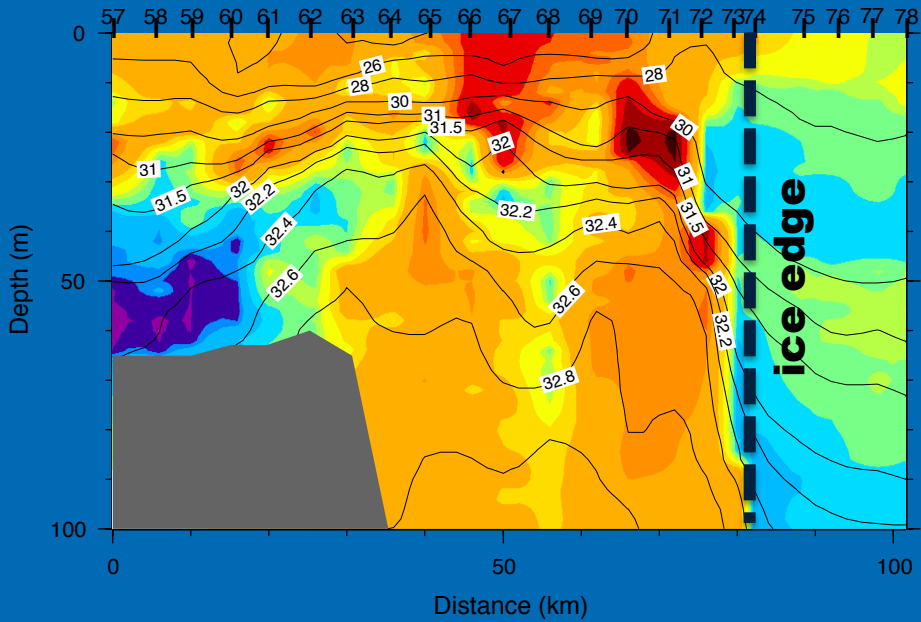
SST (°C)

July 17, 2011



viewer is looking to the west

July 17, 2011

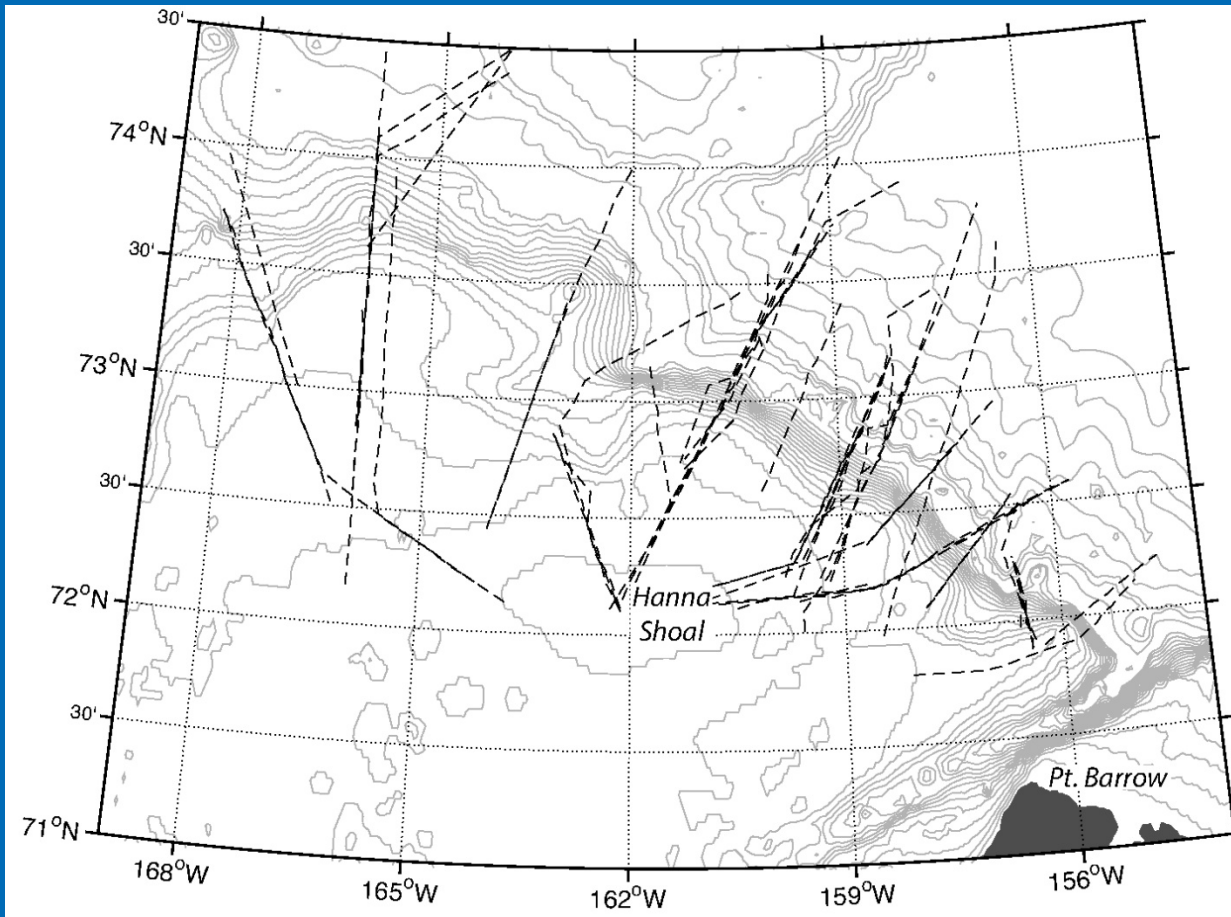


Temperature (color) overlain
by salinity (contours)

velocity (color) overlain
by salinity (contours)

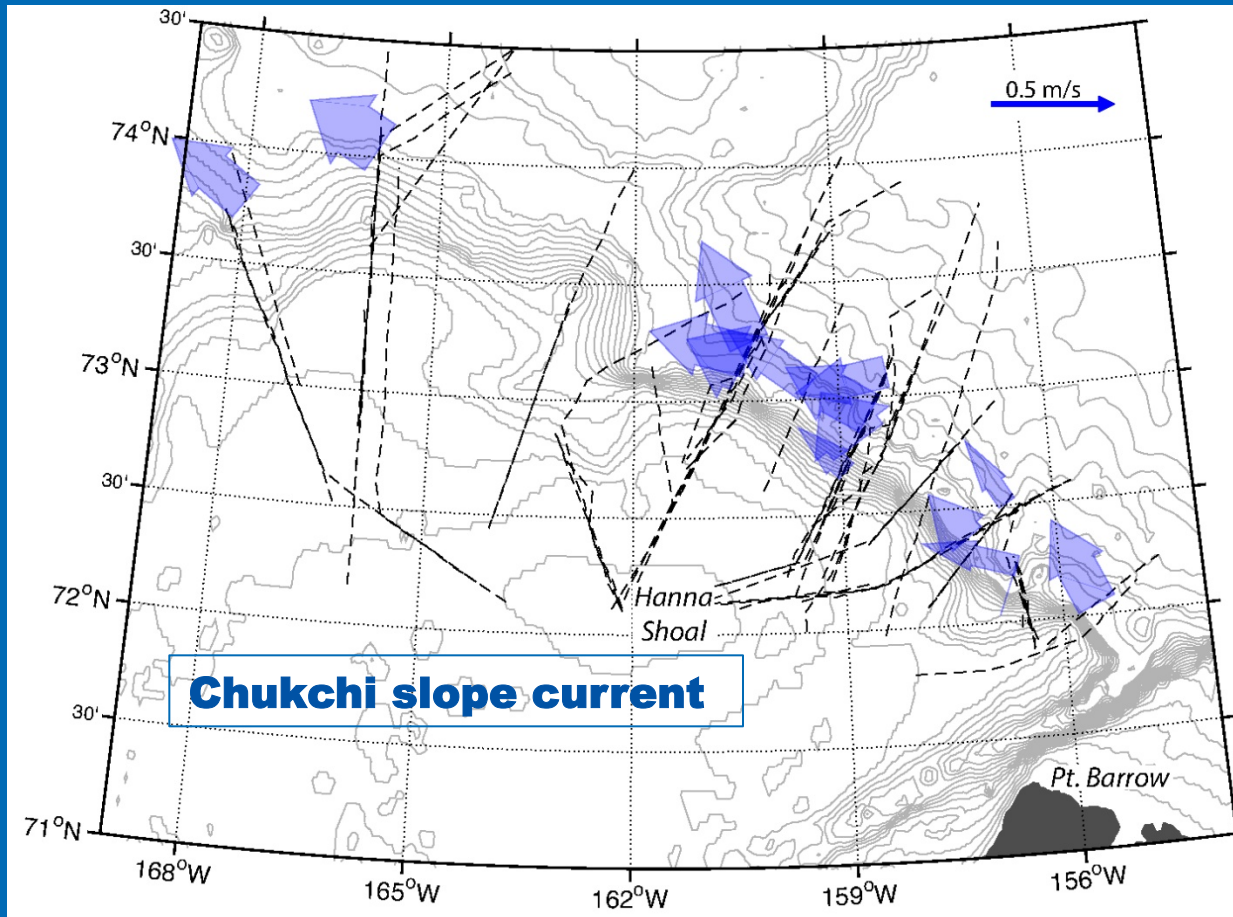
viewer is looking to the west

Chukchi slope sections



Corlett and Pickart (in prep)

Chukchi slope sections



Conclusions

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Consequently, warm summer water exits Barrow Canyon directly into the basin where it contributes significantly to ice melt

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Consequently, warm summer water exits Barrow Canyon directly into the basin where it contributes significantly to ice melt

Is this a regime shift or an interannual oscillation?