Ocean Surface Topography Science Team Meeting (OSTST)

October 23-27, 2017

"The 25th Anniversary of TOPEX/Poseidon"

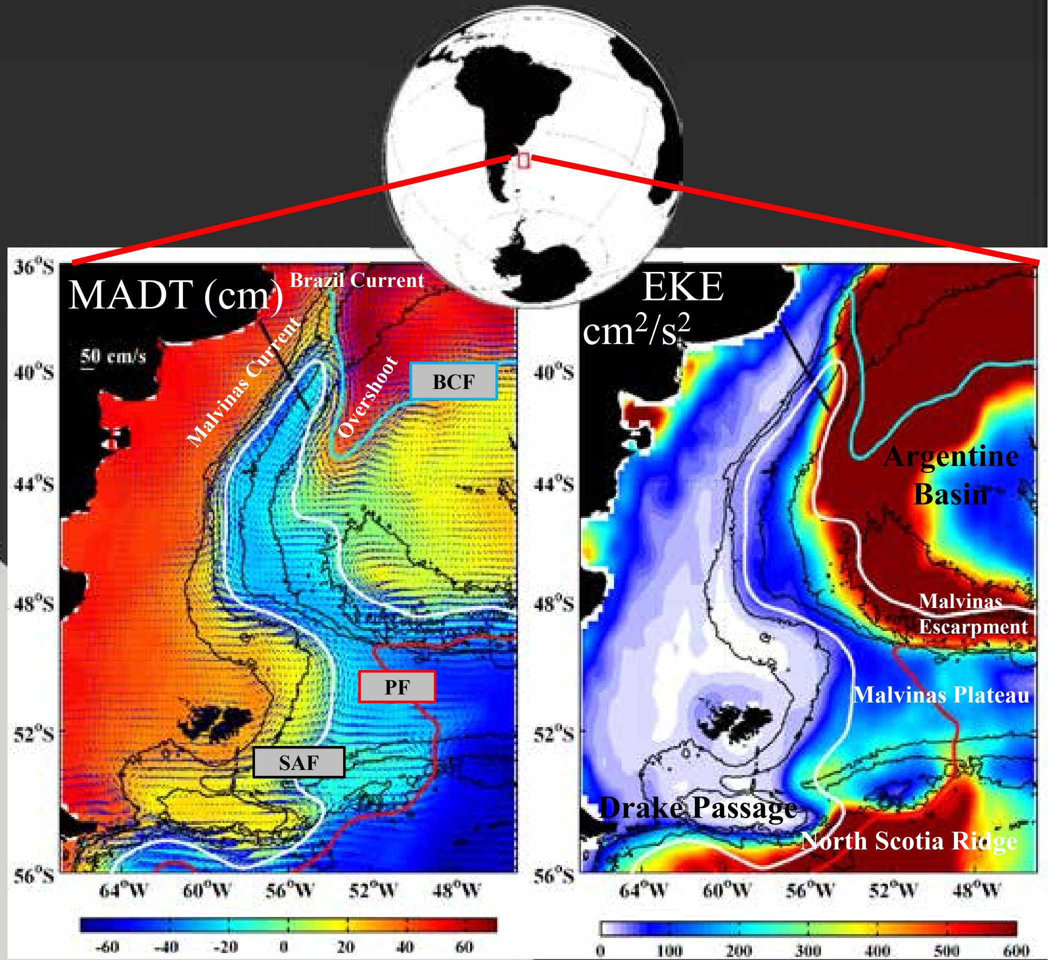
Malvinas Current volume transport at 41°S:

a 24-year long time series consistent with mooring data from 3 decades and satellite altimetry

C.Artana, R. Ferrari, Z. Koenig, N. Sennéchael, M. Saraceno, A.Piola, C. Provost

The Malvinas Current

The Malvinas Current (MC) is an offshoot of the northern branch of the Antarctic Circumpolar Current



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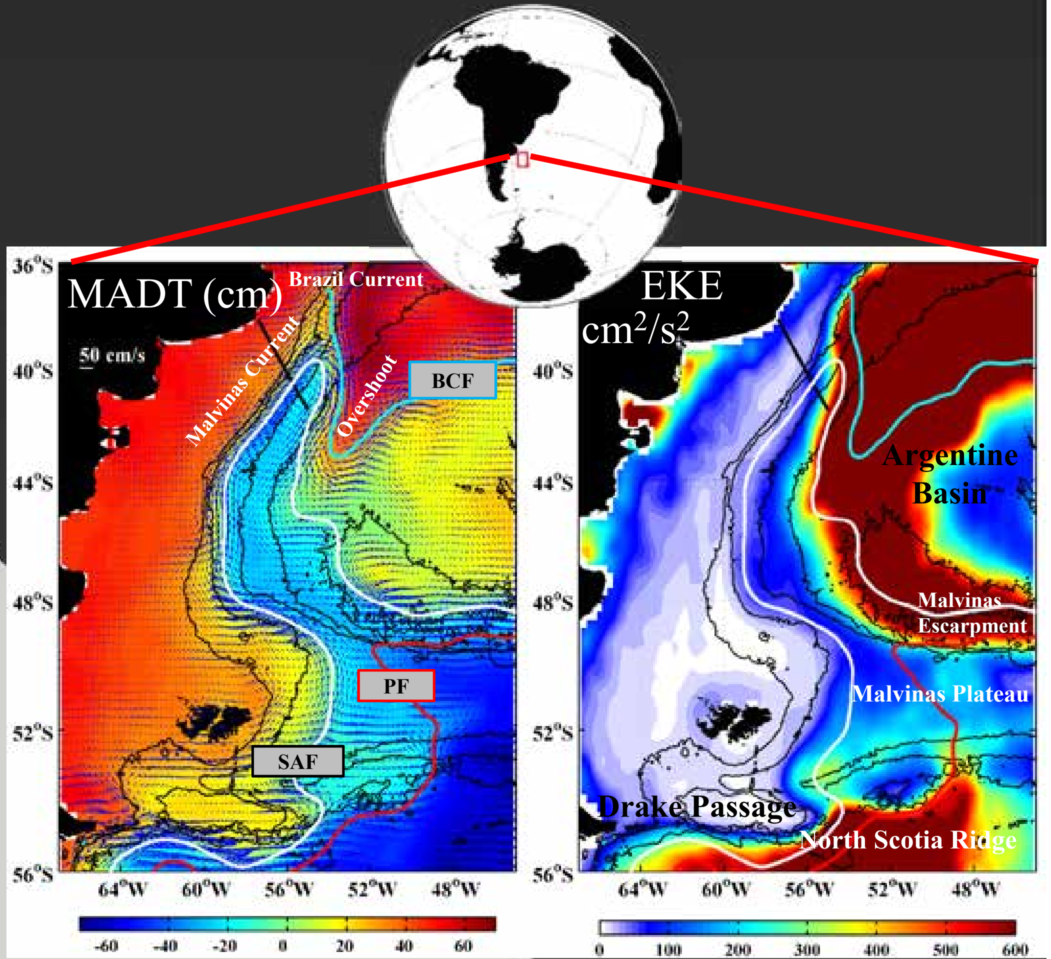

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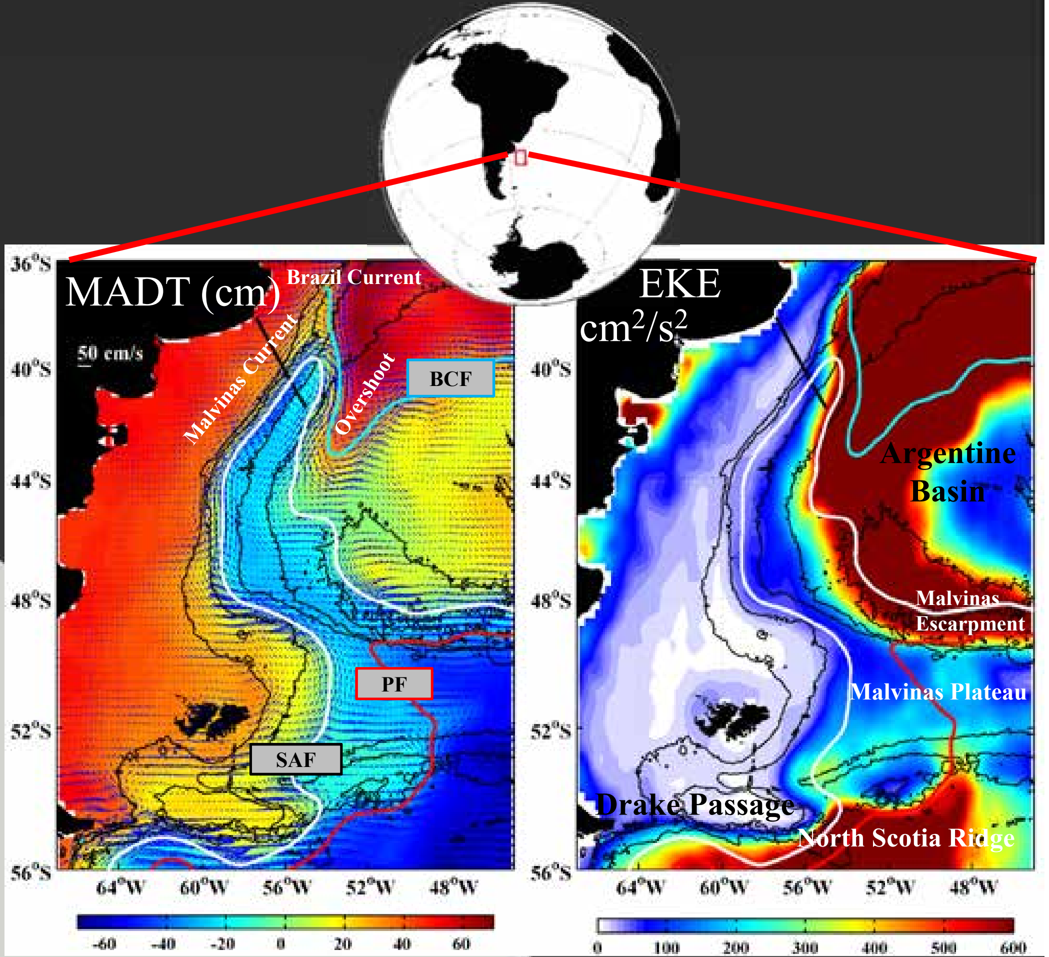

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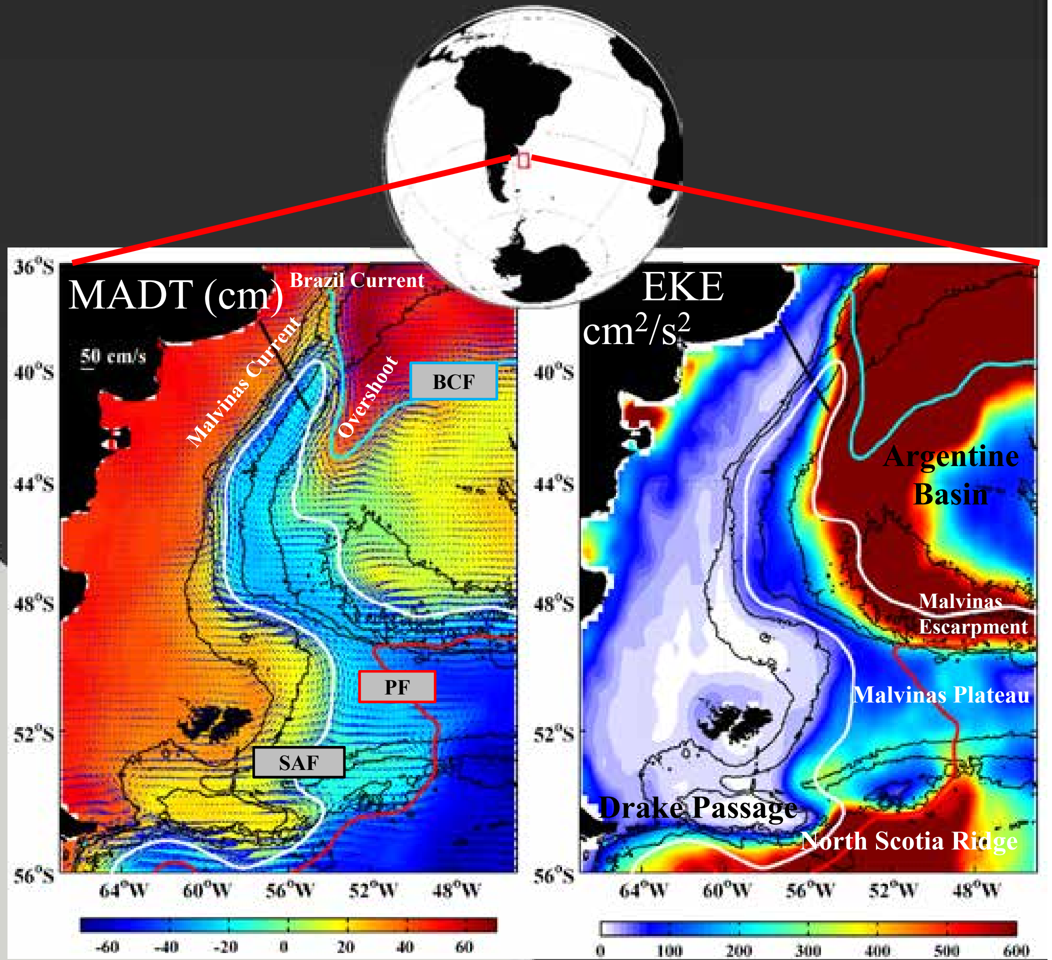
High EKE from Drake Passage leaks onto the Malvinas Plateau

EKE decreases over the Malvinas Plateau Artana et al., (2016)



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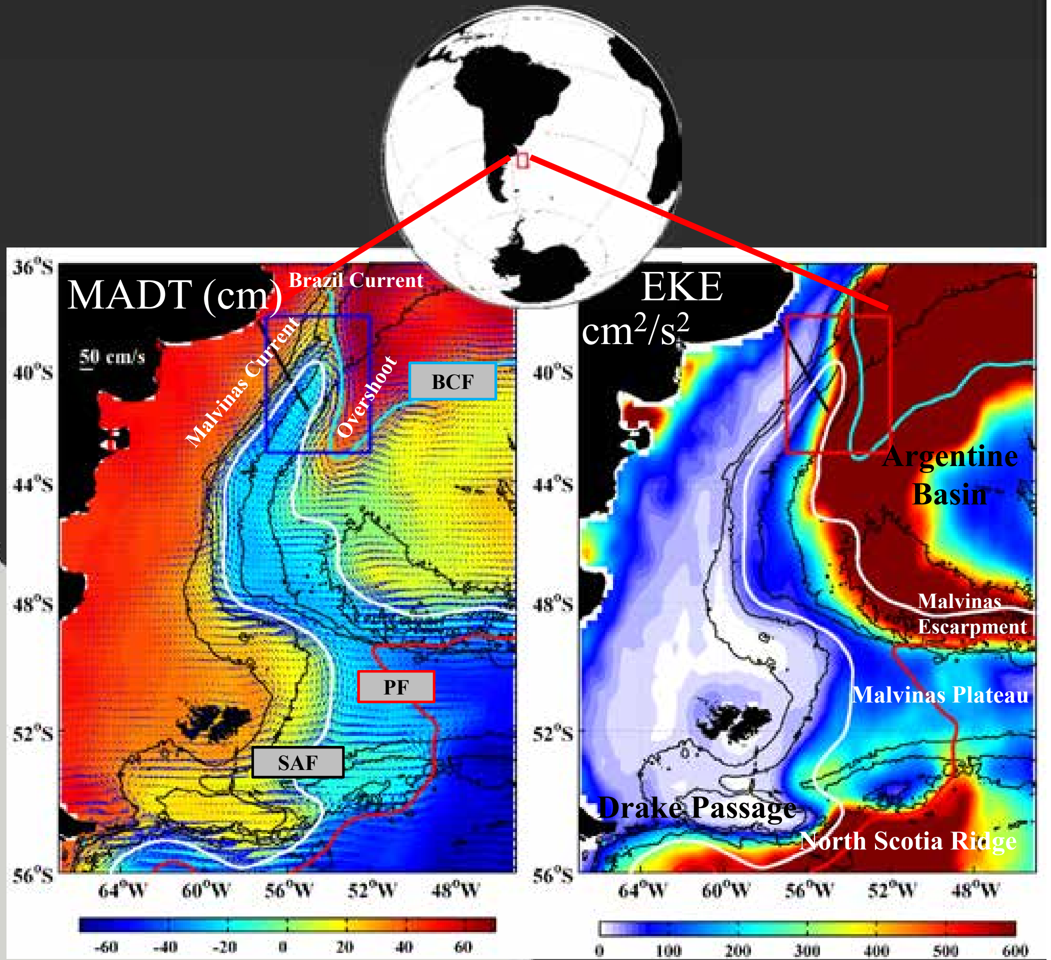


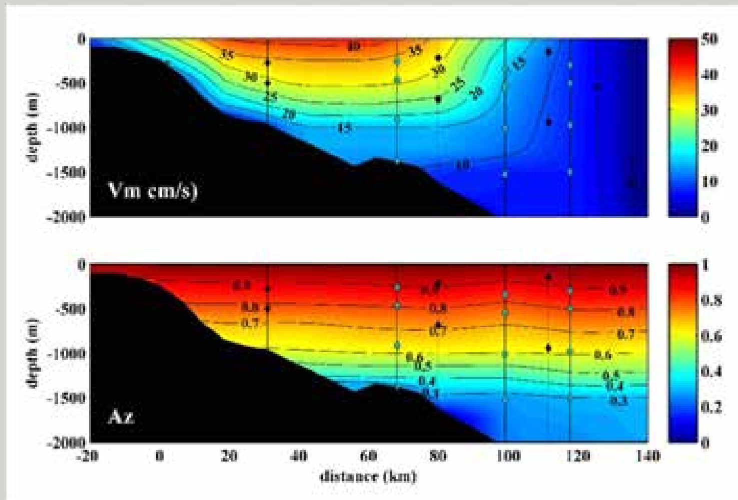
Monitoring the Malvinas Current volume transport

- '93-'95 (Vivier and Provost, 1999 b)
- '01-'03 (Spadone and Provost, 2009)

Classic method:

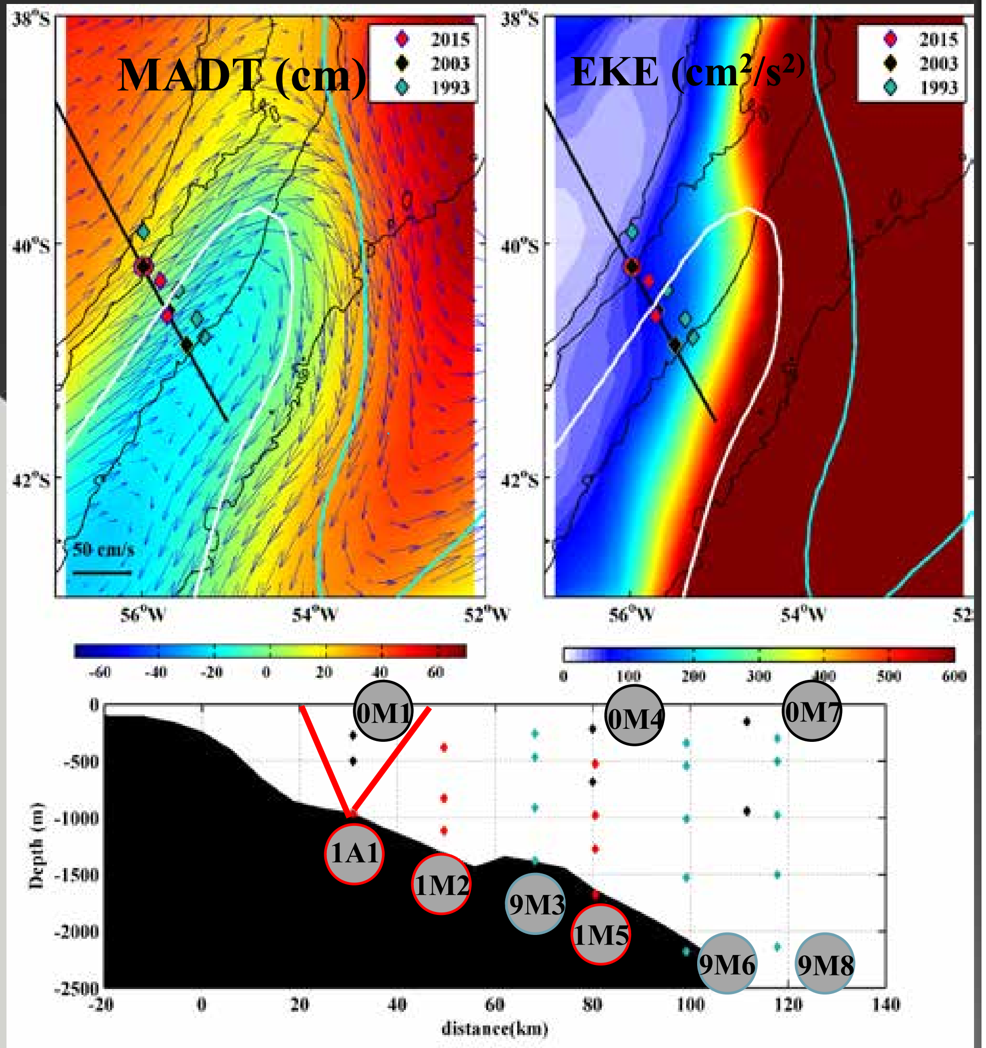
$V(x,z,t) = V_m(x,z) + A(x,z) * V'(x,0,t)$

From along track data



Az and Vm from SP09

Mooring deployments at 41 S along satellite altimetric track #26



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From along track data

- ’14-’15 (Artana et al., submitted):

Ferrari et al., 2017:

“ gridded data compares better than along-track data to 20d low-pass filtered in situ velocities”

Look up table method, **LUT**
(Koenig et al., 2014)

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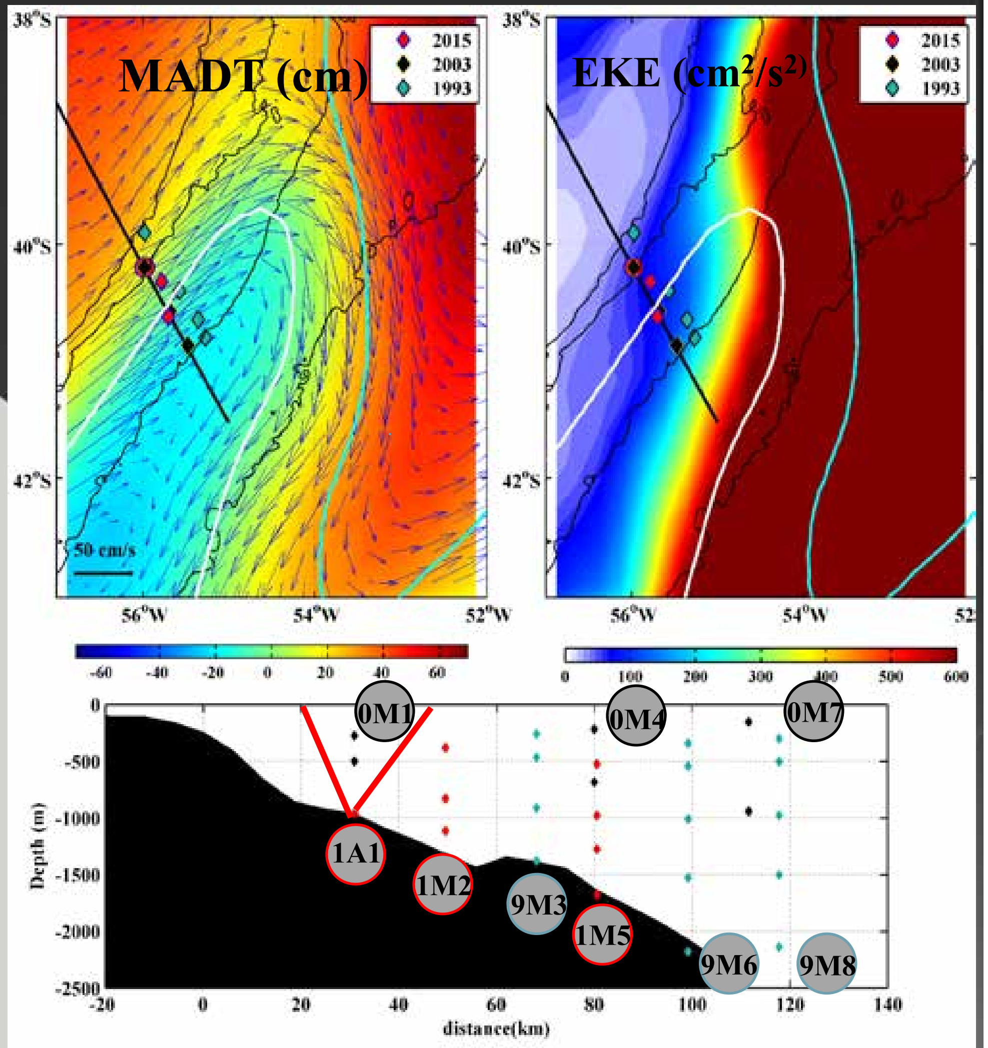
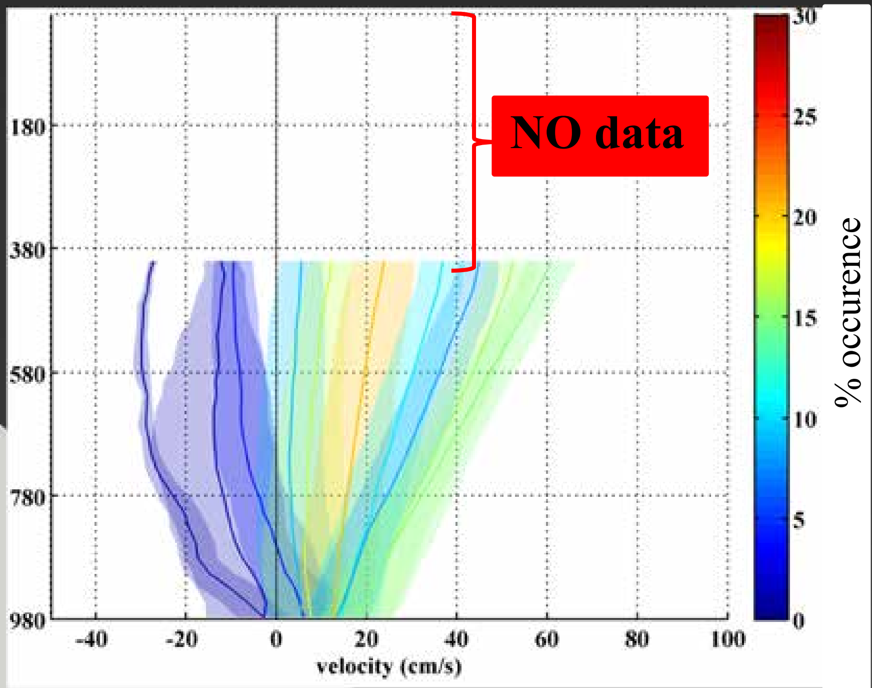


Methodology for reconstructing velocities

V(x,z,t)=B(x,z,V(x,0,t)) with V(x,0,t)=Vs(x,0)+V'(x,0,t)

A) Construction of a look up table (LUT) first and last deployments



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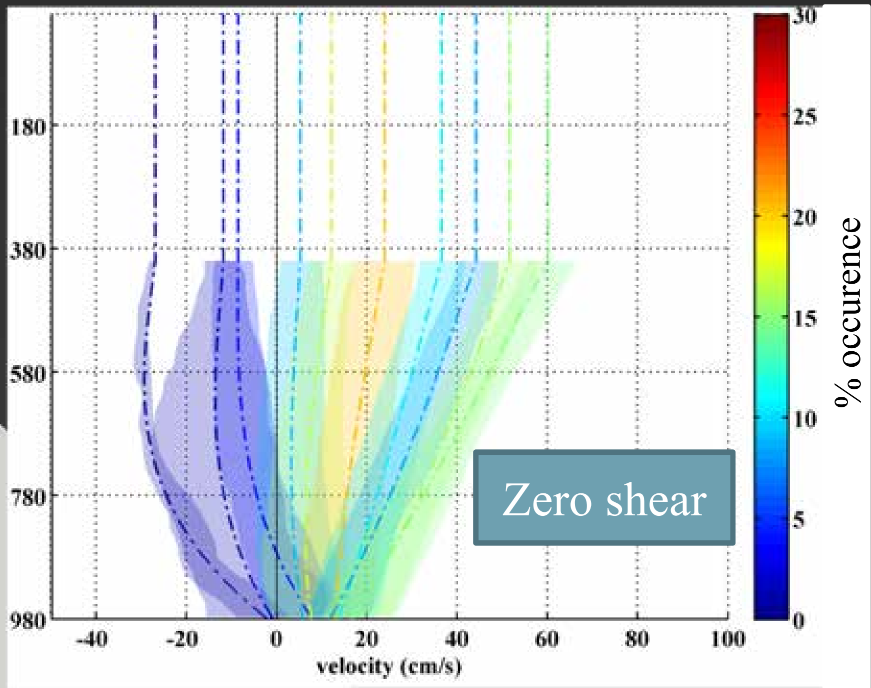

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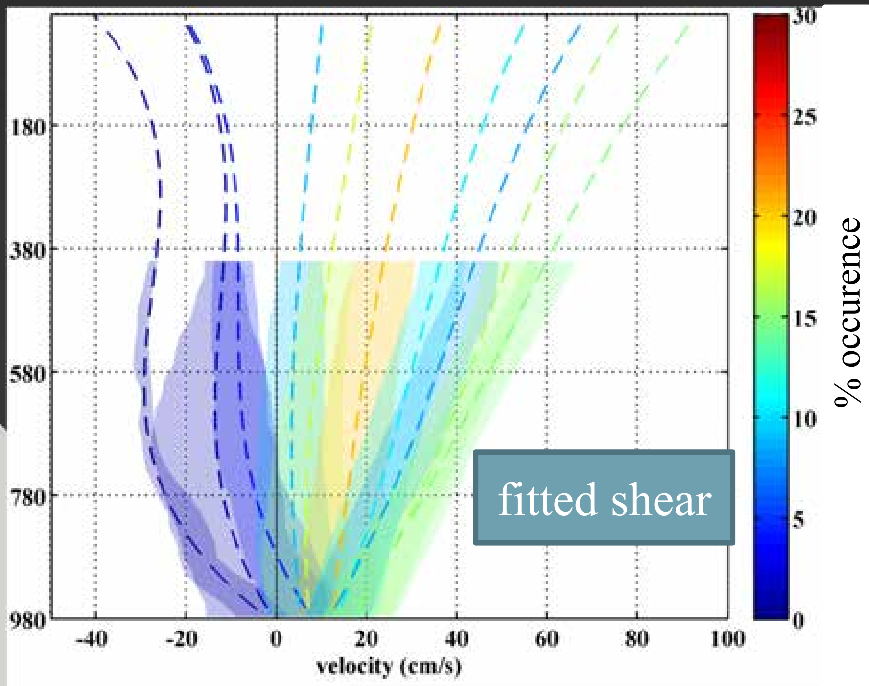

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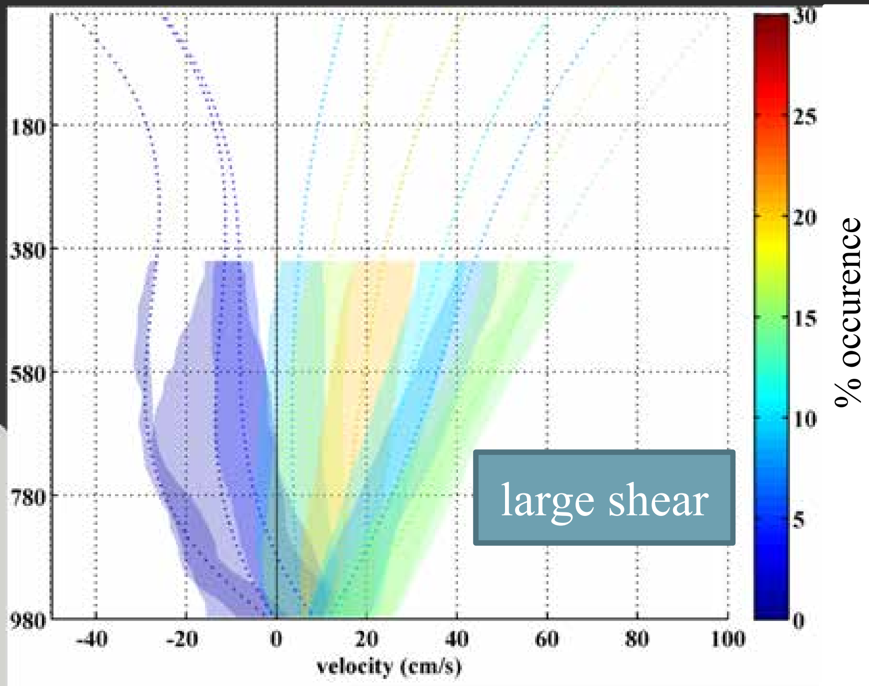

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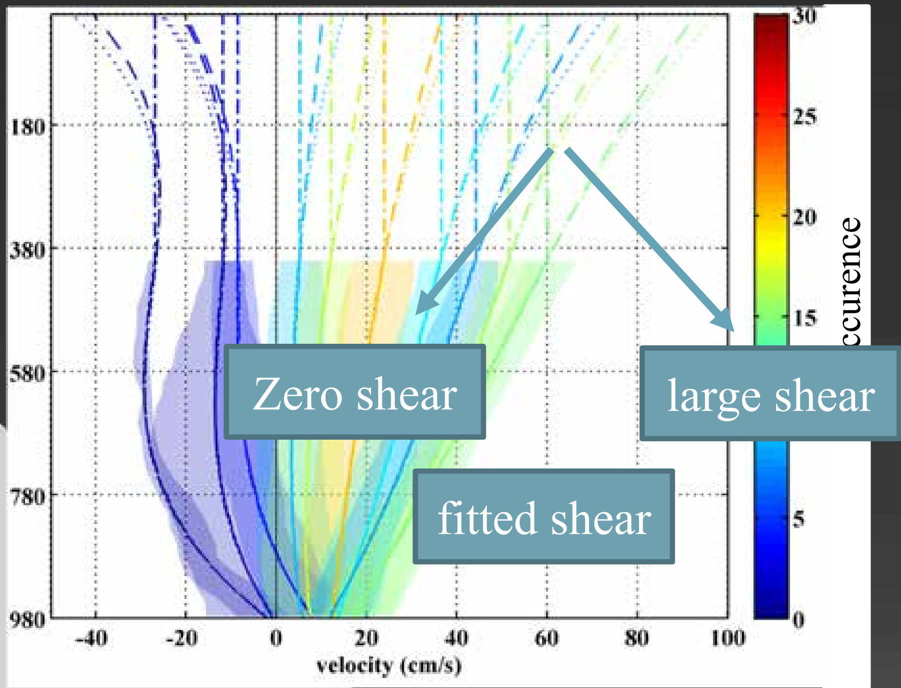

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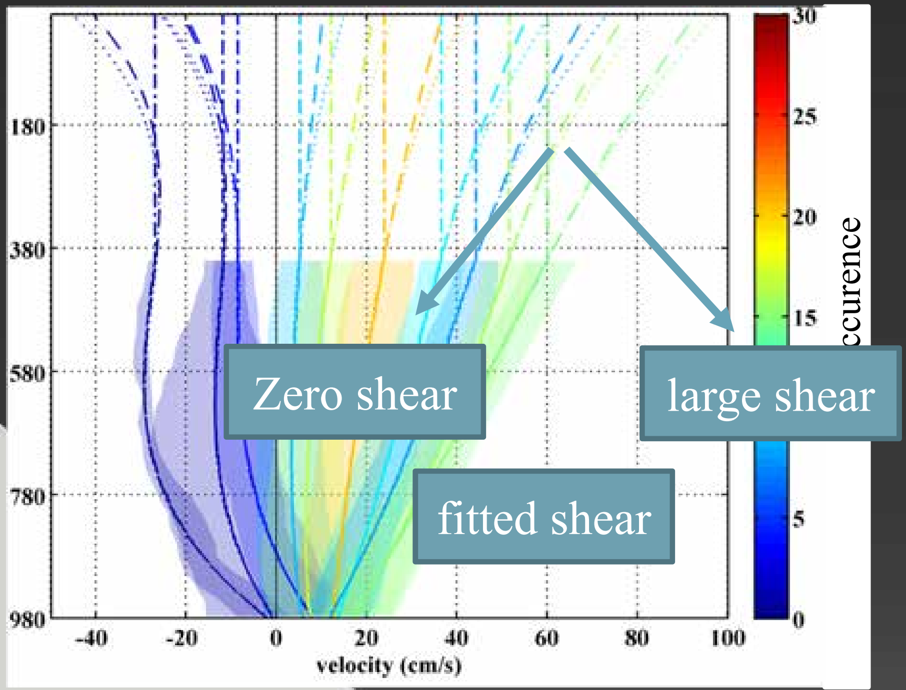
B) Estimation of a mean surface velocity



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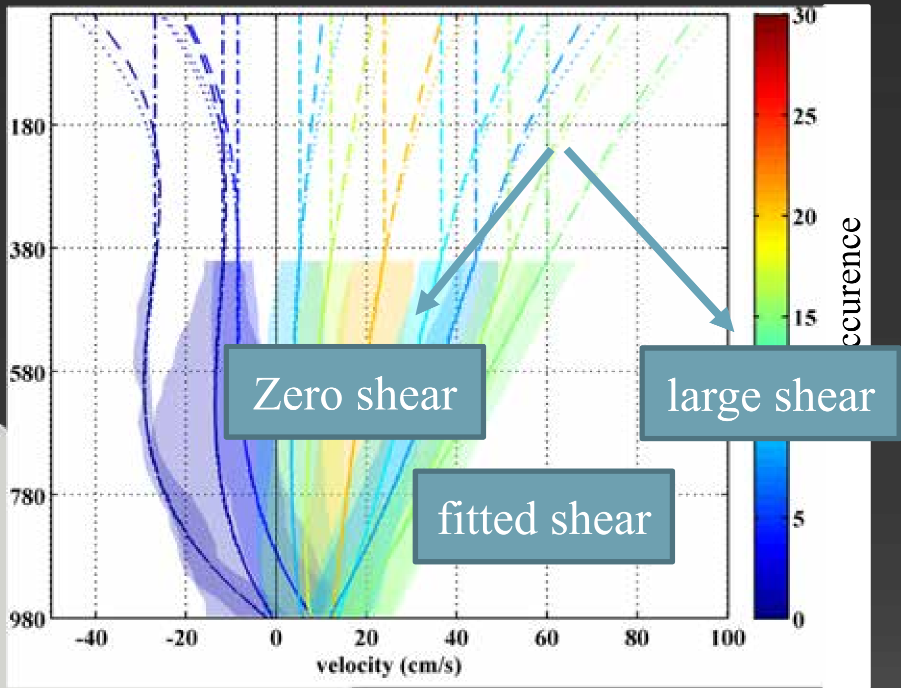


A) Construction of a look up table (LUT) first and last deployments

B) Estimation of a mean surface velocity

C) Validation:

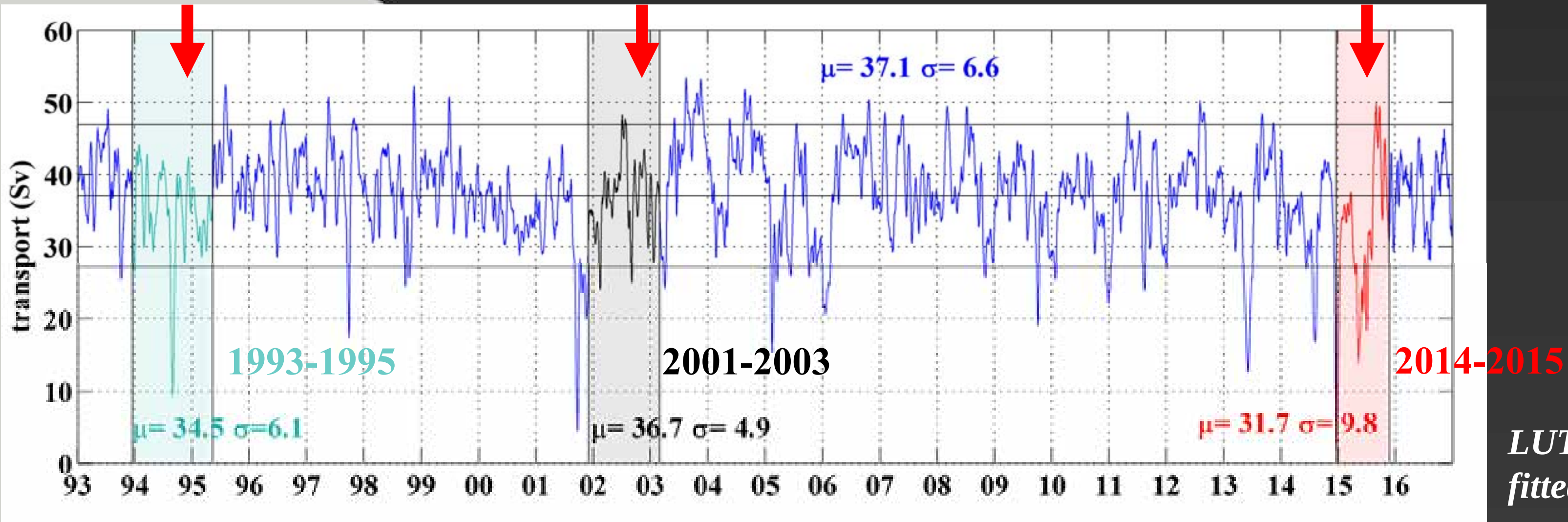
reconstructed velocities compare to

- 20 d low-pass filter in situ velocities used in the LUT (first and last period)
- independent data not used in the LUT (second deployment)

The LUT-reconstructed velocities accurately match the 20-d low-passed in situ velocities from all periods

24-years long Malvinas current volume transport time series (upper 1500 m)

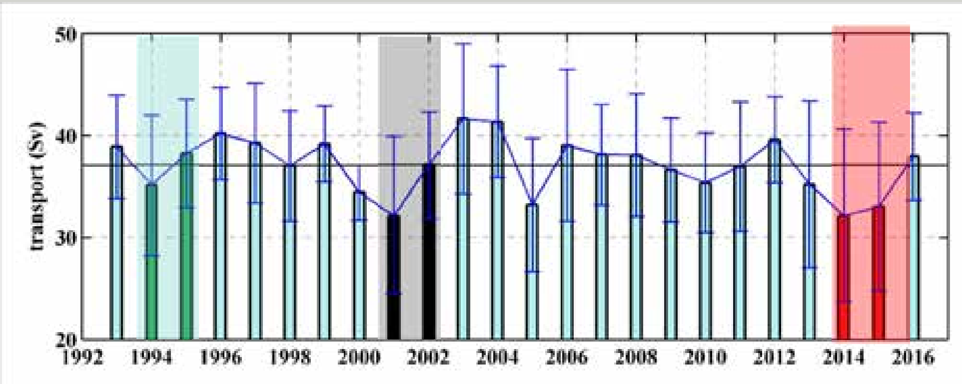
Transport time series for each shear are highly correlated (r=0.99) with rmsd ~1Sv



LUT-transport from fitted shear

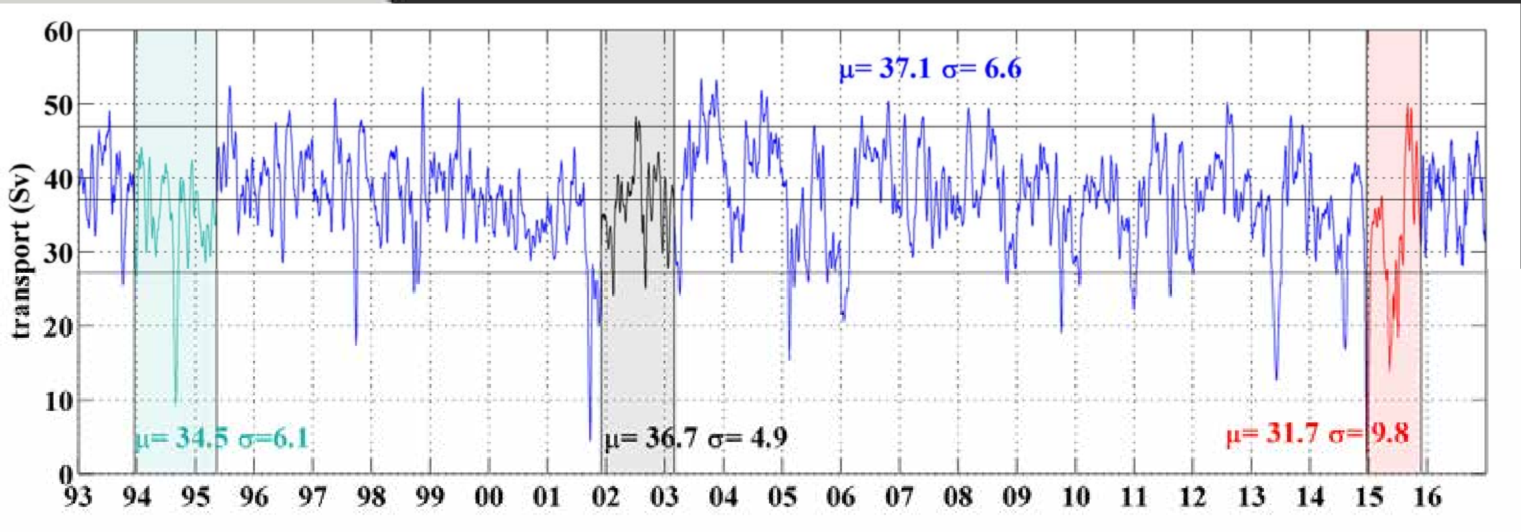
LUT: µ=37.1±2.6 Sv and σ:6.6±1.0Sv

SP09: µ=33.2 Sv σ= 7.8



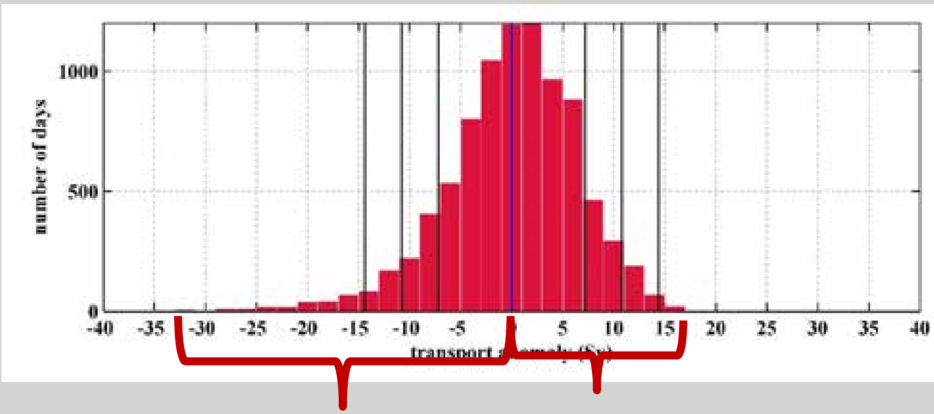
yearly average of the MC LUT-transport (fitted shear)

- **The three in situ measurement periods correspond to periods of relatively weak MC transport**
- **No significant trend**

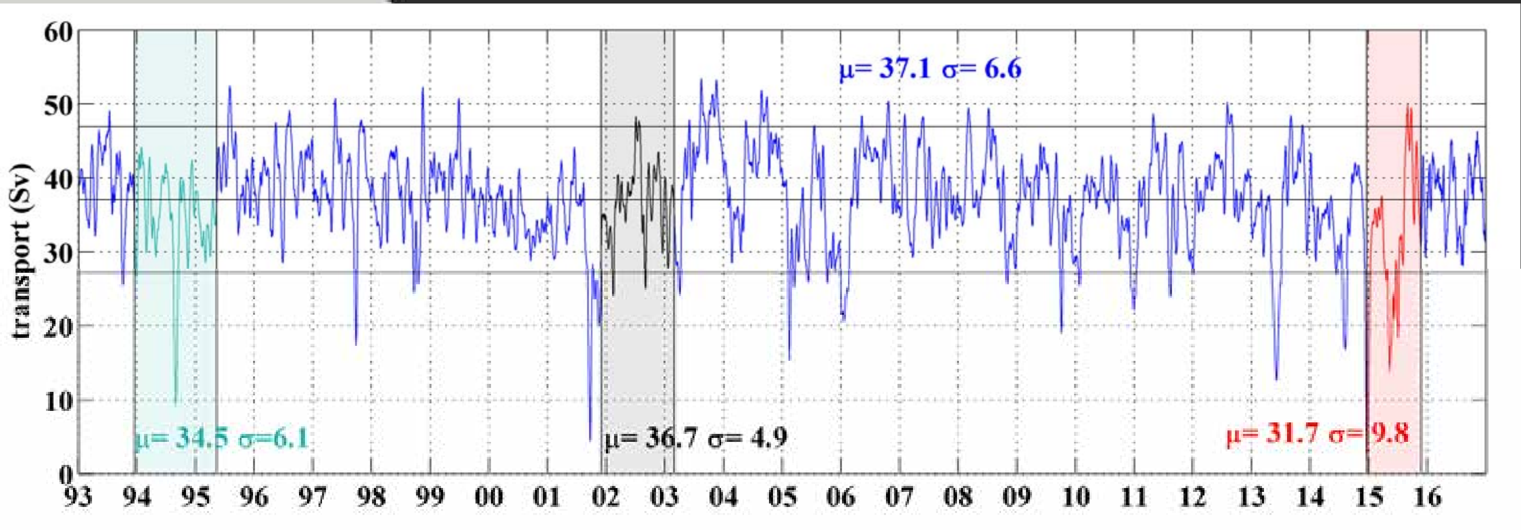


LUT-transport from fitted shear

Distribution of the MC volume transport anomalies



MC volume transport asymmetric distribution



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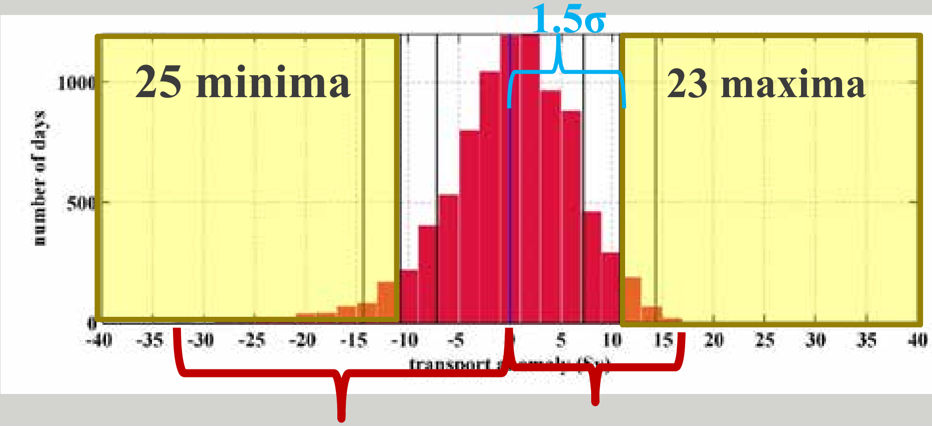
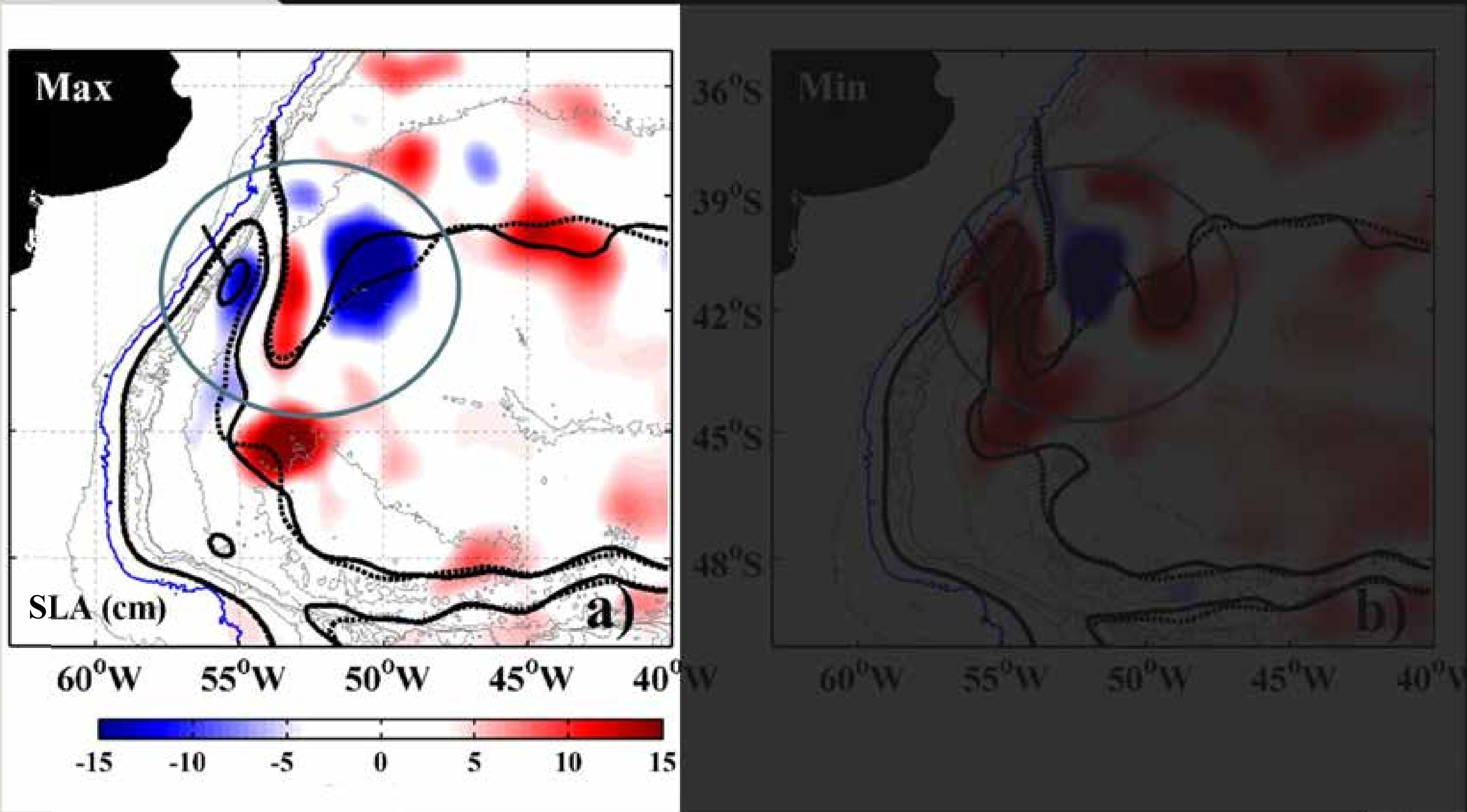


MC volume transport asymmetric distribution

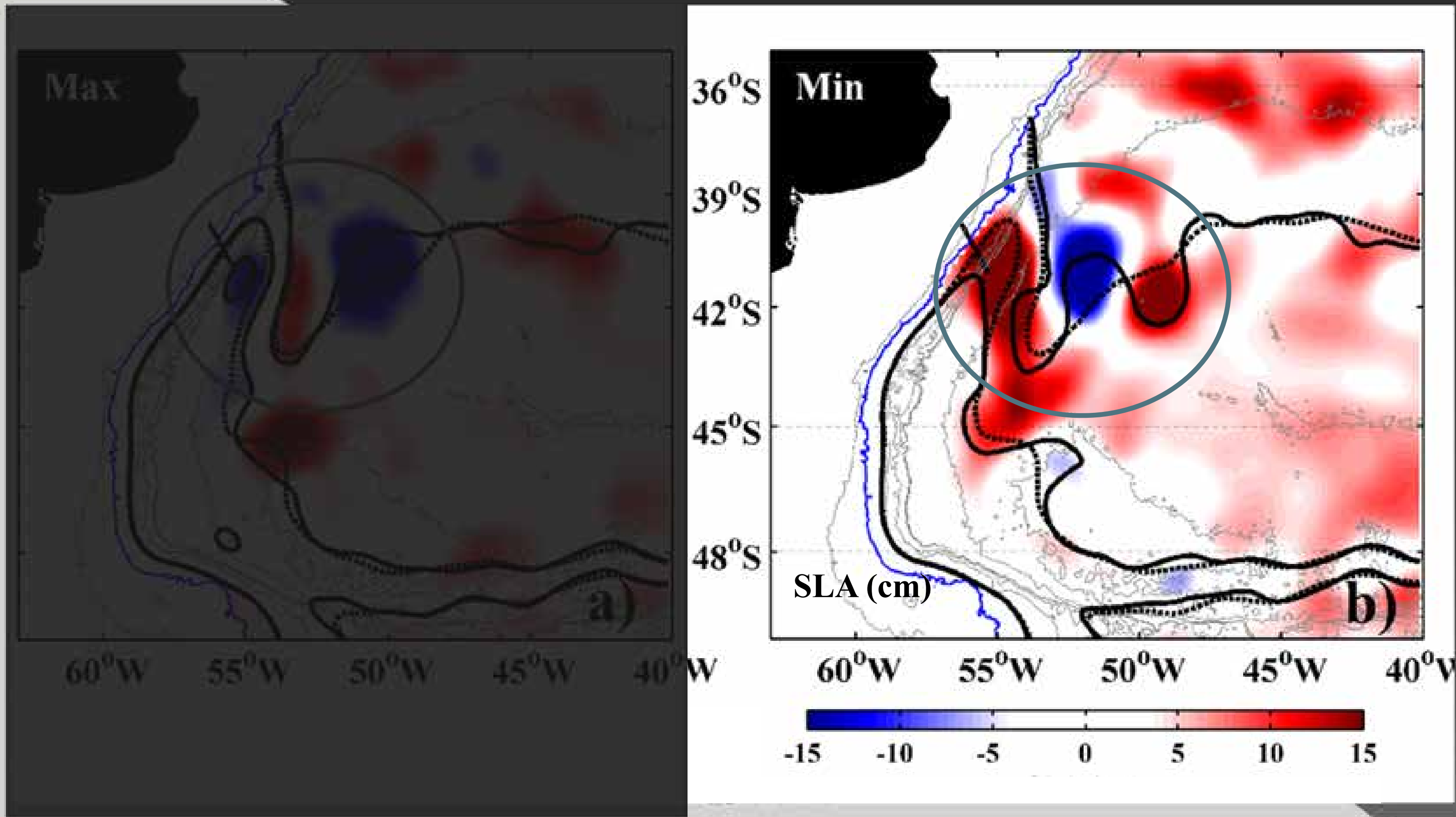
What happens during extreme events?

Extreme events: maxima of the MC transport



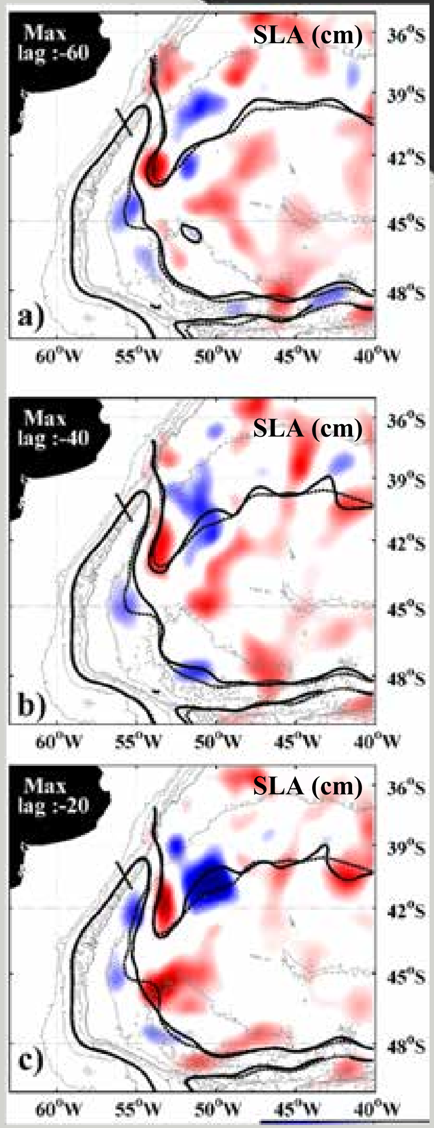
SAF: same location as the record length mean

Extreme events: minima of the MC transport



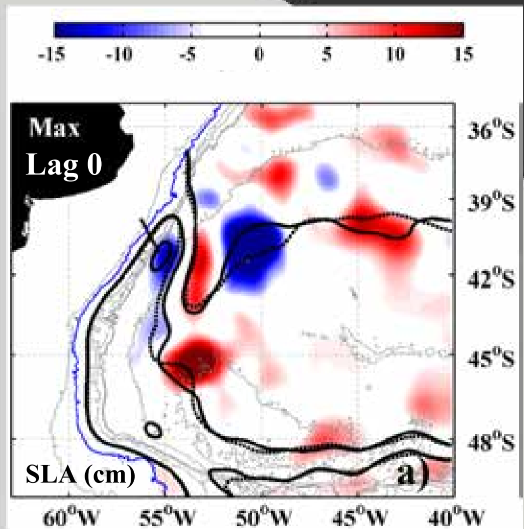
SAF: loops southward south of the mooring section

Origin of the MC transport maxima



Cyclonic SLA propagate from 48°S and 50°W to the north-west following the 4000/5000 m isobath (6km/day)

When they reach 41°S they increase the MC transport through a recirculation cell
→ Independent from upstream processes on the slope



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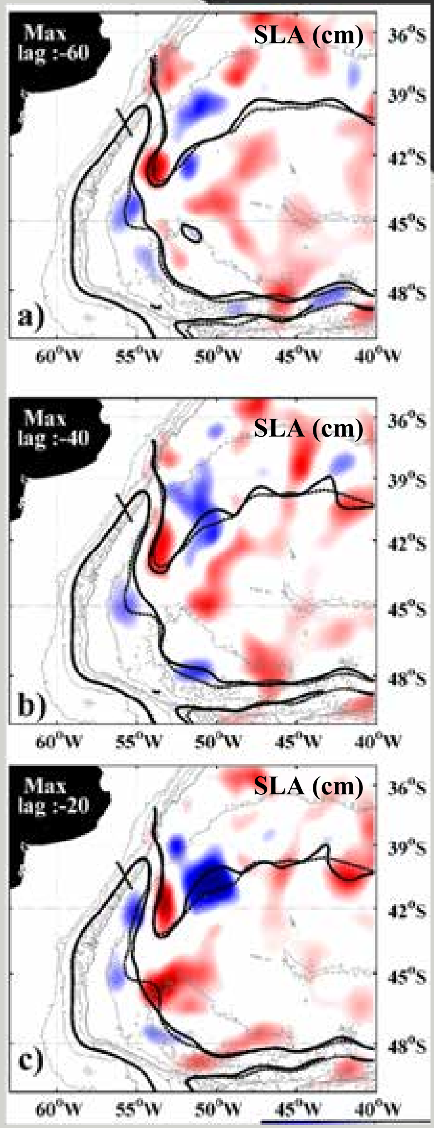

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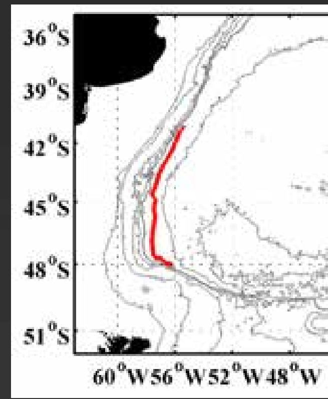
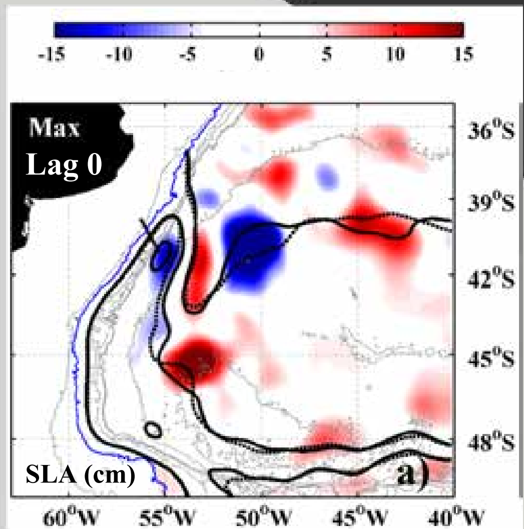
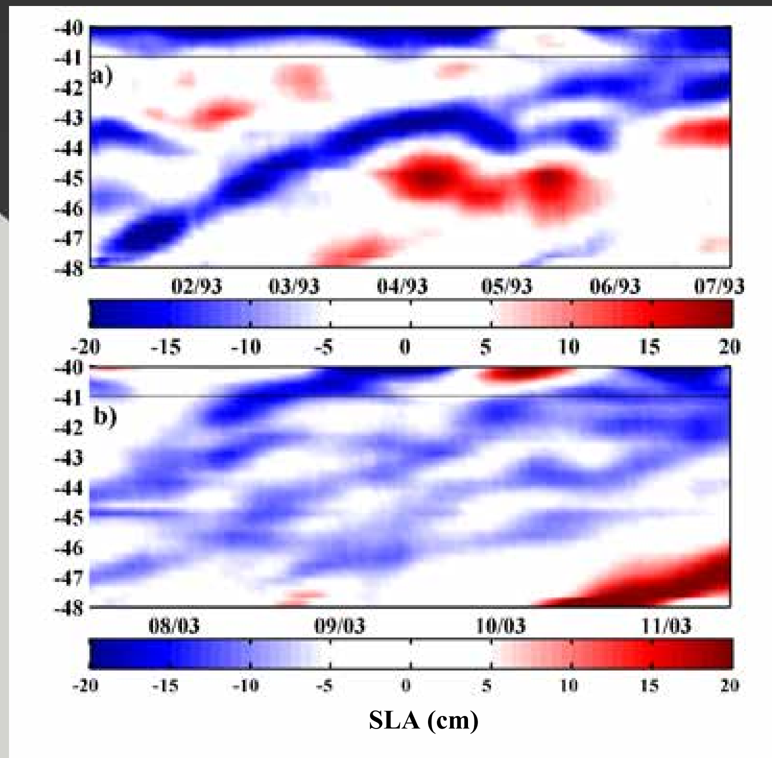
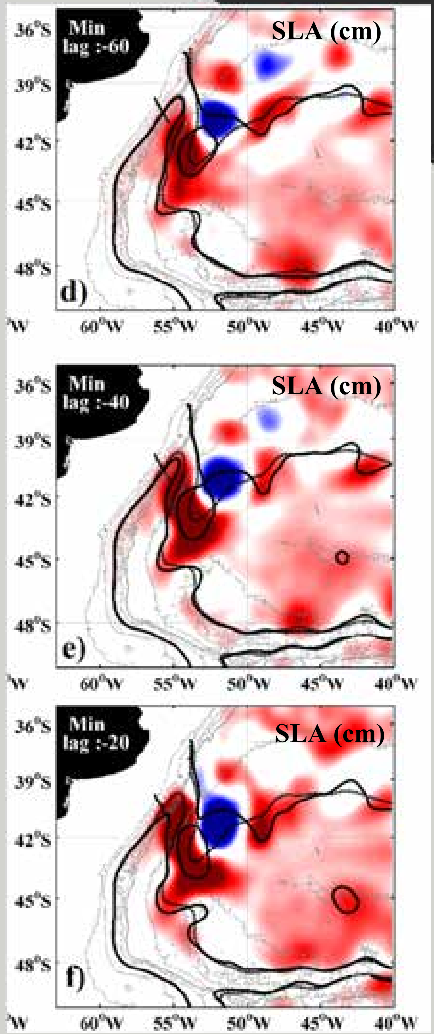






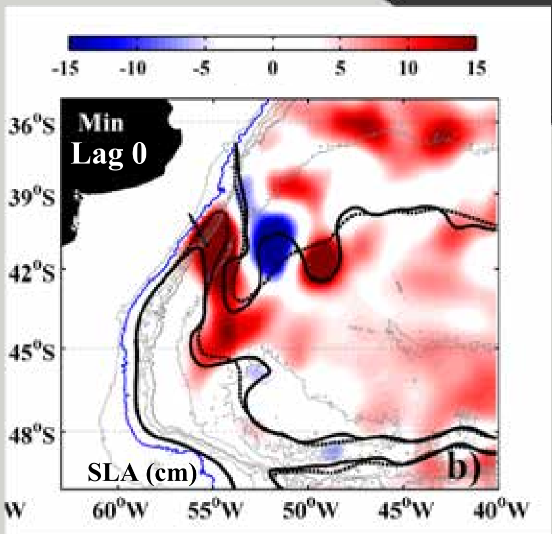
Origin of the MC transport minima



Large and intense positive anomalies shed by the BC overshoot managed to propagate westward onto the slope → SAF retreats south

Propagation speed: 2-3 km/day

Extremely high eddy kinetic energy environment



Summary

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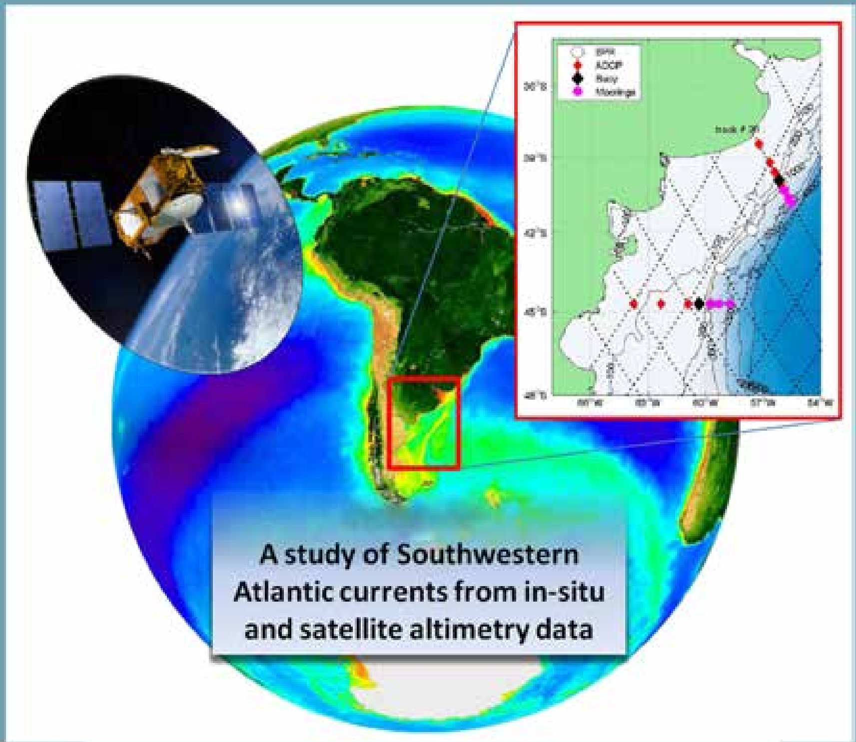
- Transport minima ← large positive sea level anomalies shed by the BC overshoot.

Thank you for your attention

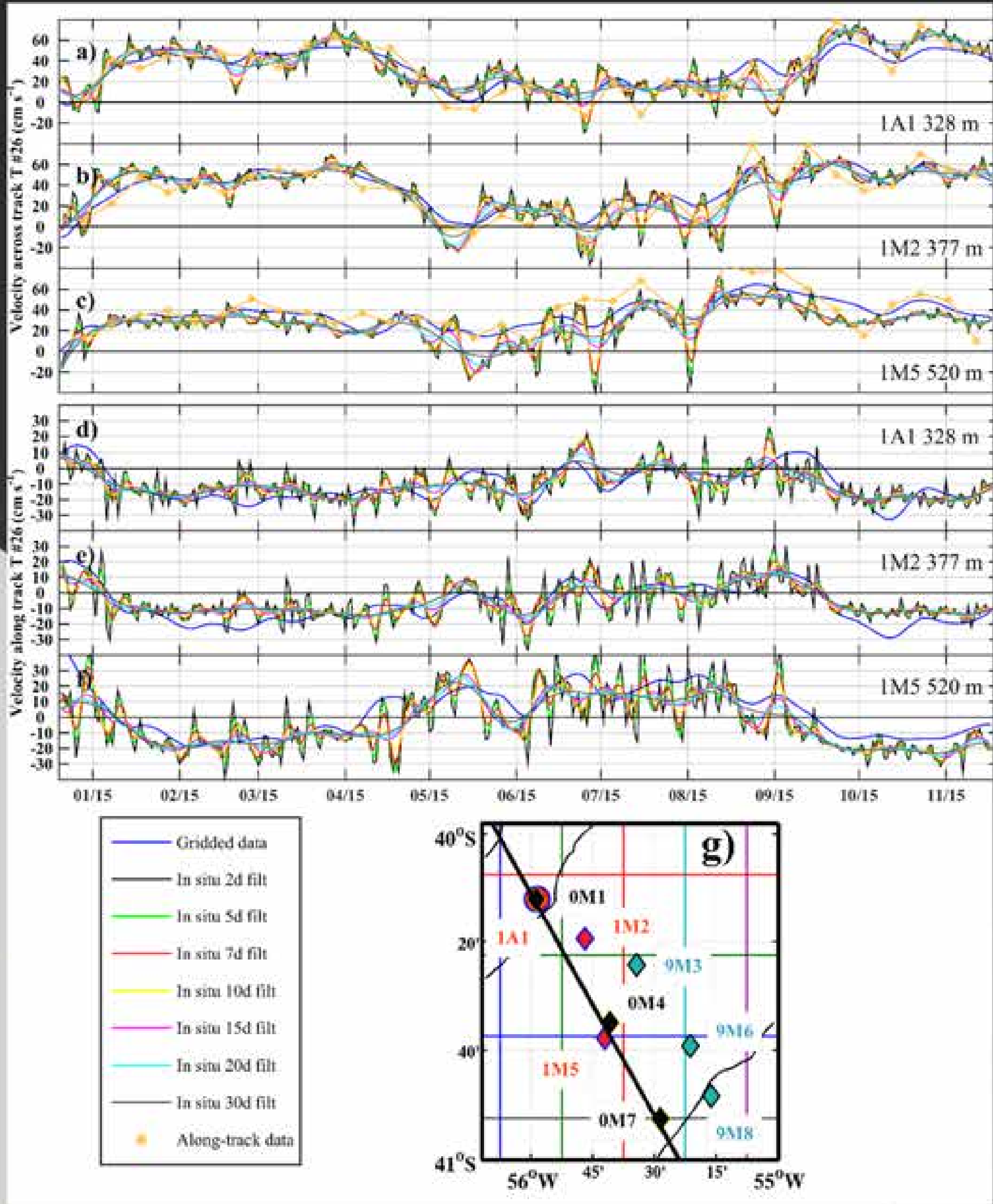
CASSIS MALVINAS PROJECT



POSTER SESSION

- Artana et. al
- Ferrari et al.
- Lago et al.
- Saraceno et al.

Mooring velocities



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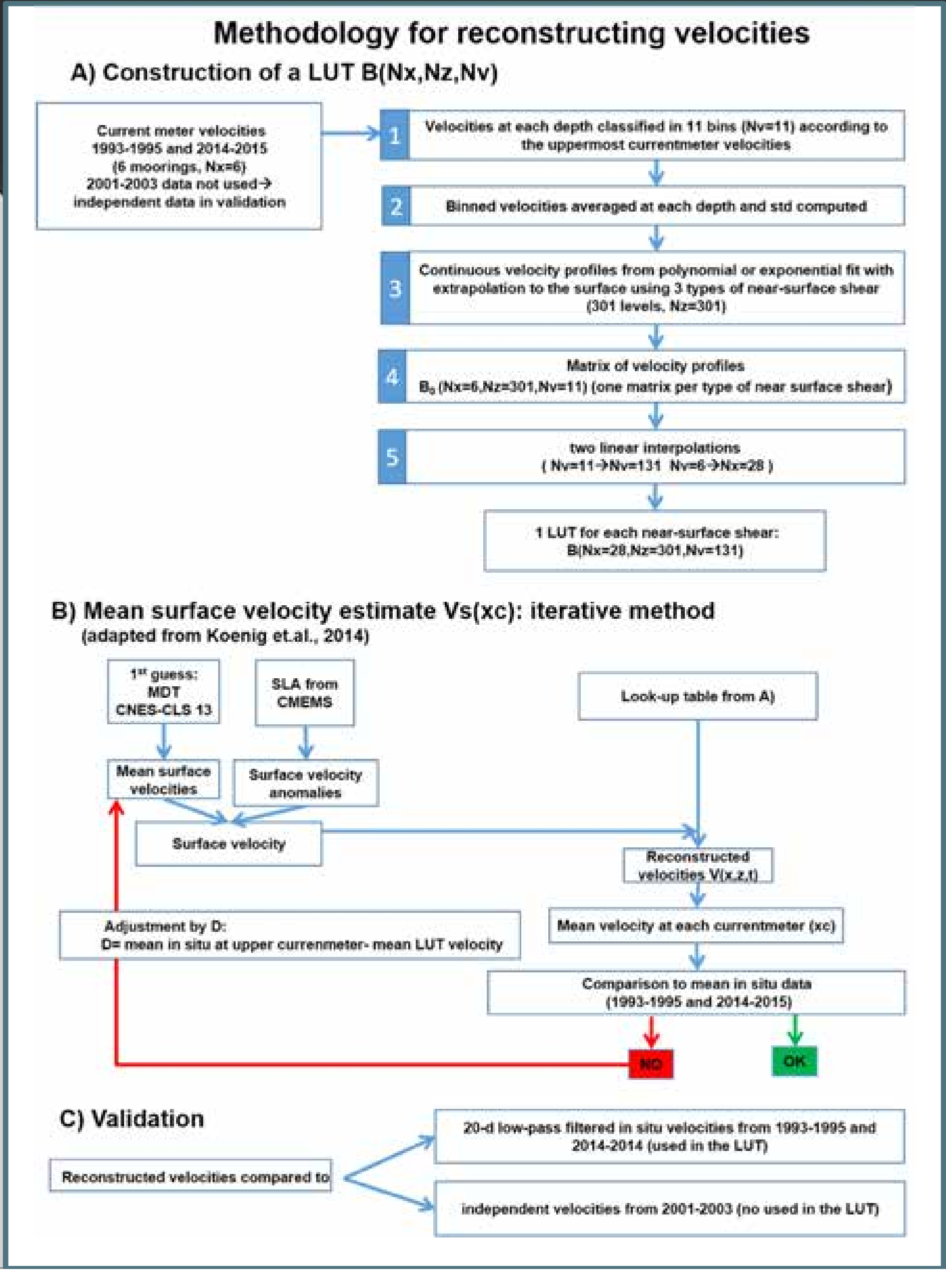
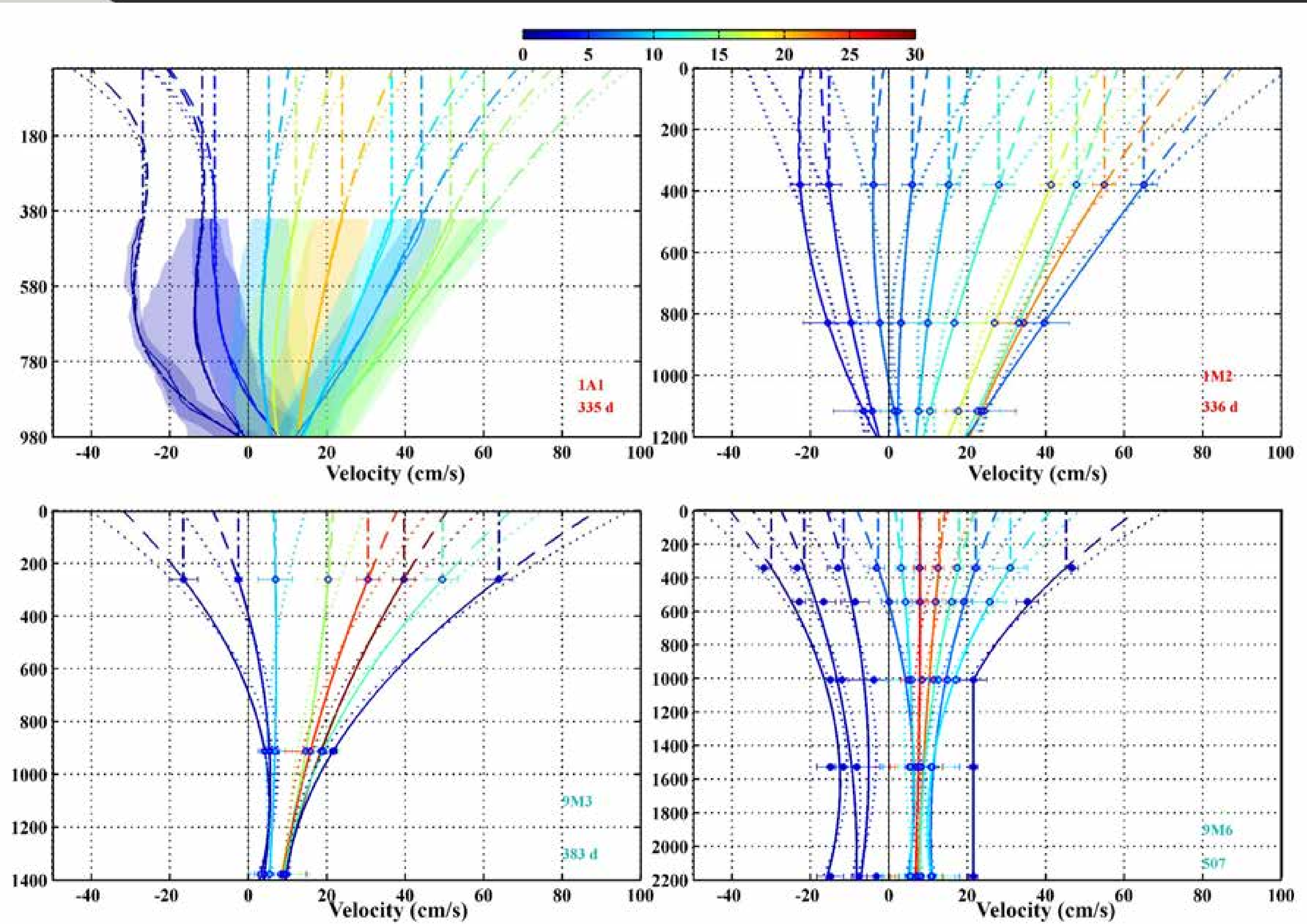
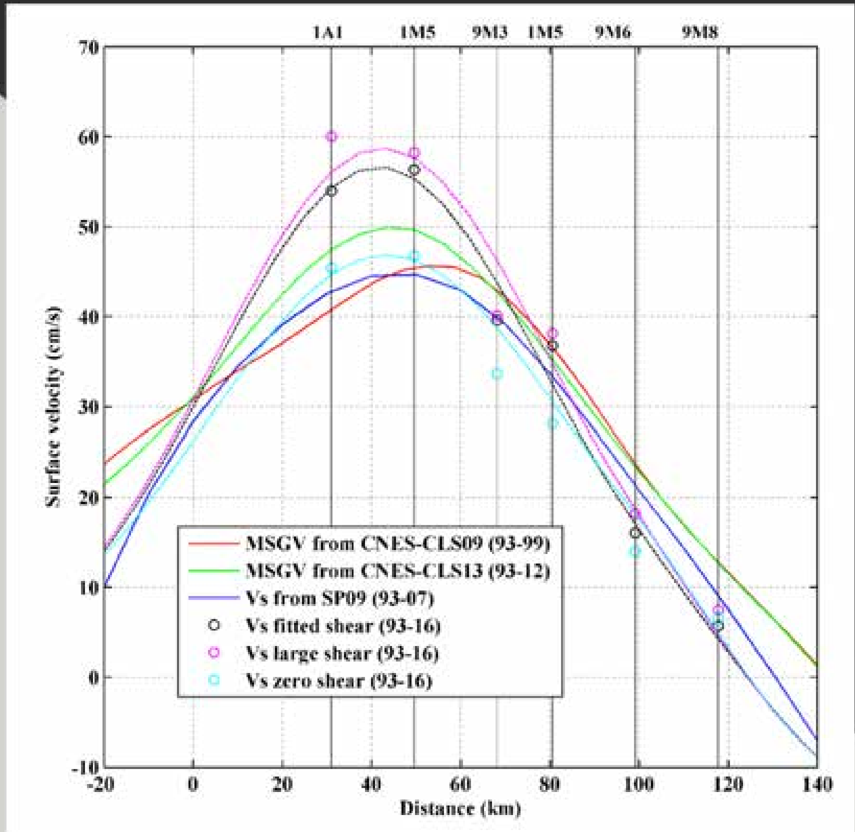


LUT



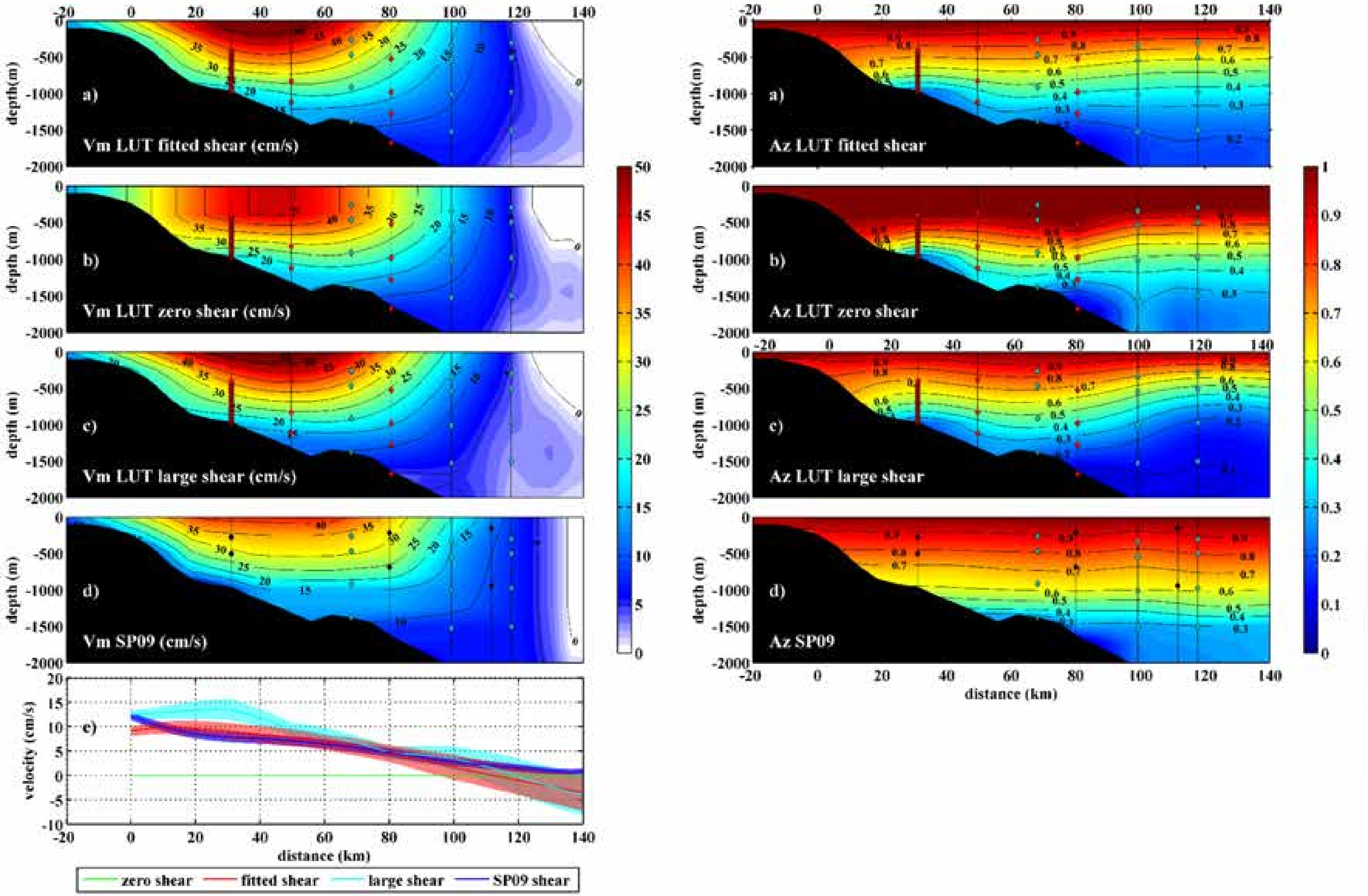
0 5 10 15 20 25 30
Velocity (cm/s)
1A1
335 d
1M2
336 d
9M3
383 d
9M6
507

Extra material: adjustment of the mean surface velocity



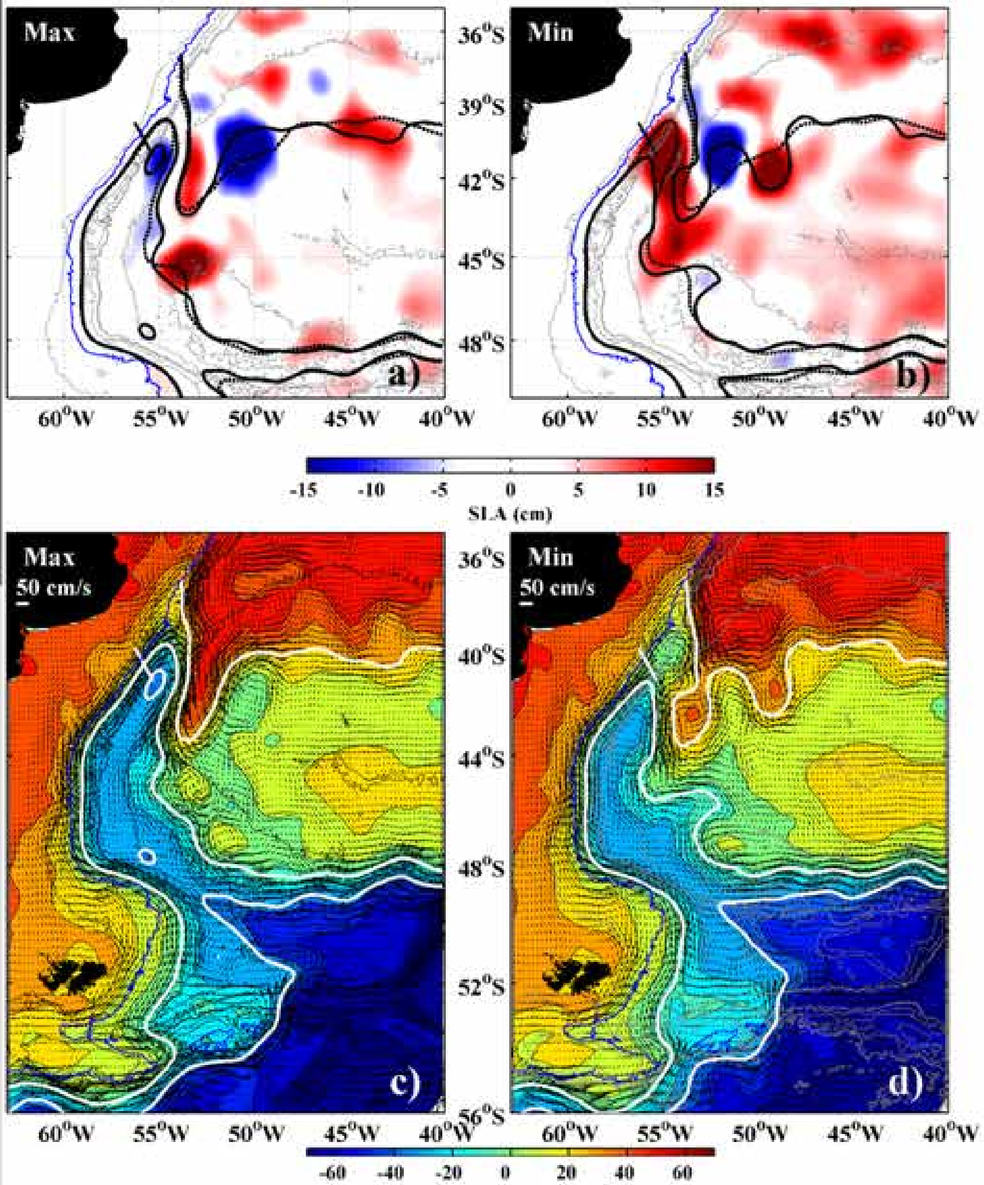
Across-track mean surface geostrophic velocity

Vm and Az

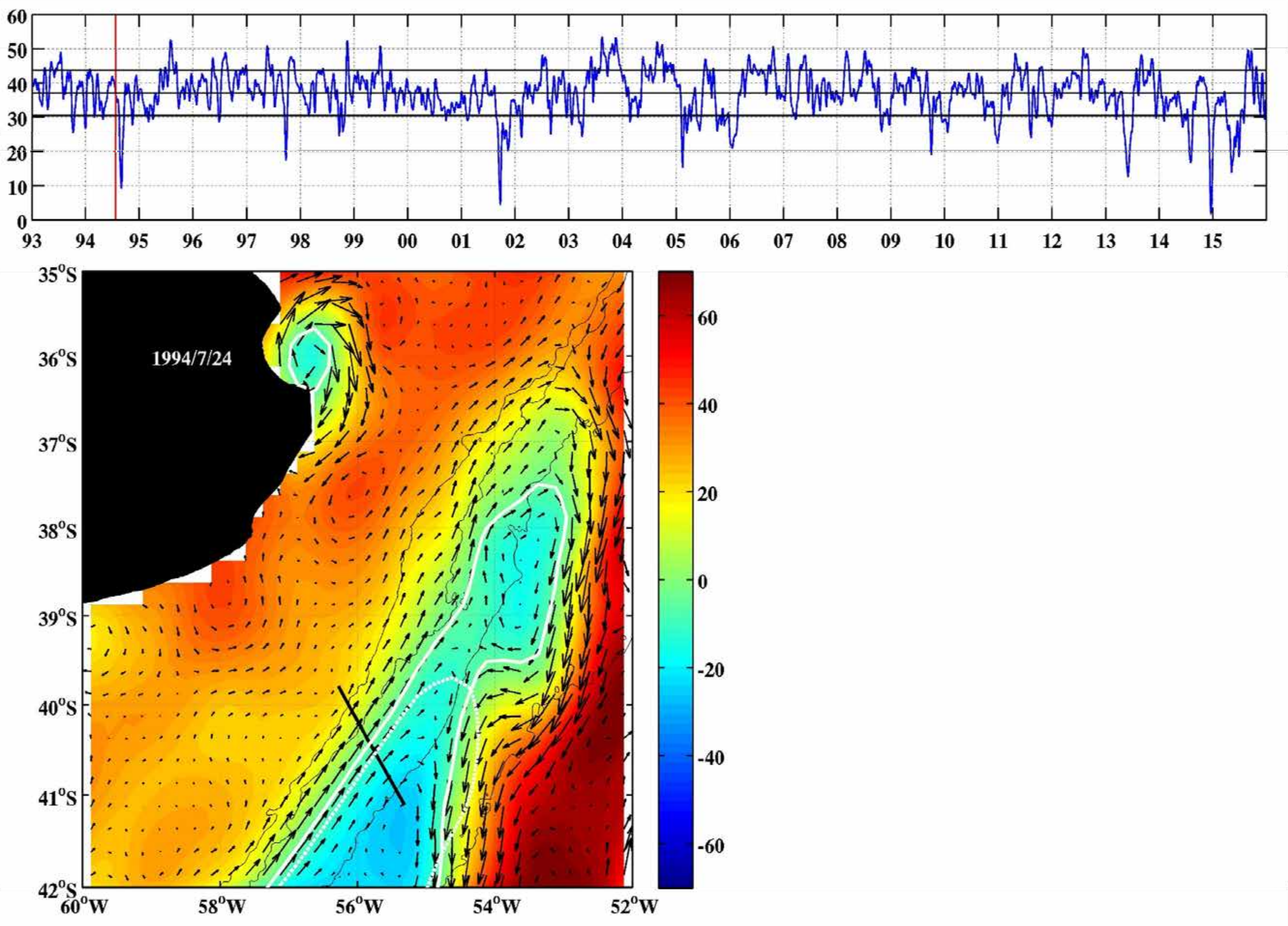


a)
Vm LUT fitted shear (cm/s)
b)
Vm LUT zero shear (cm/s)
c)
Vm LUT large shear (cm/s)
d)
Vm SP09 (cm/s)
e)
depth(m)
depth (m)
velocity (cm/s)
distance (km)
zero shear
fitted shear
large shear
SP09 shear
a)
Az LUT fitted shear
b)
Az LUT zero shear
c)
Az LUT large shear
d)
Az SP09
distance (km)

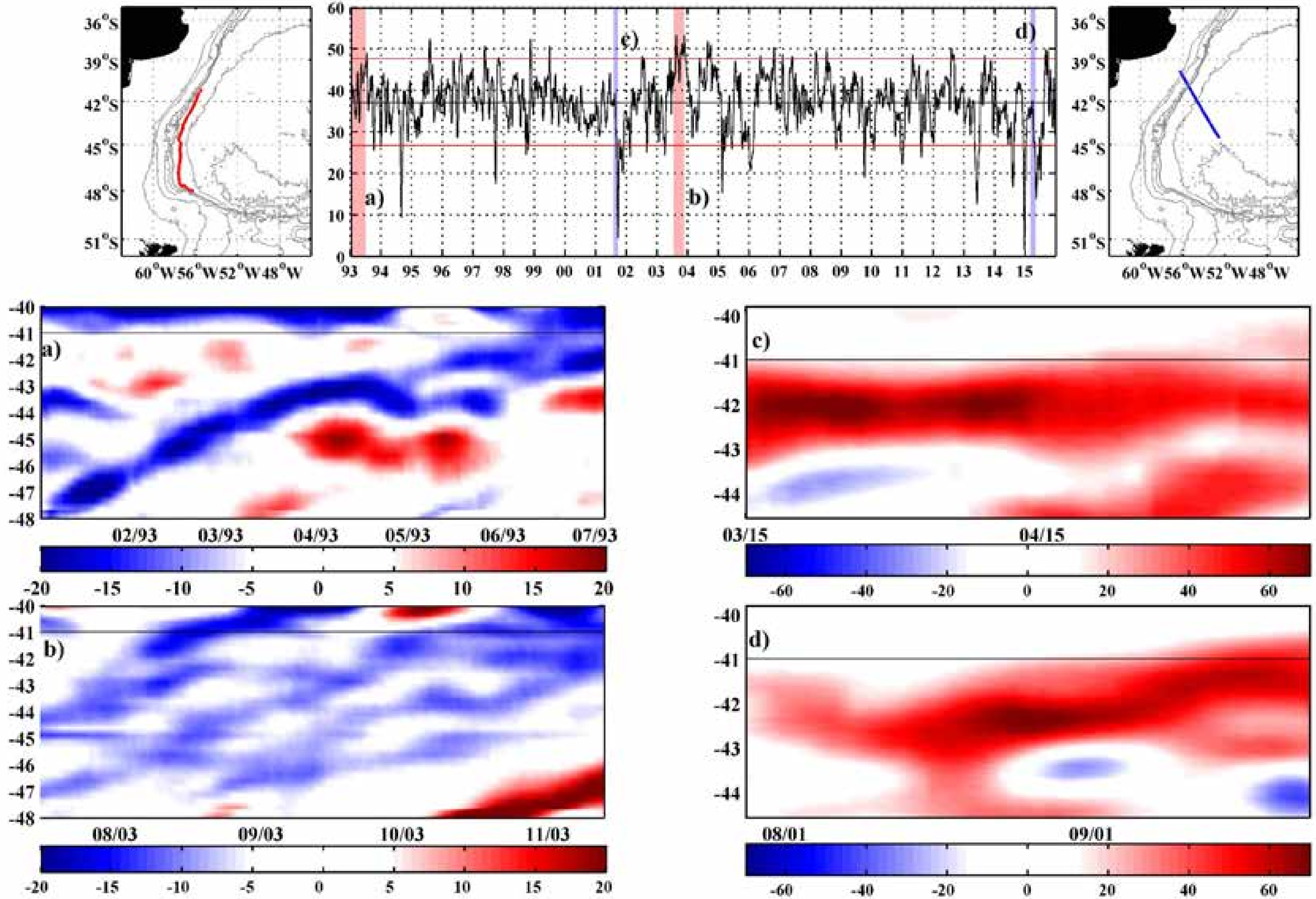
Transport maxima and minima



Position of the SAF

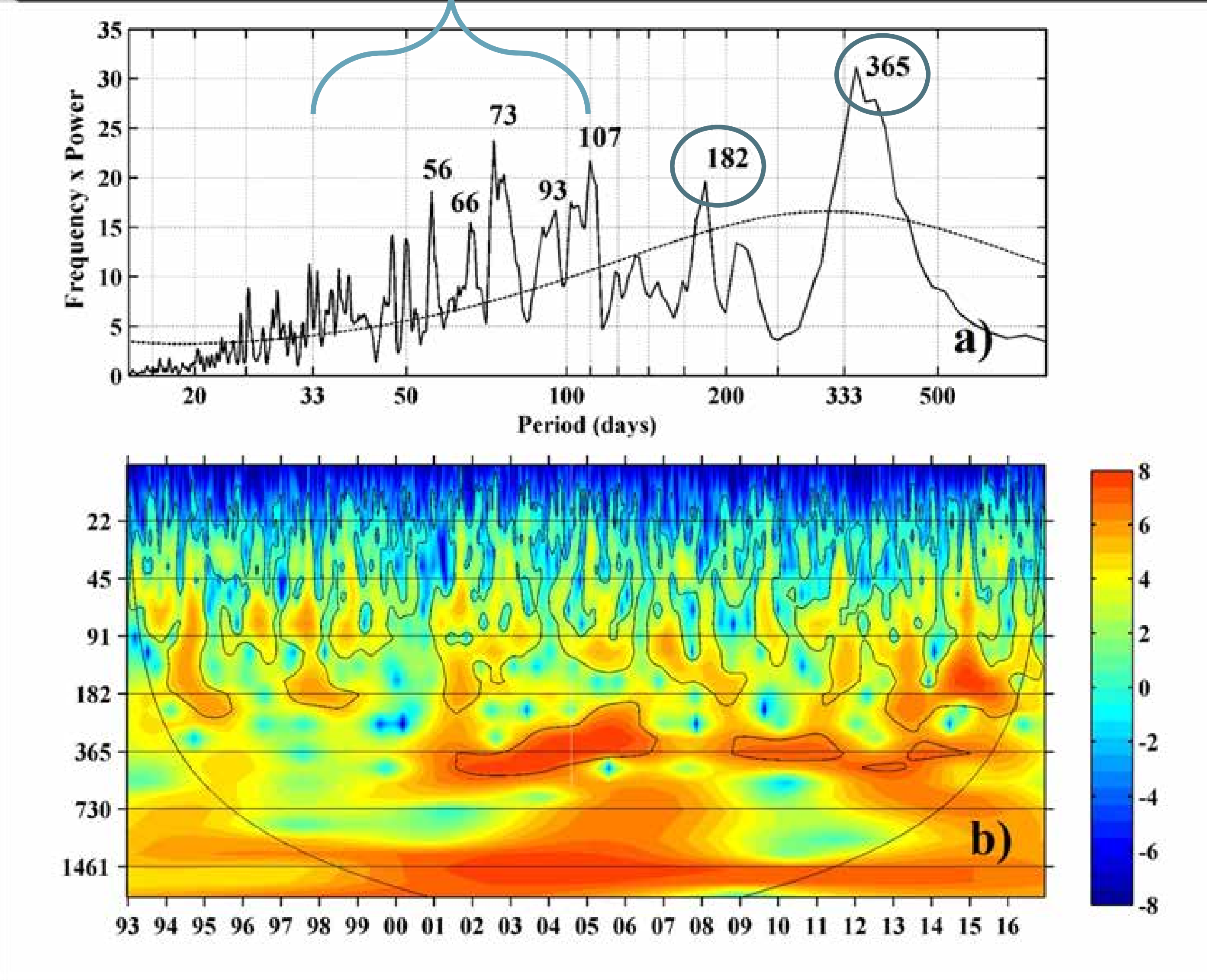


Propagation of negative and positive anomalies

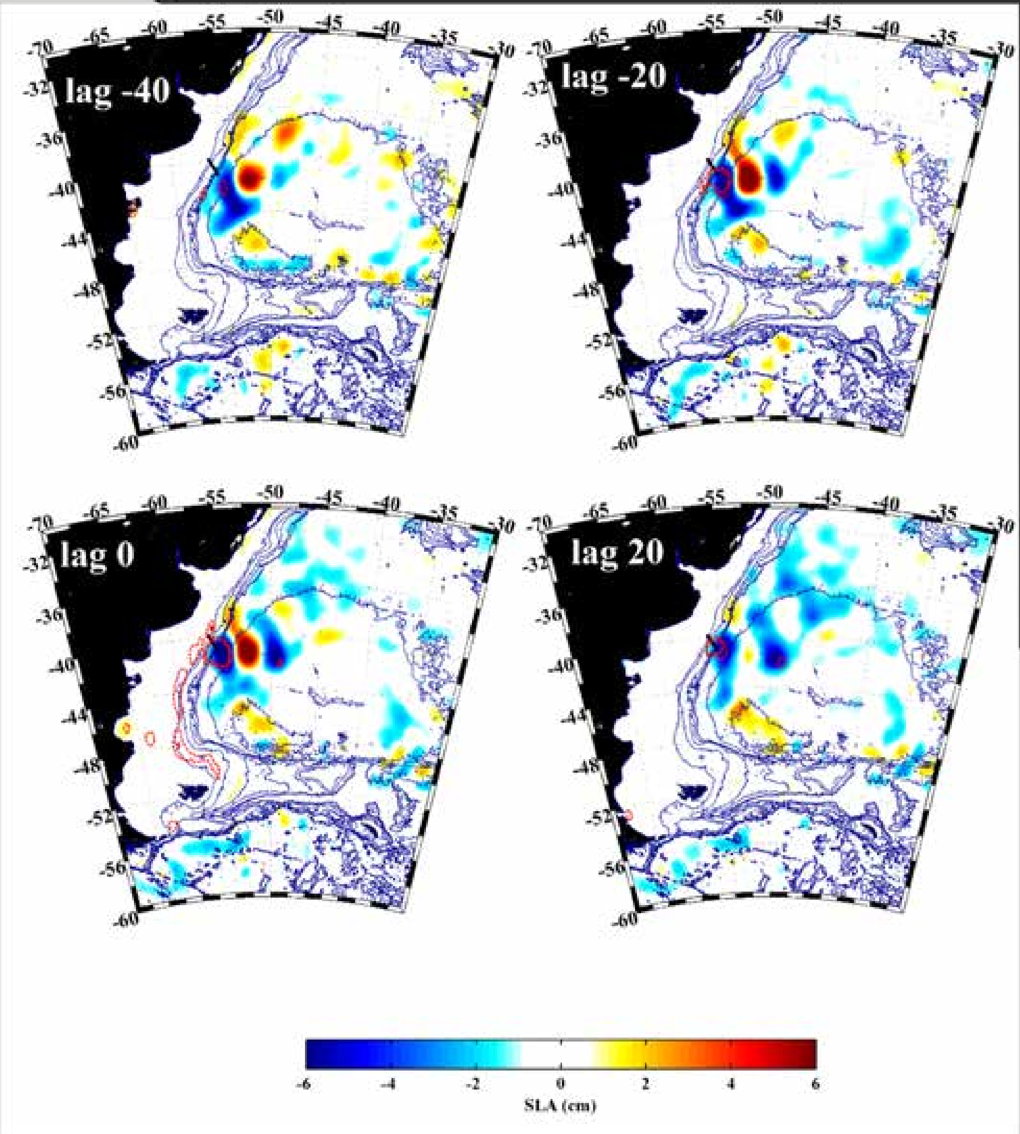


Extra material: Scales of variatios

Baroclinic costal trapped waves



MC transport variations and SLA over the SWA



Lag 0:

- Significant regression along the slope → train of fast baroclinic coastal trapped waves (Vivier et al., 2001)
- Robust SLA tripole adjacent to the section with significant regressions

Significant regressions confined are confined to the vicinity of the moorings→ apart from coastal trap waves there is no signal along the MC path at any lag→ MC transport variations at 41°S are locally forced and disconnected from upstream variability