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

by P. Castellanos¹,

E. Olmedo²,³, J. L. Pelegrí³, A. Turiel²,³, E. J. D. Campos⁴,⁵
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.
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 Retroflection (ACR)
3. North Brazil Current Retroflection (NBR)
Malvinas Brazil Confluence:

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

In the MBC the subantarctic and subtropical waters collide frontally and are diverted offshore
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 responsible for 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.
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.
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).
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.
We fit HYCOM gradient of SSS and SSV data:

probability density function between the speed and the amplitude of the salinity gradient
We fit HYCOM SSS and SSV data: probability distribution between the angle of SSS gradient and the velocity vector.
We compute SMOS-derived SSV by using the last relationships.

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

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

Positive values denote eastwards transport and negative values westwards.
NBCR (blue): Zonal transport integrated section in 40°W with latitudes between 2°N-6°N

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)
MBC (purple) Zonal transport integrated in a section in 47°W with latitudes between 40°-44°S

Latitudinal BC and MC transports do not display a prominent seasonal cycle
ACR (green) Zonal transport integrated in a section in 17°E with latitudes between 34°- 38°S

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.
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!