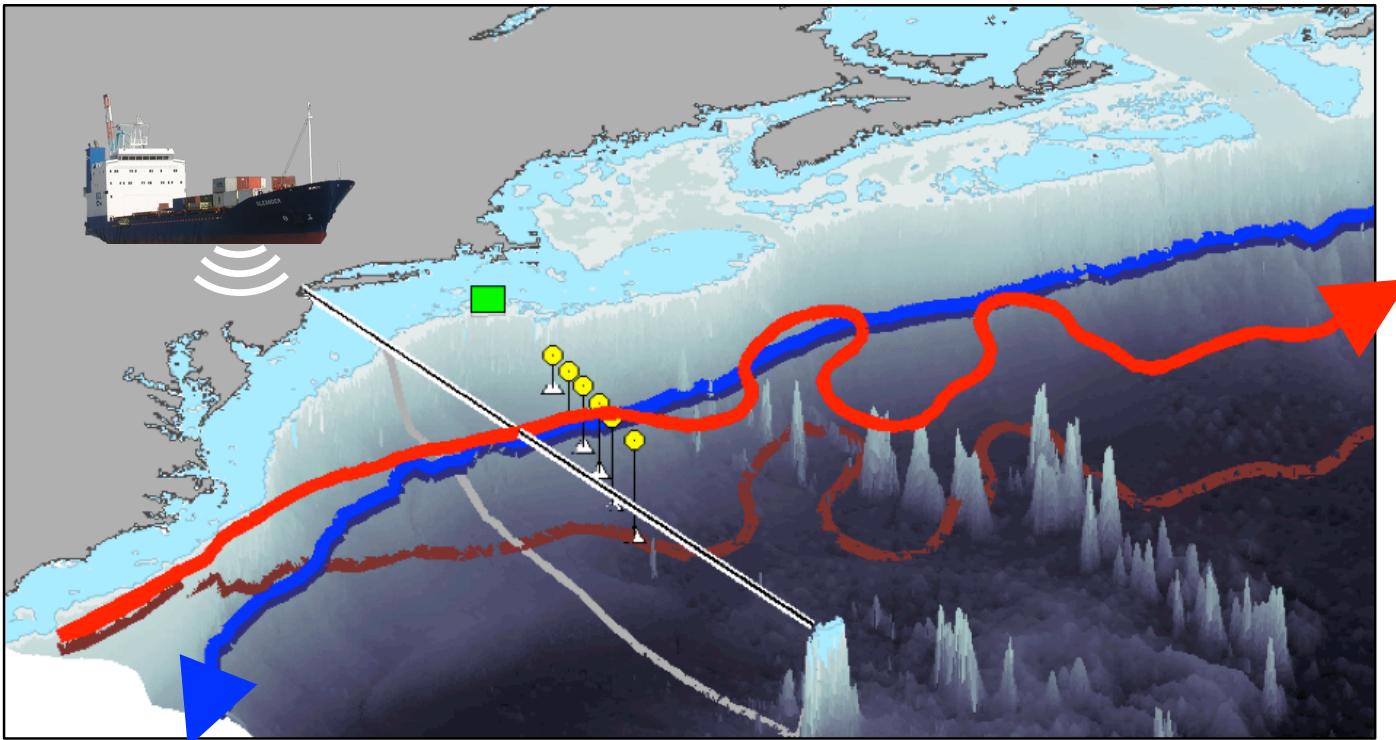


Session 1:

AMOC observing system implementation and evaluation

- 1) What is the observed AMOC variability and what are the underlying mechanisms driving variability?
- 1a) What gaps do we have in the present AMOC observing system?
- 2) What is the meridional coherence of the observed AMOC?
- 3) What technological advances and novel combinations of existing technologies can be used to make AMOC observations sustainable into the future? Status of present/previous AMOC observational elements?

The Role of a Changing Gulf Stream in Driving Enhanced Exchange between the Deep Western Boundary Current and Interior



Magdalena Andres

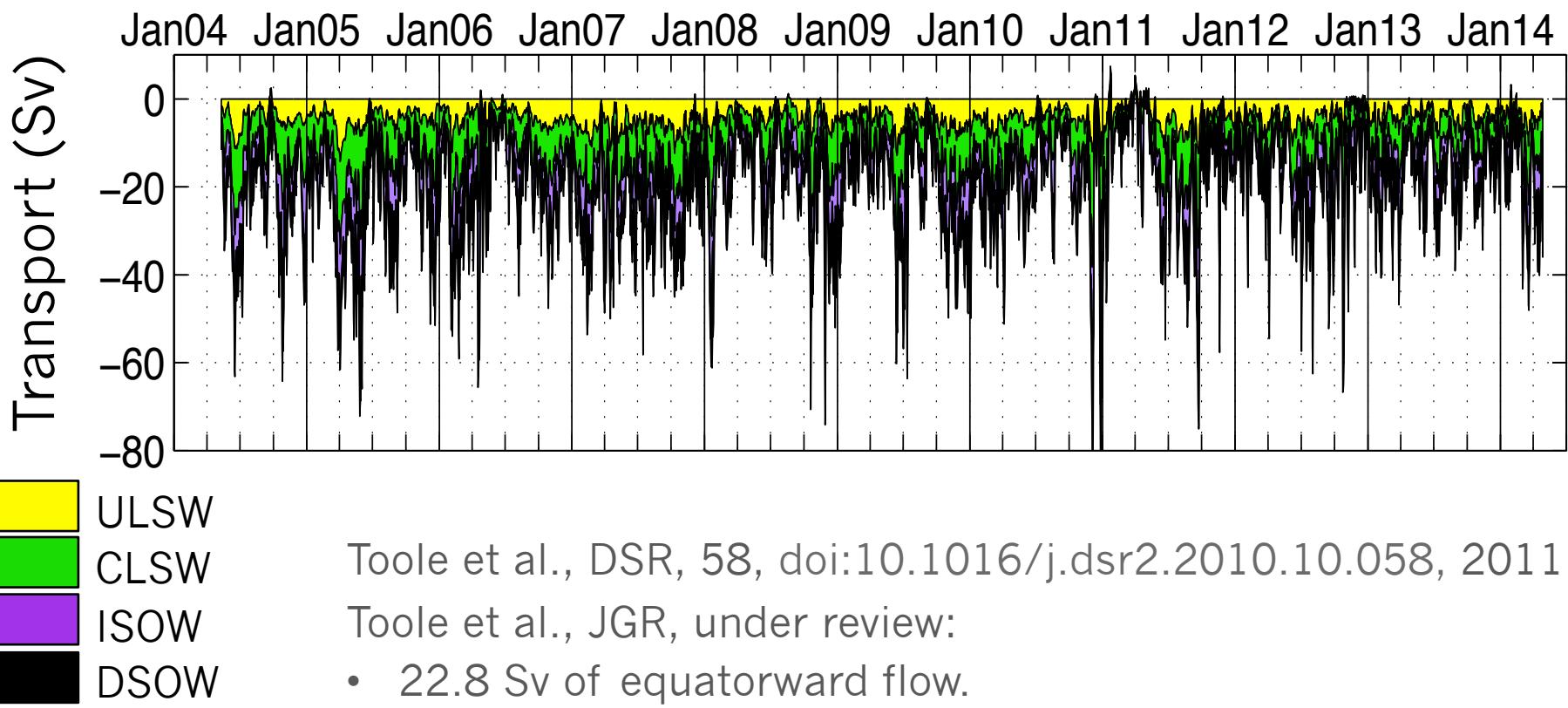
Woods Hole Oceanographic Institution



Session 1: Observing Systems Implementation and Evaluation
US AMOC Science Team Meeting | Santa Fe, NM | 23-25 May 2017

DWBC Transport at Line W

from 10 years of mooring measurements near 39°N



See John Toole's poster (presented by Isabela LeBras): Moored observations of the Deep Western Boundary Current in the NW Atlantic 2004-2014.

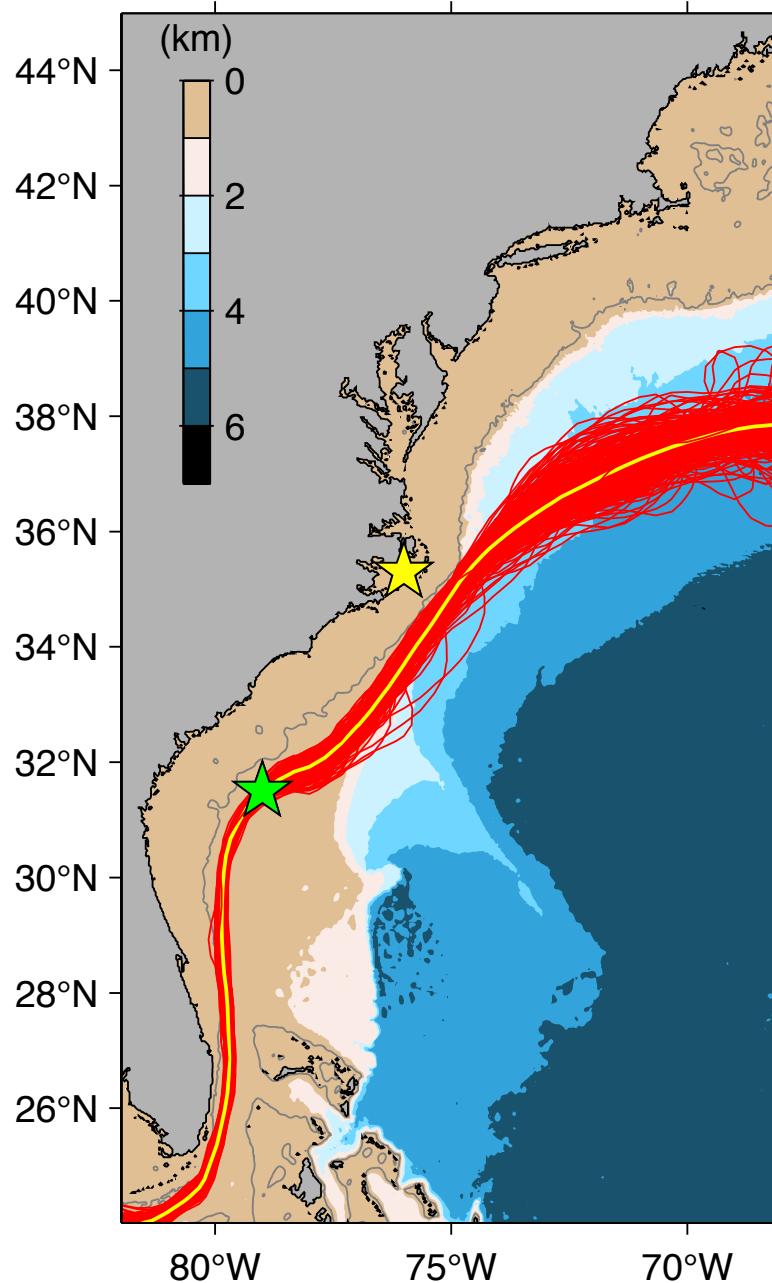
The Meandering Gulf Stream

consequences for the Middle Atlantic Bight and the Abyss

Goals for today (2 of 3):

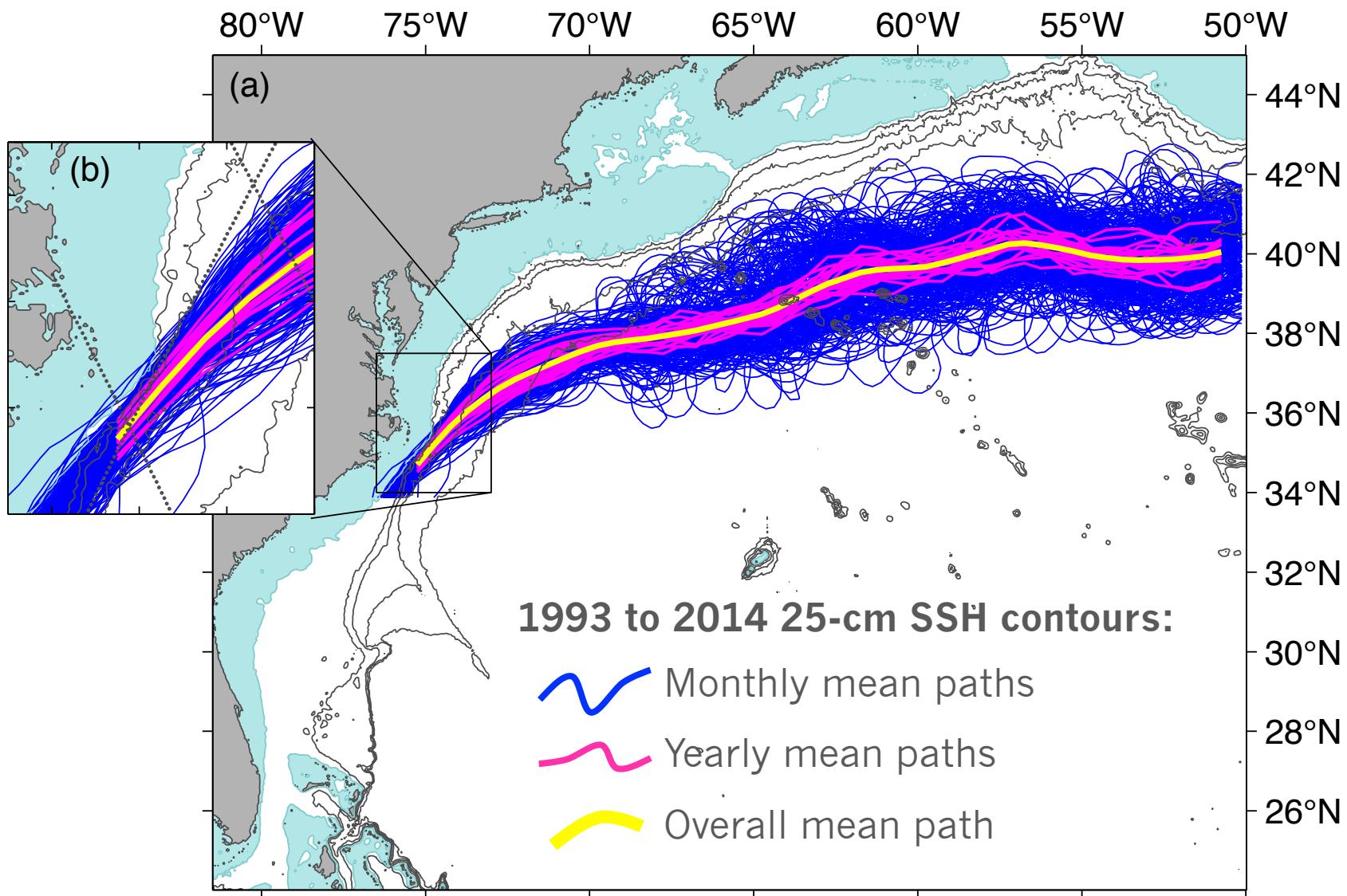
- Define Gulf Stream Destabilization Point and convince you that it is undergoing interesting changes.
- Convince you that these changes are relevant for the DWBC: (deep cyclogenesis under Gulf Stream meanders affects the DWBC).
- Speculate on why the Gulf Stream is undergoing these changes (forced vs. intrinsic variability).

Gulf Stream position: tightly constrained until Cape Hatteras

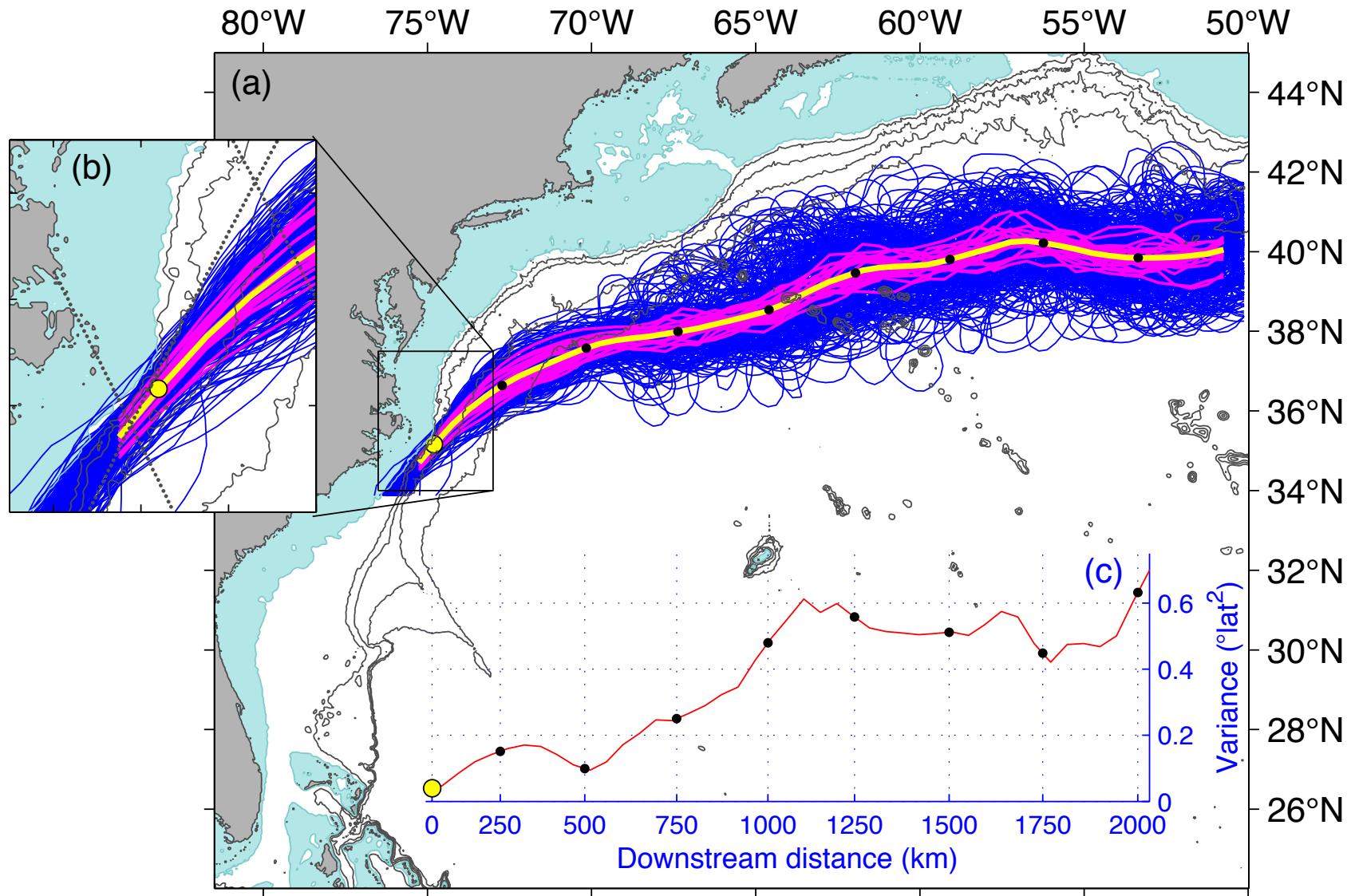


- Gulf Stream path from 40-cm SSH contours (**monthly means**).
- 1993-2013 **overall mean** Gulf Stream path.
- Cape Hatteras.
- Charleston Bump.

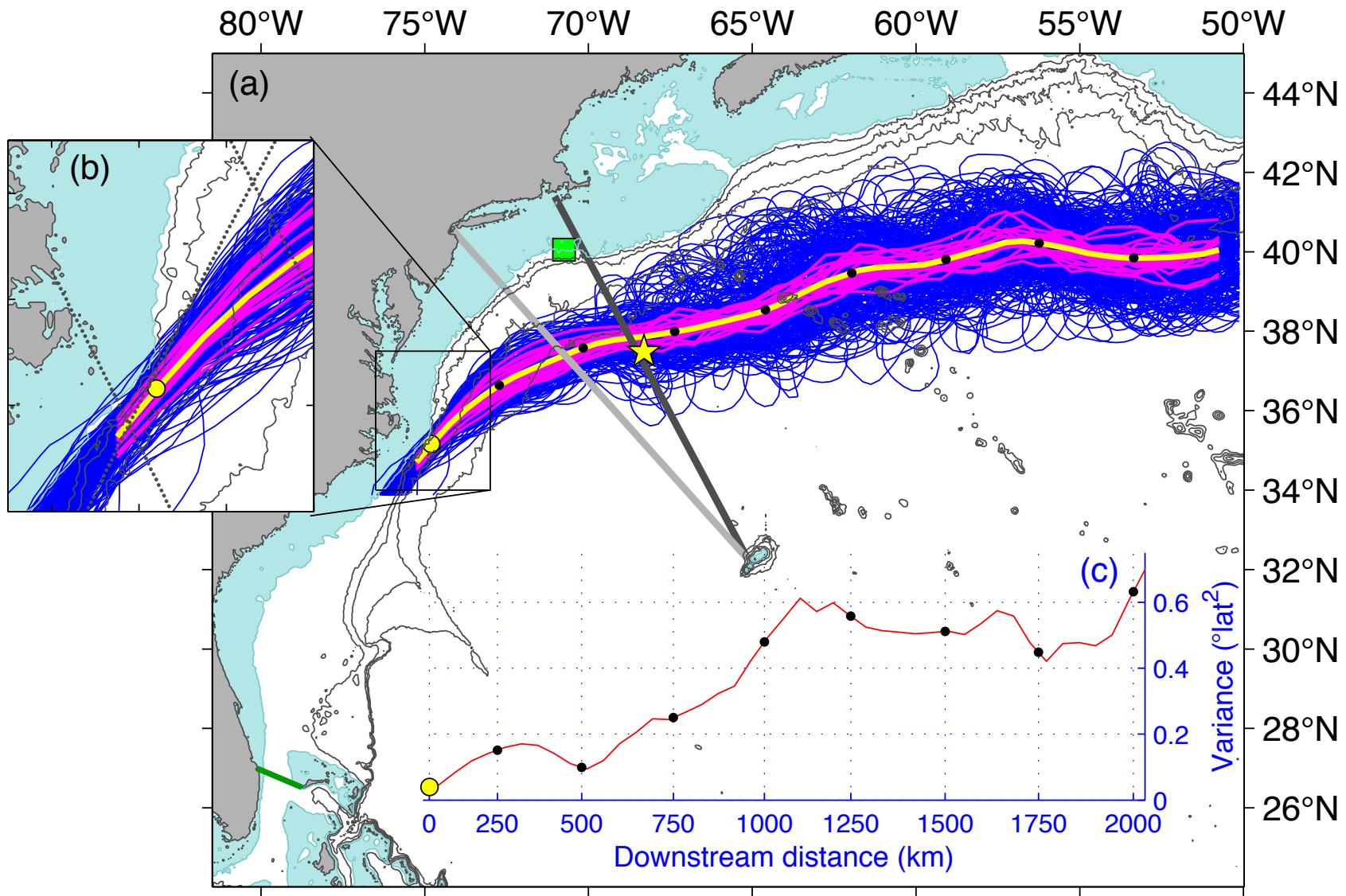
The Gulf Stream gets very wiggly beyond 70°W



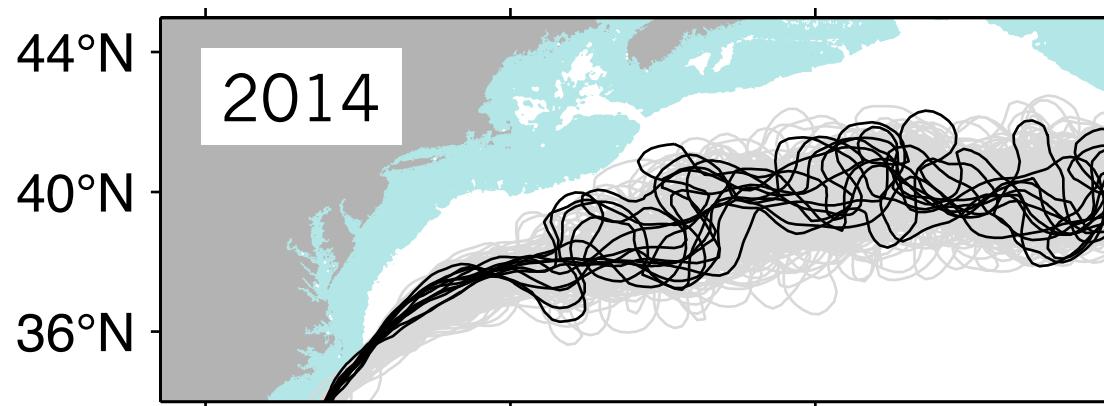
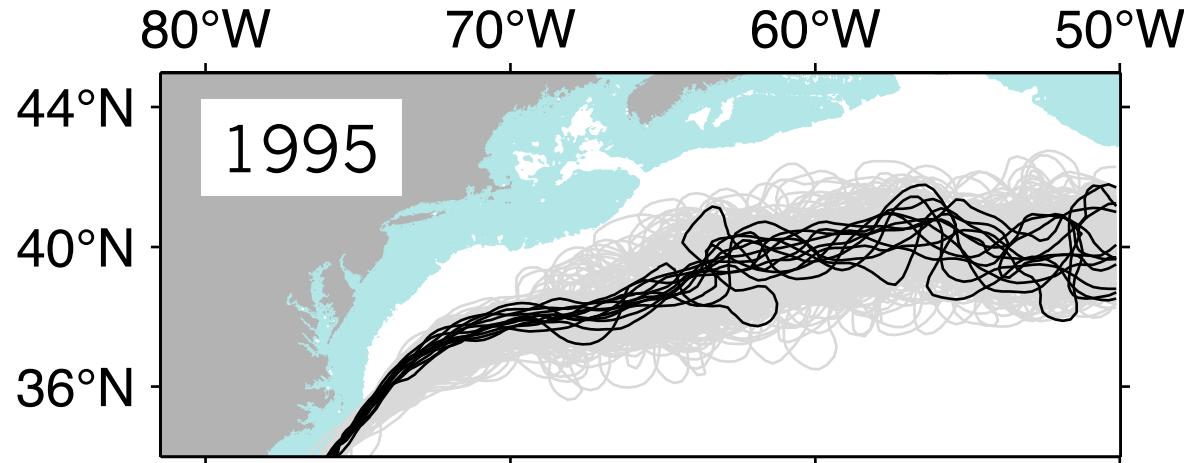
The Gulf Stream gets very wiggly beyond 70°W



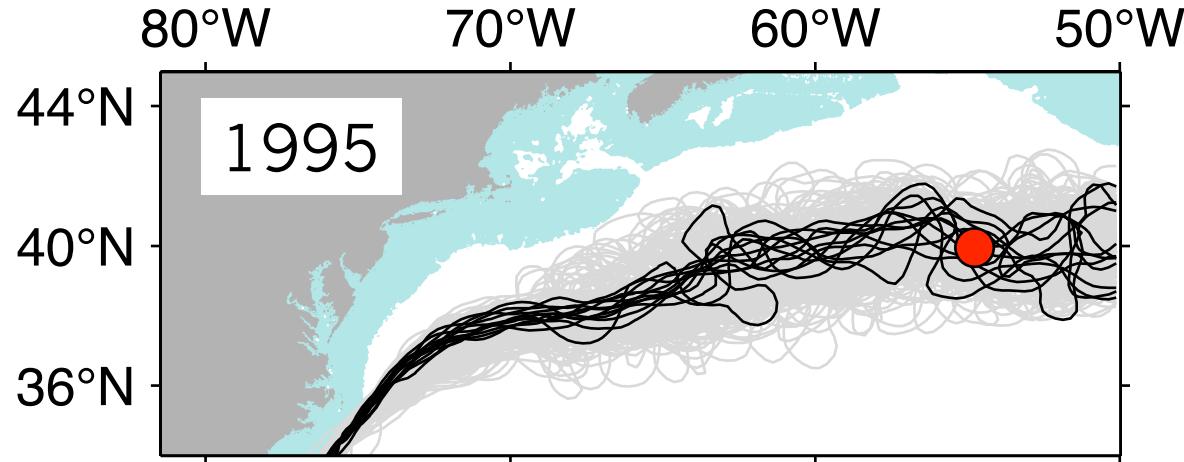
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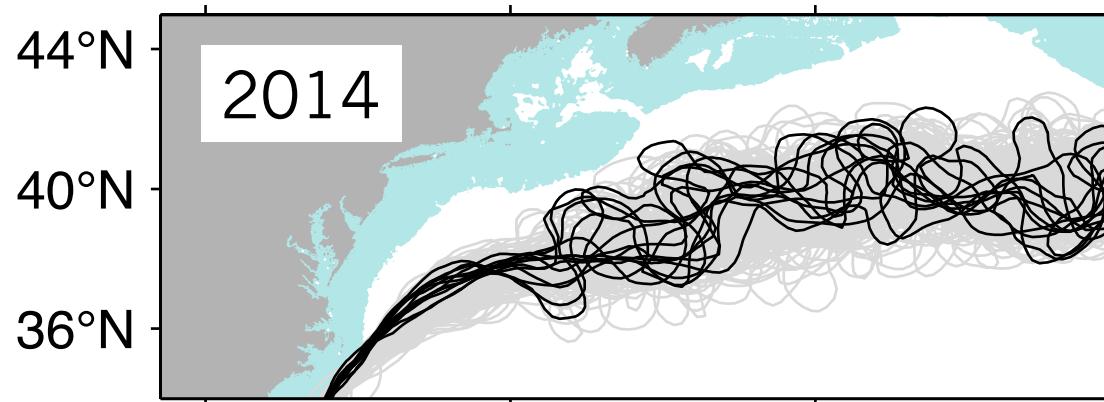
Some years are more wiggly than others:



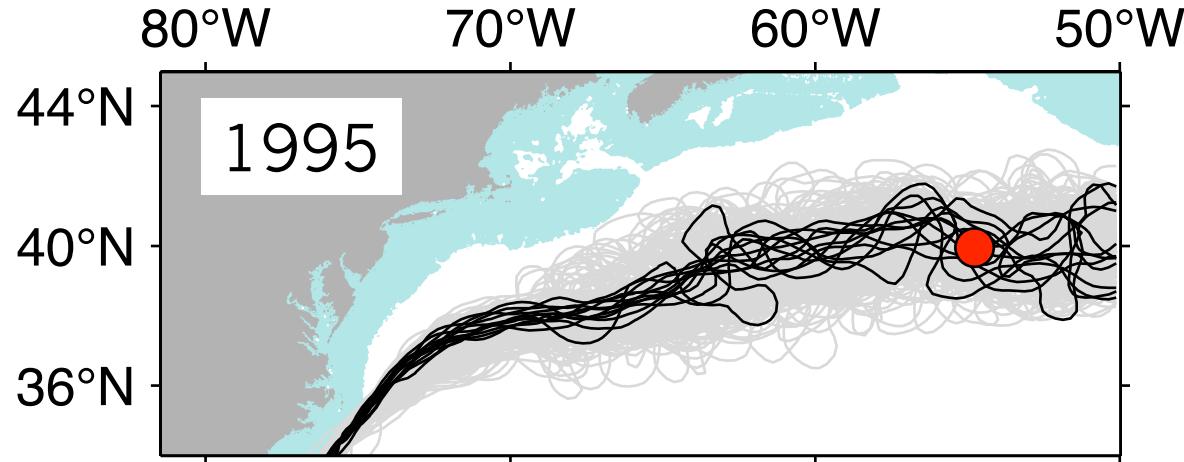
Some years are more wiggly than others:



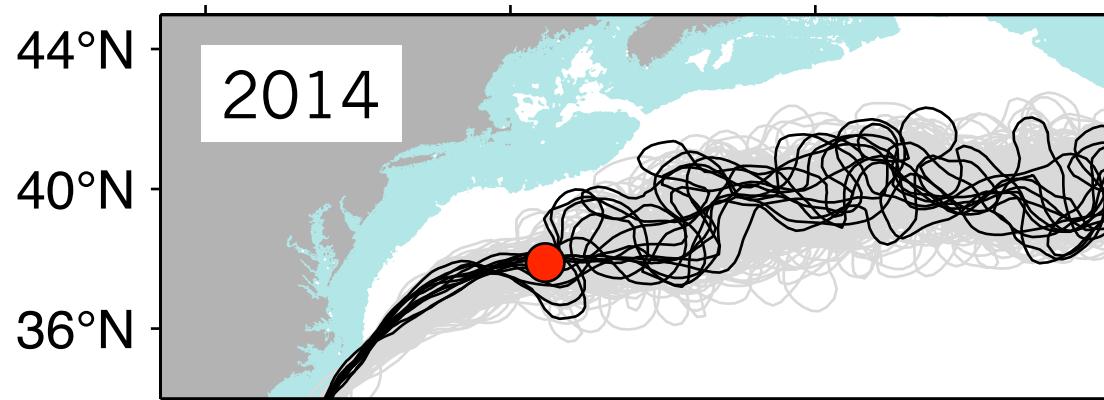
- Longitude where variance first reaches $(0.5^\circ\text{lat})^2$



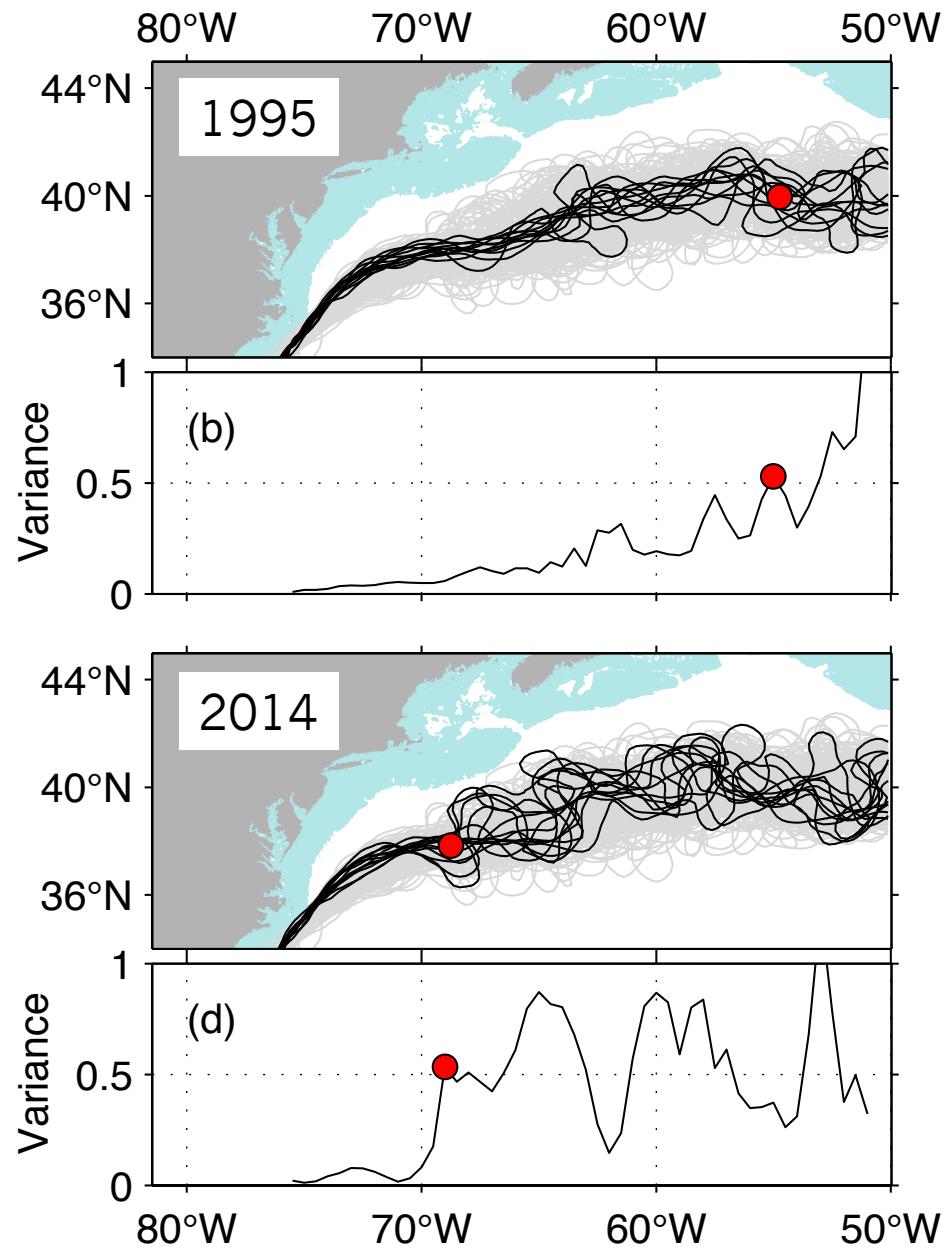
Some years are more wiggly than others:



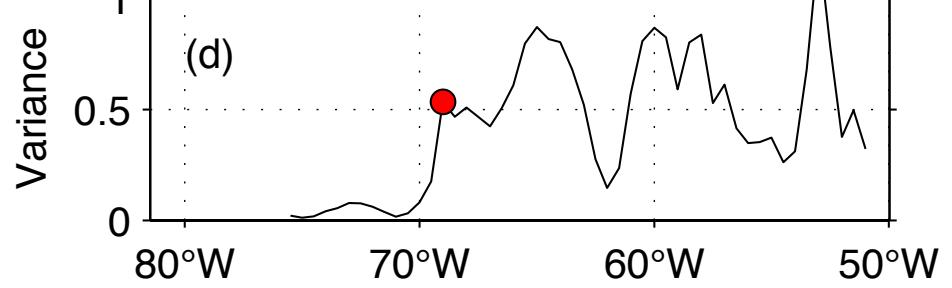
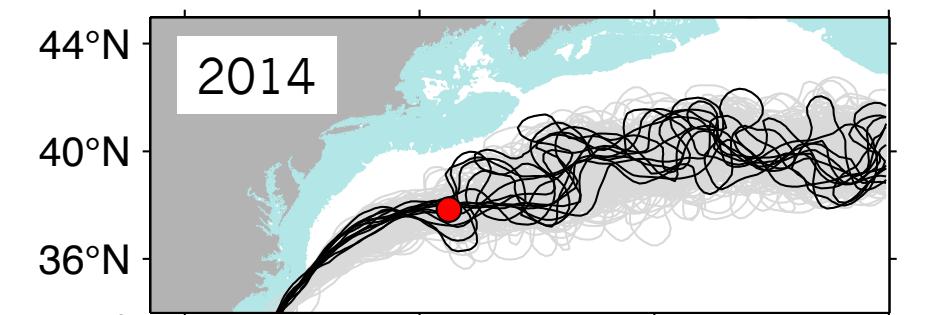
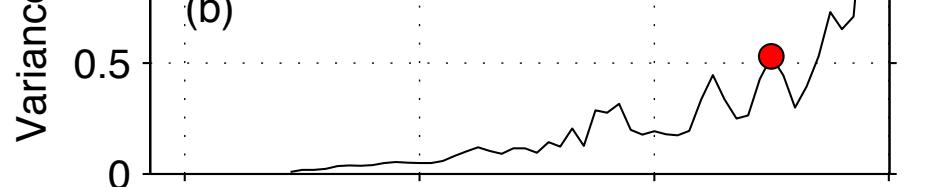
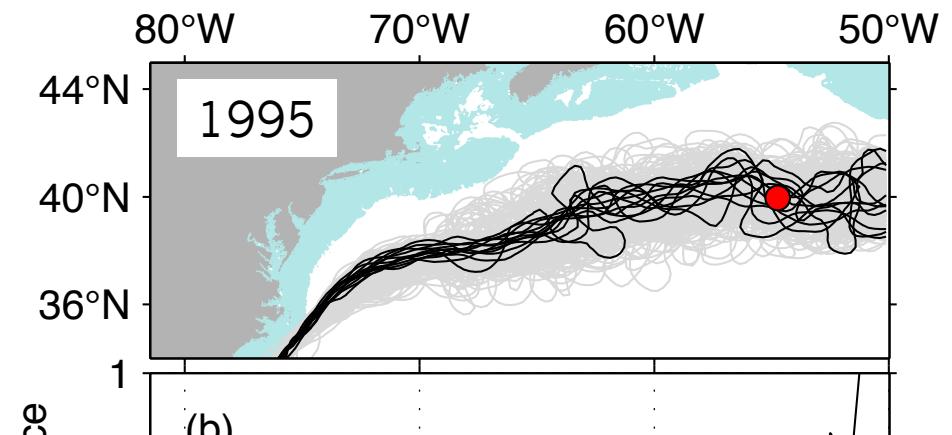
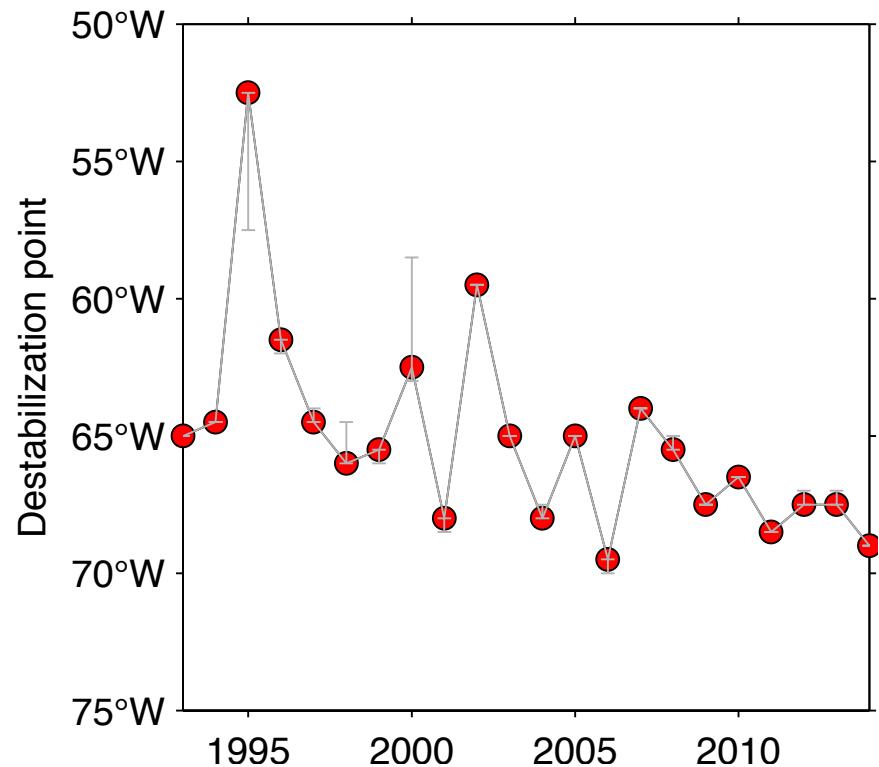
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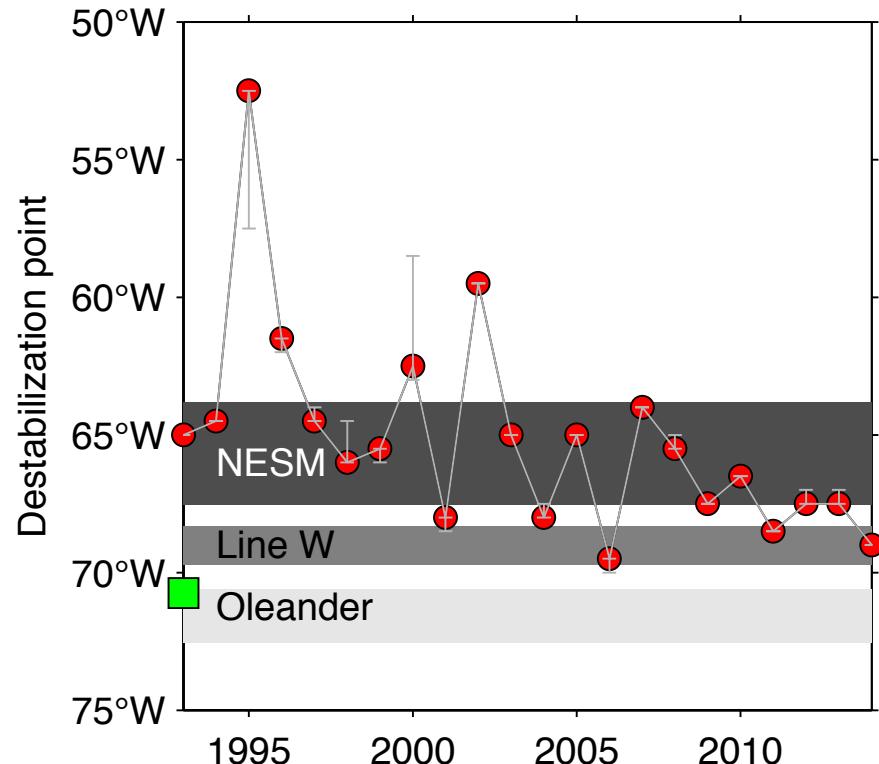
Some years are more wiggly than others:



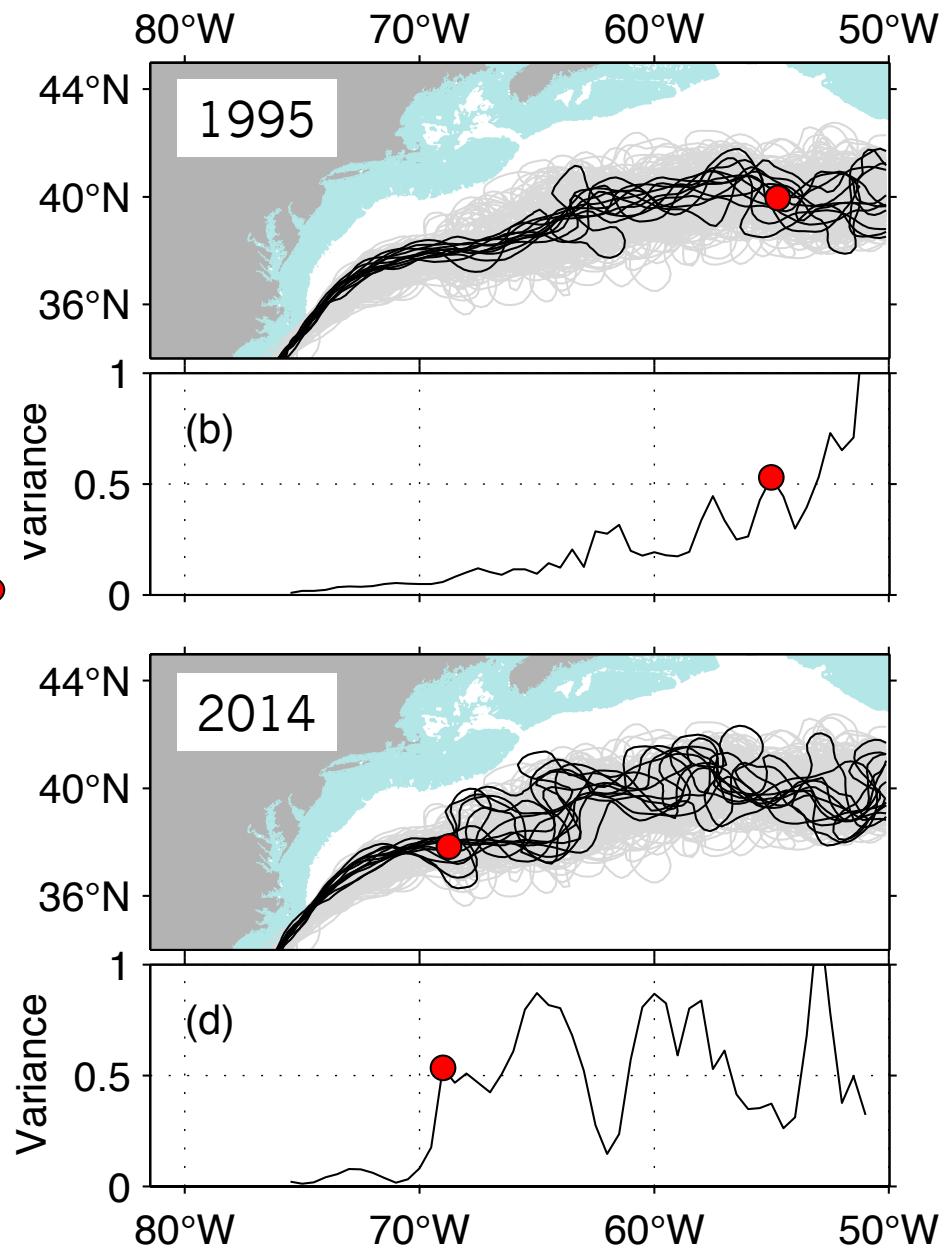
Some years are more wiggly than others:



Location where GS gets “wiggly” is moving west.



Lately things have gotten wiggly west of the New England Sea Mount Chain.



The Meandering Gulf Stream

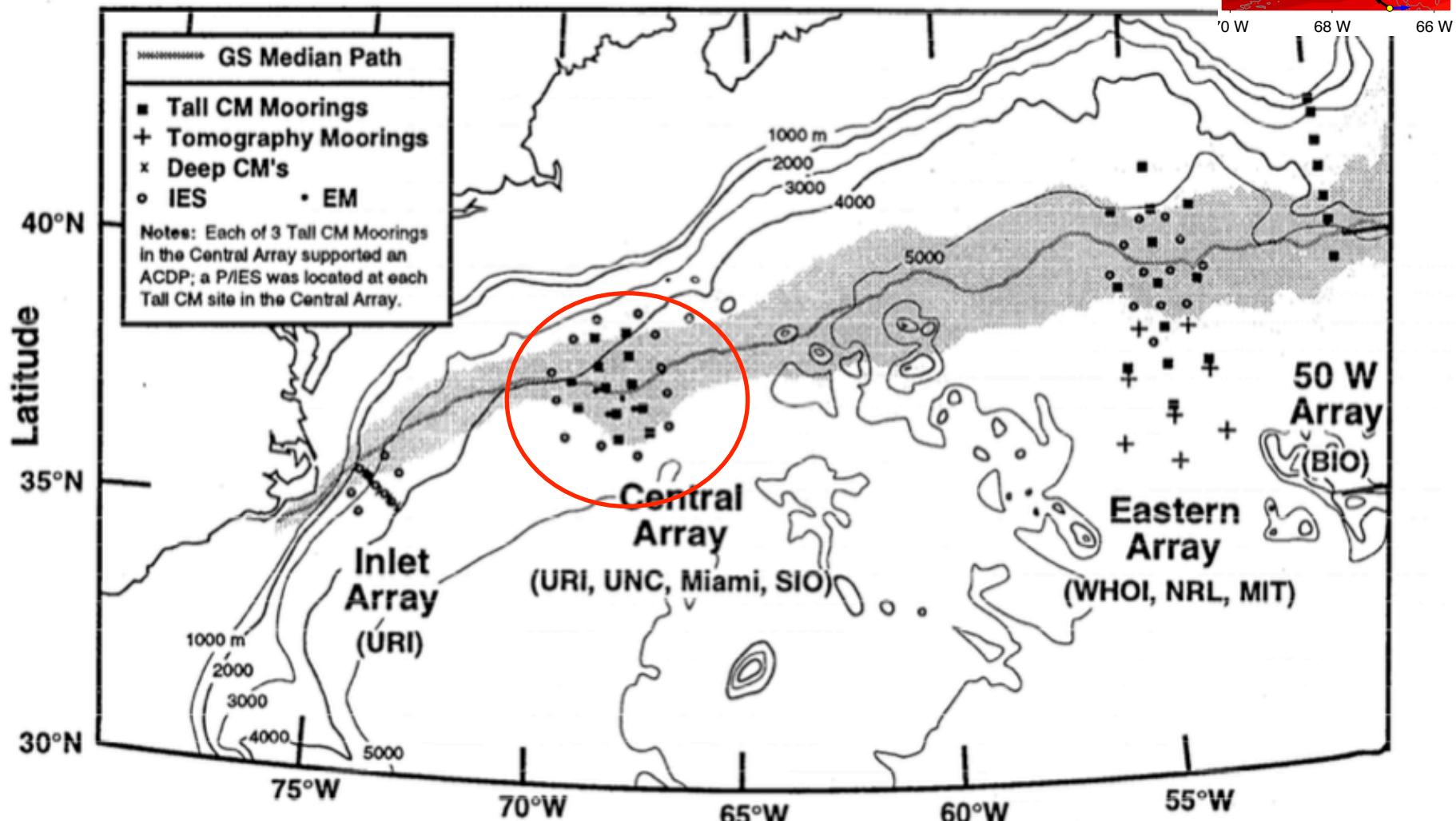
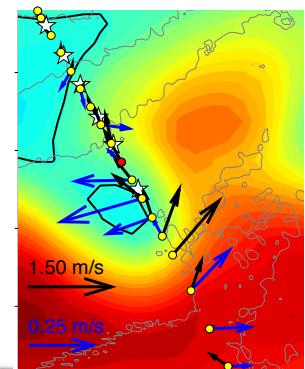
consequences for the Abyss

Goals for today (2 of 3):

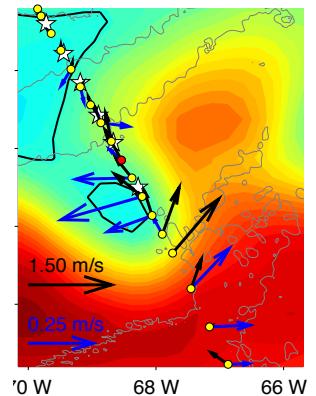
- Define Gulf Stream Destabilization Point and convince you that it is undergoing interesting changes
- Convince you that these changes are relevant for the DWBC
- Speculate on why the Gulf Stream is undergoing these changes (forced vs. intrinsic variability?)

The SYNOP Central Array

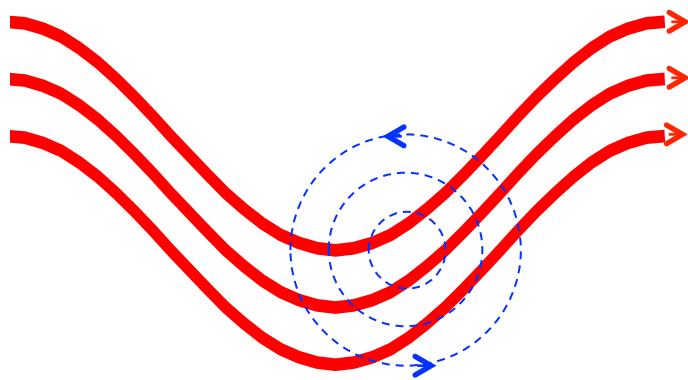
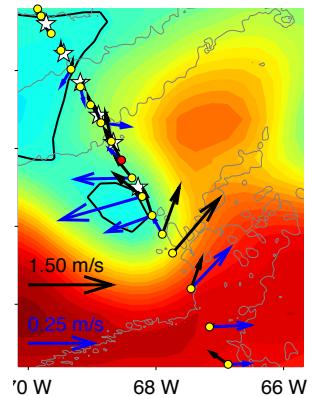
June 1988 – August 1990



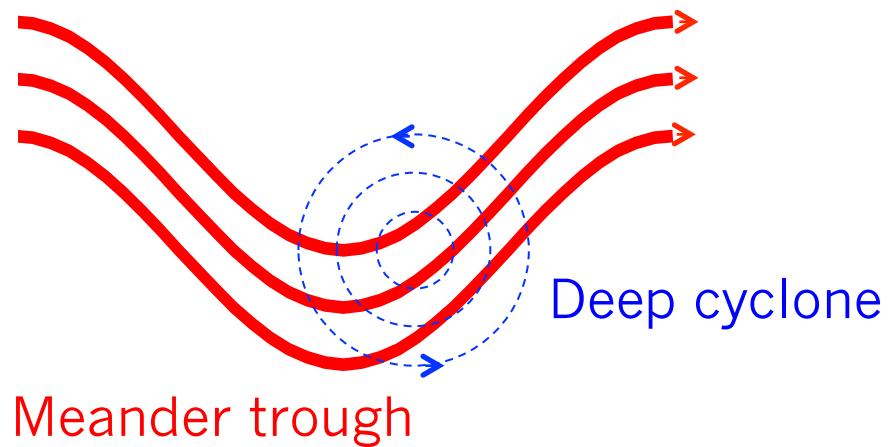
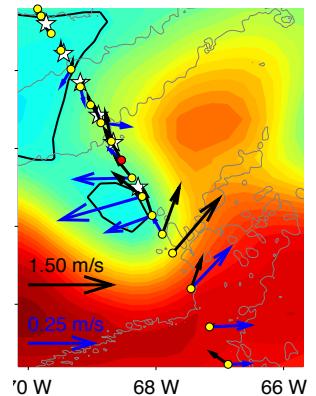
Deep Cyclogenesis under Gulf Stream Meanders



Deep Cyclogenesis under Gulf Stream Meanders

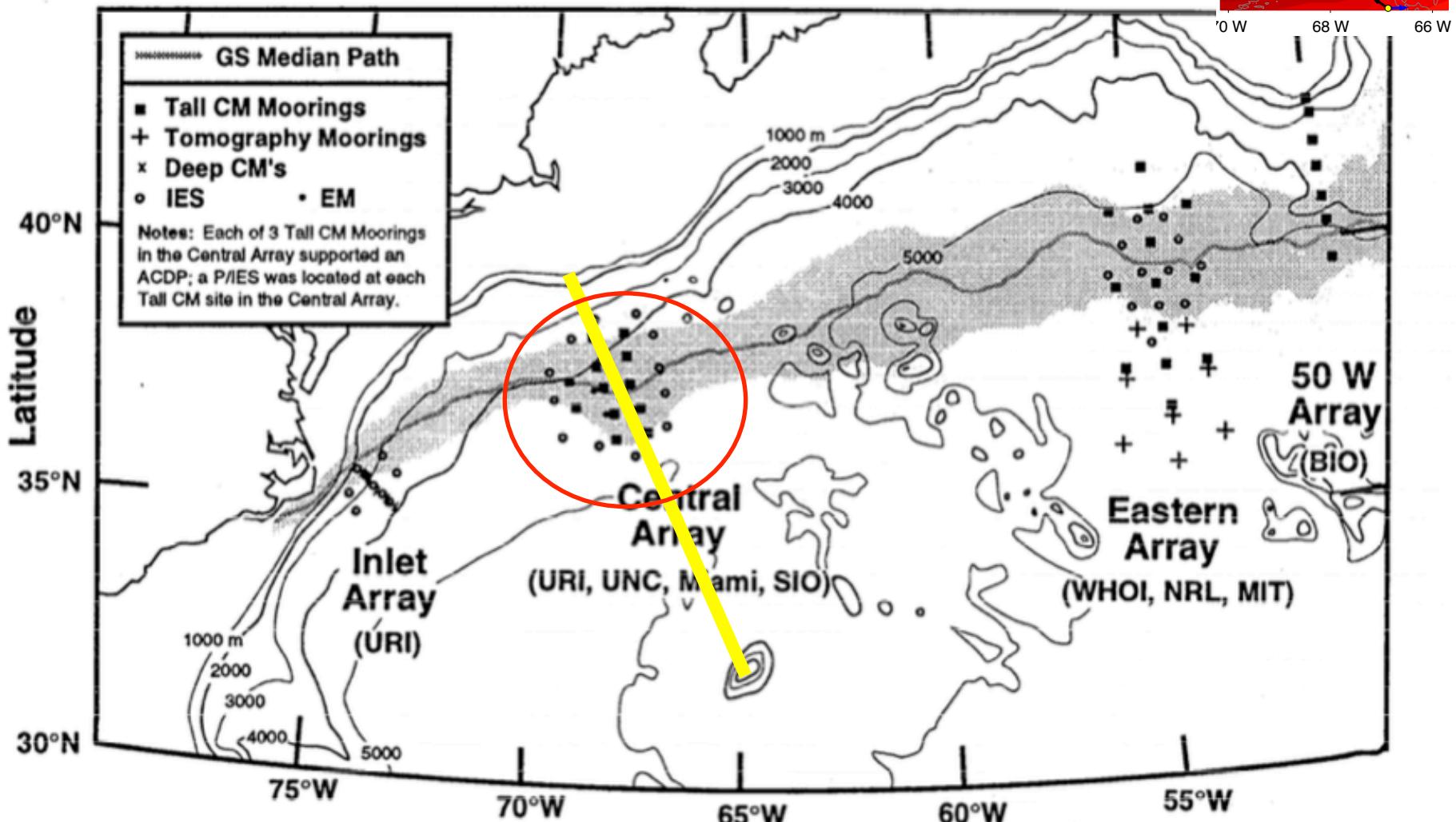
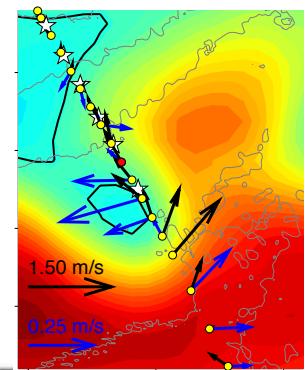


Deep Cyclogenesis under Gulf Stream Meanders

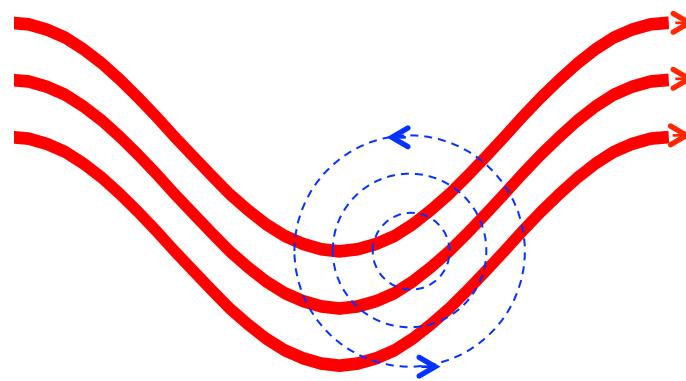


The SYNOP Central Array

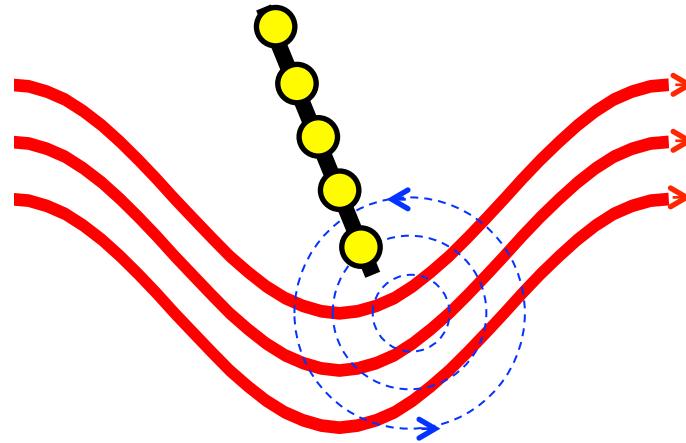
June 1988 – August 1990



Does Deep Cyclogenesis under Gulf Stream Meanders Influence the DWBC?



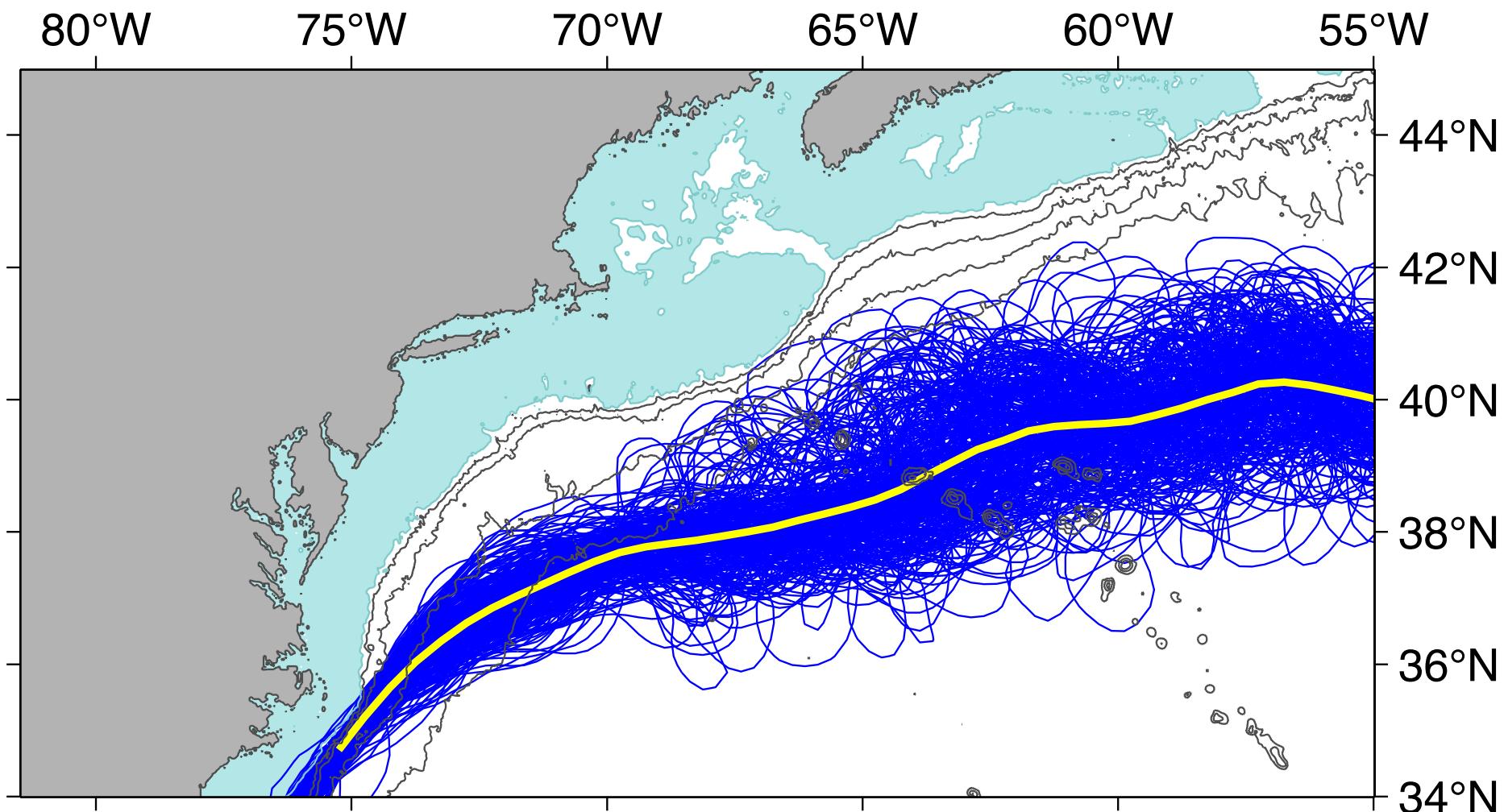
Does Deep Cyclogenesis under Gulf Stream Meanders Influence the DWBC?



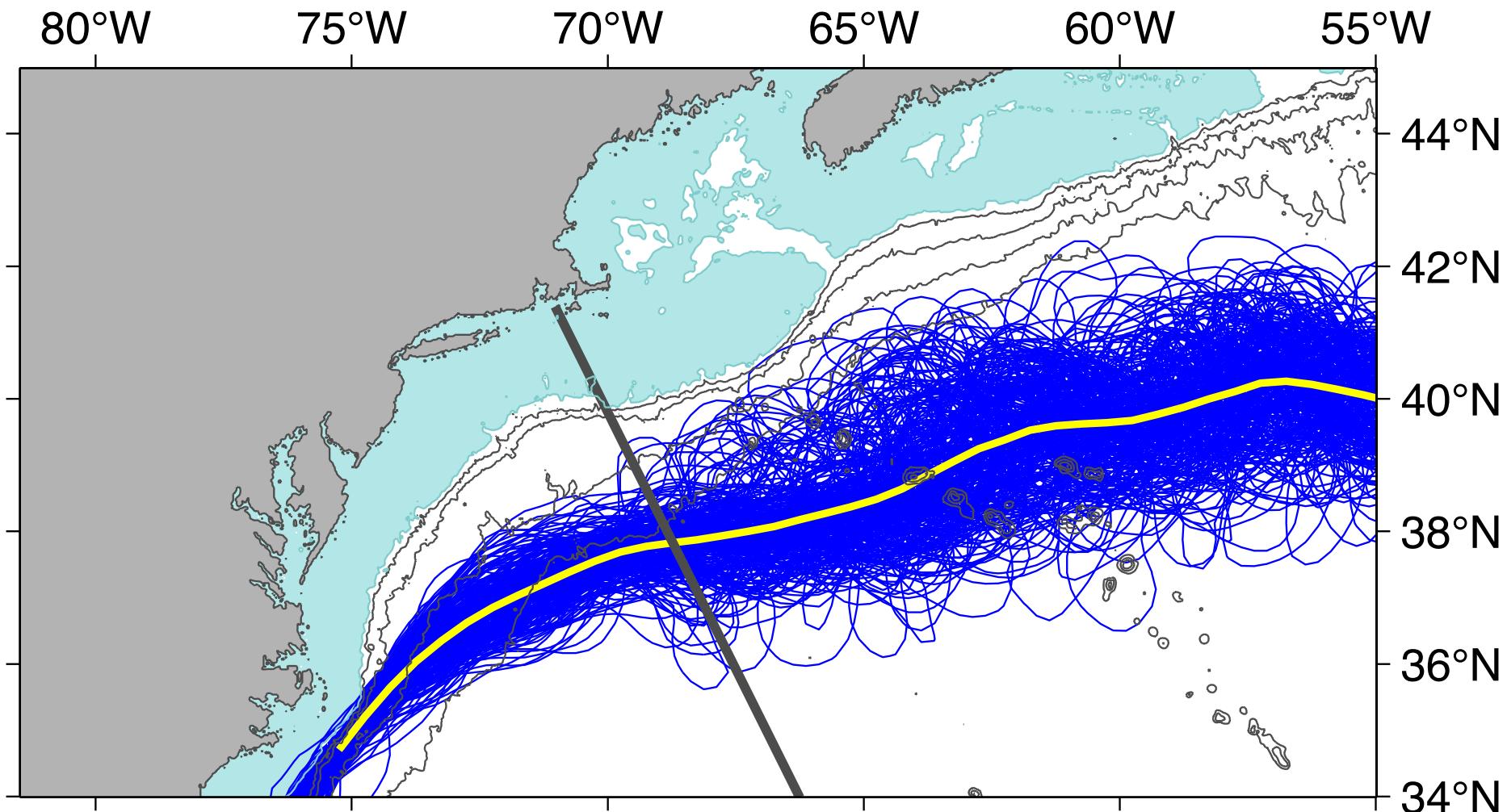
Yes!

- transport variability in the DWBC
- water exchange between the DWBC and deep interior

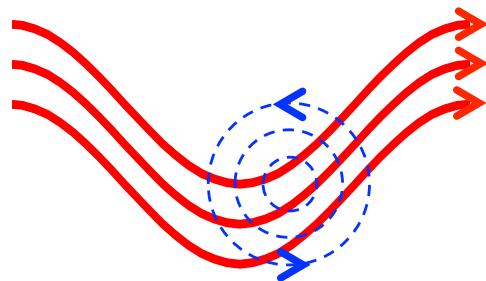
Consequences for the abyss



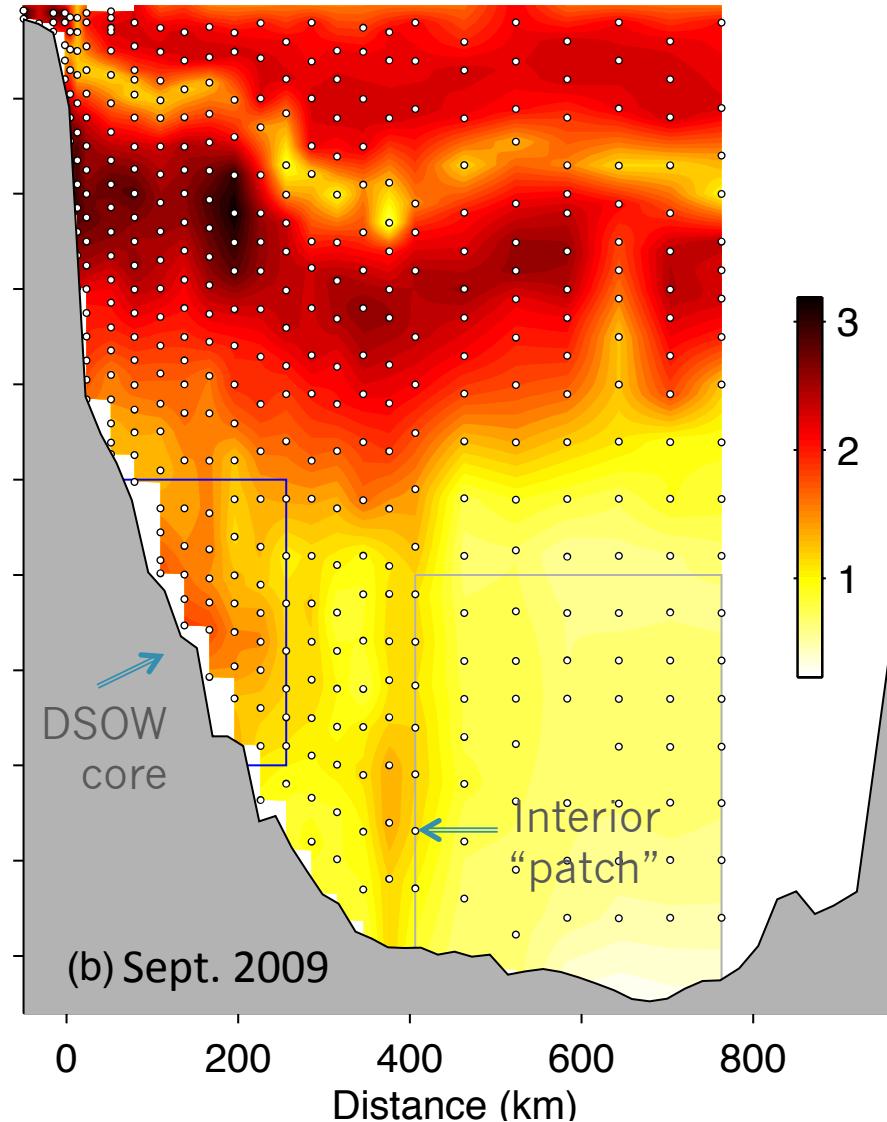
Consequences for the abyss



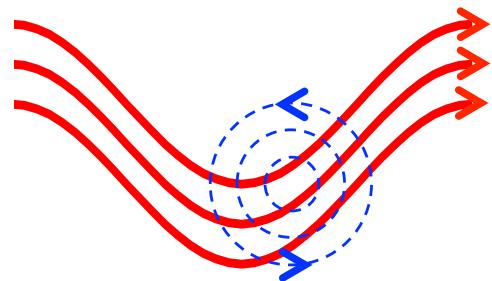
Proximity of the Gulf Stream to the slope: (where the meanders occur matters)



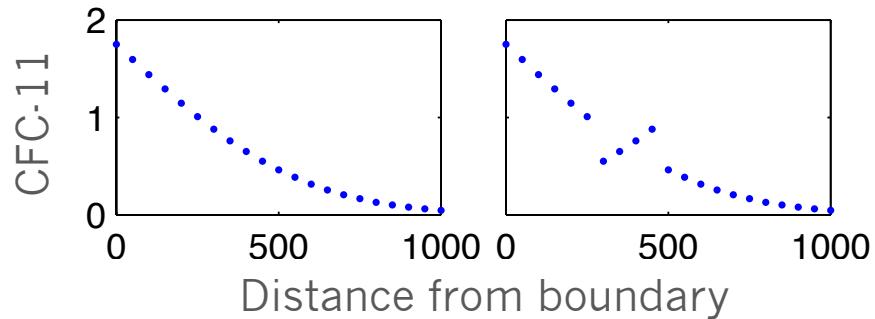
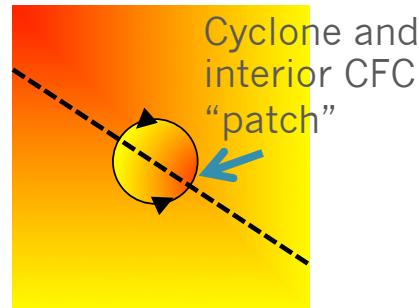
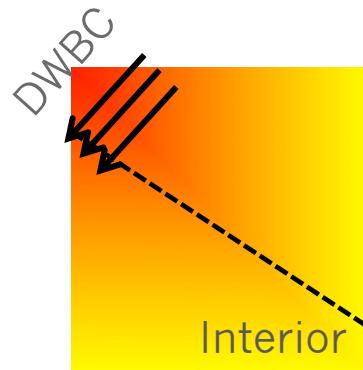
CFC-11 at Line W (pmol kg^{-1})



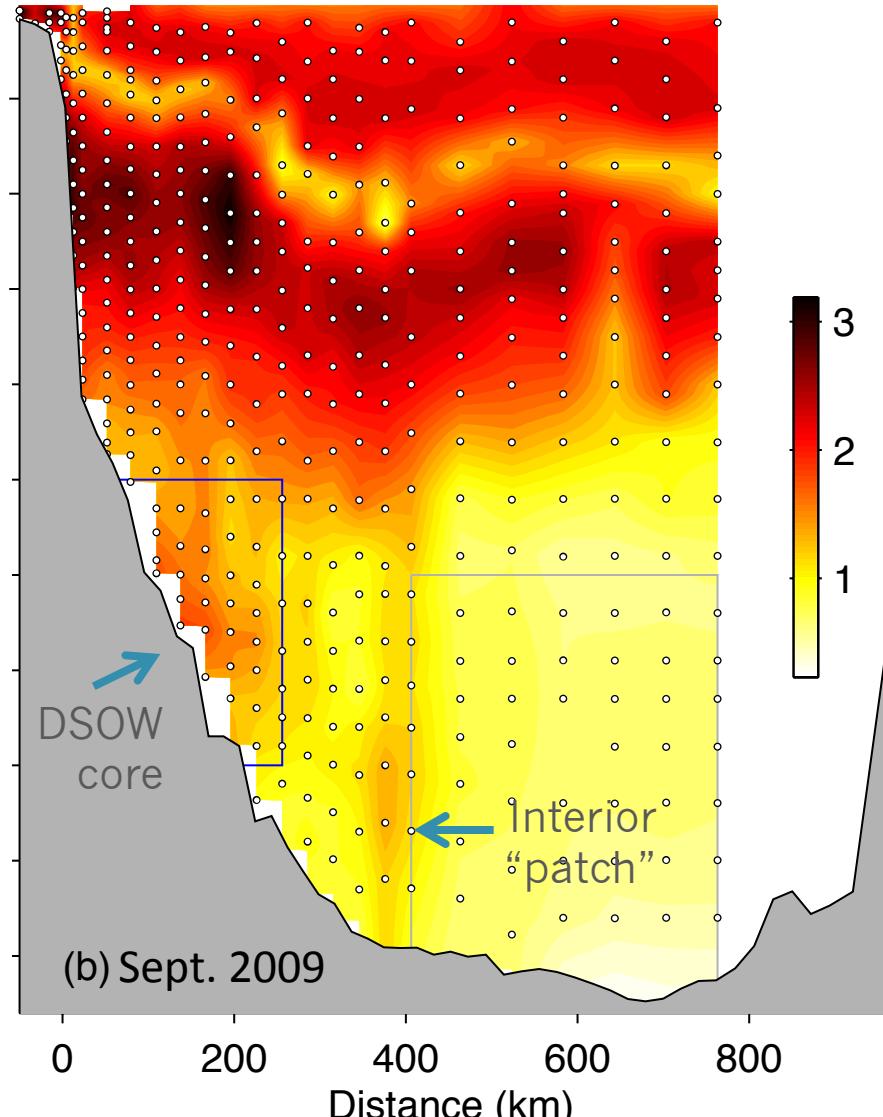
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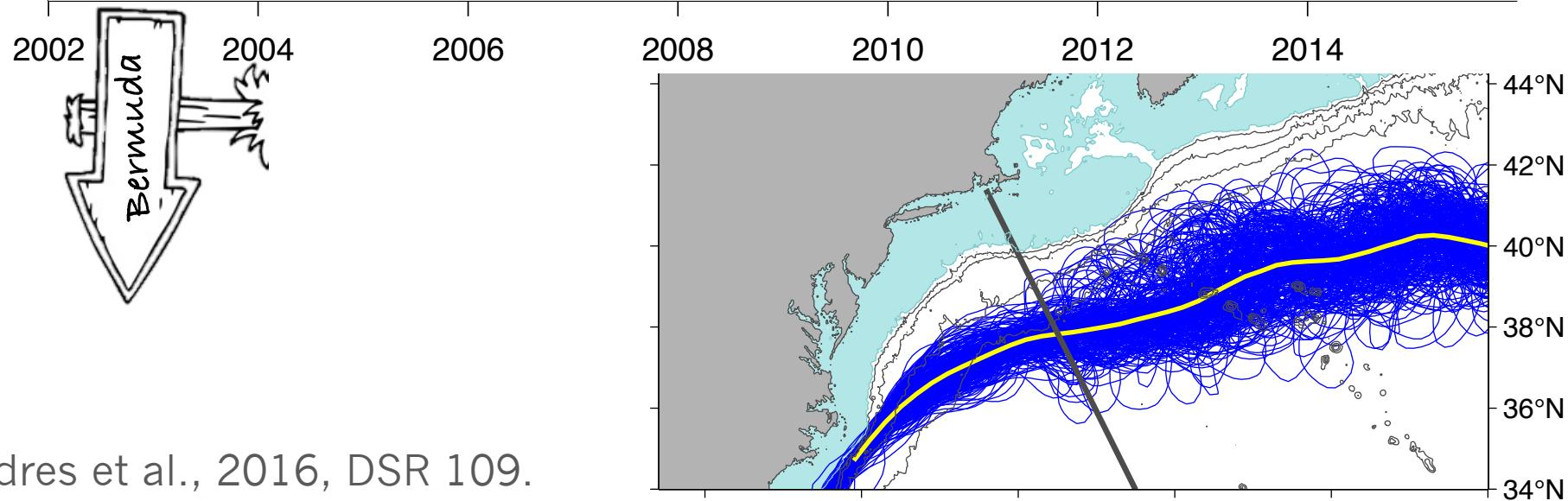
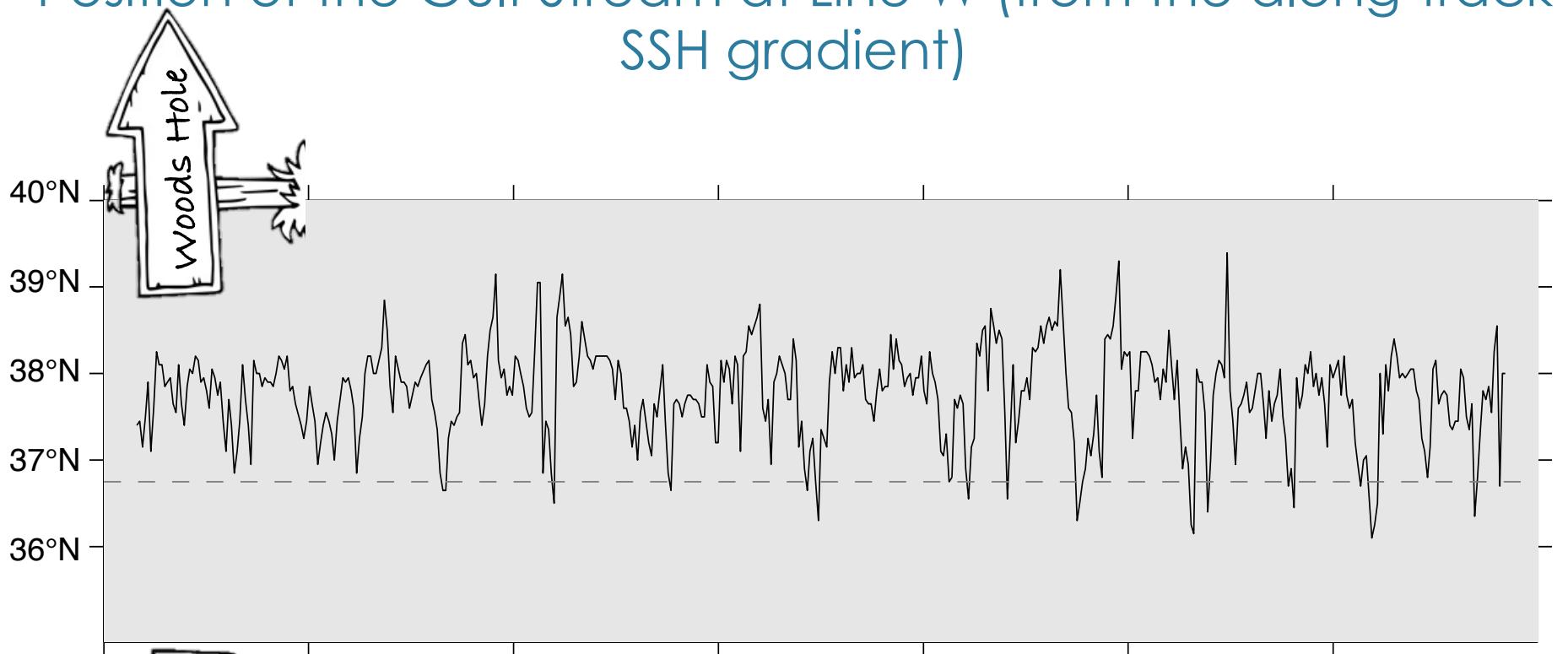
Map views of abyssal CFC concentration:



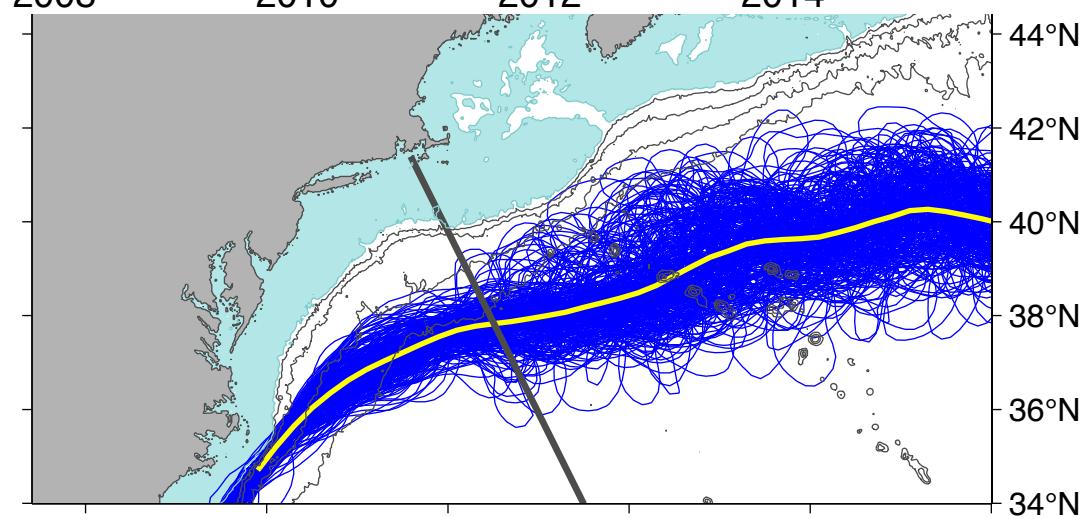
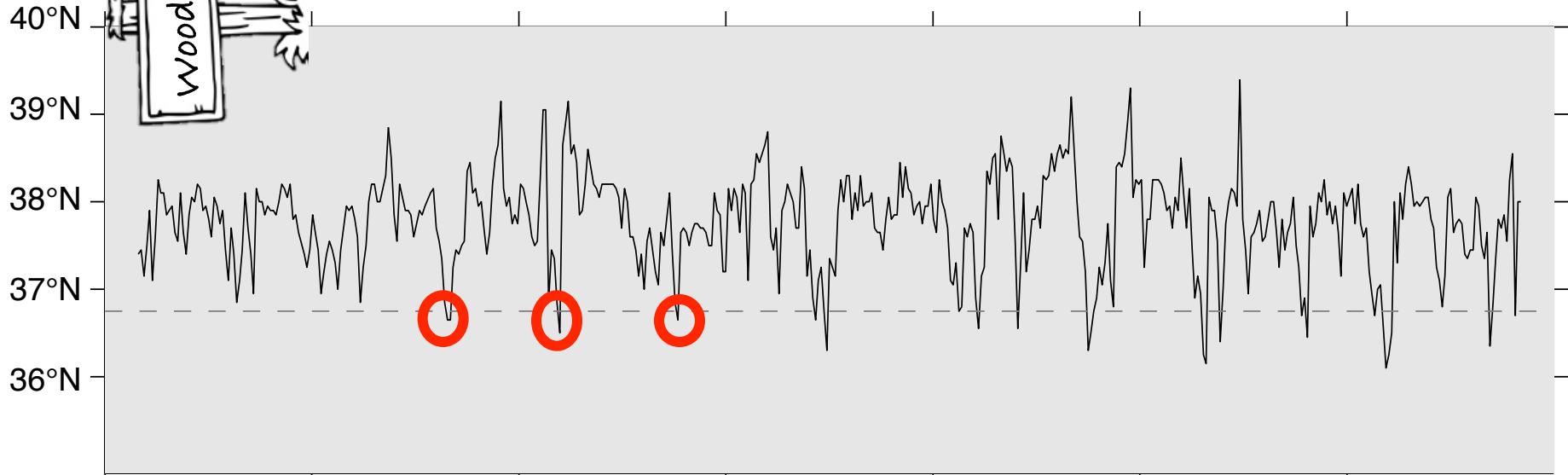
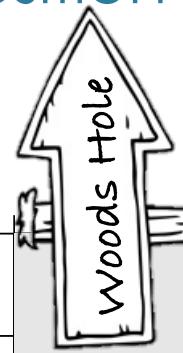
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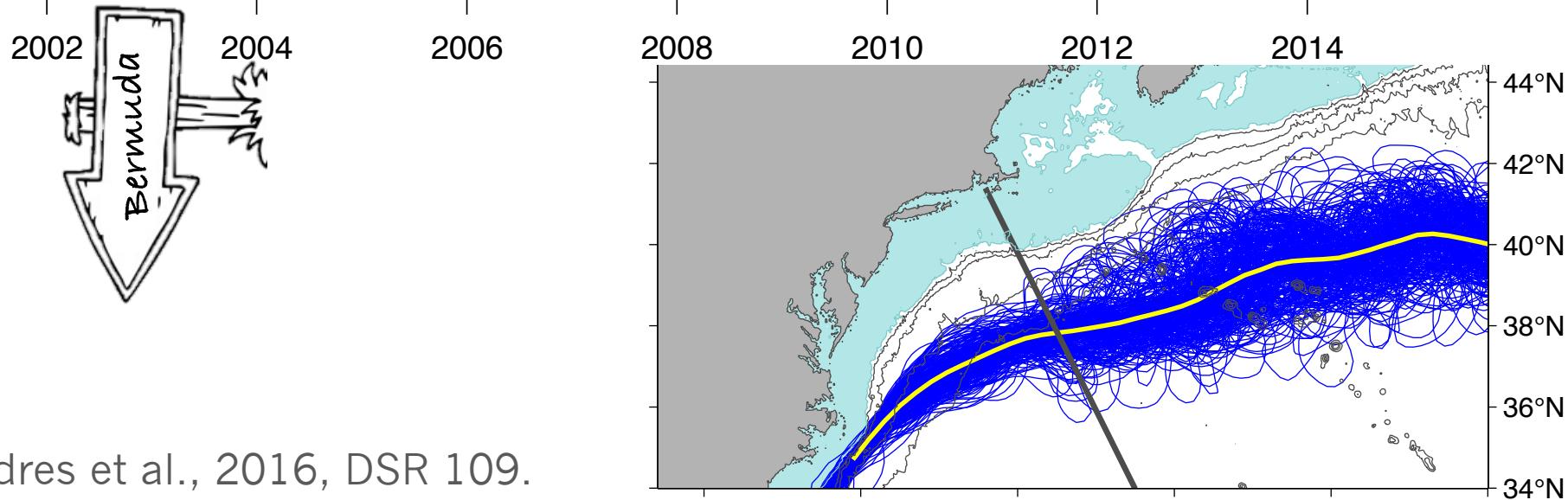
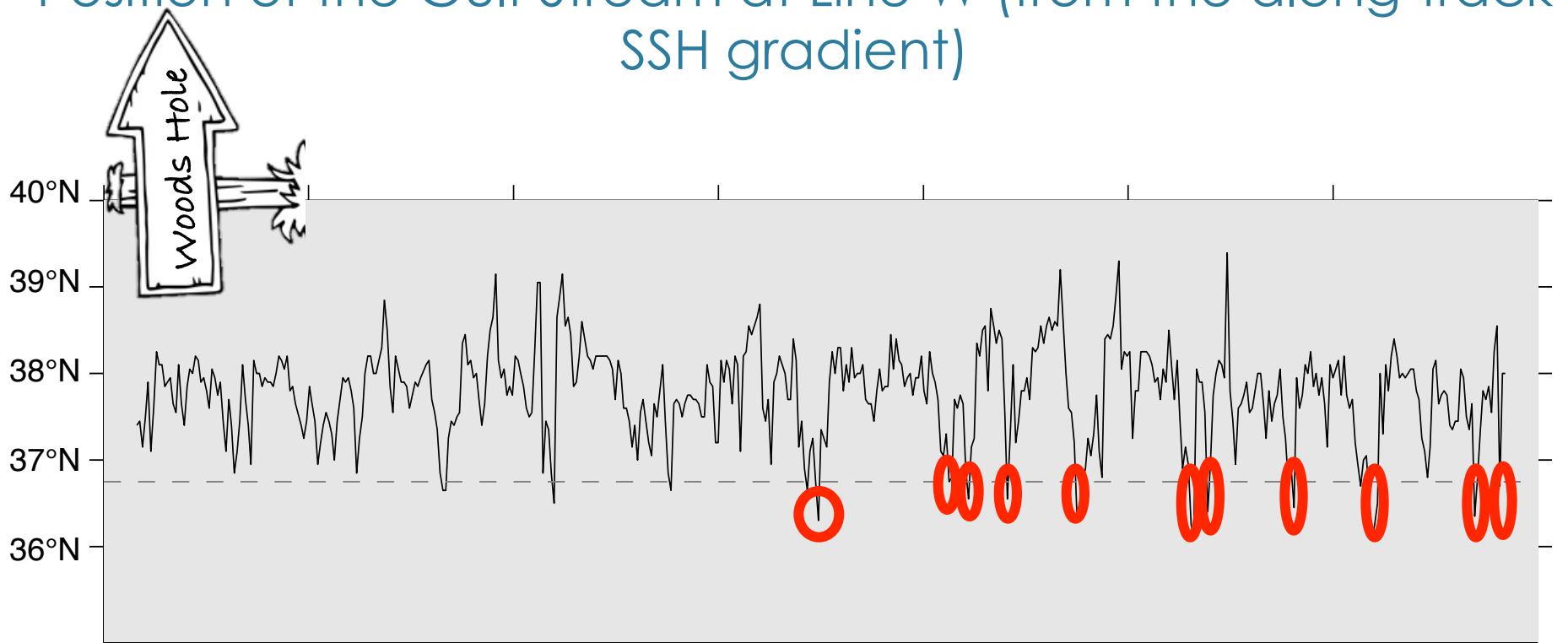
Position of the Gulf Stream at Line W (from the along-track SSH gradient)



Position of the Gulf Stream at Line W (from the along-track SSH gradient)



Position of the Gulf Stream at Line W (from the along-track SSH gradient)



Gulf Stream path downstream of Cape Hatteras:

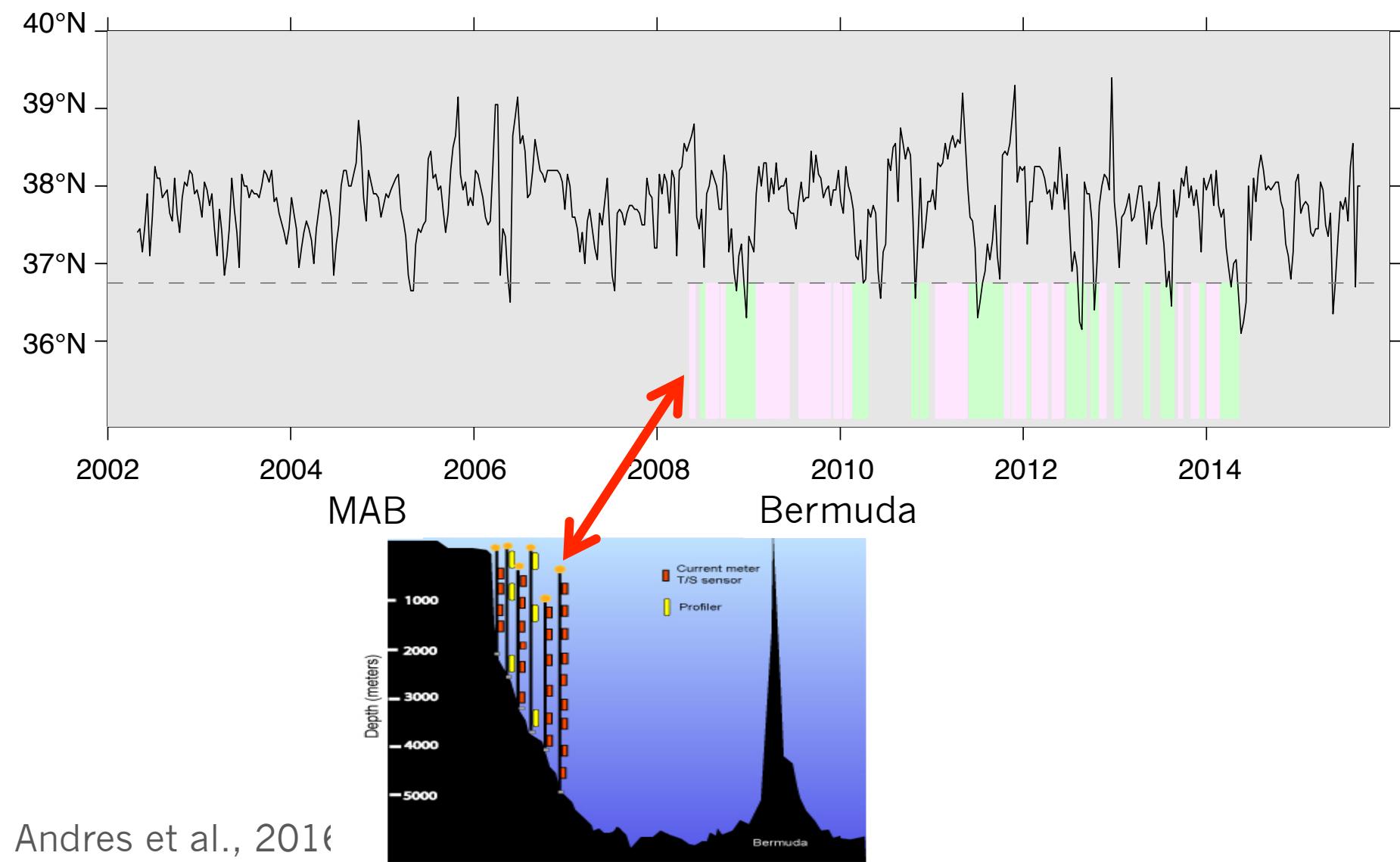
- The longitude where the Gulf Stream path ‘goes unstable’ varies inter-annually.
- Gulf Stream meander troughs are associated with DWBC mixing events at Line W.
- Increases in the numbers of events might lead to long-term trends in the rate of DWBC-interior exchange.
- How about models? Do they capture this process? Does it occur in other regions? Does the amount of exchange vary inter-annually?

2014
Line W Finale
on the
R/V Knorr

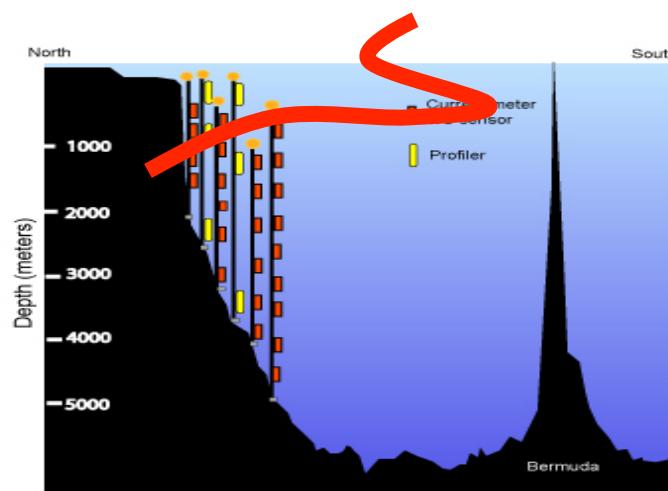
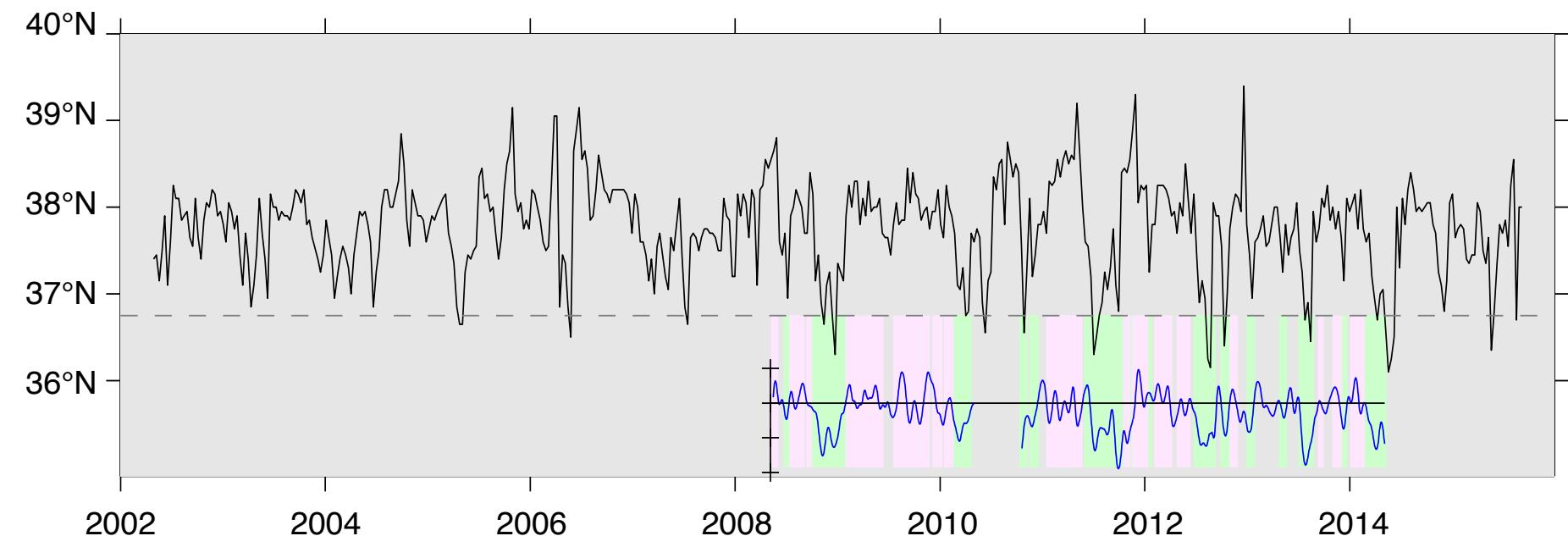


Questions?

Position of the Gulf Stream at Line W (from the along-track SSH gradient)

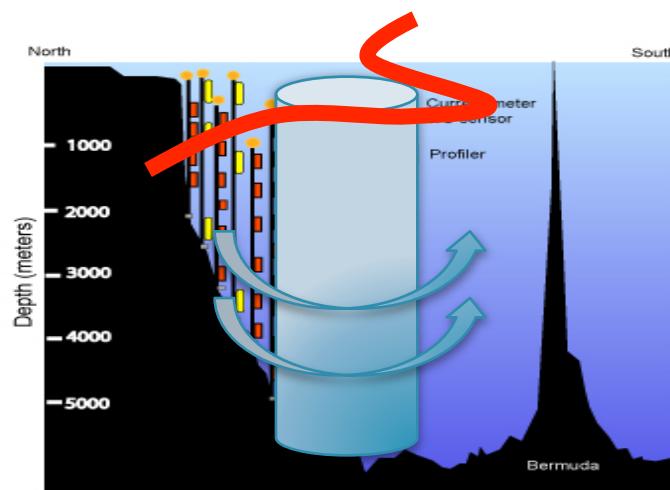
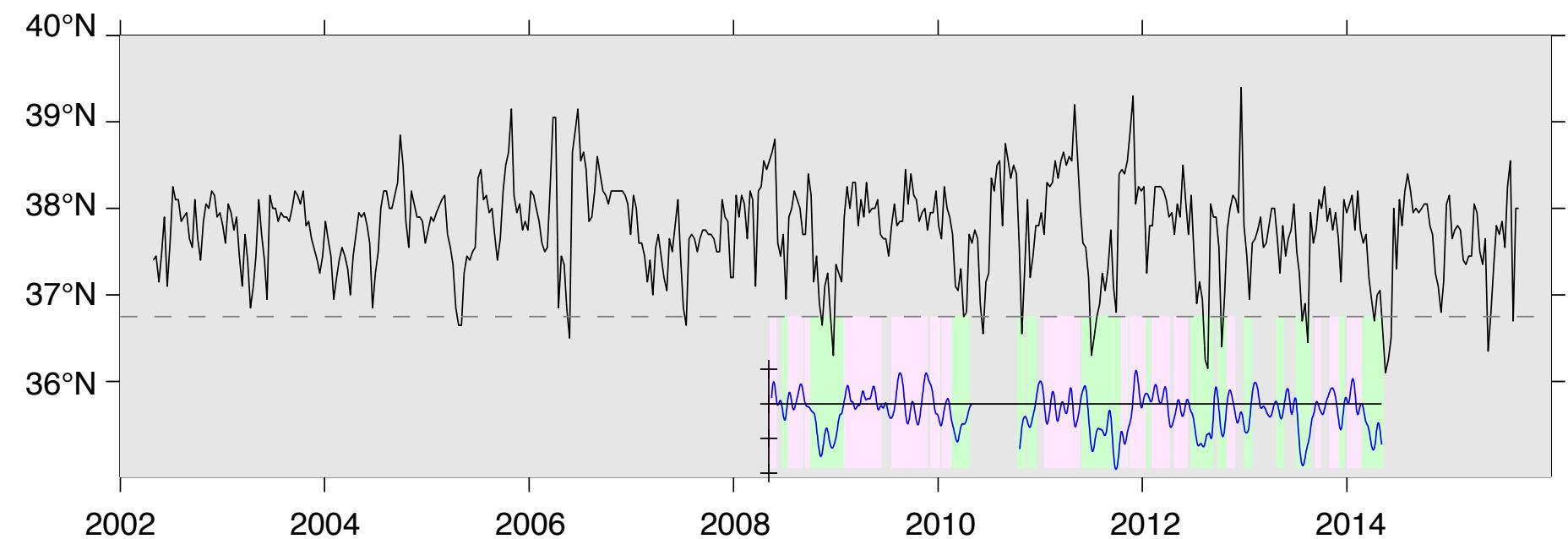


Position of the Gulf Stream at Line W (from the along-track SSH gradient)



Andres et al., 2016

Position of the Gulf Stream at Line W (from the along-track SSH gradient)



Position of the Gulf Stream at Line W (from the along-track SSH gradient)

