Use of Altimeter Data over the Broad Continental Shelf In the SW Atlantic Ocean

→ 8th COASTAL ALTIMETRY WORKSHOP

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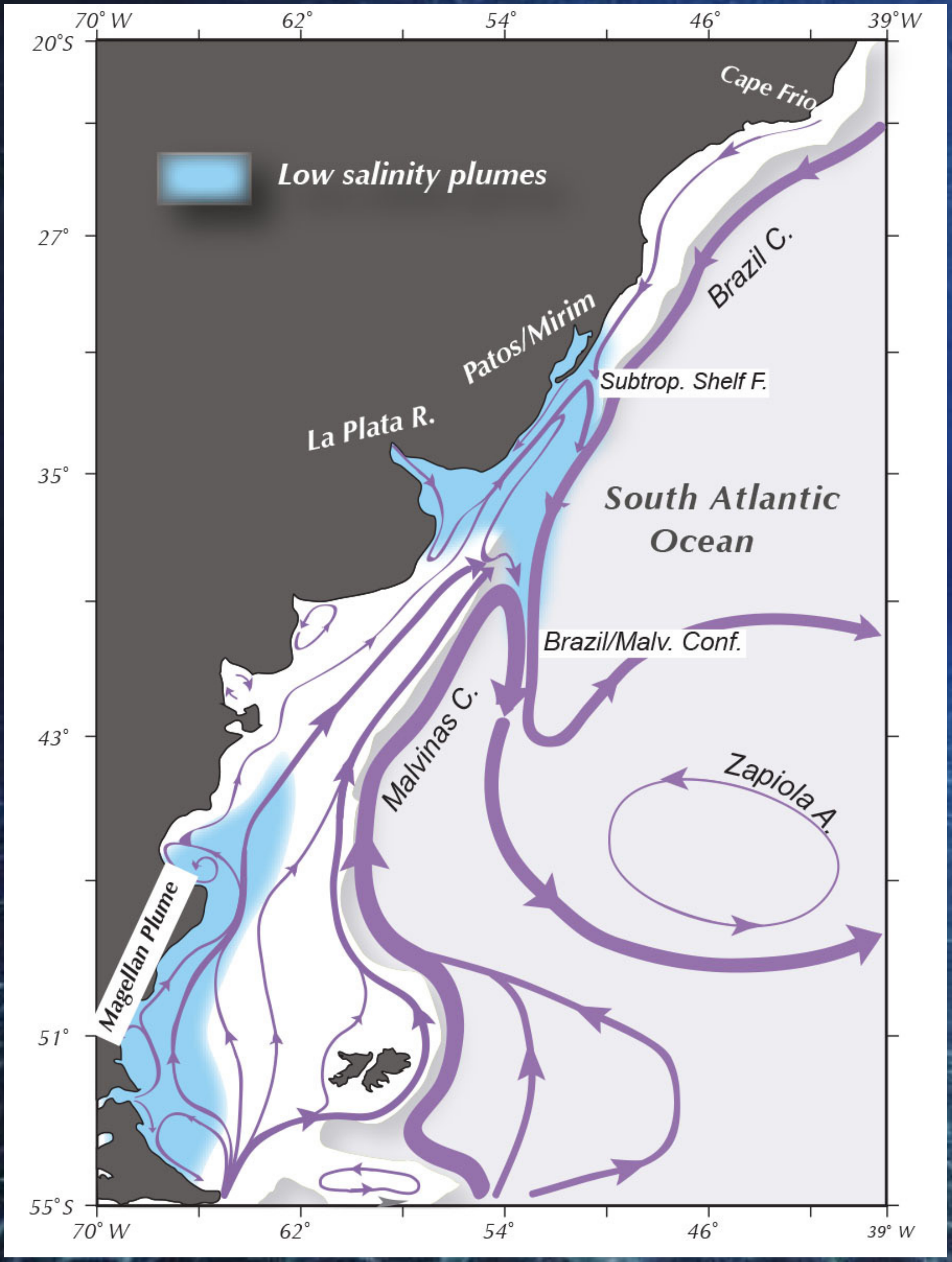


ALT Data Use Over the Wide SW Atlantic Shelf

Strub, James, Matano, Combes

The Rio de la Plata (RdlP) feeds fresh water into the energetic confluence of the Brazil and Malvinas Currents (BMC).

Can altimetry resolve the seasonal variability of sea level and velocity over the wide shelf? Including the cross-shelf transports?

Data Used:

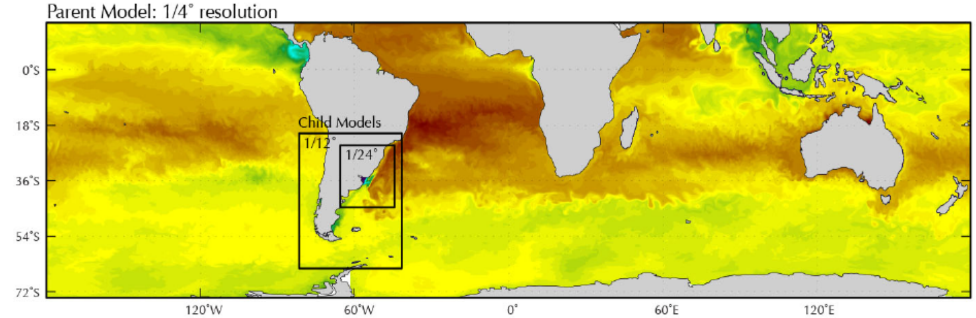
AVISO SLA, 2001-2012

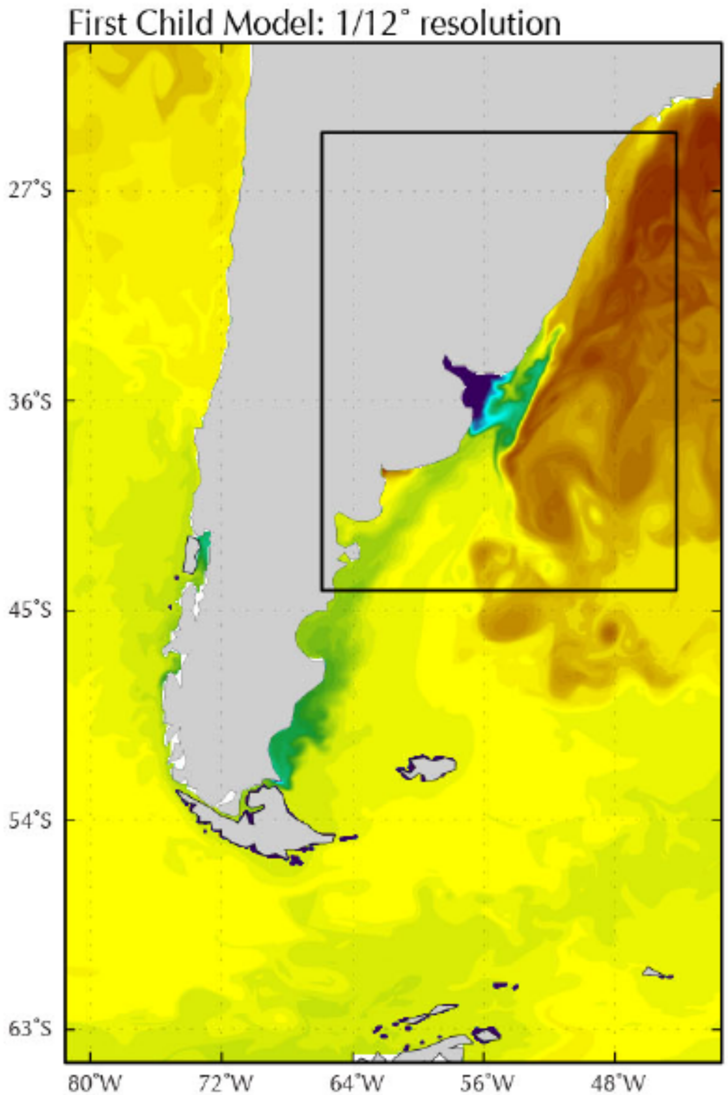
ECMWF Wind Stress

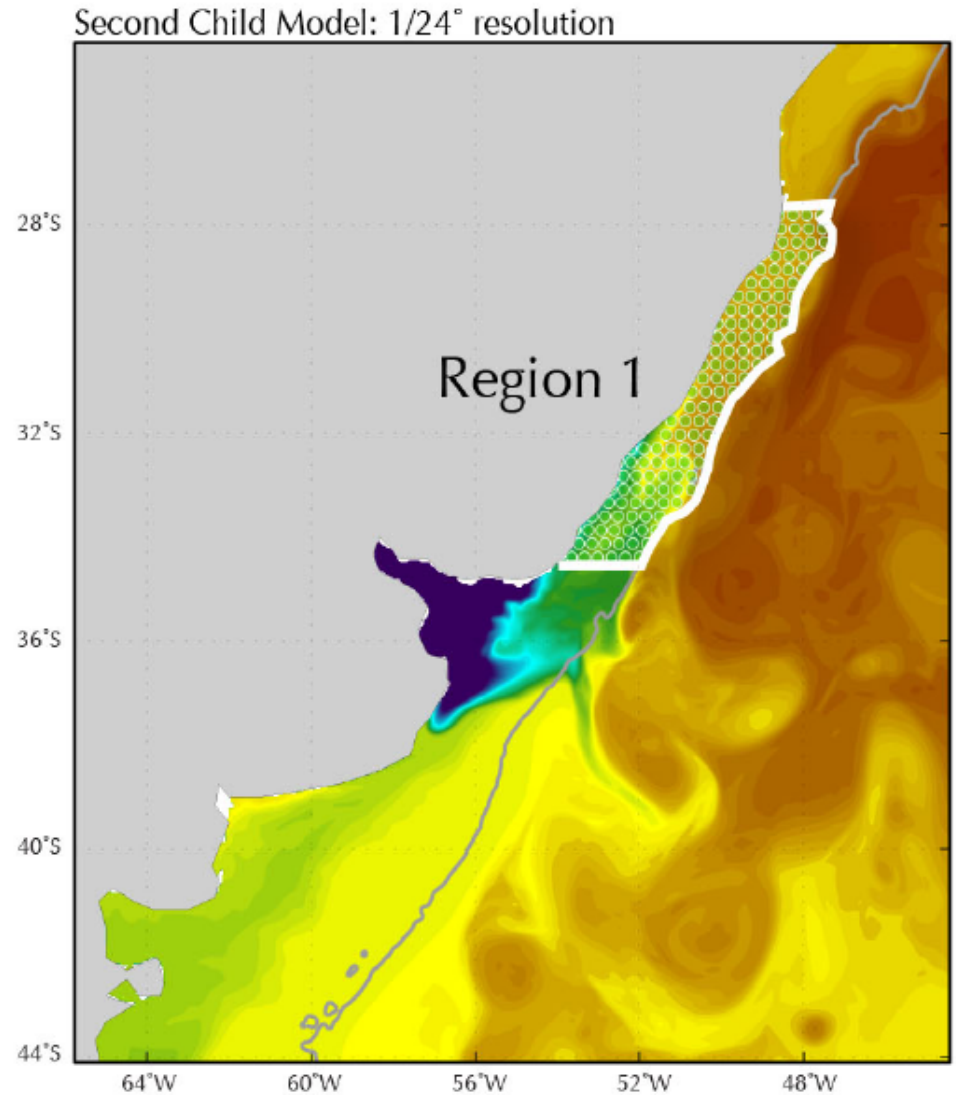
Nested ROMS Model

Doubly Nested ROMS Model

* 15°N to Antarctica, ¼° Grid
- Southern S. America, 22-64°S, 1/12°
- SW Atlantic, 24-44°S , 1/24°







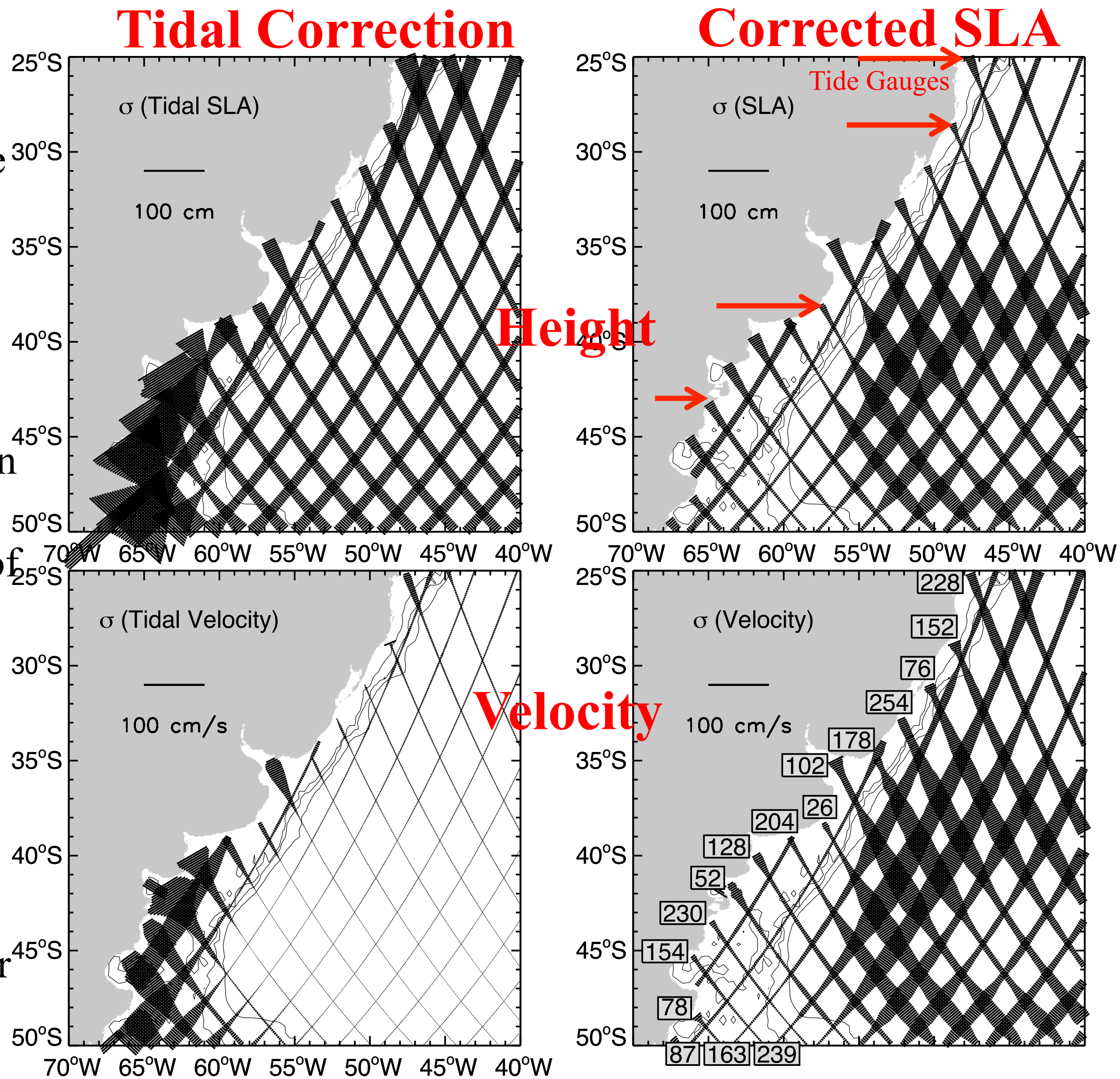
Variance of SLA (top) and Geostrophic Velocity (bottom) Using 20 Years of AVISO SLA Data

The SLA includes the difference between the real tidal signal as observed by the altimeter and the tidal model.

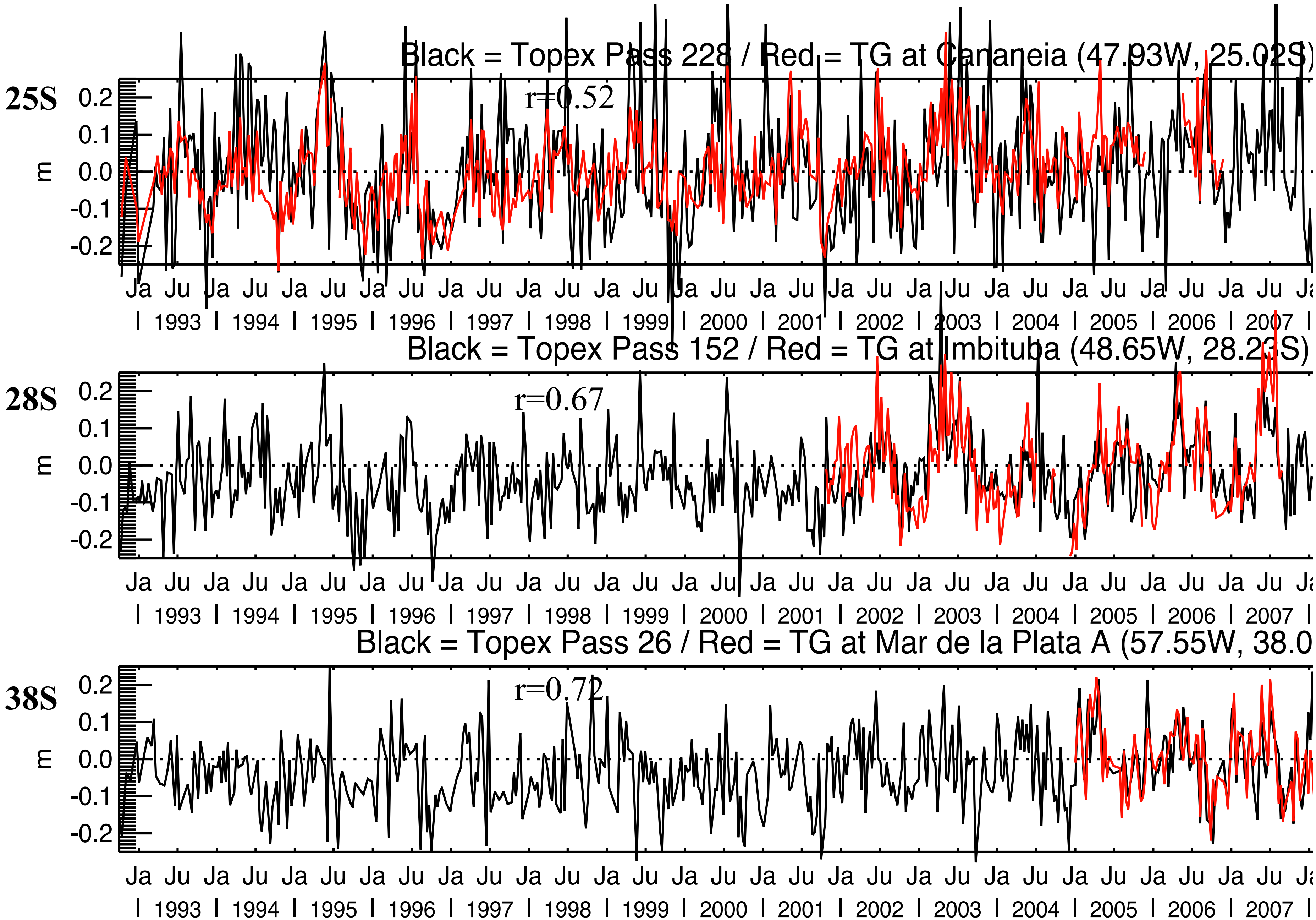
$SLA = \ldots (TT - TT_m)$

If the tidal model is inaccurate, part of both signals will remain in the SLA and the variance of the SLA will look like the variance of the tides, as represented here by the tidal model.

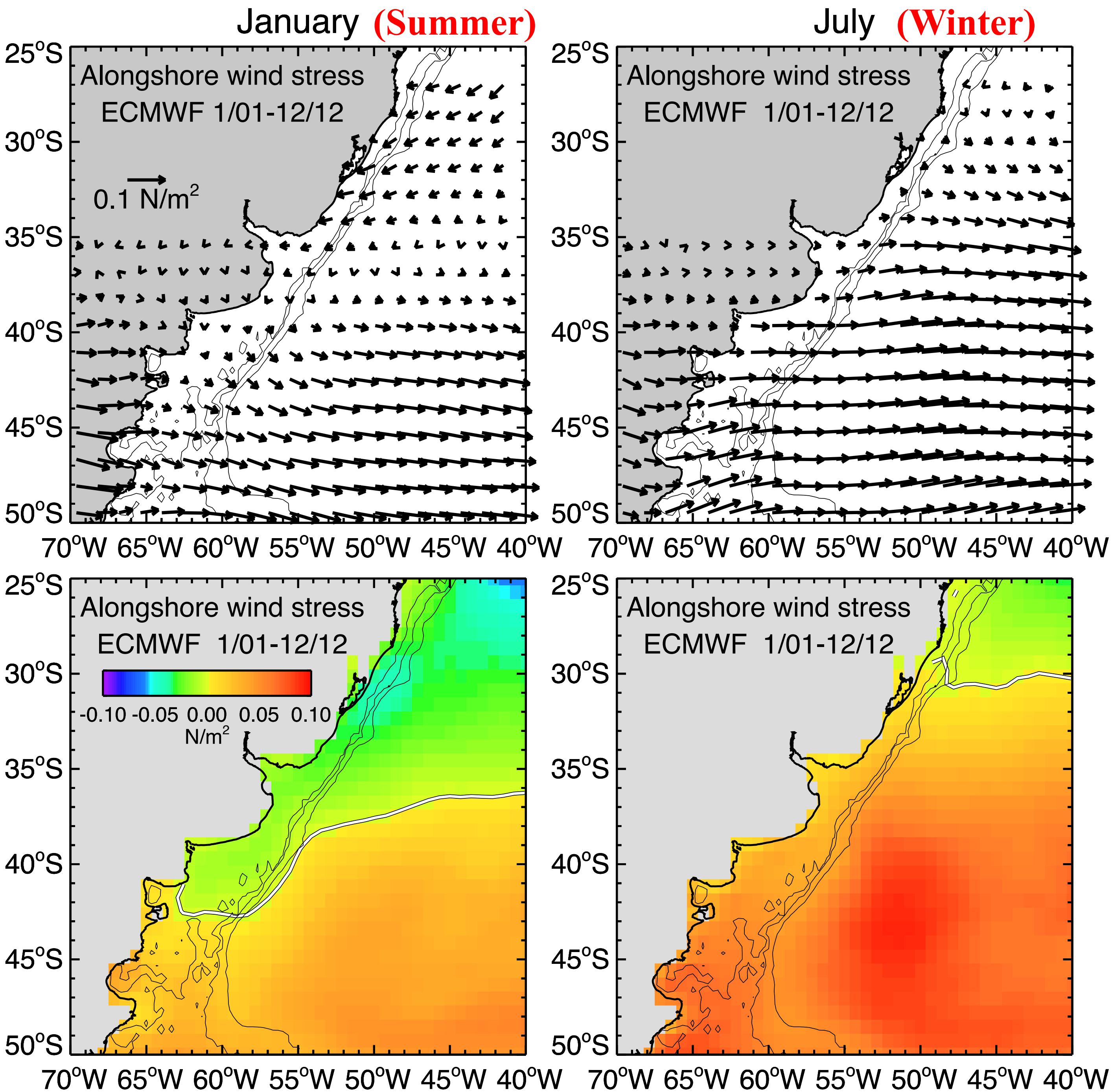
The SLA variance of neither the height nor the cross-track geostrophic velocity resembles that of the tidal model, giving us confidence in using the SLA over the shelf.



Tide Gauge (black) vs Along-track SLA (red)



ECMWF Wind Stress



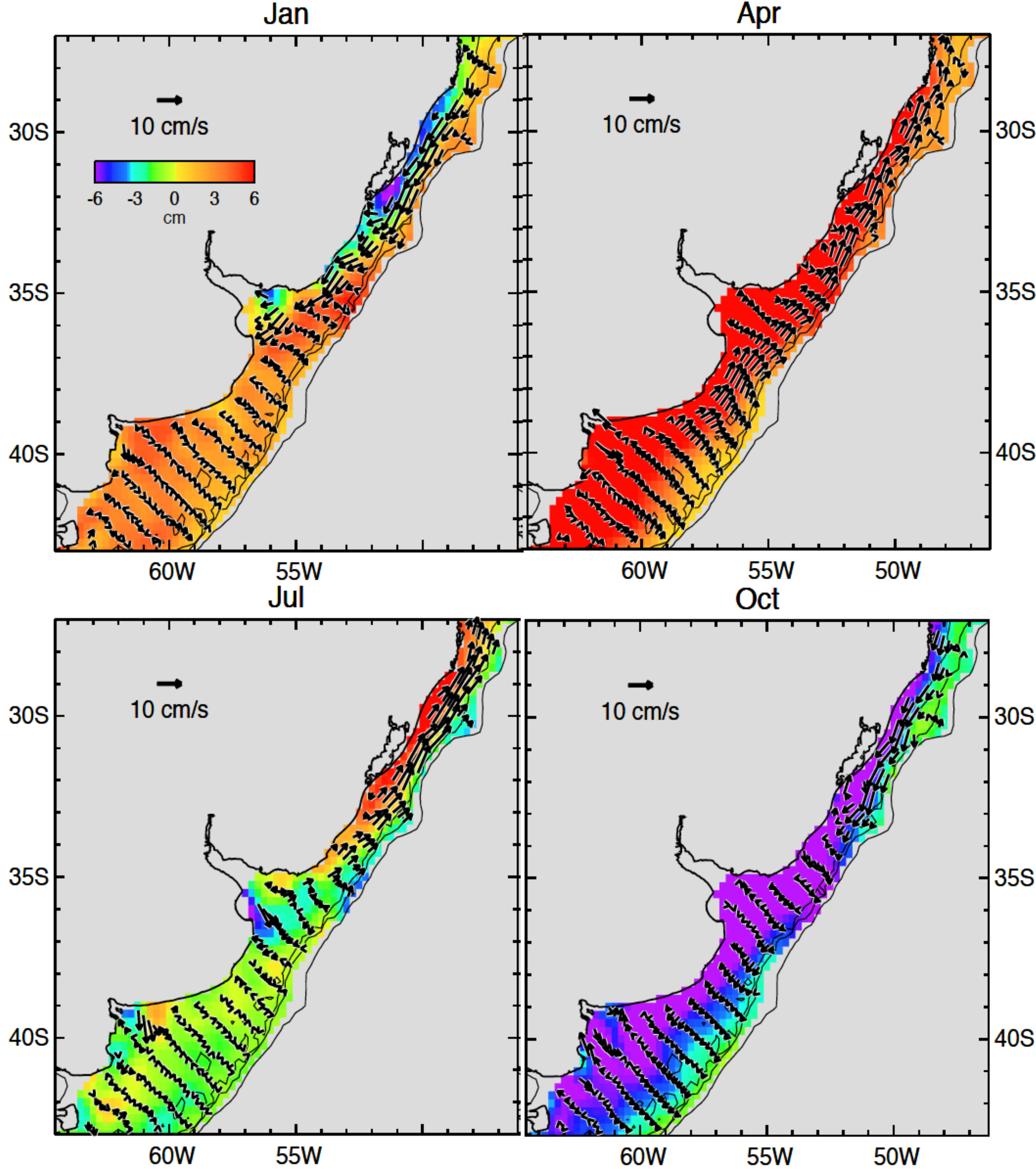
Seasonal change from upwelling to downwelling north of the Rio de la Plata.

“Alongshore” wind stress

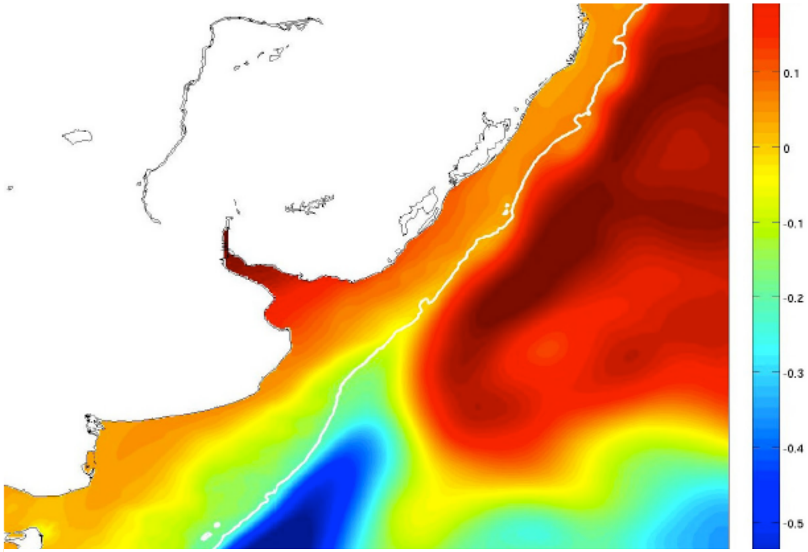
Seasonal V_g Anom. & SLA develop from south to north

Upwelling winds (poleward) Oct-Feb north of the RdlP lower sea level next to the coast and create poleward current anomalies.

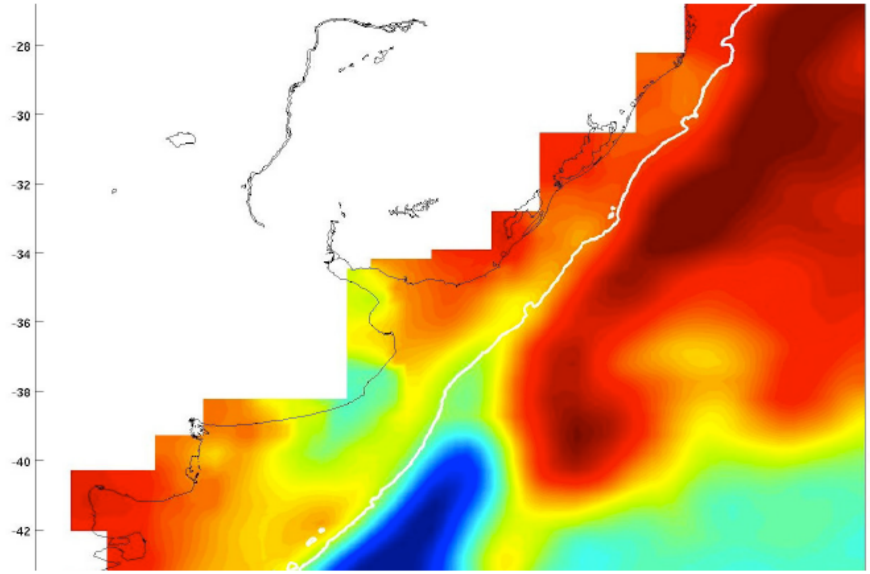
Opposite conditions Apr-Sept.



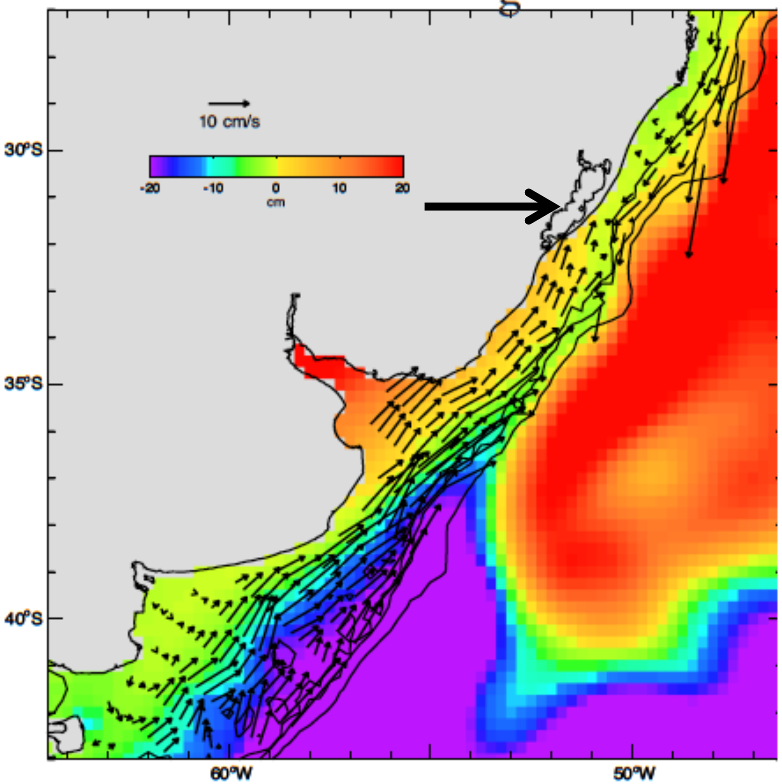
Model MSL



AVISO ALT MSL



Model Mean V_g



Mean Model Sea Level (top left)

Mean Dynamic Topography from AVISO (top right)

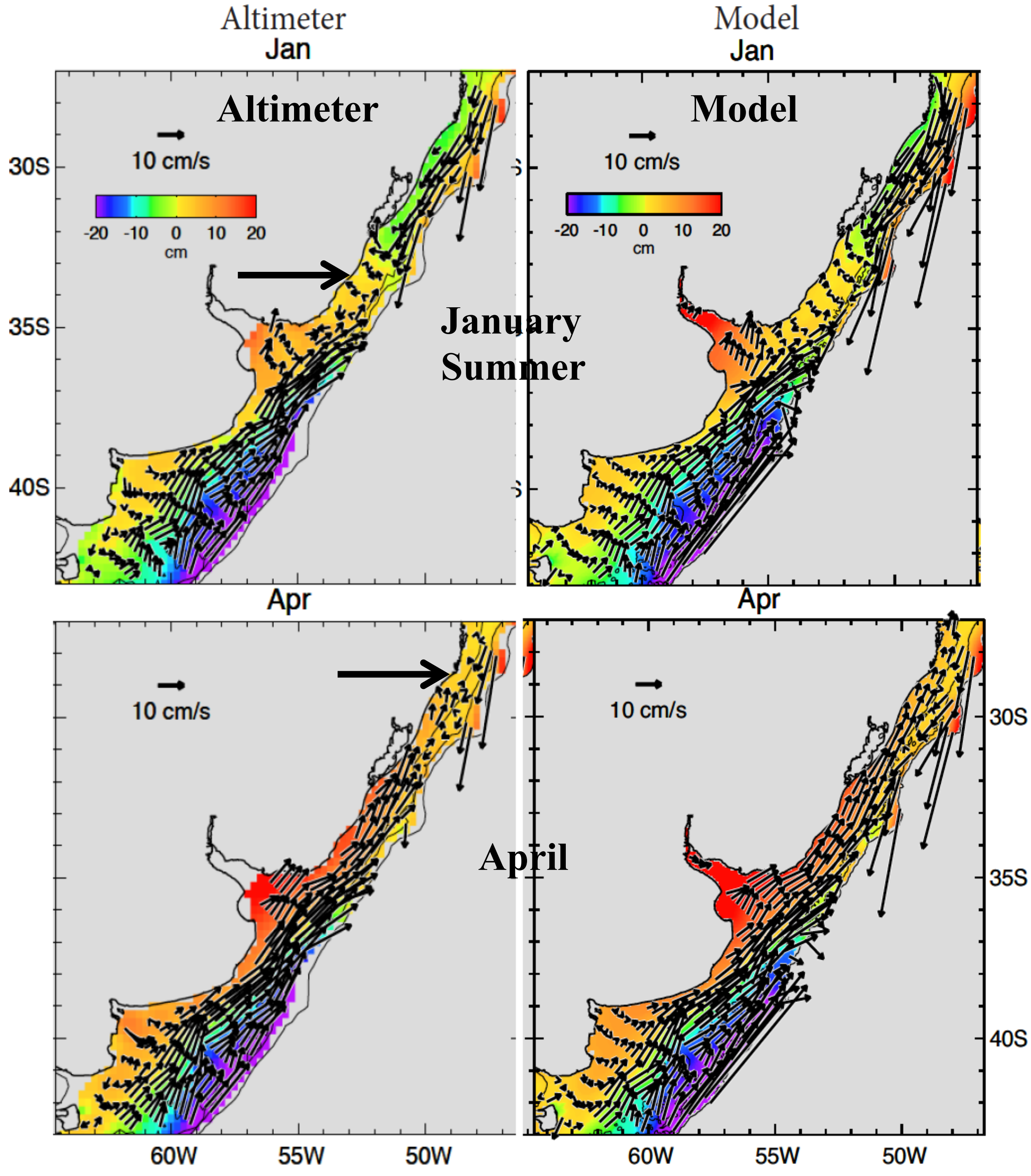
Mean Geostrophic Current from the Model MSL (left)

Note the confluence over the shelf near 31-32°S.

Mean "Absolute Dynamic Topography" = SLA + Model MSL

Altimeter (left) Model SSH, V_g

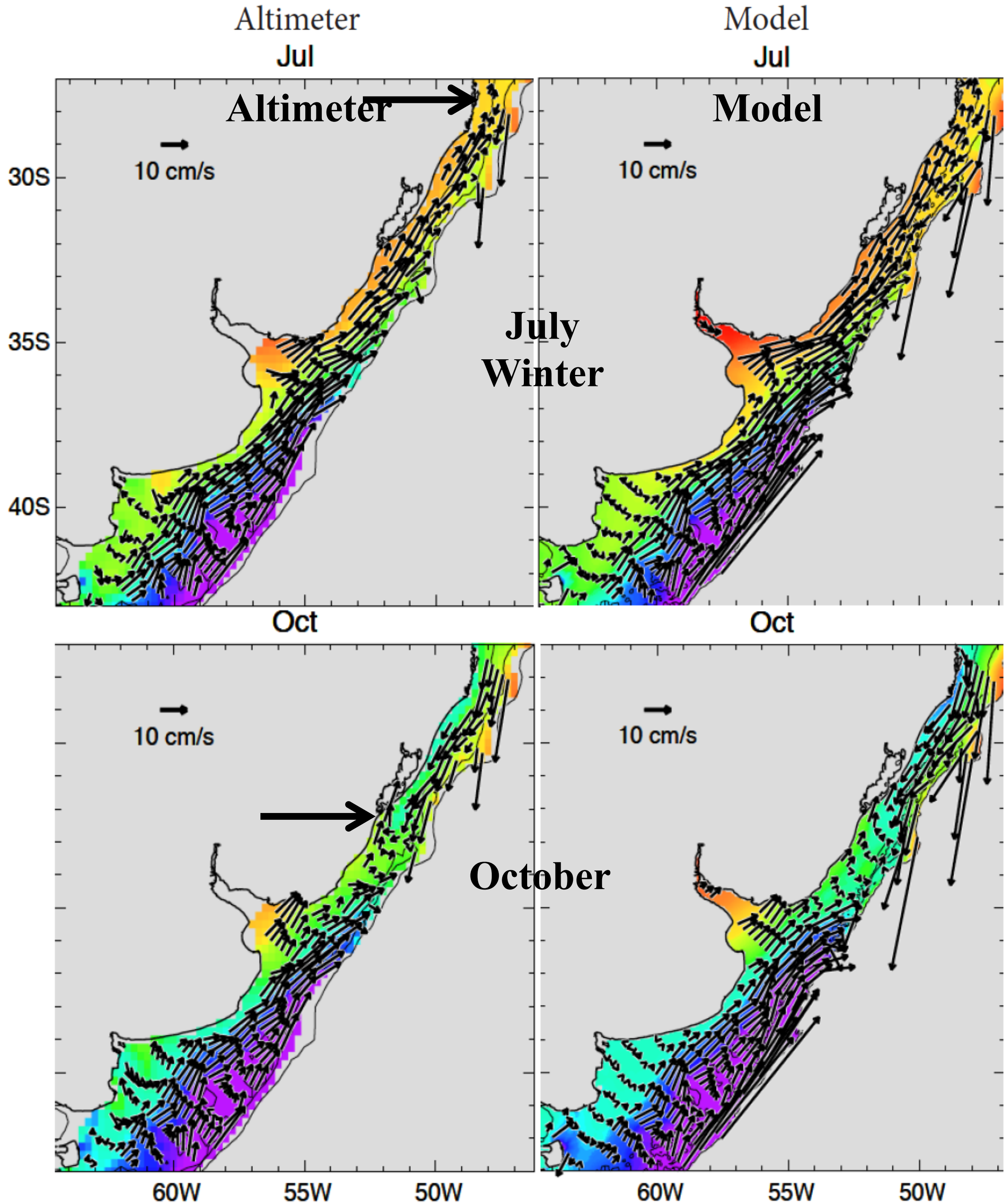
In summer, upwelling favorable winds extend the poleward flow south to 33-35°S



Mean "Absolute Dynamic Topography" = SLA + Model MSL

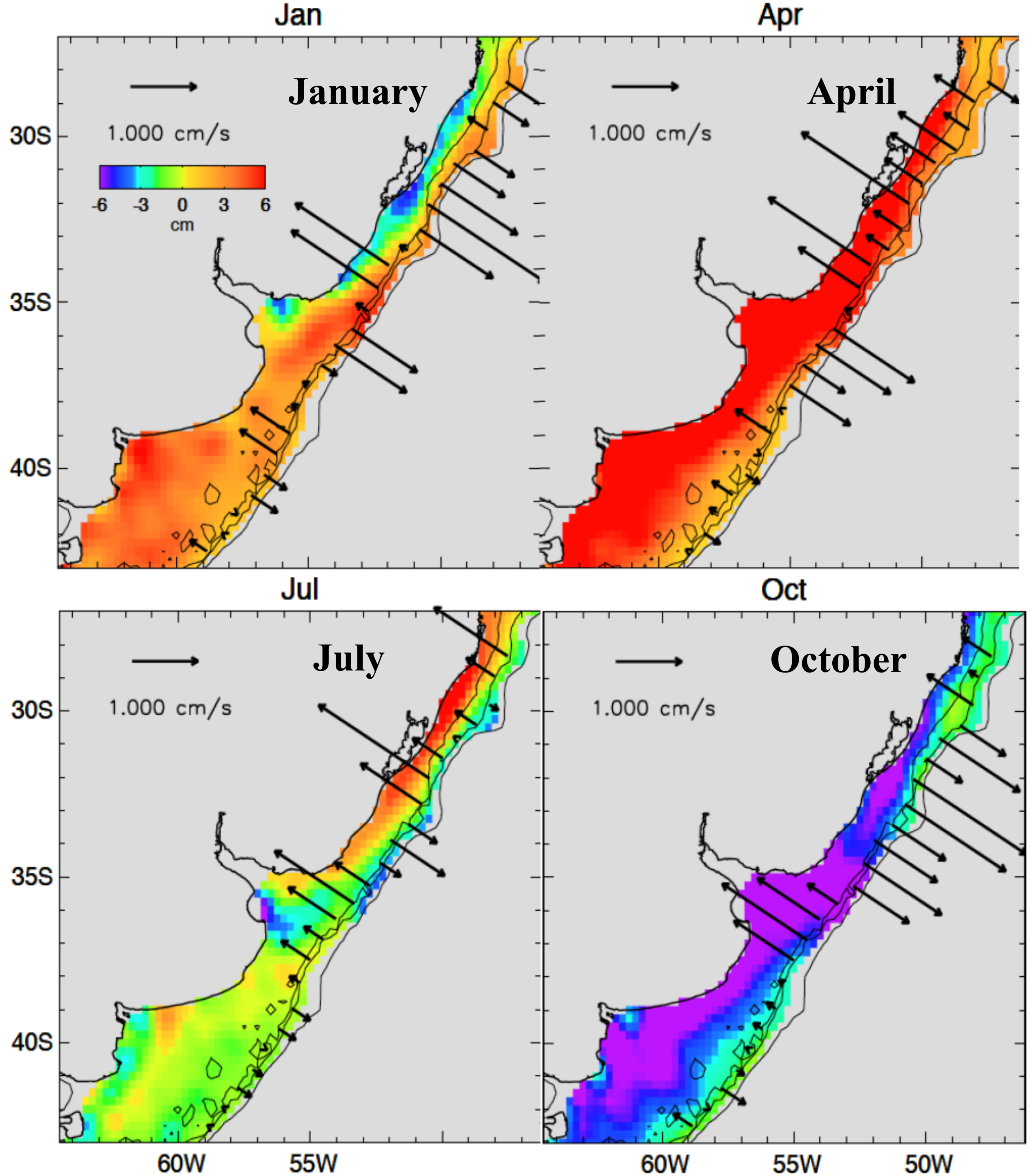
Good agreement of Altimeter (left) & Model SSH, V_g

In winter, downwelling favorable winds extend the equatorward flow north to ~27-28°S.



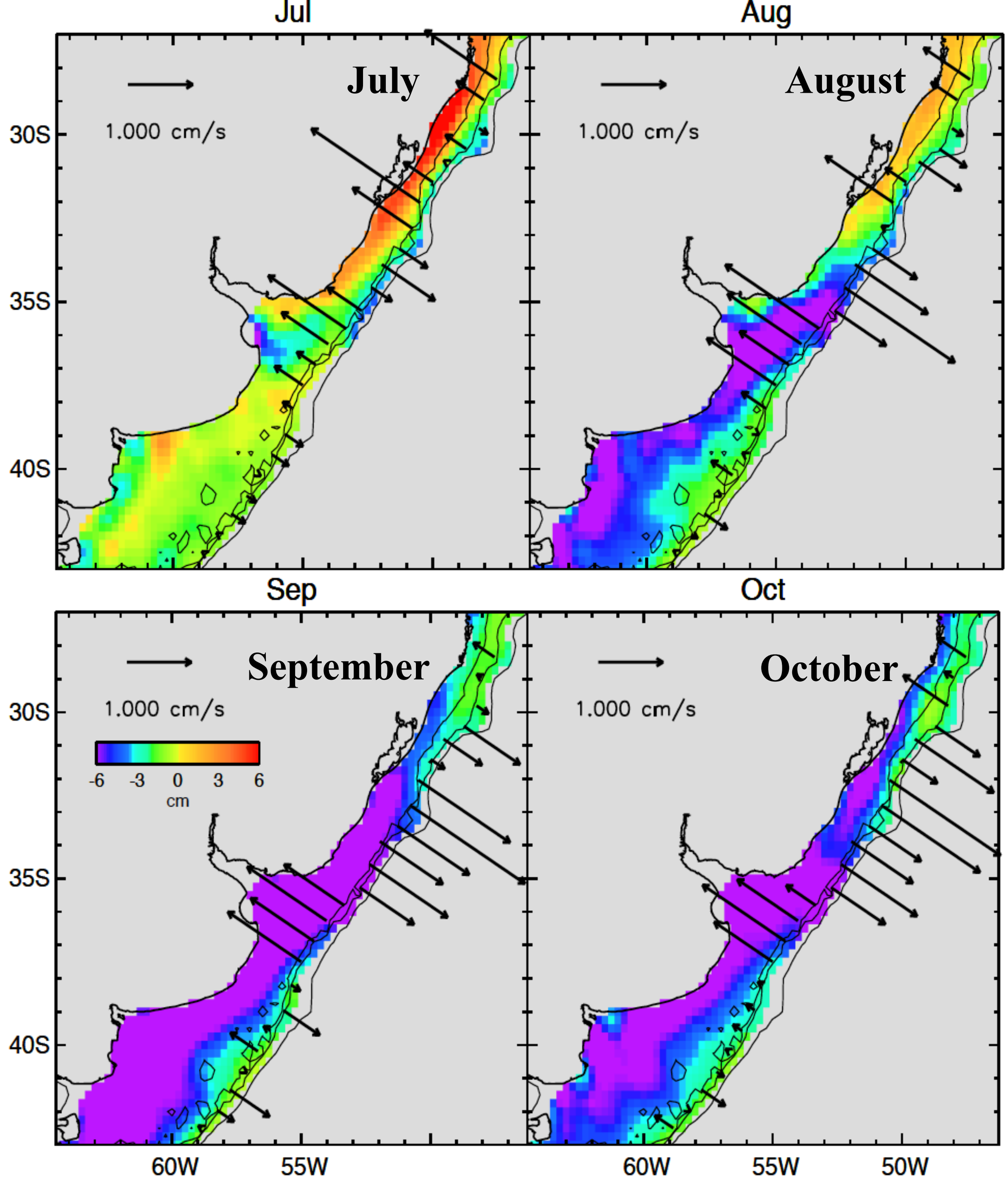
Geostrophic Cross-shelf Currents across the 200m isobath, reconstructed from the first 4 EOFs

Four Seasons – Offshore flow is strong off the RdlP in summer-fall; north of the RdlP, offshore flow decreases during summer, increases during winter.

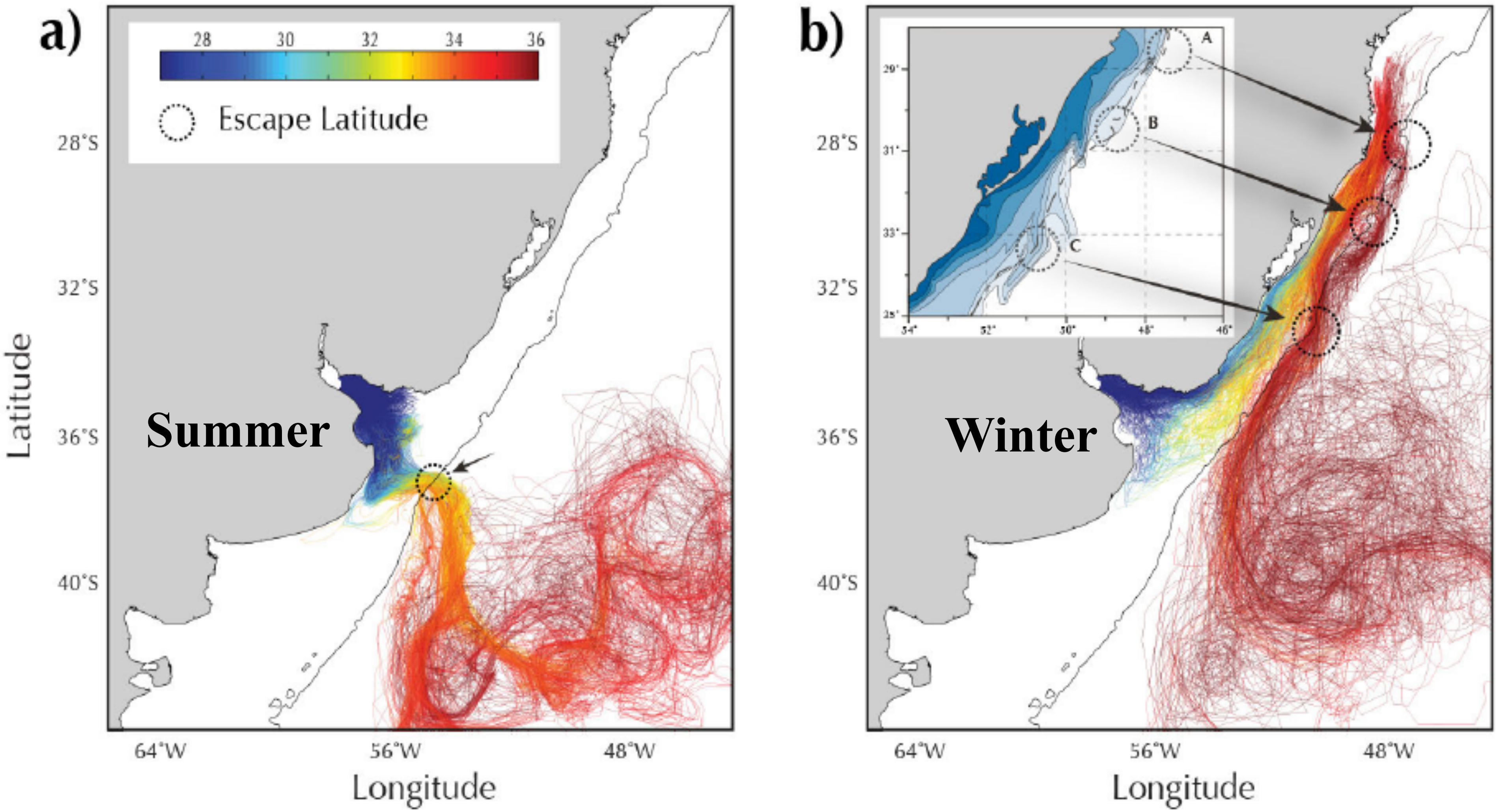


Geostrophic Cross-shelf Currents across the 200m isobath, reconstructed from the first 4 EOFs

Winter development of offshore flow north of the RdlP in July-October



Pathways between the shelf and deep ocean during the summer (left) and winter (right)



Along-shore wind stress

Raw SLA over shelf

Mean SLA over shelf

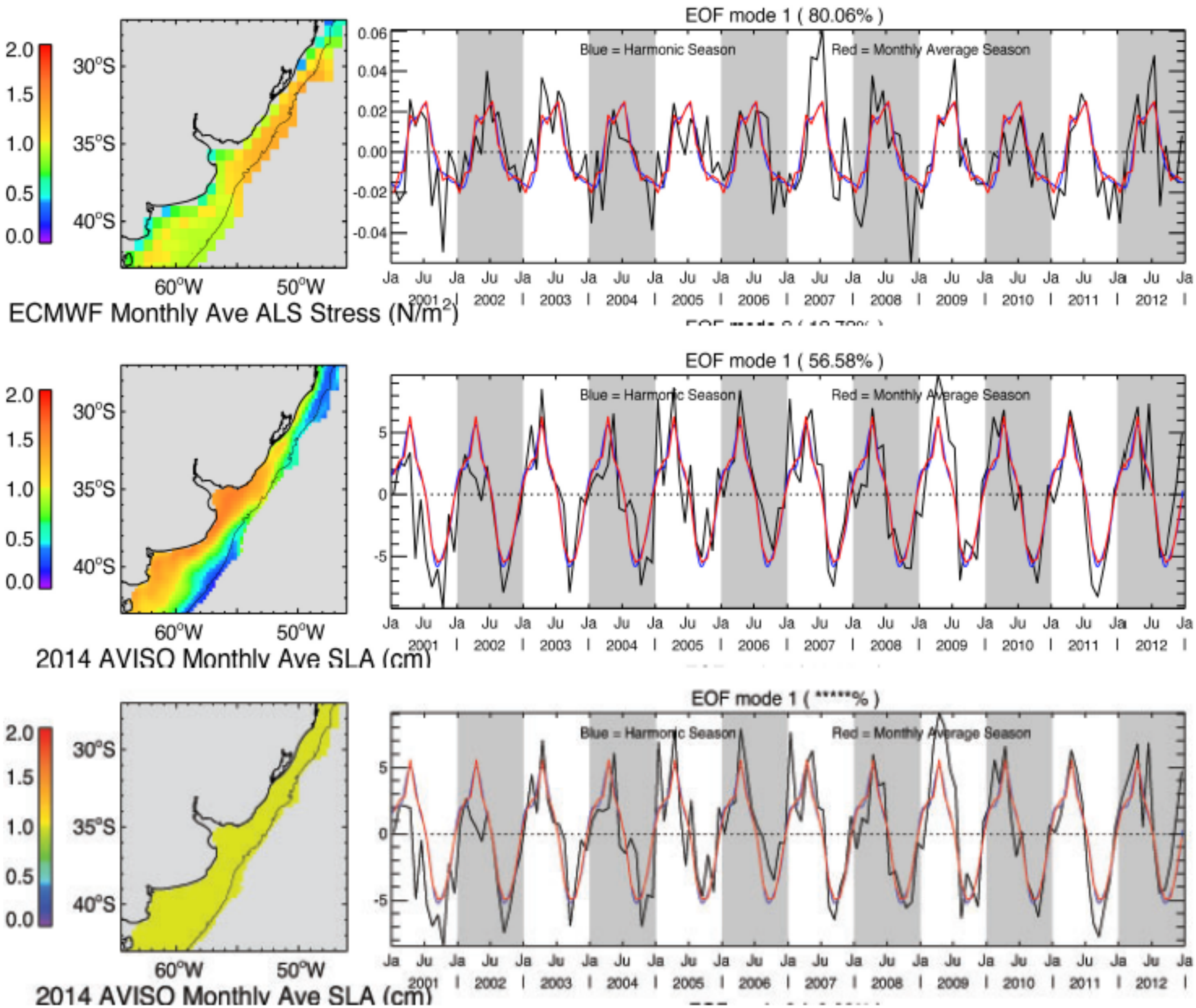
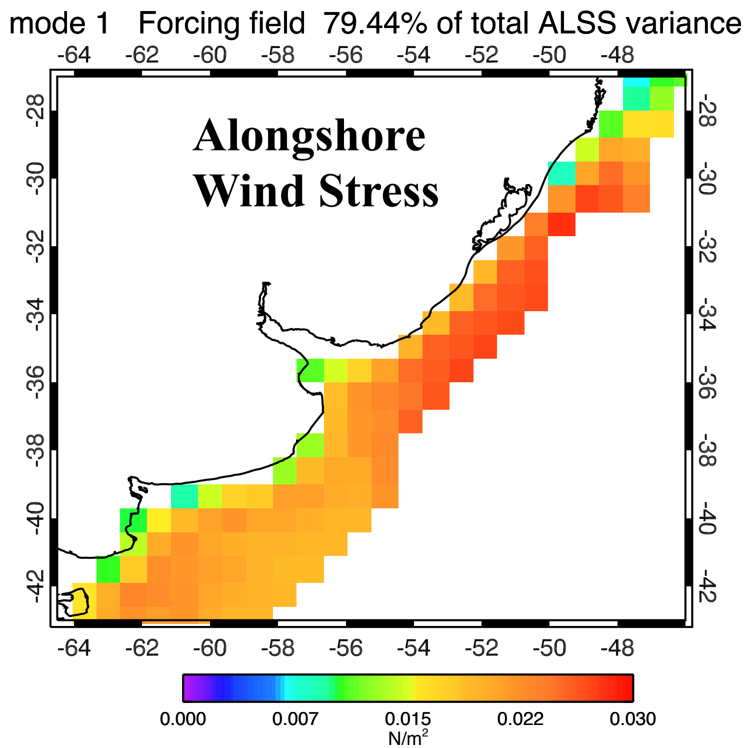
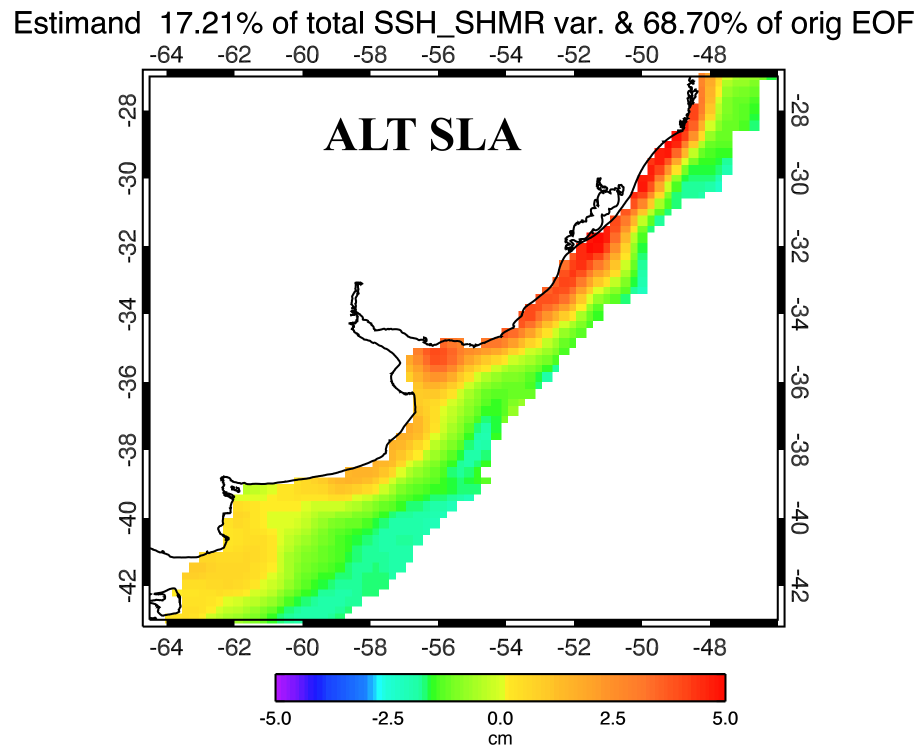


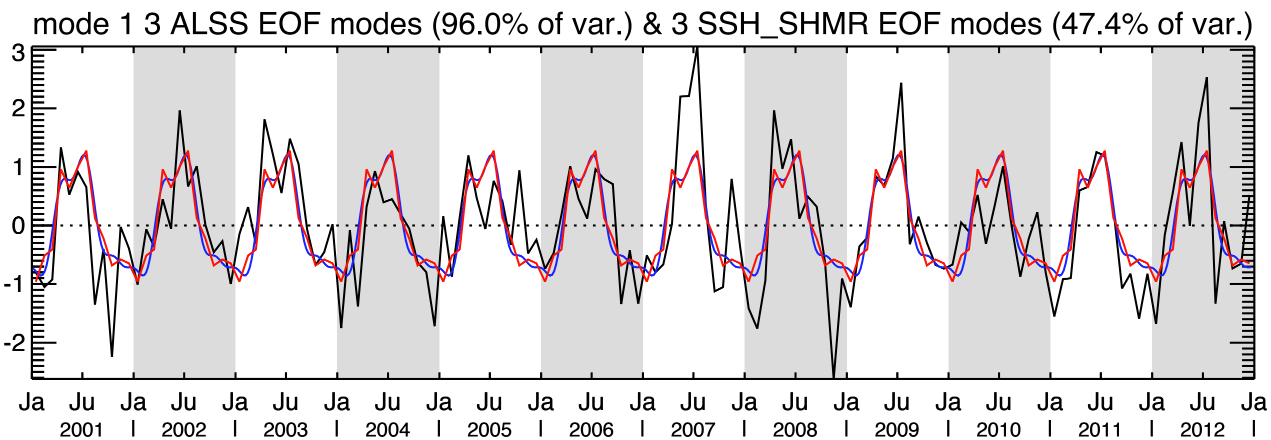
Figure 9. First EOFs of alongshore wind stress (top, explaining 80% of the variance) and SLA over the shelf (middle, explaining 57% of the variance). The bottom panel shows the time series for the mean SLA averaged over the entire shelf (depicted here by a spatial pattern of 1.0 everywhere for comparison to the SLA first EOF).

Principle Estimator Pattern: SLA (17%) vs Wind Stress (79%)





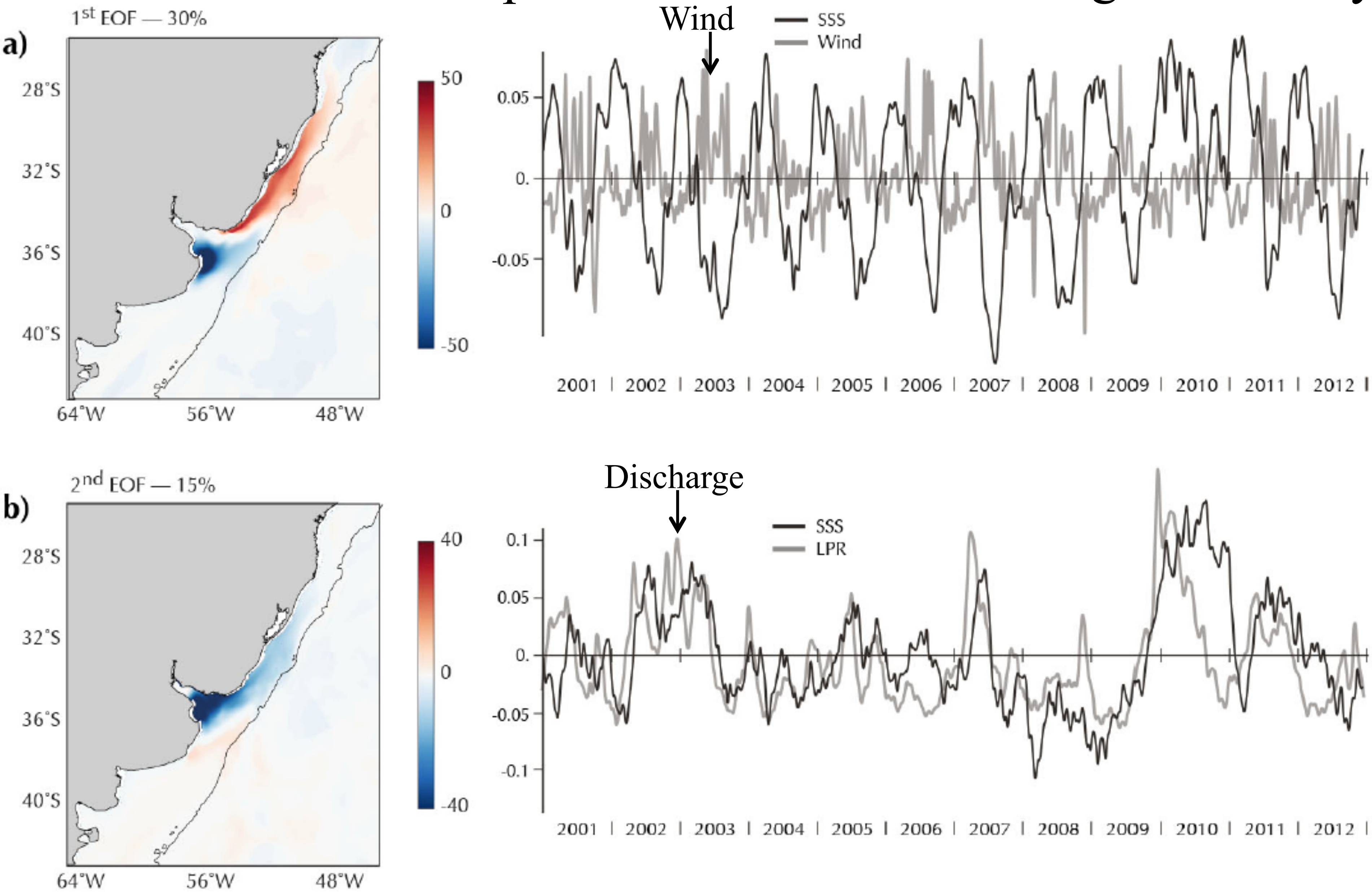
Principle Estimator Time Series



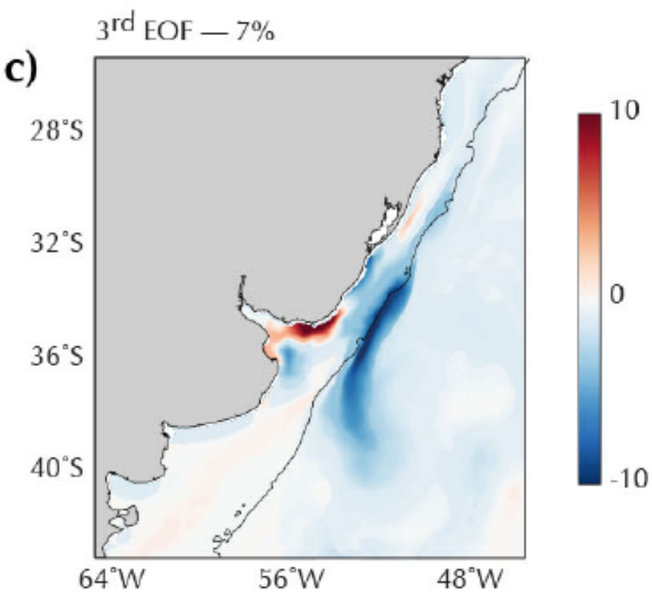
Blue = Harmonic Season

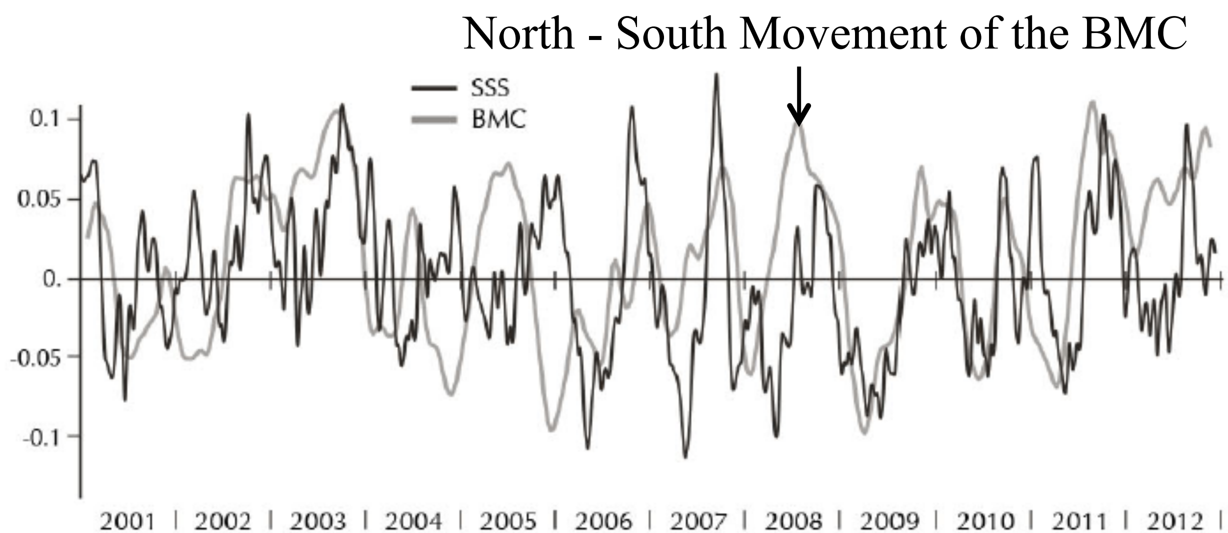
Red = Monthly Average Season

The first two EOFs of model salinity represent the wind driven movement of the river plume and the river discharge variability



The third EOF of model salinity becomes the leading mode if the shelf is excluded. It represents the fresh water that leaves the shelf north of the Rio de la Plata and enters the Brazil Current, flowing back to the south and out into the Brazil-Malvinas Confluence



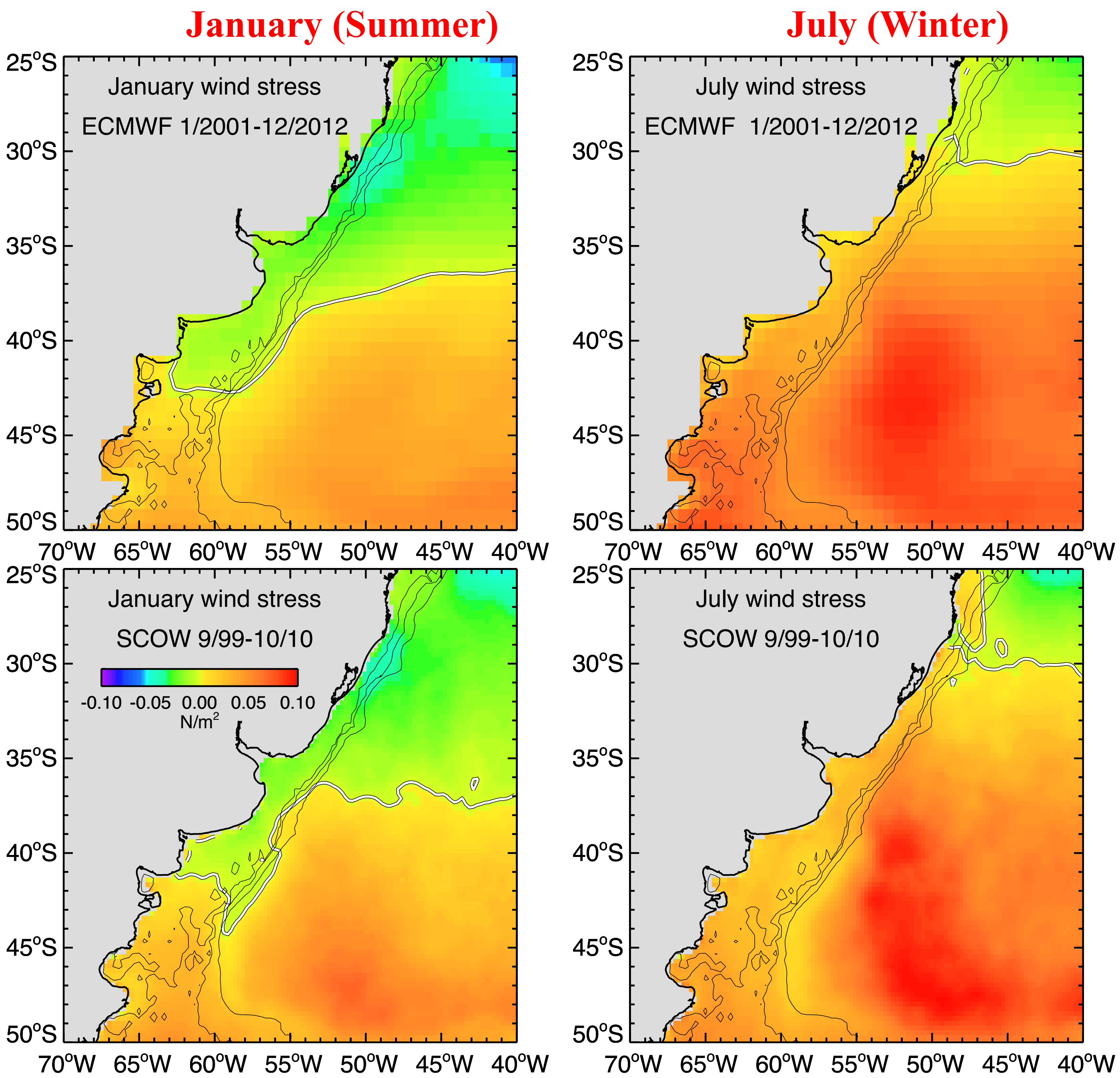


SUMMARY

- The altimeter fields show the seasonal wind-driven reversal of currents and the upwelling/downwelling cycle north of the Rio de la Plata.
- These currents move the fresh water in the RdlP plume north over the shelf in winter and more directly offshore in summer.
- South of the RdlP, the seasonal variability in flow is weak, leaving a continuous equatorward flow over the shelf inshore of the Malvinas Current.
- There is a seasonal change in SLA south of the RdlP, consisting of a steric rise that peaks at the end of summer, including an upward slope toward the coast that is coincident with the steric rise of the mean.
- Offshore flow is indicated by the altimeter, becoming stronger during winter north of the RdlP and stronger during summer offshore of the RdlP.
- There is good agreement between the altimeter and model fields over the shelf.

SEE THE POSTER & ANIMATIONS DURING OST-ST

EXTRAs



Similar patterns in **alongshore wind stress** are seen in

ECMWF (top)

&

QuikSCAT (bottom)