RETROFLECTION STRUCTURES AND TRANSPORTS AS INFERRED FROM SATELLITE-DERIVED SALINITY MAPS

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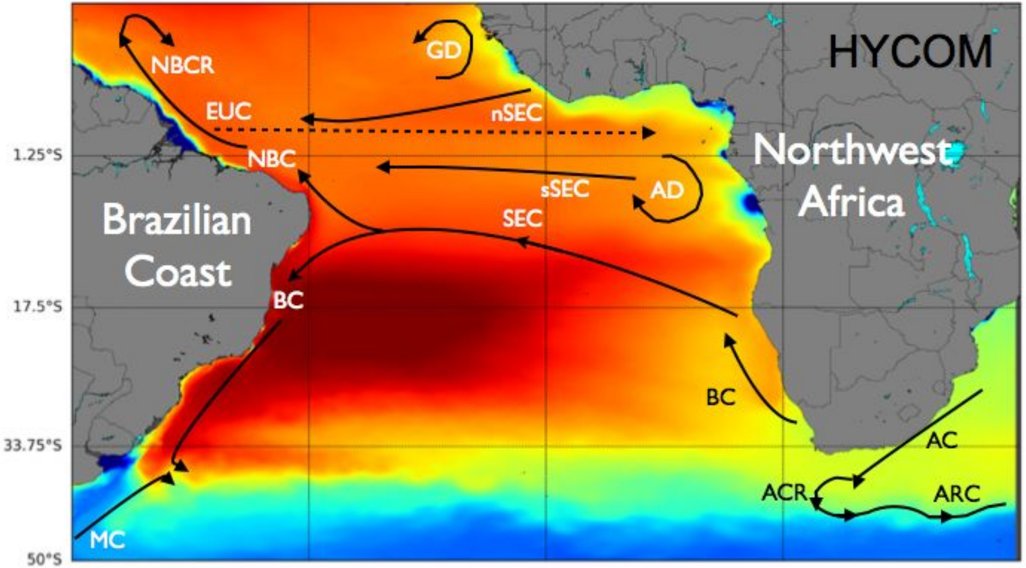
Introduction

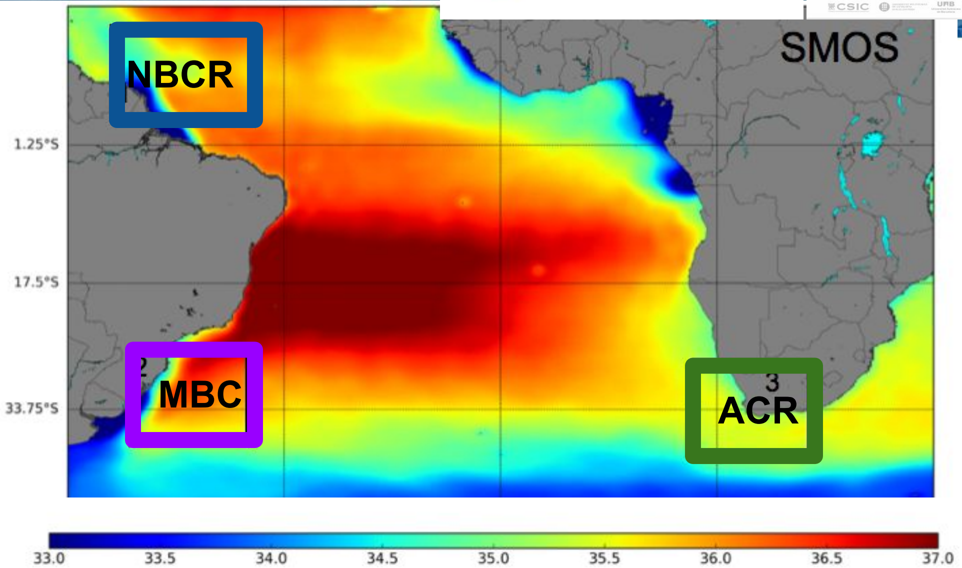
Long-term variations in the Atlantic Meridional Overturning Circulation (AMOC) can lead to regional changes in the SSS and SST

The pathways followed by the returning limb of the AMOC are especially relevant



There is still uncertainty regarding the origins and the pathways

DATA SETS AND METHODS



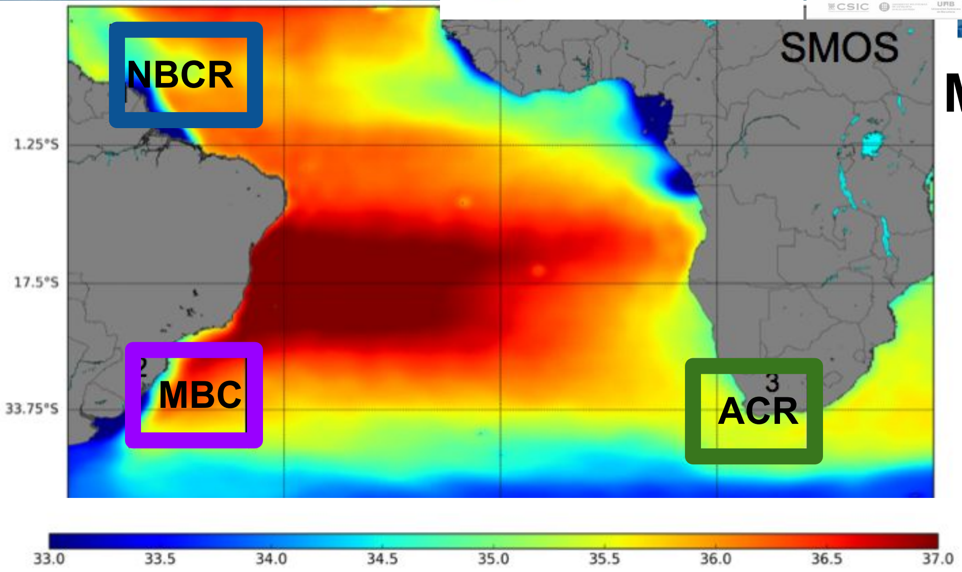
The existence of major regional diversions, the retroflexion regions, contributes to this uncertainty:

- High variability
- Interconnections between the basins

In the subTropical and South Atlantic there are three major retroflexion regions:

1. Brazill Malvinas Confluence (BMC)
2. Aghulas Current Retrofletion (ACR)
3. North Brazil Current Retroflection (NBR)

DATA SETS AND METHODS

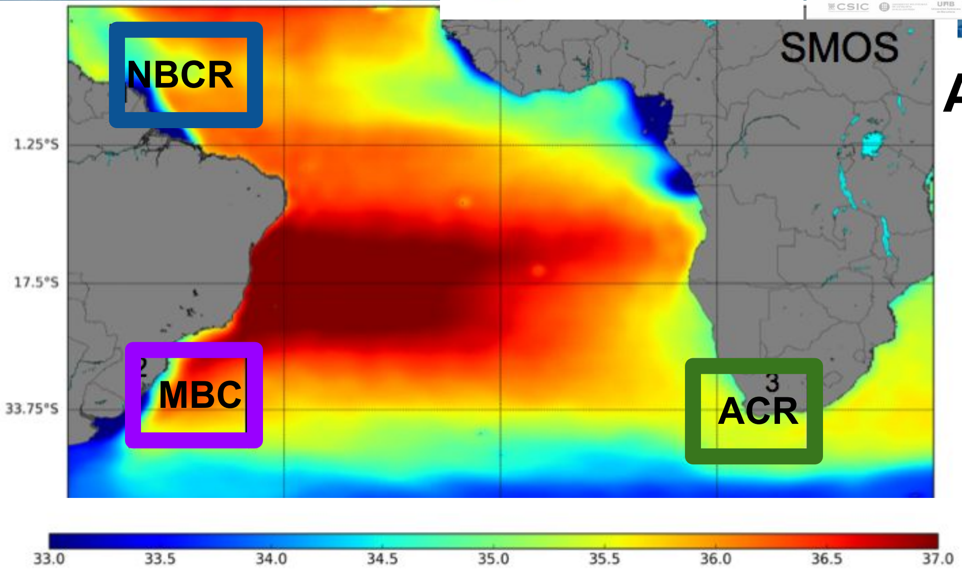


Malvinas Brazil Confluence:

- Malvinas current brings subpolar fresh and cold waters flows towards the equator
- At 36º-38ºS MC encounters the Brazil Current forming the MBC

In the MBC the subantartic and subtropical waters collide frontally and are diverted offshore

DATA SETS AND METHODS

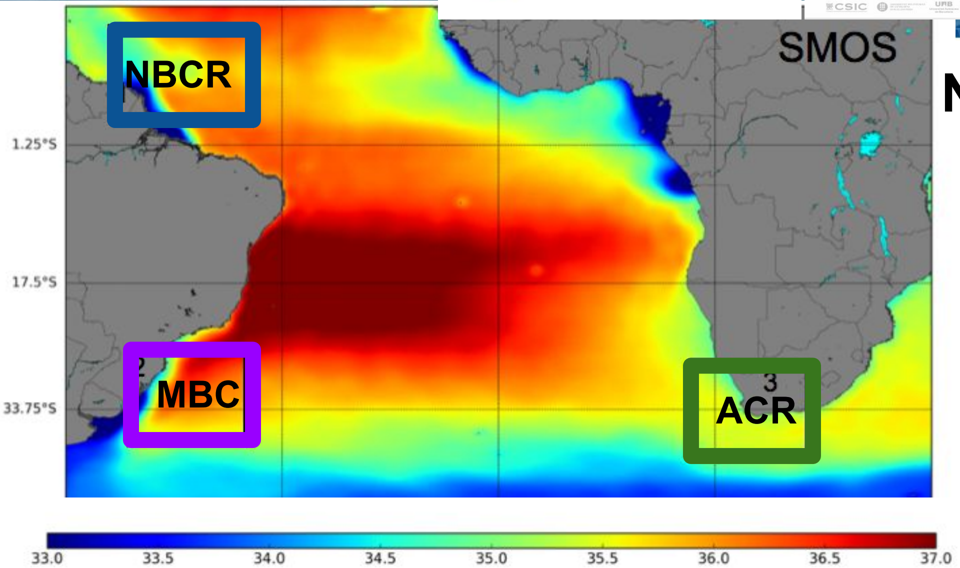


Aghulas Current Retroflexion:

- Aghulas Current tips along the souther coast of Africa
- As the AC surpasses the southern end of Africa, it curls back upon itself

That leaks rings and filaments into the Atlantic Ocean (Agulhas Leakage, AL)

DATA SETS AND METHODS

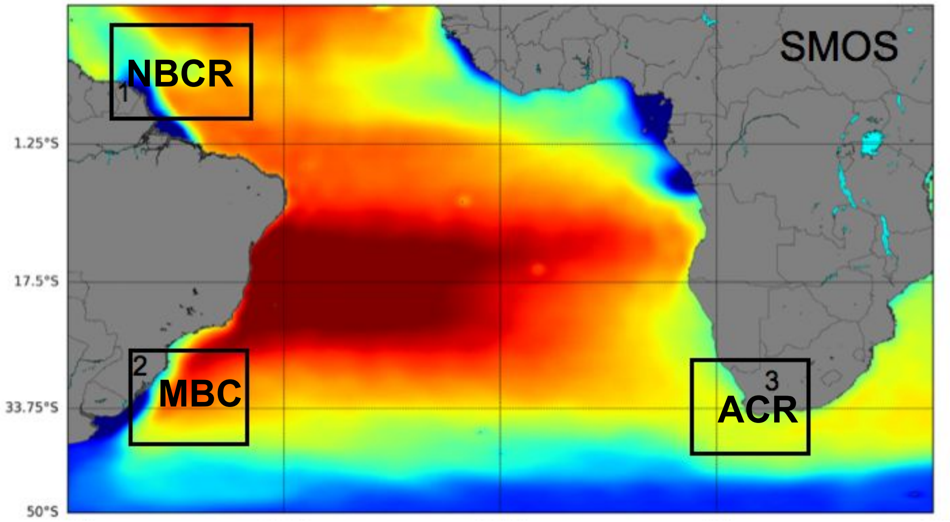


North Brazil Current Retroflexion:

- The North Brazil Current is responsble of the transport of heat and salt away from the equatorial and tropical regions
- However, this transport is blocked on a seasonal basis, as the NBCR diverts waters offshore

To understand this transport of properties we must assess the seasonal cycle of the NBCR.

Introduction

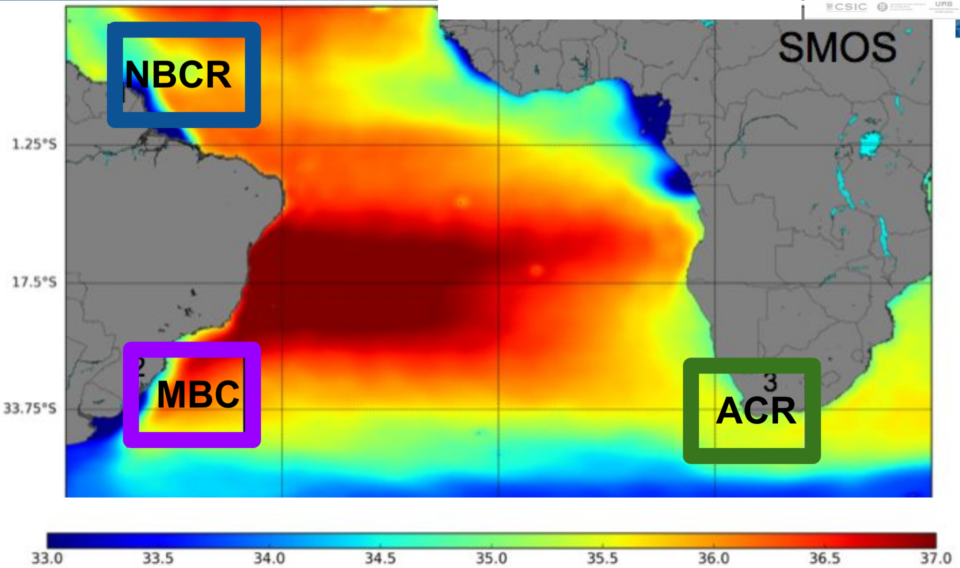


The variability of the SSS in these regions provide:

- regional descriptors
- insight on the predominant pathways

The objective is to examine if we can use the information in the SSS fields not only to describe the variability in regional patterns but also to estimate how the volume and salt transports change in time.

DATA SETS AND METHODS



DATA SETS:

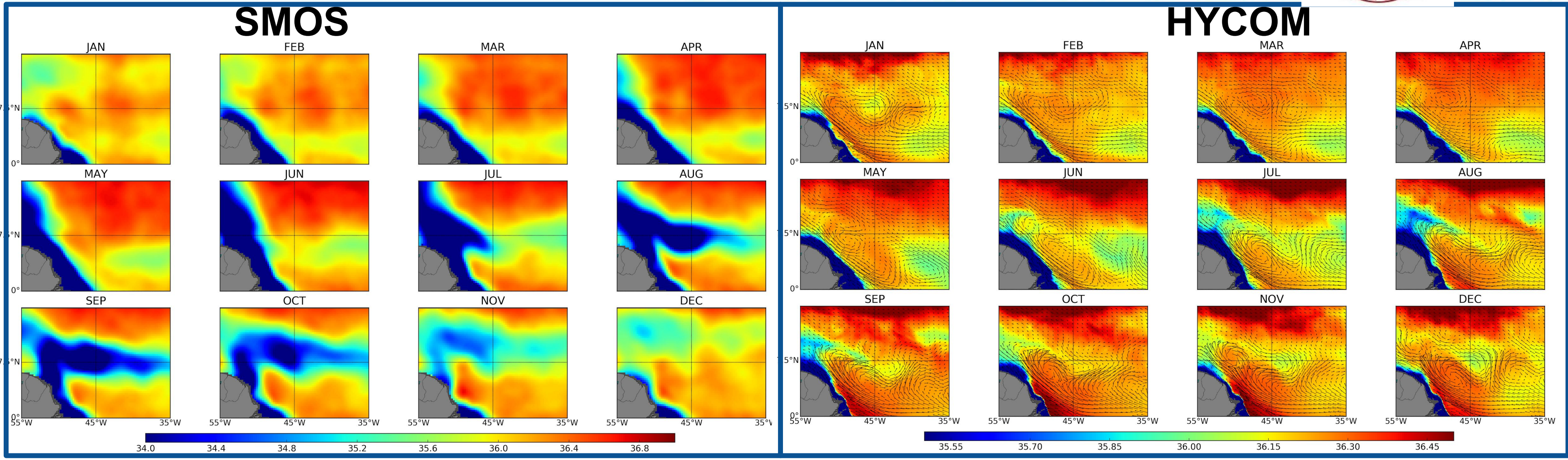
MODEL SSS and Sea Surface Velocities (SSV): HYCOM run at the Ocean Modeling Laboratory (LABMON) .Daily product at 1/12º

SATELLITE SSS: SMOS-BEC SSS product. 0.25º 9-day maps

METHODS:

1. We study the seasonal variations of the SSS in these three regions
2. We use the modeled SSS and SSV to derive relationship between the gradient of SSS and SV.
3. We apply these relationships to SMOS SSS and we compute SMOS-derived SSV.
4. We use SMOS SSV to generate salt transport in those three regions.

SSS VARIABILITY: NORTH BRAZIL CURRENT RETROFLECTION (**NBCR**)

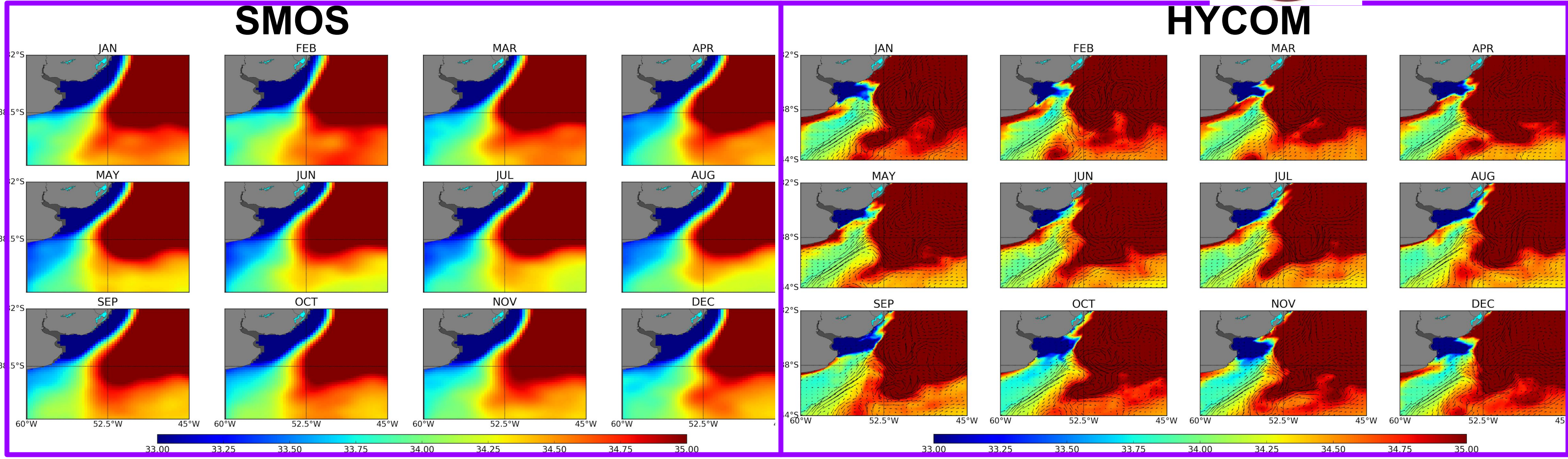


Seasonal pattern in both SMOS and HYCOM:

- The plume of low salinity waters stretching offshore in JUL- DEC
- The maximum in SEP

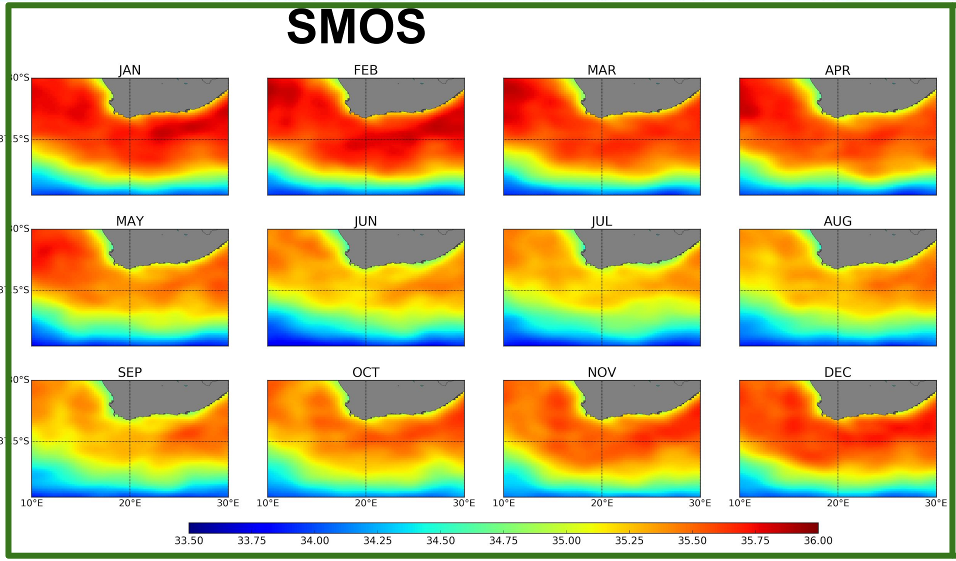
The changes in the eastward extension of the low-salinity plume are not directly related to the temporal variation in Amazon River discharge – min. in OCT-NOV and max. in MAY-JUN– but to the seasonal appearance of the interior North Equatorial Counter Current

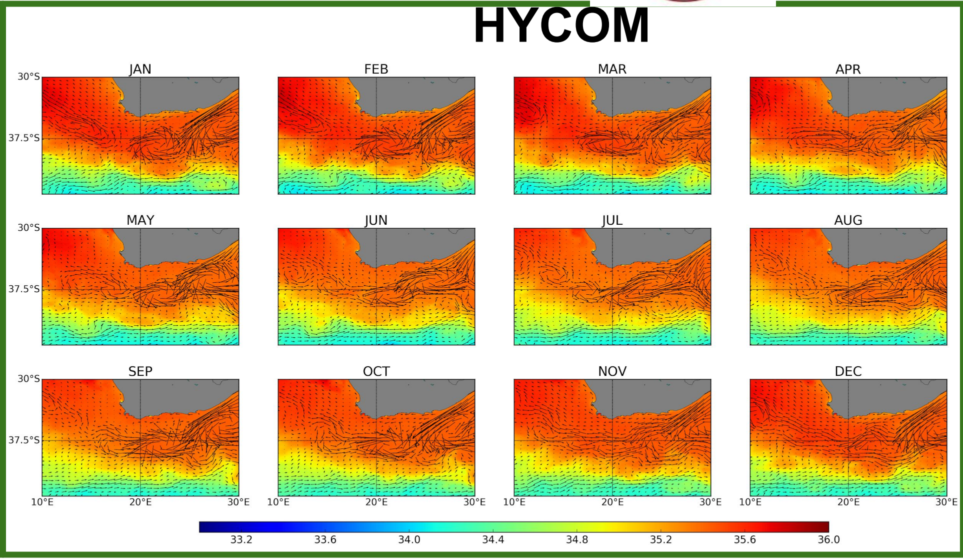
SSS VARIABILITY: BRAZIL MALVINAS CONFLUENCE (**MBC**)



- HYCOM and SMOS capture moderate latitudinal variations in the frontal system -small near the shelf break and more visible offshore (east of 52.5°W).
- Subtropical SSS reach further south during the austral summer (NOV-MAR).

SSS VARIABILITY: AGULHAS CURRENT RETROFLECTION (**ACR**)





SMOS data shows maximum SSS values between DEC-APR, and minimum values between JUN-SEP.

The seasonal appearance of high SSS values is more related to the oscillation in the longitude of retroflection than to the intensity of the AL

SSV INFERRED FROM SSS

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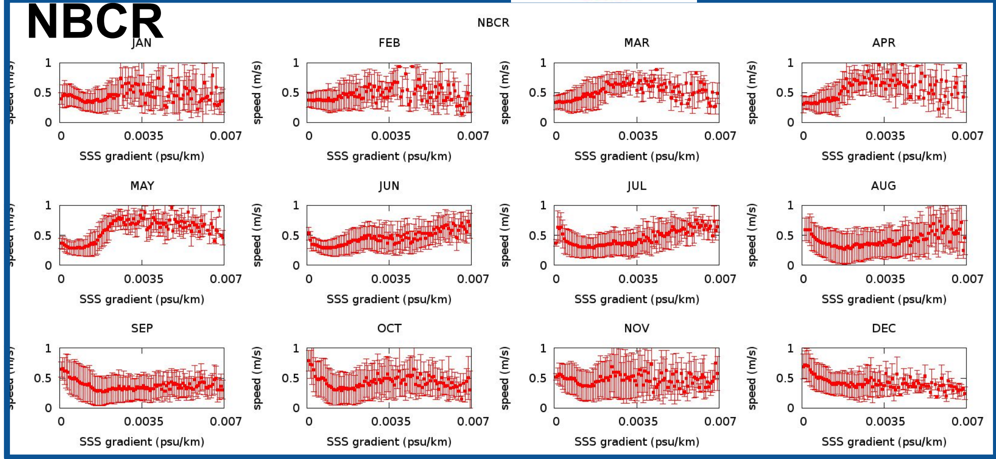
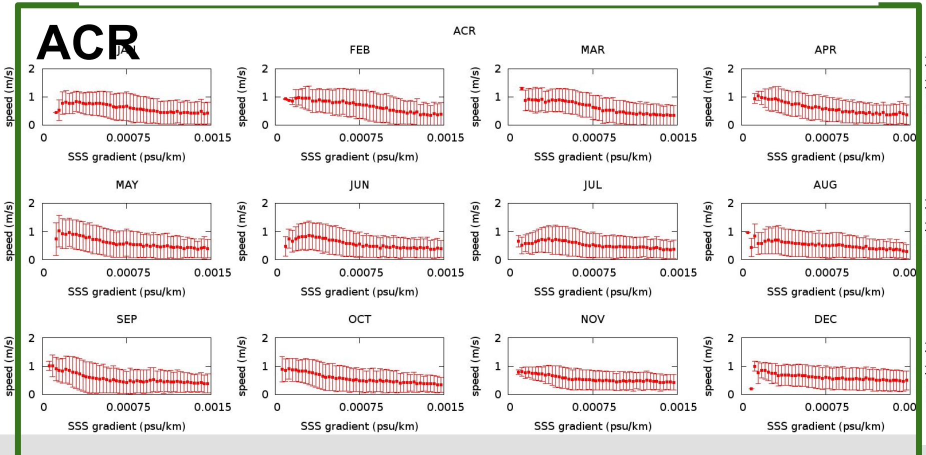
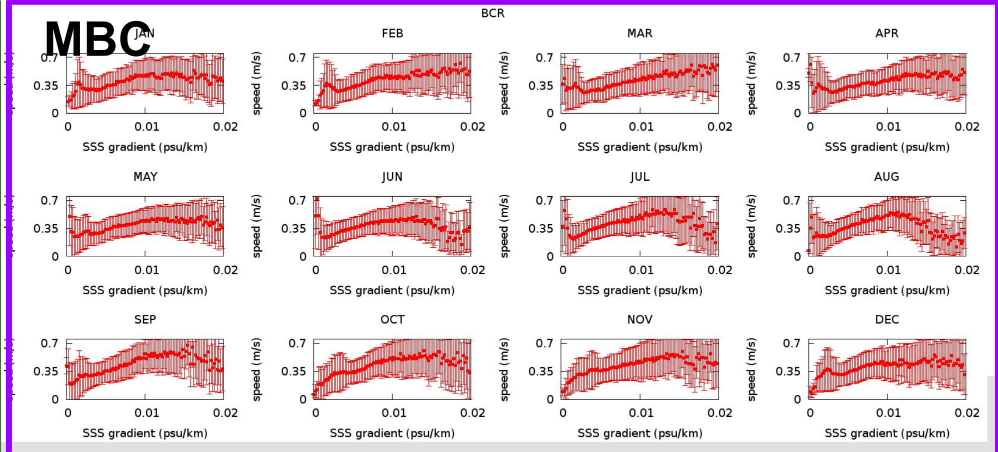
We fit HYCOM gradient of SSS and SSV data:

probability density function between the speed and the amplitude of the salinity gradient





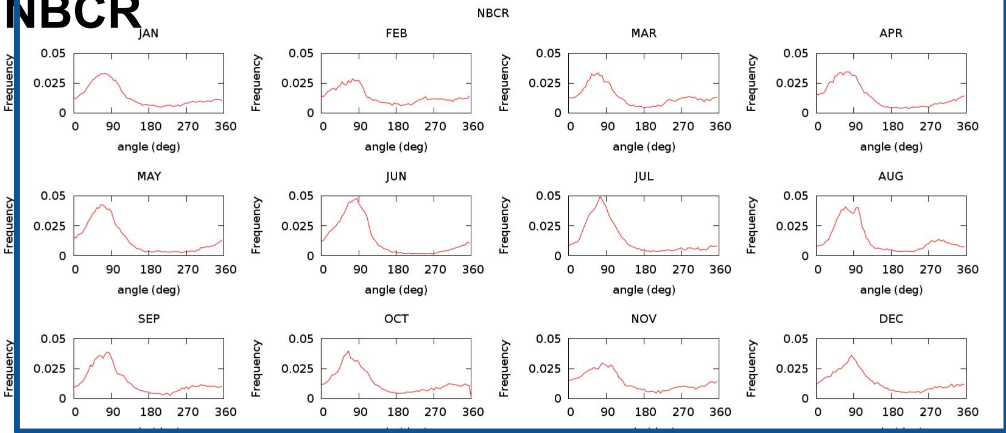


SSV INFERRED FROM SSS

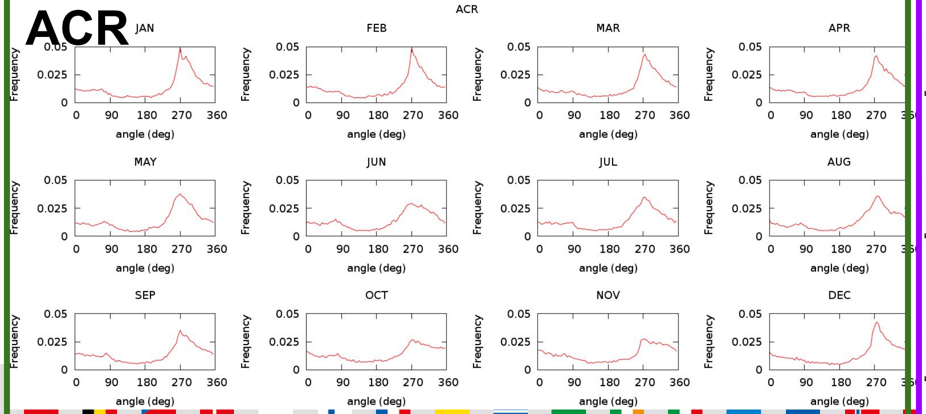
We fit HYCOM SSS and SSV data:

probability distribution between the angle of SSS gradient and the velocity vector

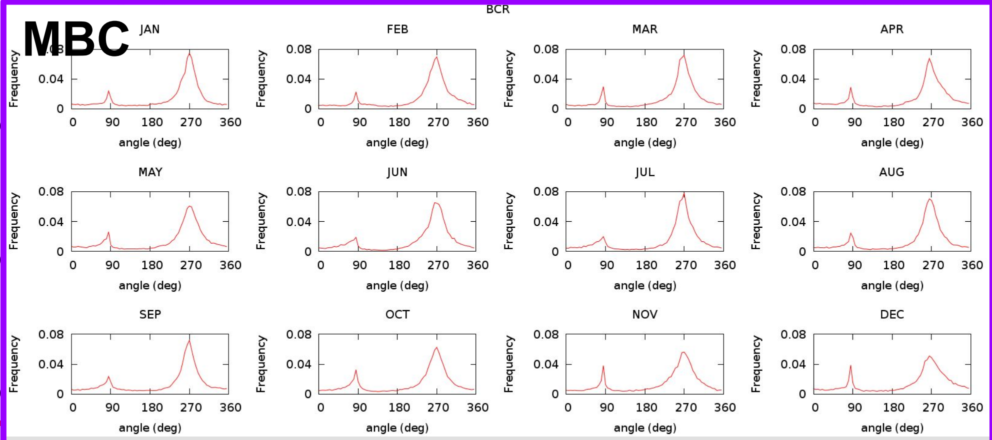
NBCR



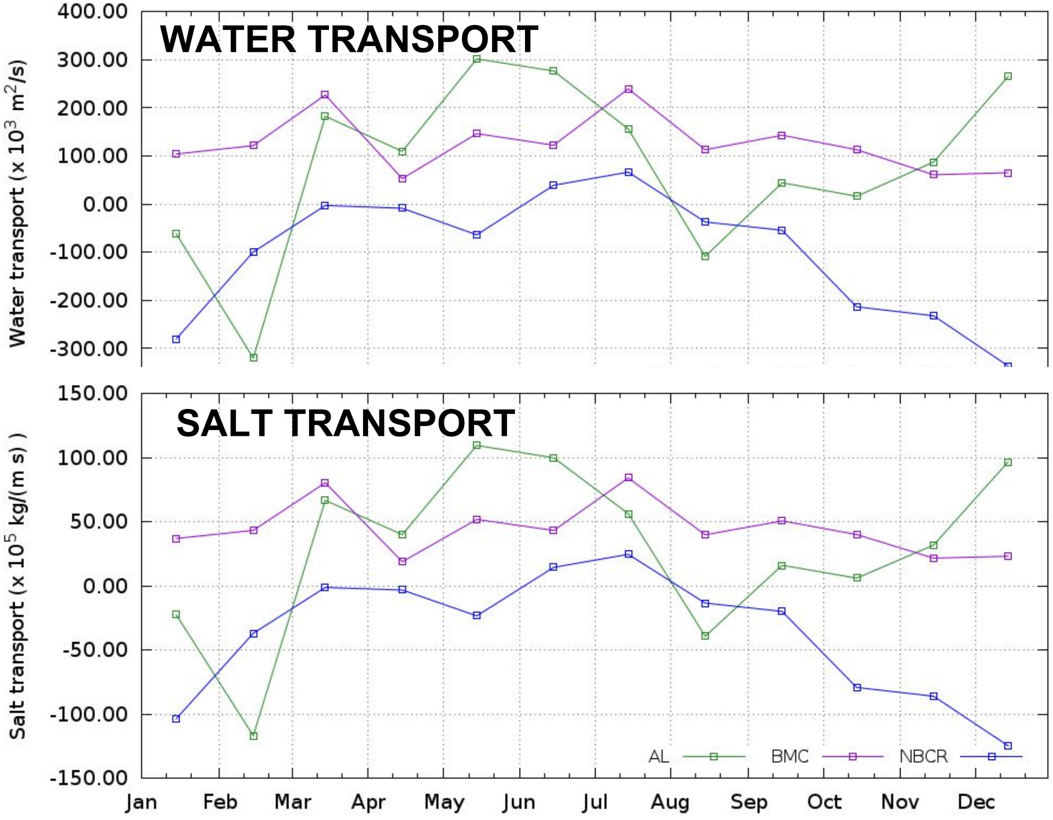
ACR



MBC



SALT TRANSPORT VARIABILITY



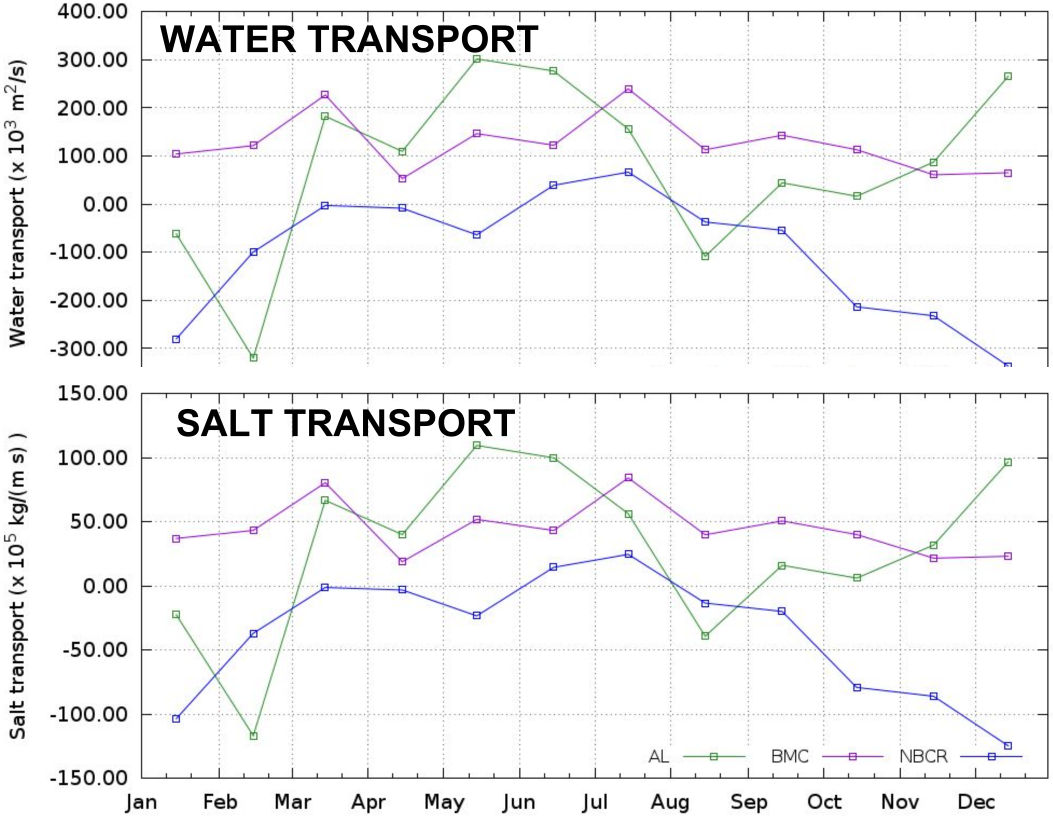
We compute SMOS-derived SSV by using the last relationsships.

We use the SMOS-derived SSV to compute water and salt transport

We integrate the zonal transport per unit depth over 4º latitude section in each region

Positive values denote eastwards transport and negative values westwards.

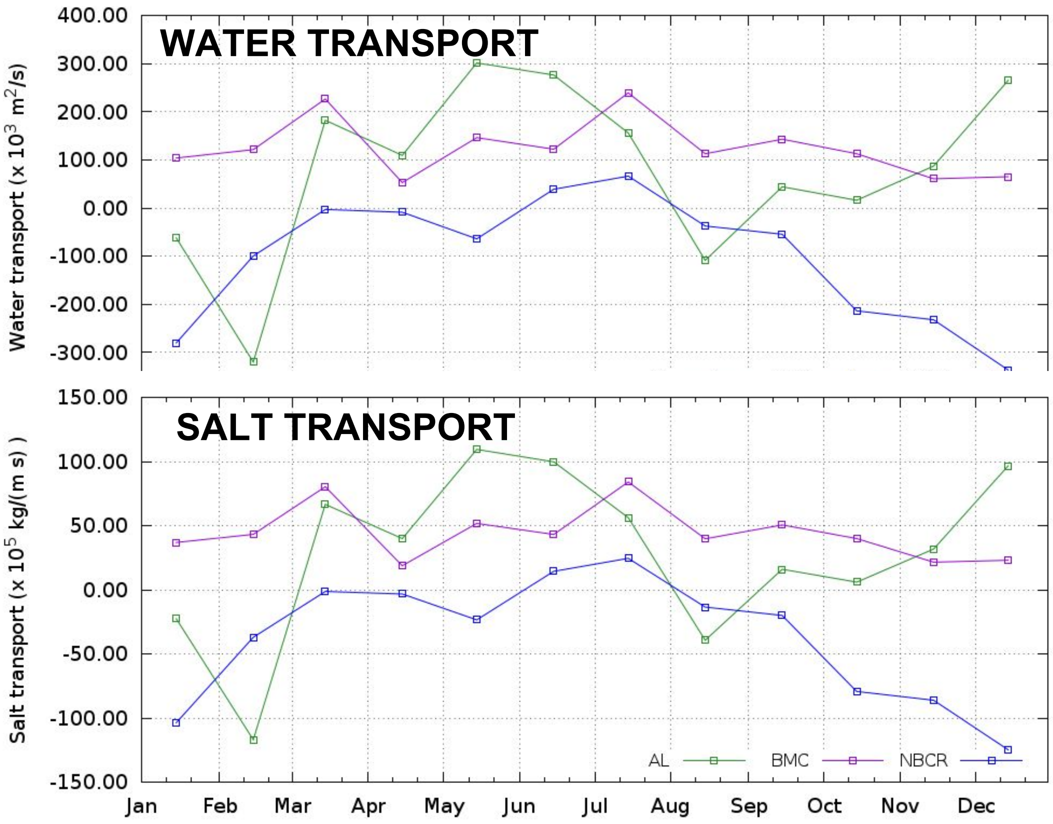
SALT TRANSPORT VARIABILITY



<u>NBCR (blue): Zonal transport integrated section in 40ºW with latitudes between 2ºN-6ºN</u>

Intense westward transports OCT-JAN (characteristics of the year dominance of South Equatorial Current) that revert in JUN-JUL (when the NBCR develops and connects to the downstream eastward North Equatorial Countercurrent)

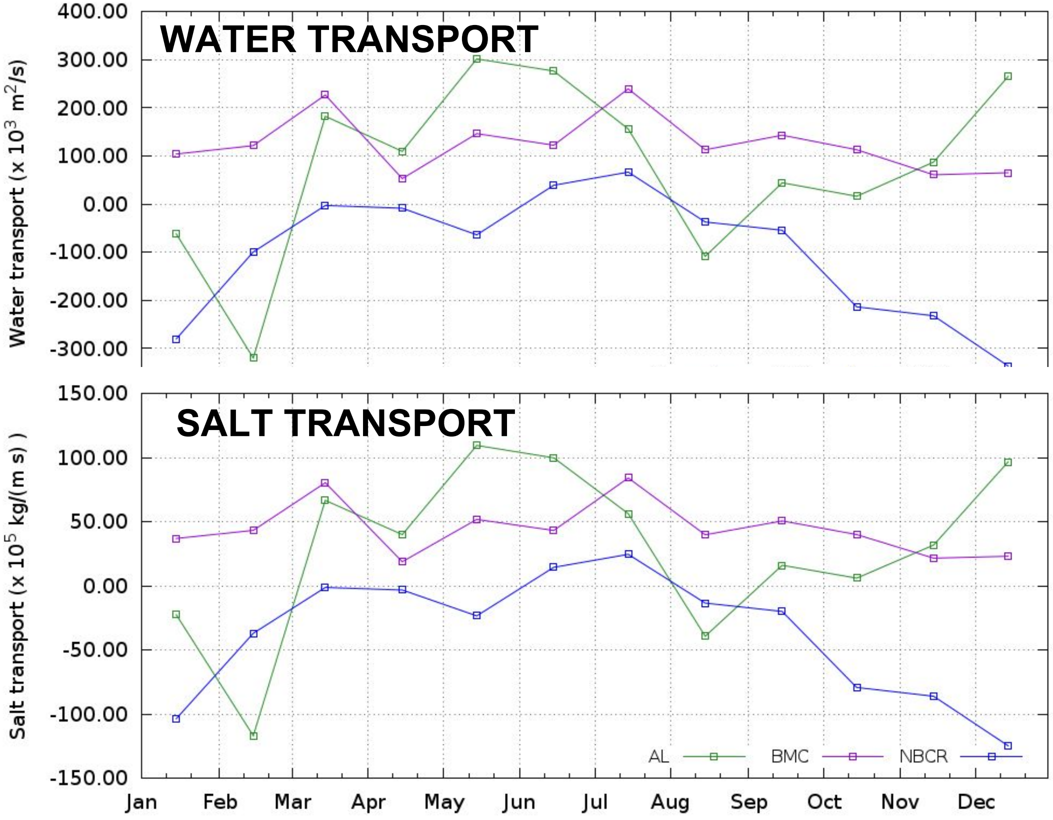
SALT TRANSPORT VARIABILITY



<u>MBC (purple) Zonal transport integrated in a section in 47ºW with latitudes beteween 40º-44ºS</u>

Latitudinal BC and MC transports do not display a prominent seasonal cycle

SALT TRANSPORT VARIABILITY



ACR (green) Zonal transport integrated in a section in 17ºE with latitudes between 34º- 38ºS

The subsequent water and salt zonal transports display substantial intermittency

No prominent seasonal pattern in the AL

The actual monthly transports changes as a function of the shedding of rings from the AL.

SUMMARY

We have explored the use the SSS fields to characterize the flow in three retroflection regions

The approach has consisted in:

1. Using an ocean model to infer monthly functional relations between SSS and SSV
2. Applying these relationships to the SMOS data

The results are encouraging and lead to consistent patterns of seasonal variability for the water and salt transports associated with the retroflections

Developing a density product from SMOS SSS and satellite Sea Surface Temperature

Computing SSV from this new density product.

Comparing with altimetric-derived SSV

Better estimate of the salt transport in terms of:

- Mesoscale structure and eddy dynamics
- Shorter time periods and interannual variability

THANK YOU VERY MUCH FOR YOUR ATTENTION!

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