Investigating interannual freshwater variability along the NW Atlantic shelf using satellite salinity data

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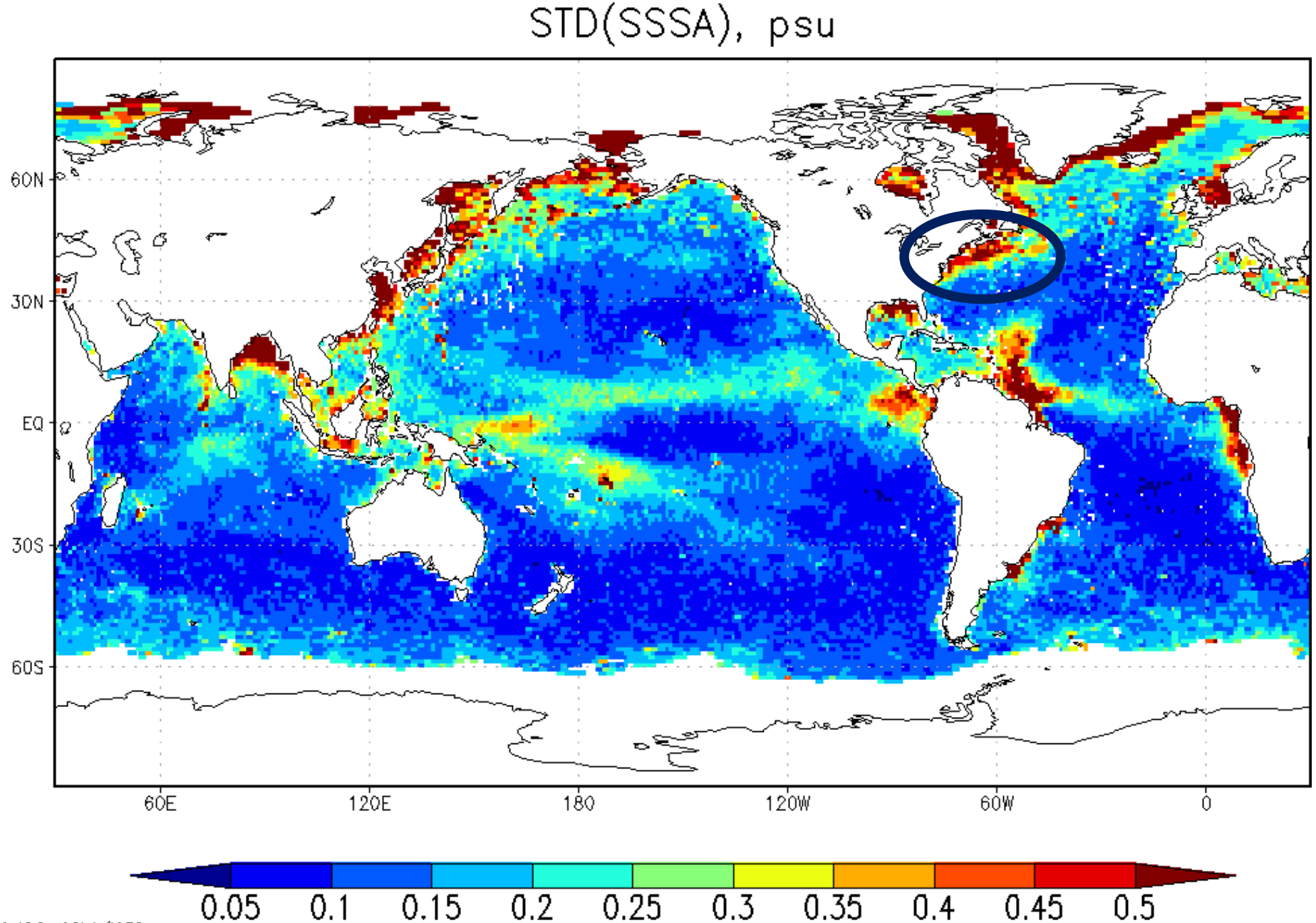
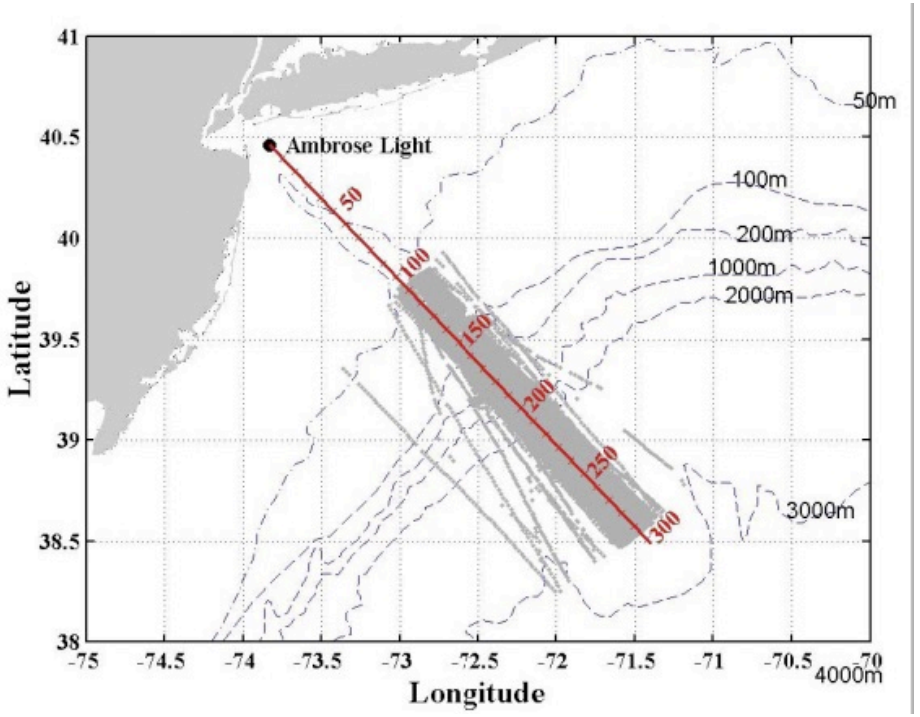
STD of anomalous SSS (AQUARIUS)

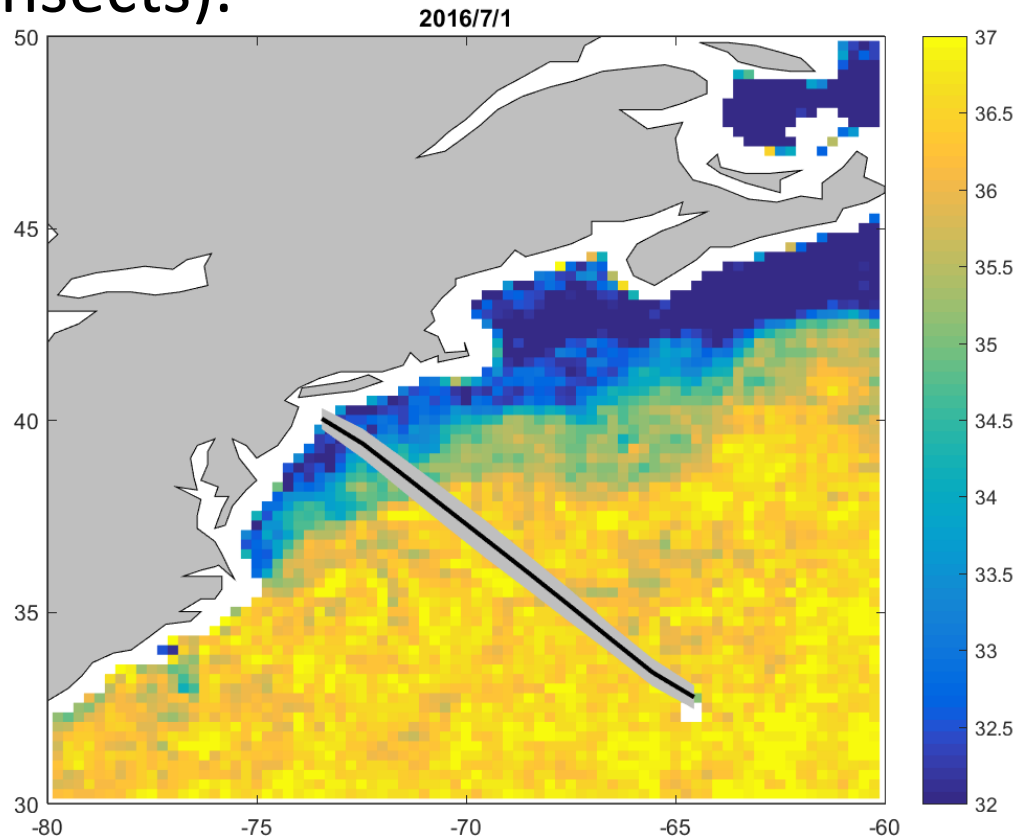


Seasonal cycle is removed

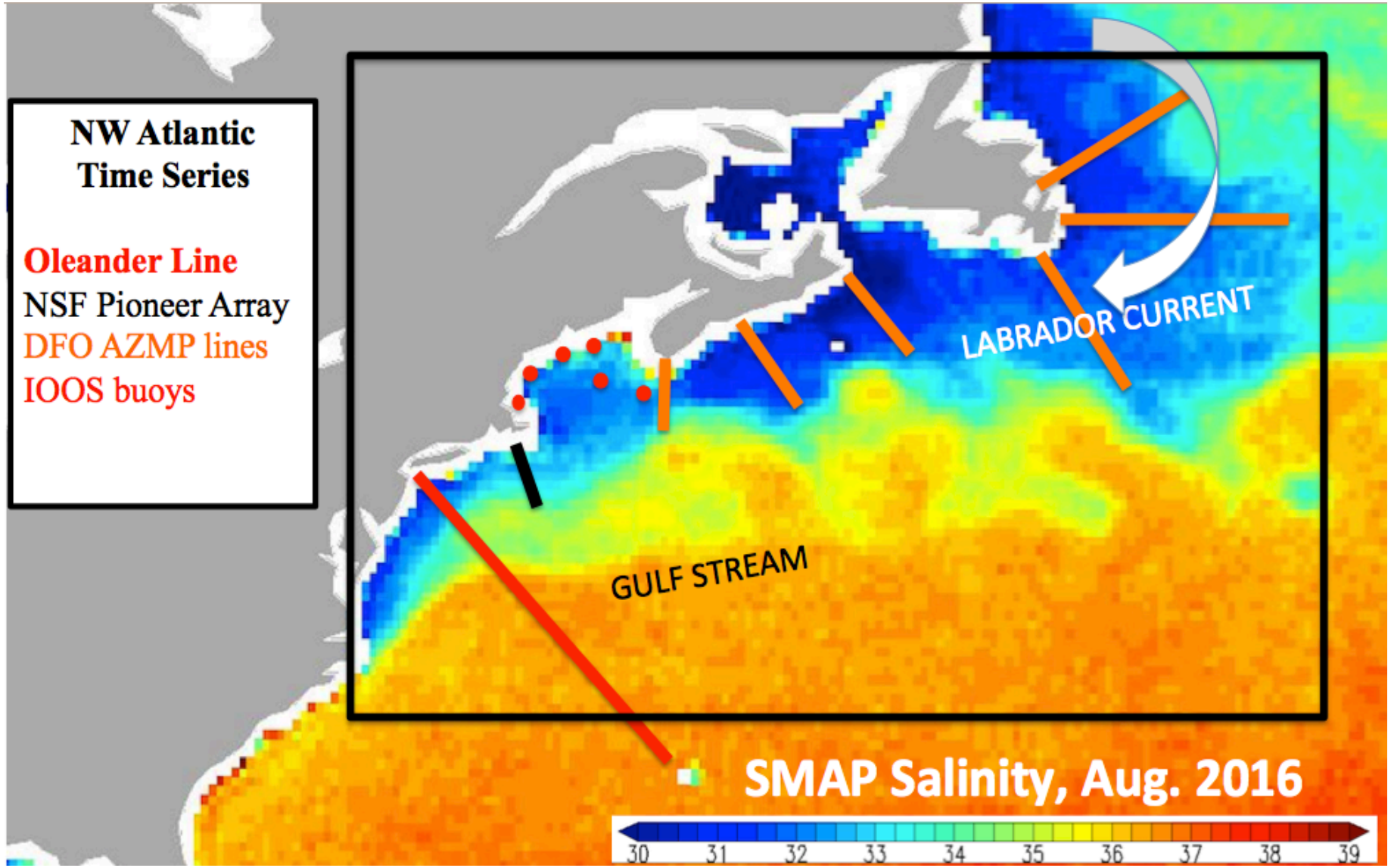
Motivation

- Previous observations suggest that T and S experience in-phase interannual oscillations in the shelf region of the Northwestern Atlantic that are correlated with shelfbreak currents (e.g. *Flagg et al.*, 2006 based on the Oleander transects).



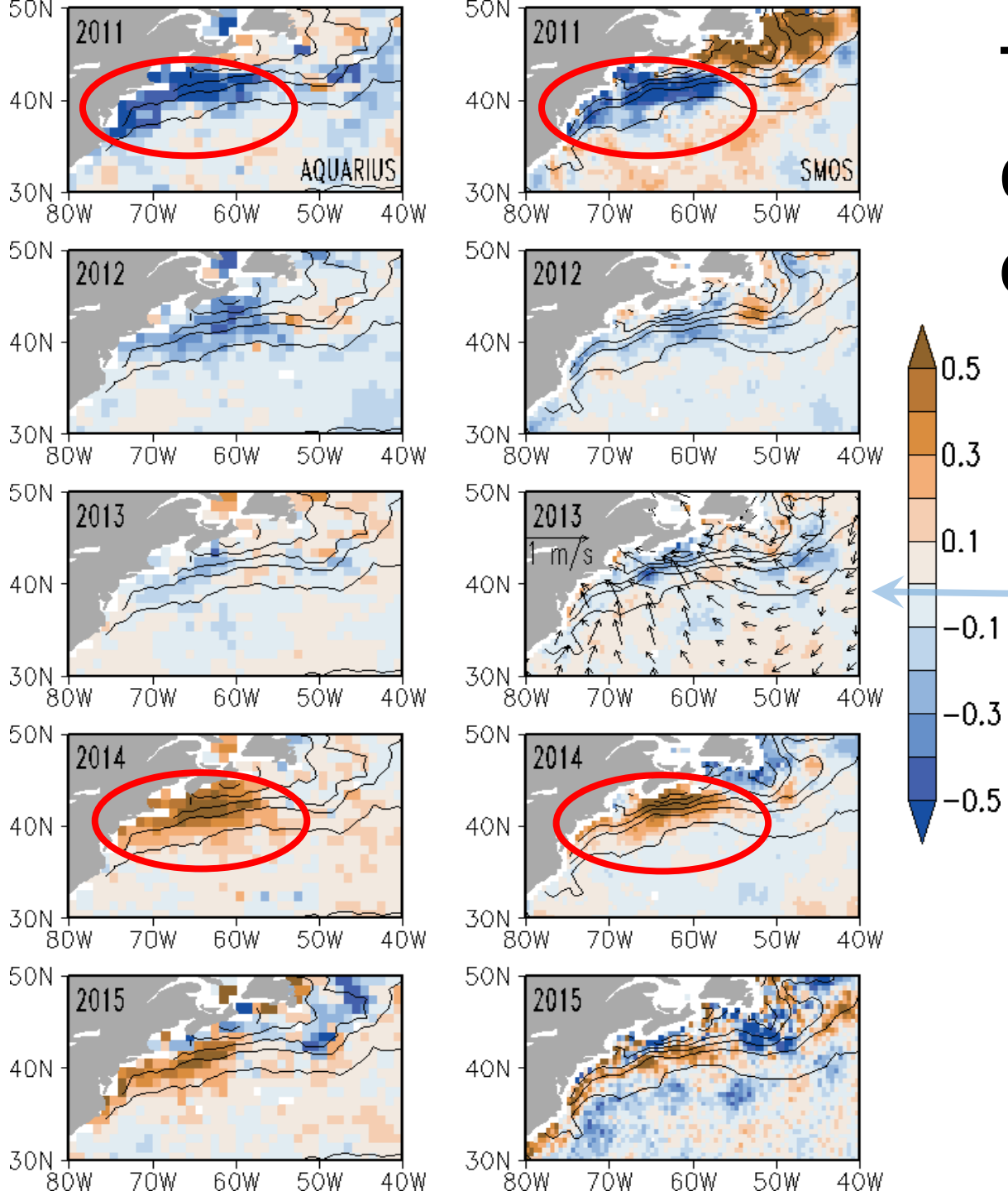


Motivation: **Map of monthly surface salinity from the SMAP sensor (L3 V2 data from RSS) for Aug. 2016 as well as of the study site in the NW Atlantic. Included are key in situ measurement time series programs identified to support this research.**



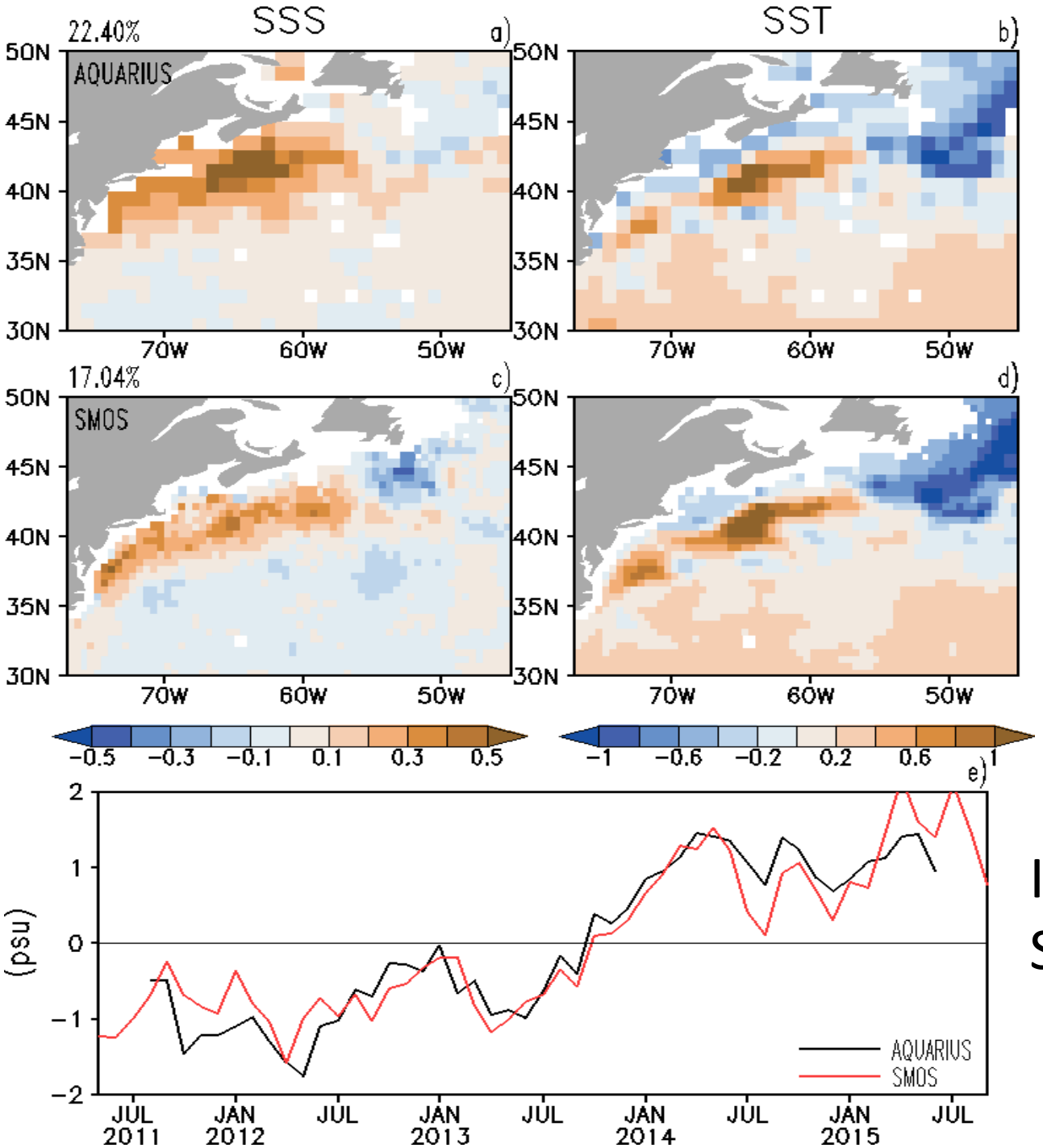
The equatorward freshwater advection along the coast is evident in the image, with salinity of 32 psu roughly delineating the shelf. The Gulf Stream and its north wall meanders are also apparent.

Temporal evolution of SSS during satellite salinity observations (2011-2015)



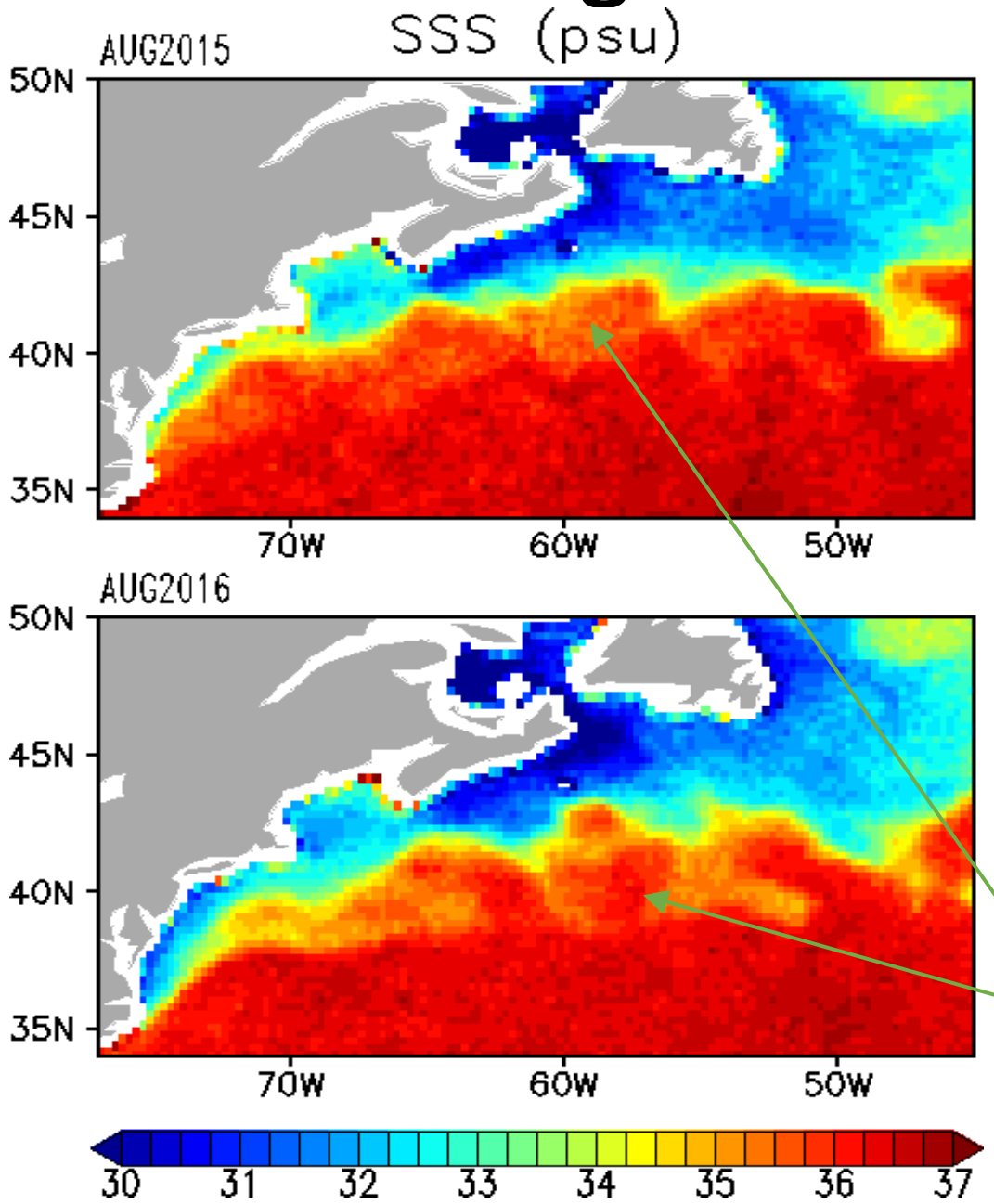
2013 SMOS panel includes the 2011-2015 mean wind anomaly. Salinification tendency corresponds to anomalous southeasterly winds over the shelf.

Leading multivariate EOF (SSS & SST) from Aquarius and SMOS



Interannual SSS from Aquarius and SMOS show similar temporal changes

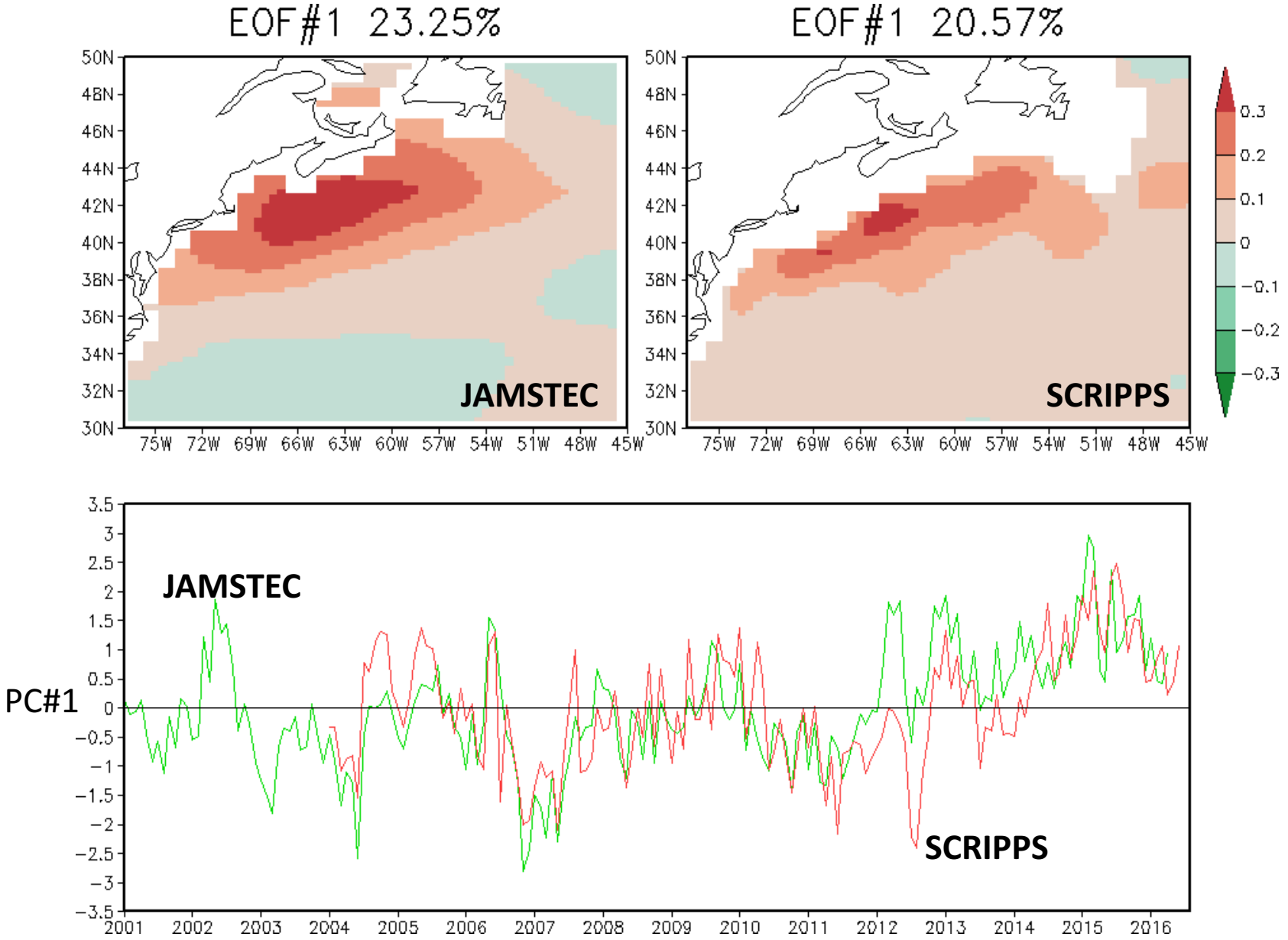
SMAP SSS in August 2015 and 2016.



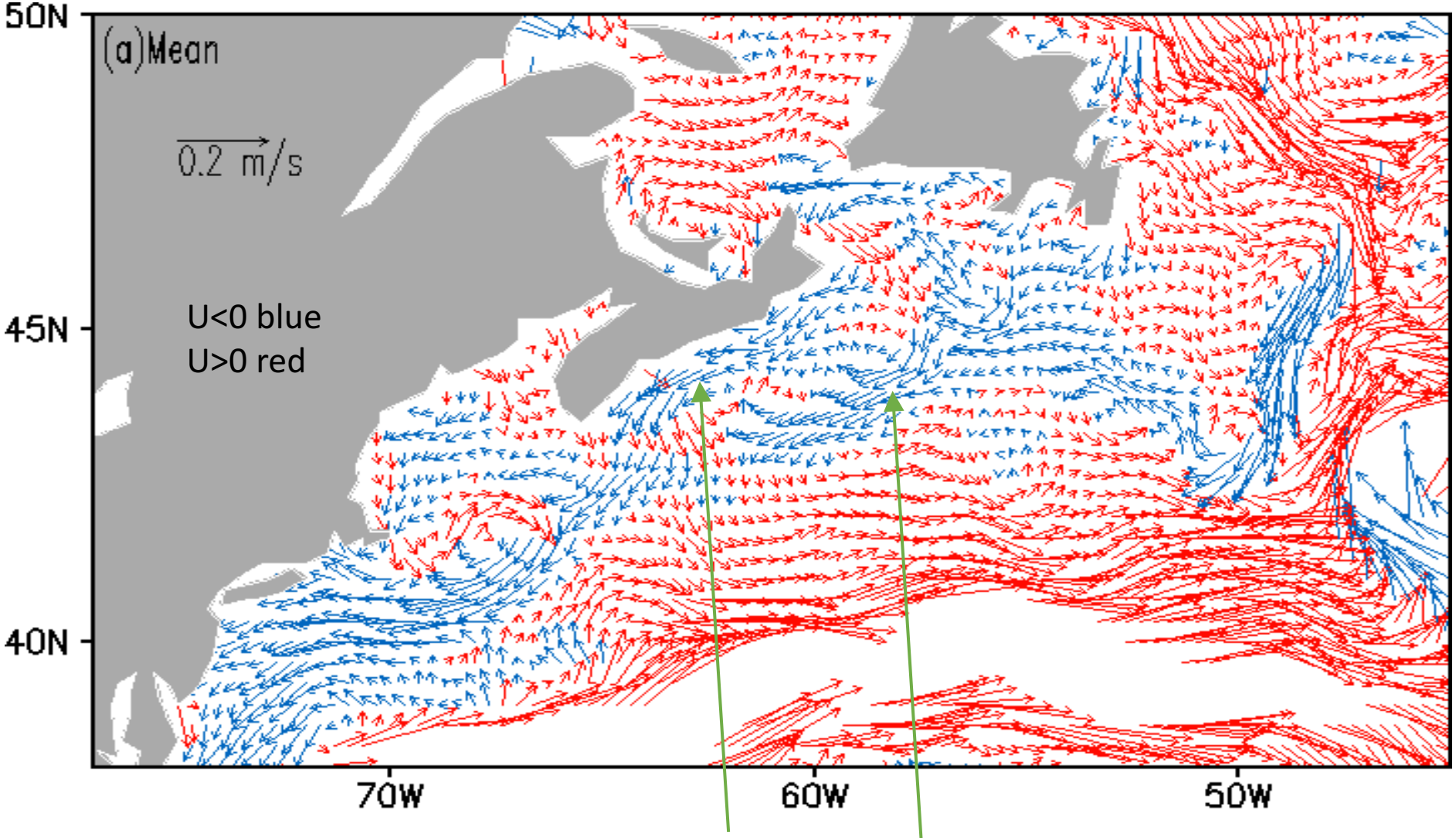
Salinity trend reversed in the recent years

Shelf SSS is fresher in 2016 than in 2015 despite stronger Gulf Stream eddies

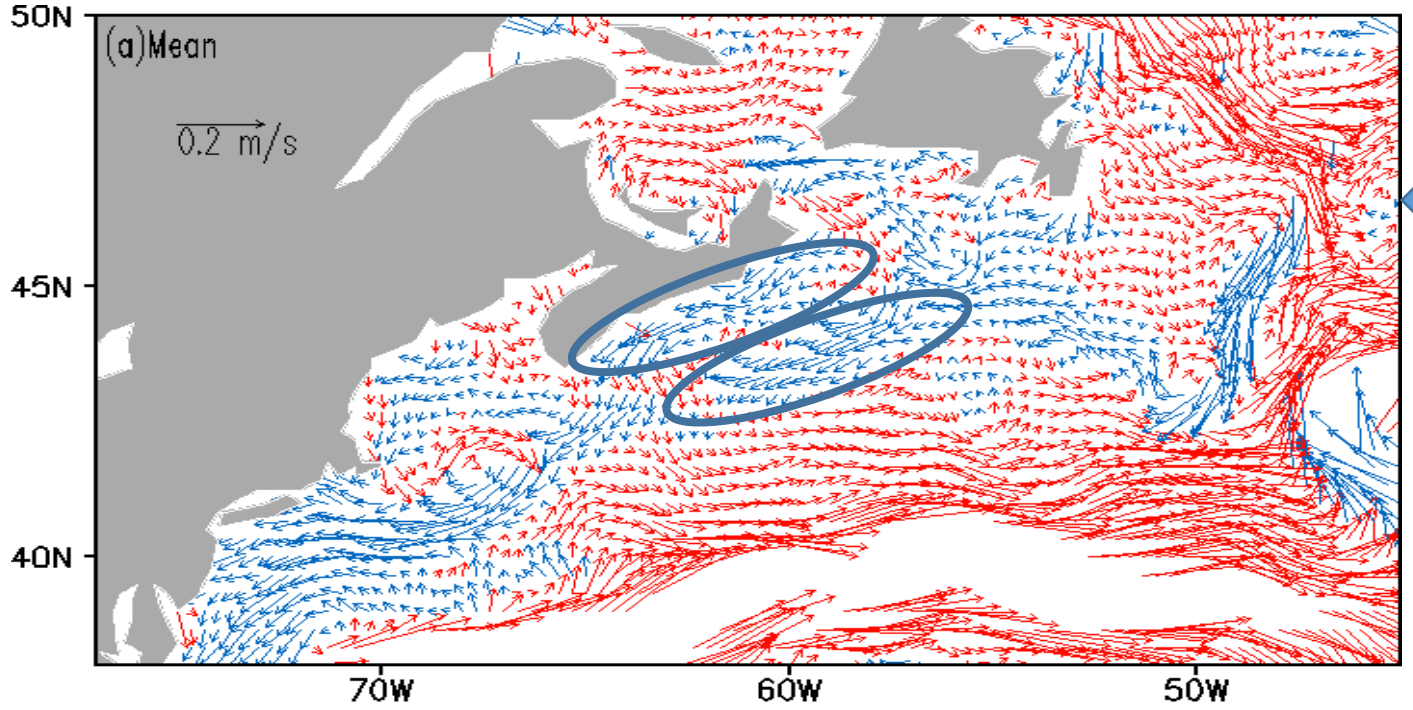
(top) Leading EOF of the surface salinity from (left, since 2001) JAMSTEC and (right, since 2004) SCRIPPS analyses. (bottom) Corresponding principal components in green/red, respectively.



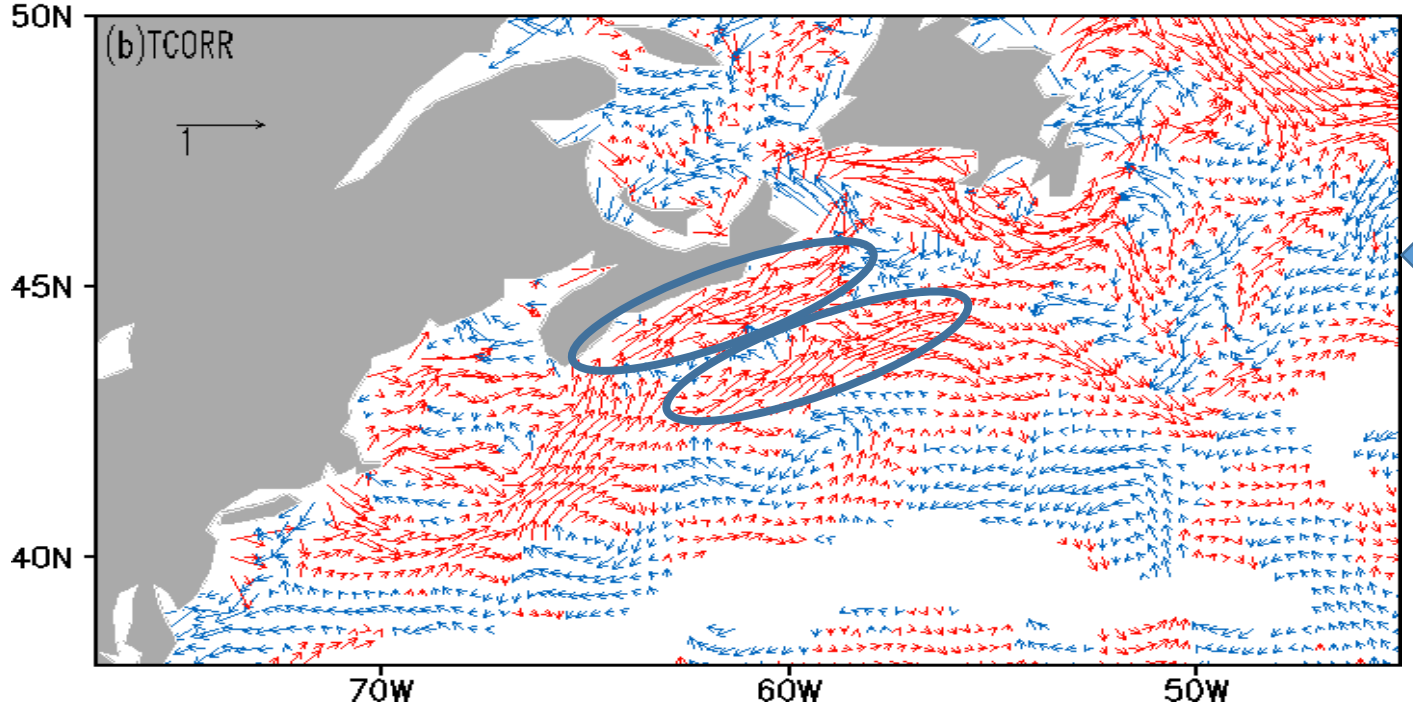
Time mean shelf surface currents (OSCAR)



Fresh water from the north is transported either by **inshore** or **outshore** branch of the Scotian Shelf Current (SSC)



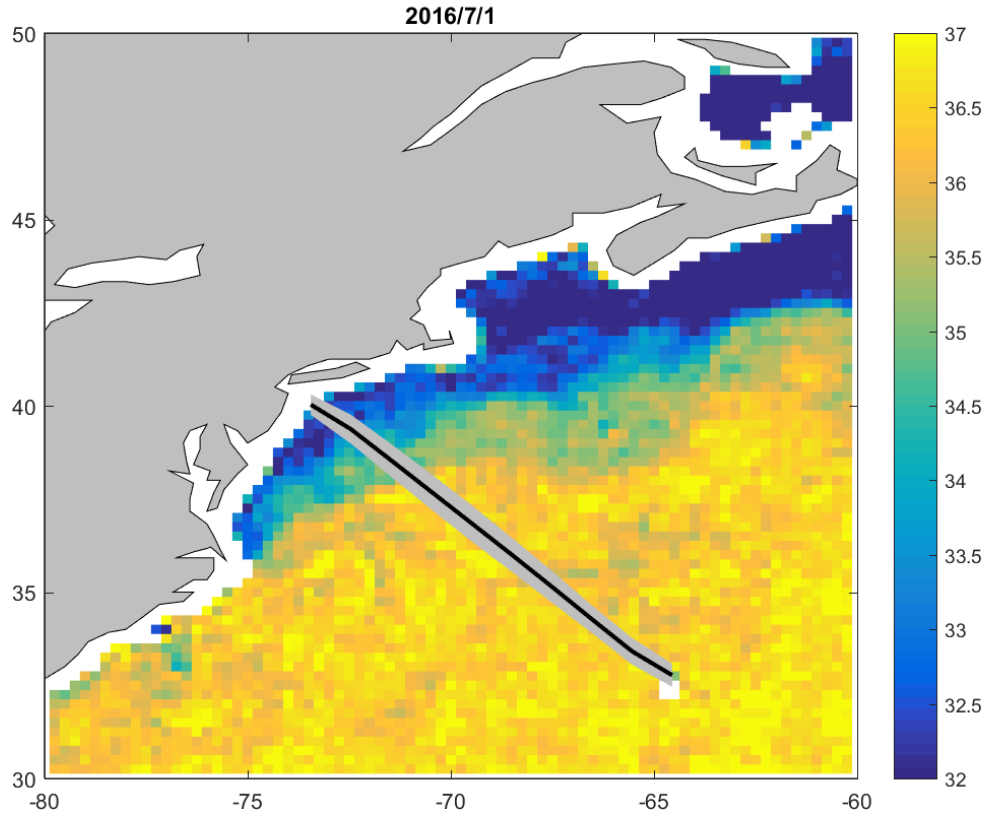
Time mean OSCAR currents. Currents >0.25m/s are blanked

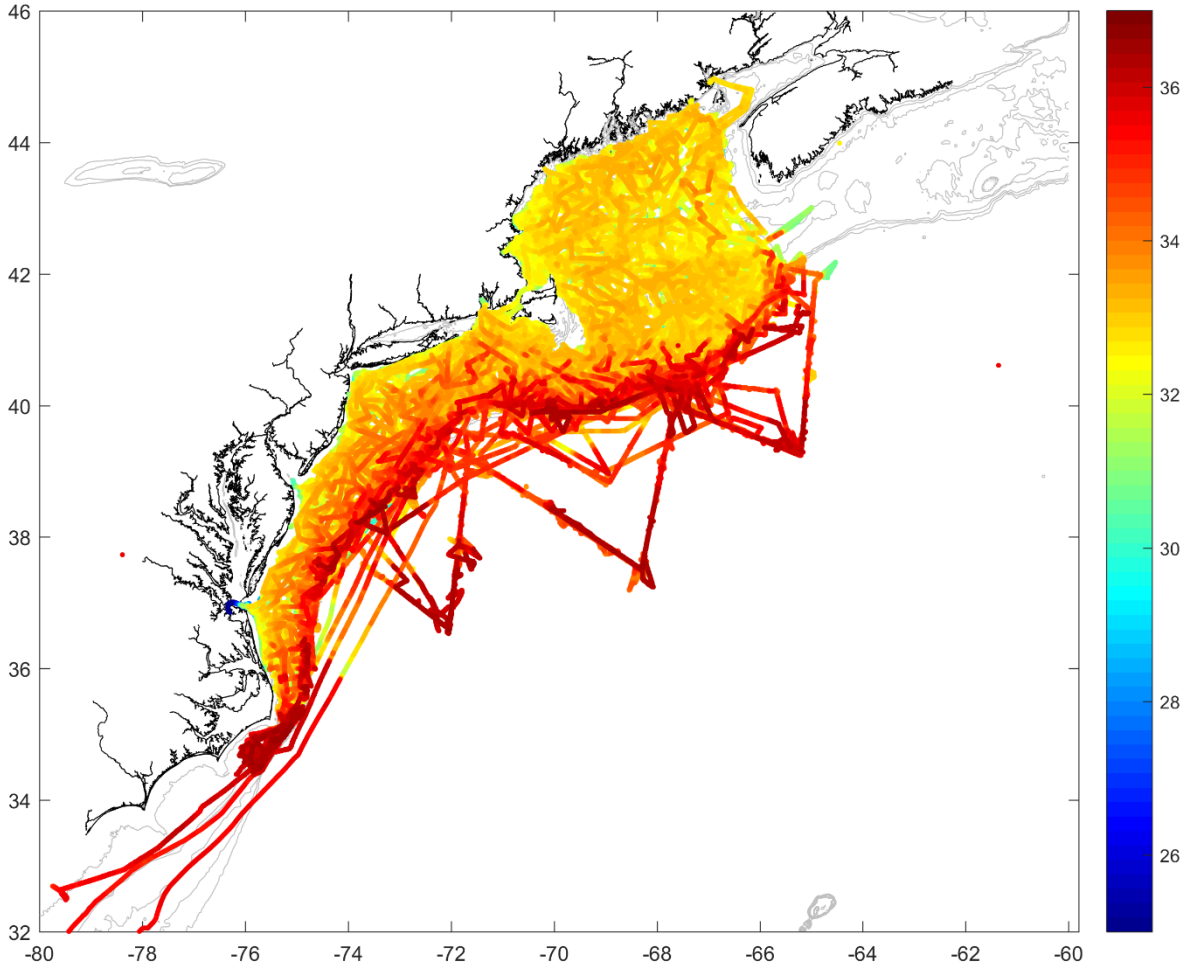


Time correlation of anomalous currents with temporal part of the leading EOF

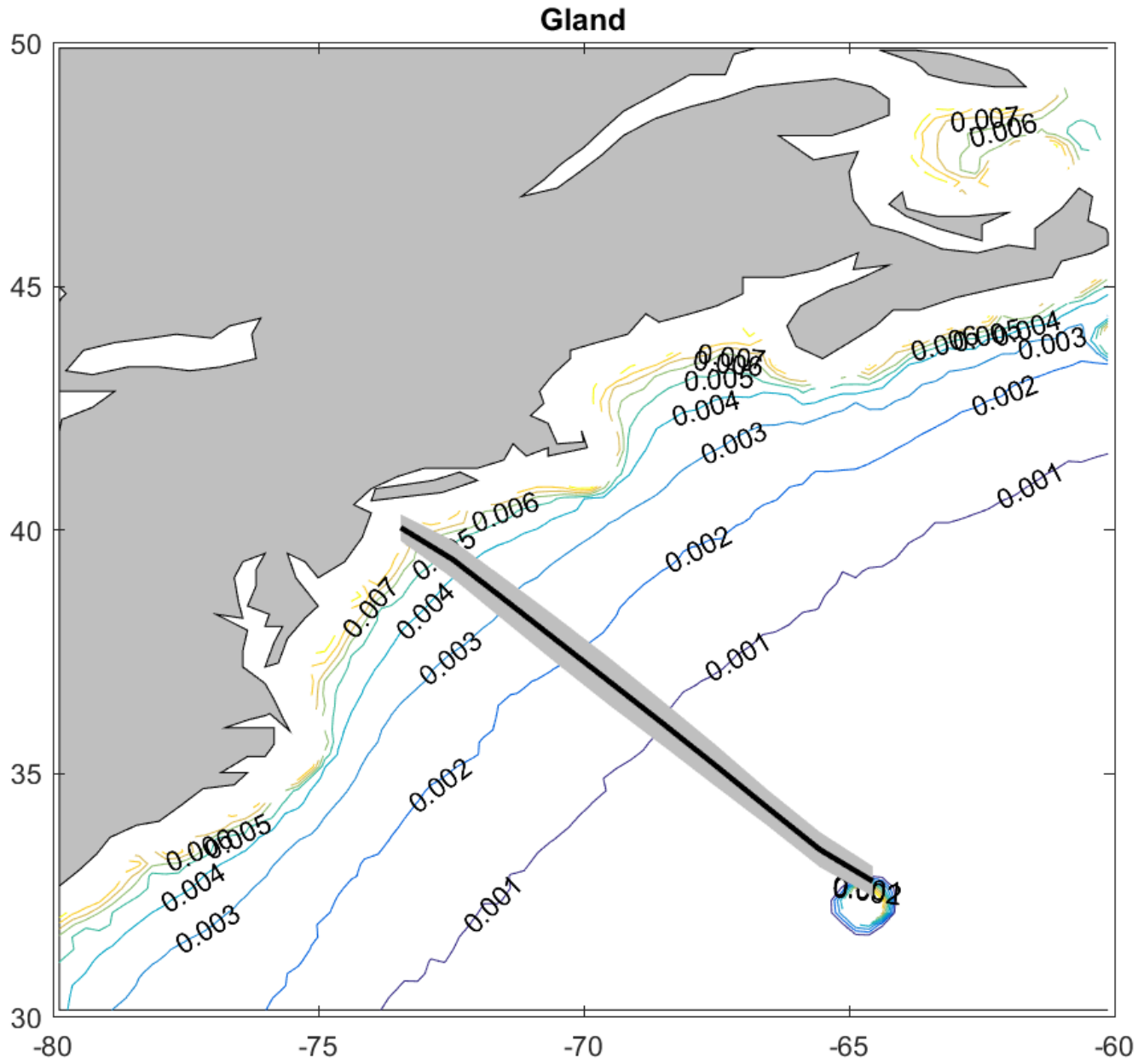
Both branches of the Scotian Shelf Current are anomalously weak during salty events

Validation of satellite SSS, Oleander TSG transects; Bigelow TSG collection

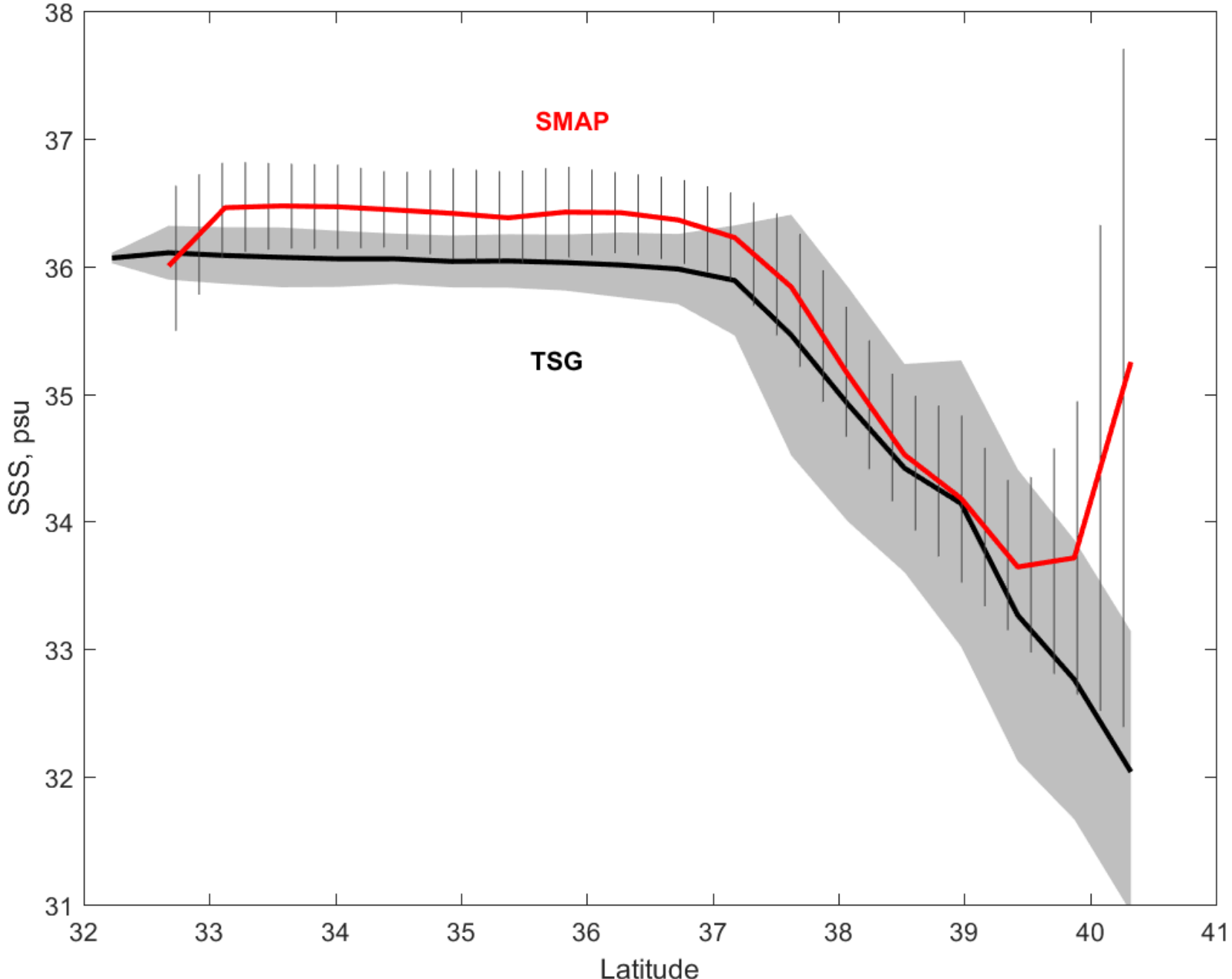




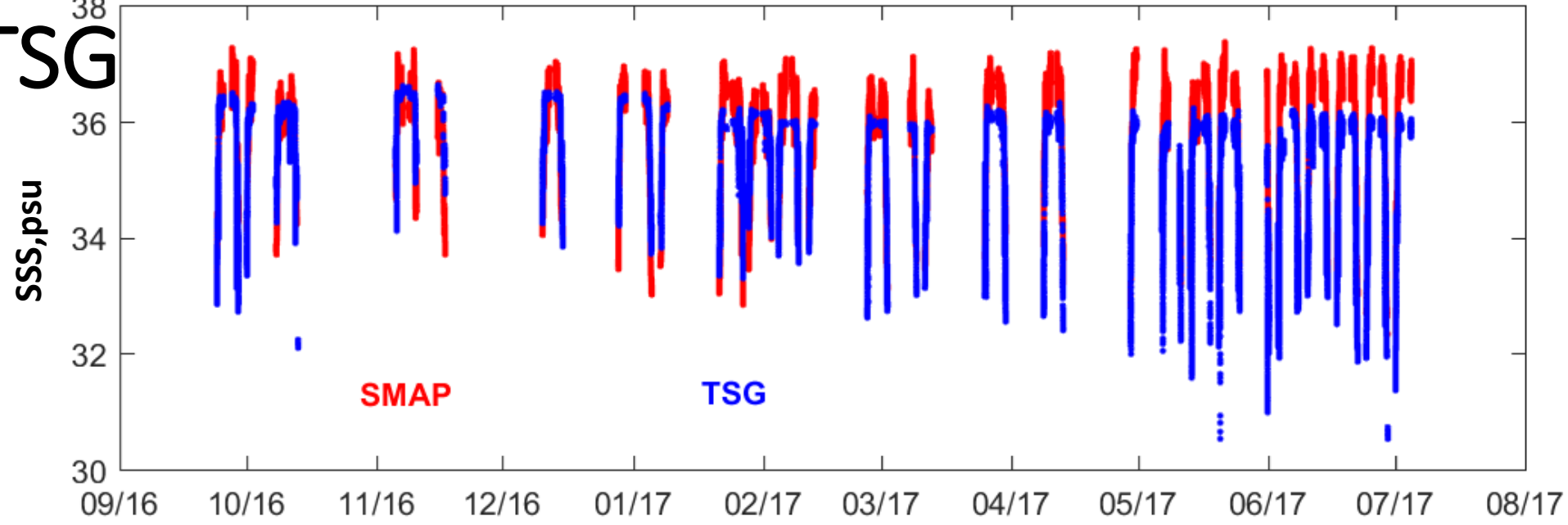
SMAP Gland map



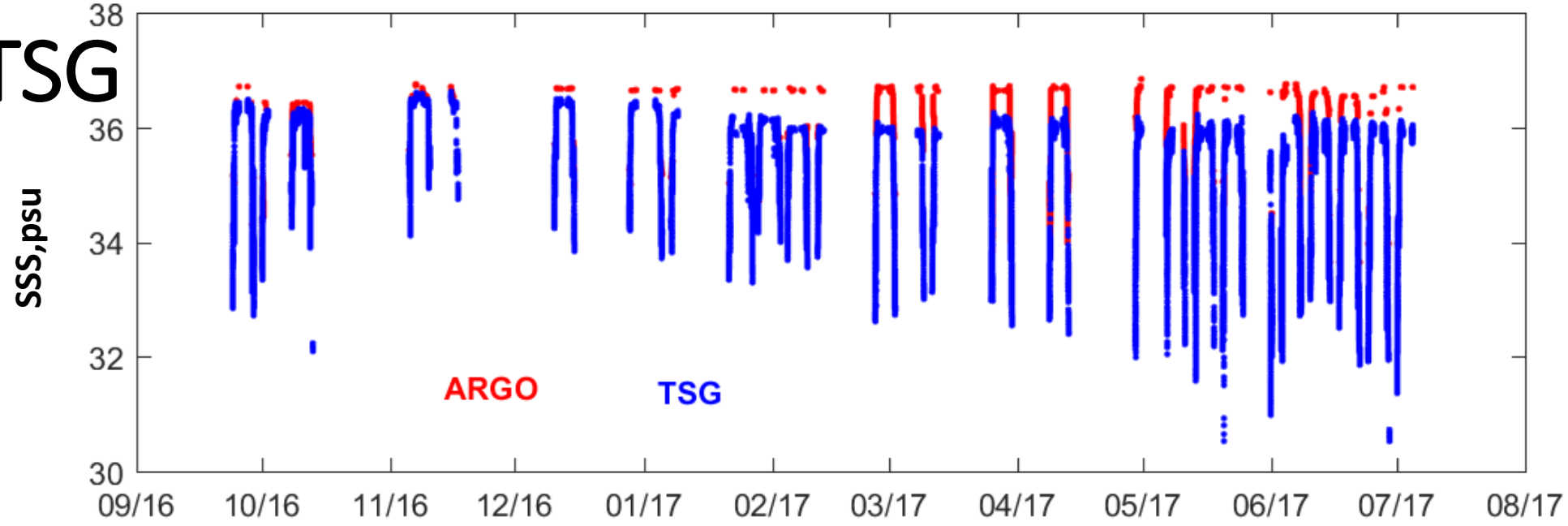
SMAP vs Oleander TSG



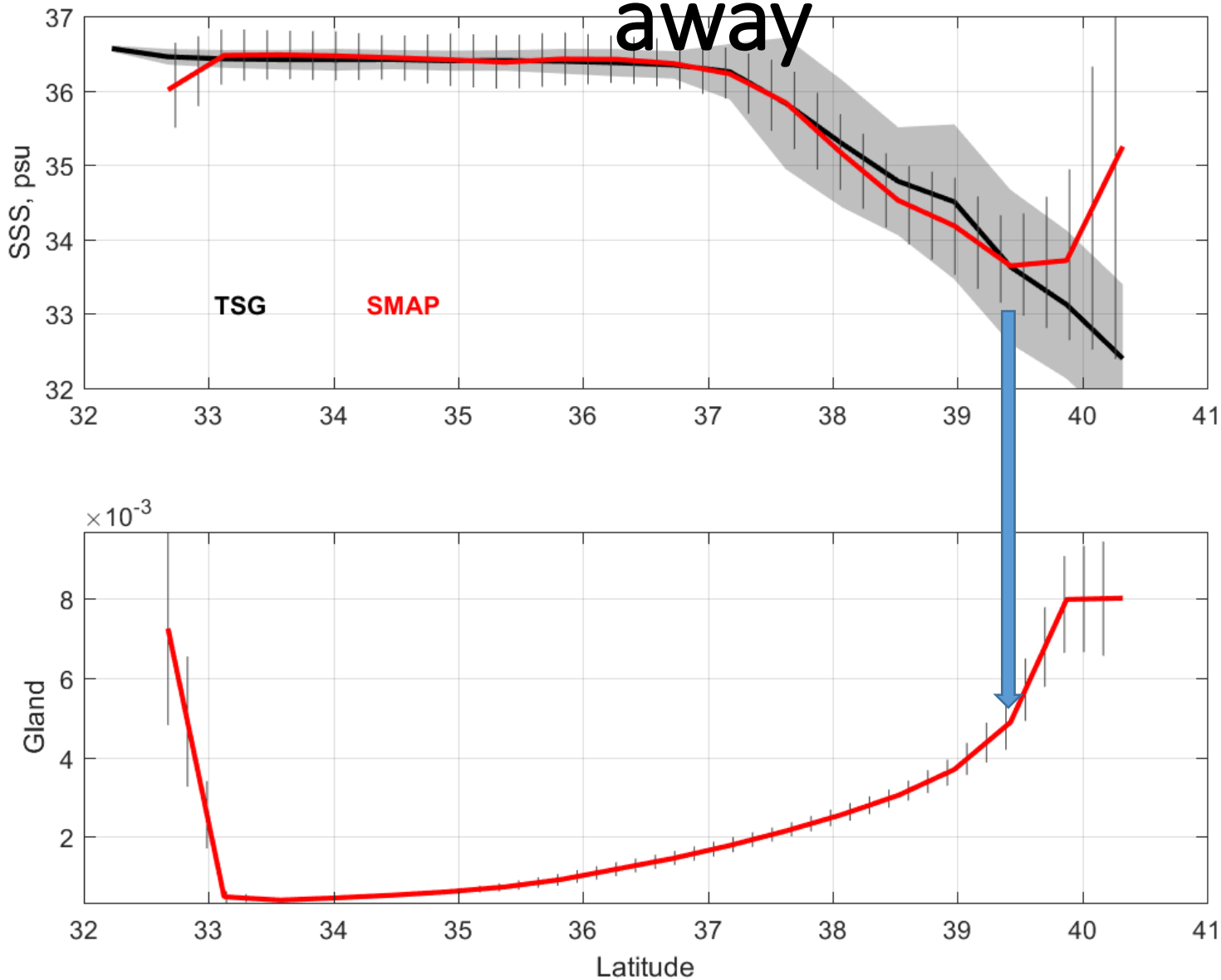
SMAP vs TSG



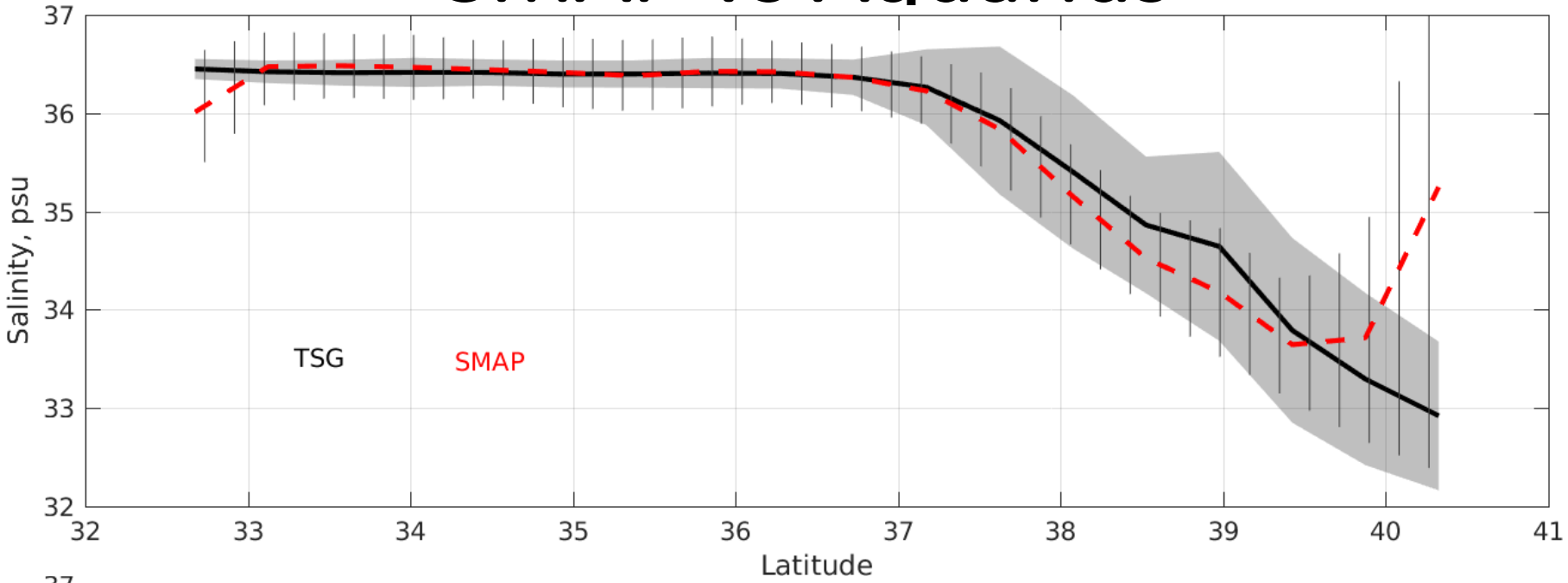
ARGO vs TSG



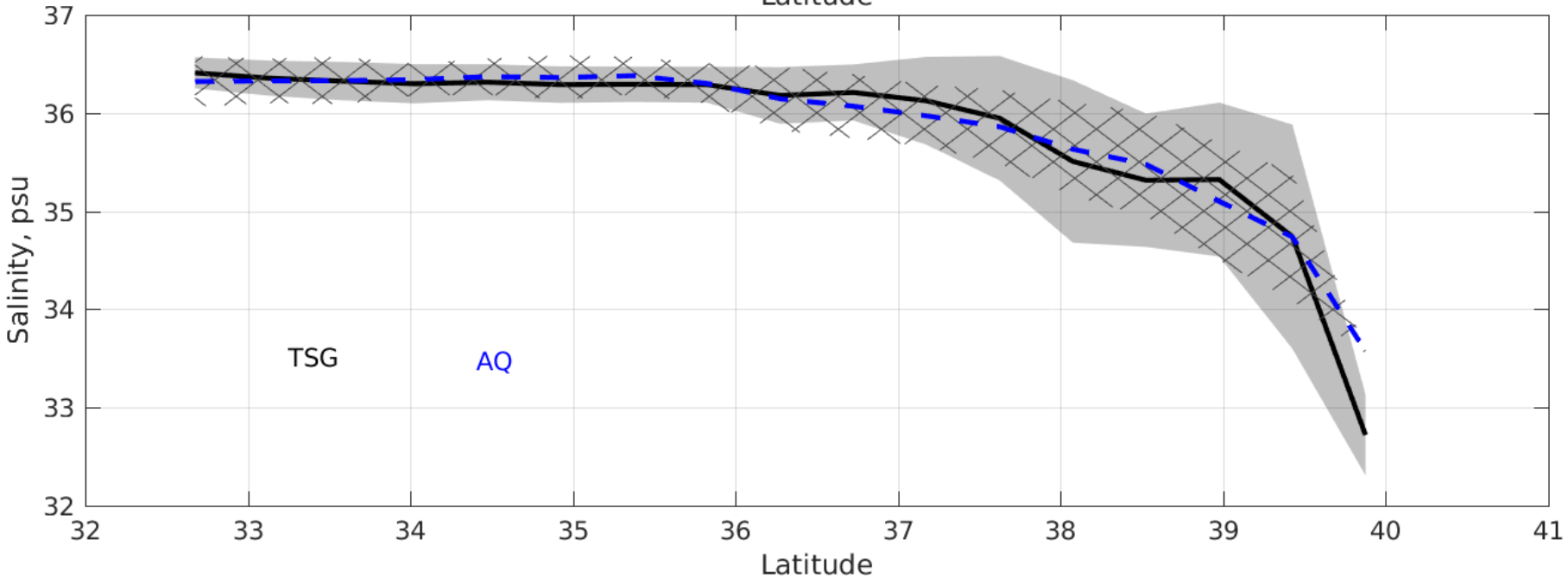
After correction of Oleander conductivity based on collocated ARGO, the bias goes away



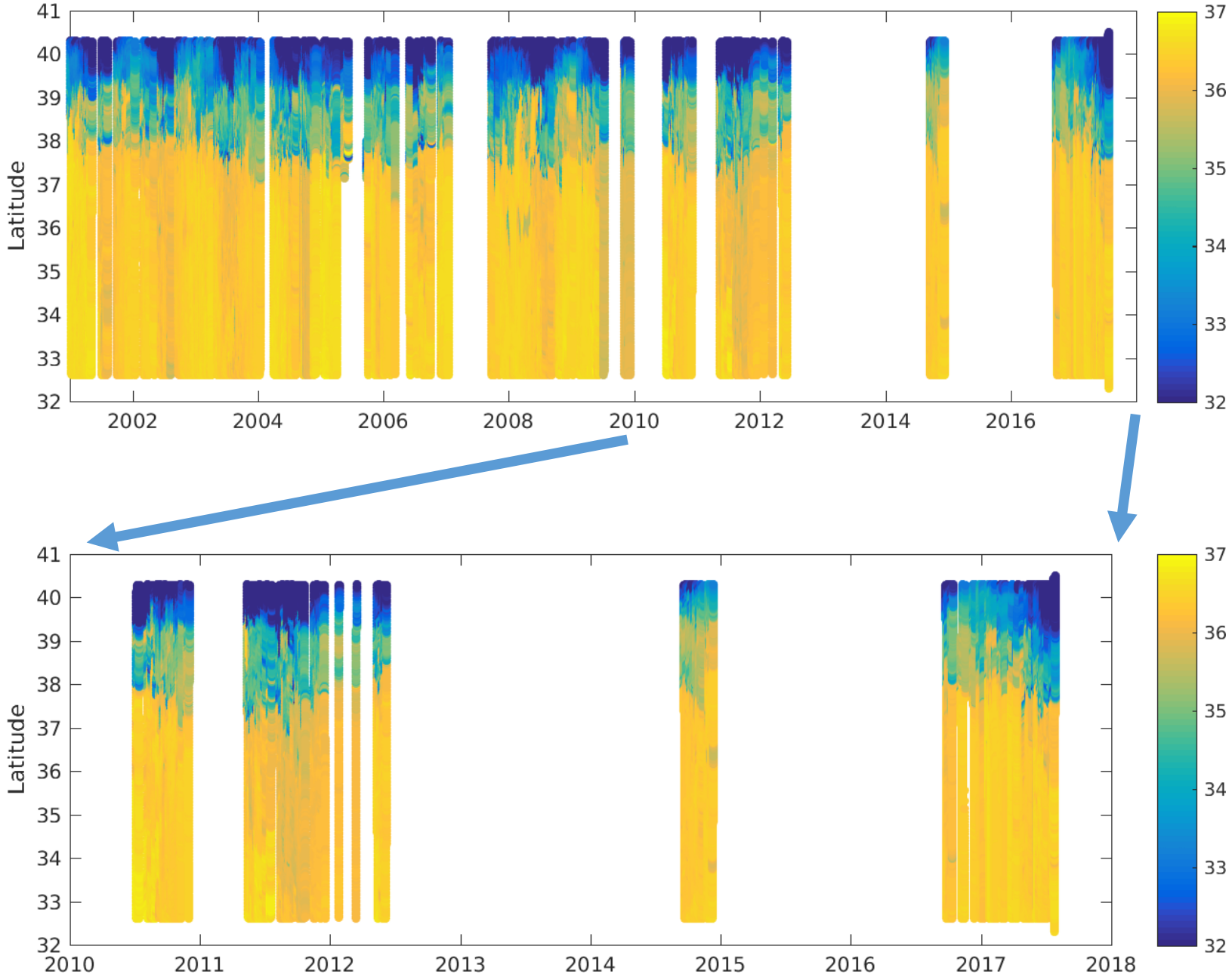
SMAP vs Aquarius



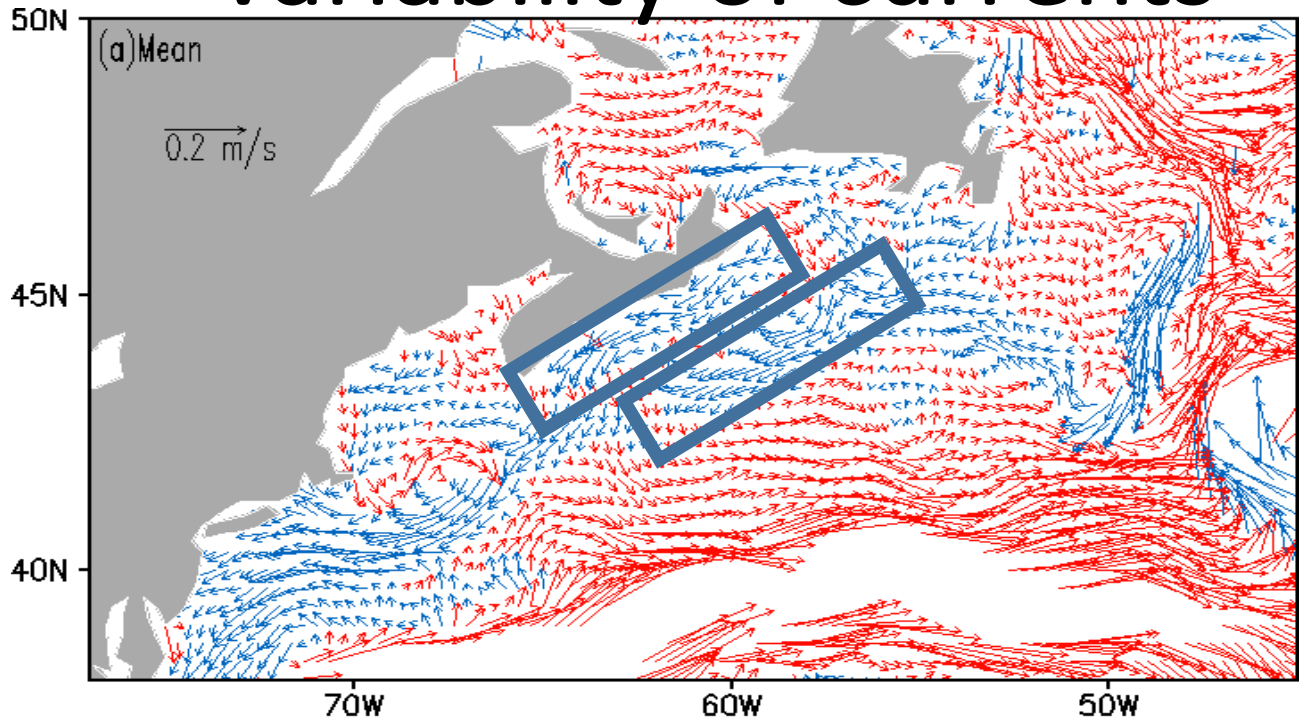
Fresh bias

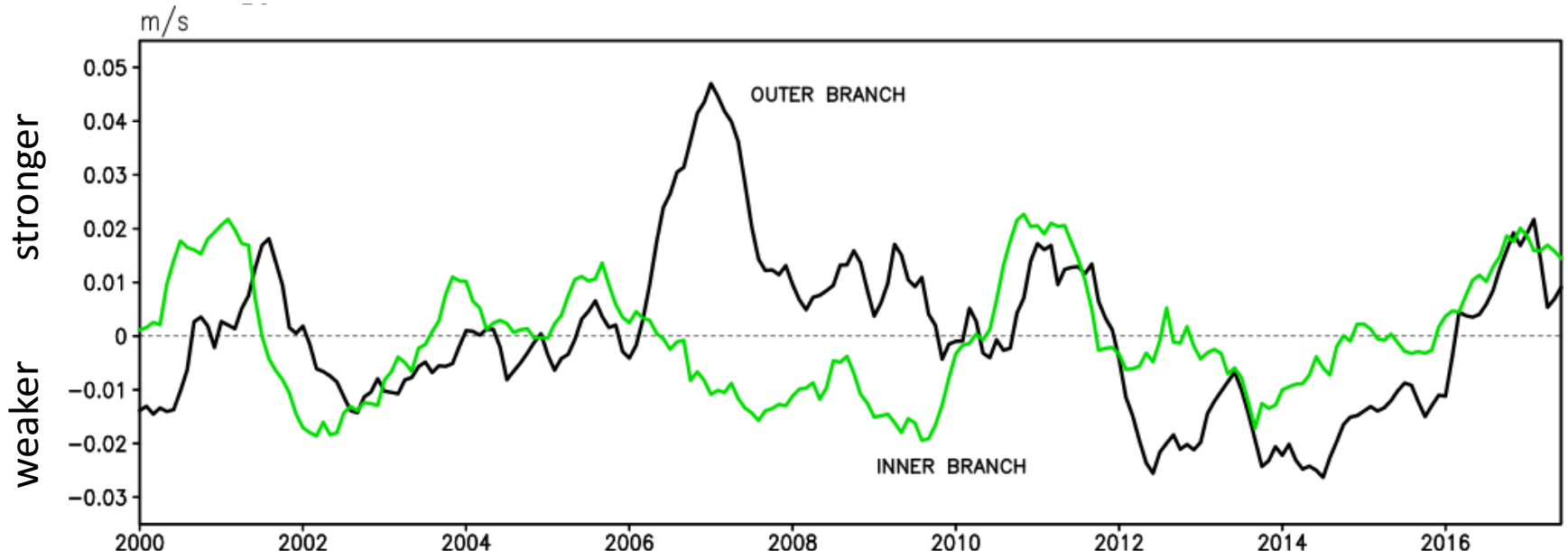


Temporal variability of Oleander SSS



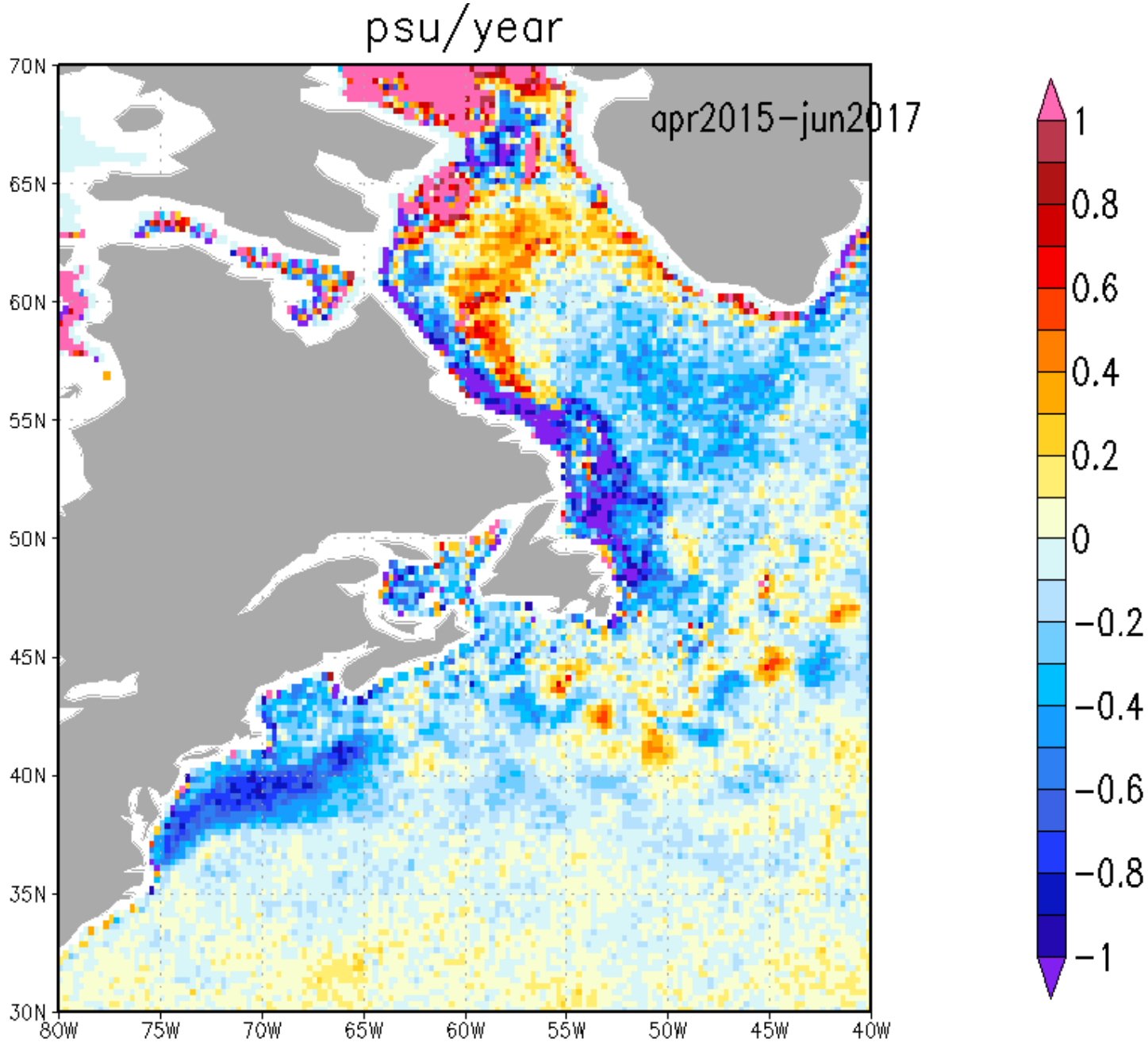
Variability of currents





Anomalous current speed

Conclusions

- Both, Aquarius and SMAP are consistent with collocated TSG seaward of the Gulfstream. SMAP has a fresh bias of ~0.5psu on the shelf.
- During Aquarius period (2011-2015) SSS increased by ~1psu south of the Nova Scotia. This salinification tendency was reversed in 2016-2017.
- Warm/Salty conditions are coincident with the weakening the Scotian Shelf Current (SSC). The event detected by the Aquarius was associated with abnormally weak inner and outer branches of the SSC. But, variations of the two branches are not always coherent.
- Comparison of collocated TSG and SMAP (8day, 4 nearest grid points) suggests that apparent land contamination starts at gland>0.5% (RESS v2 L3).
- More validations can potentially be done using shelf-wide TSG collections (say the Bigelow data), but vigorous QC of TSG data is required.

SMAP period (late March2015-June2017)