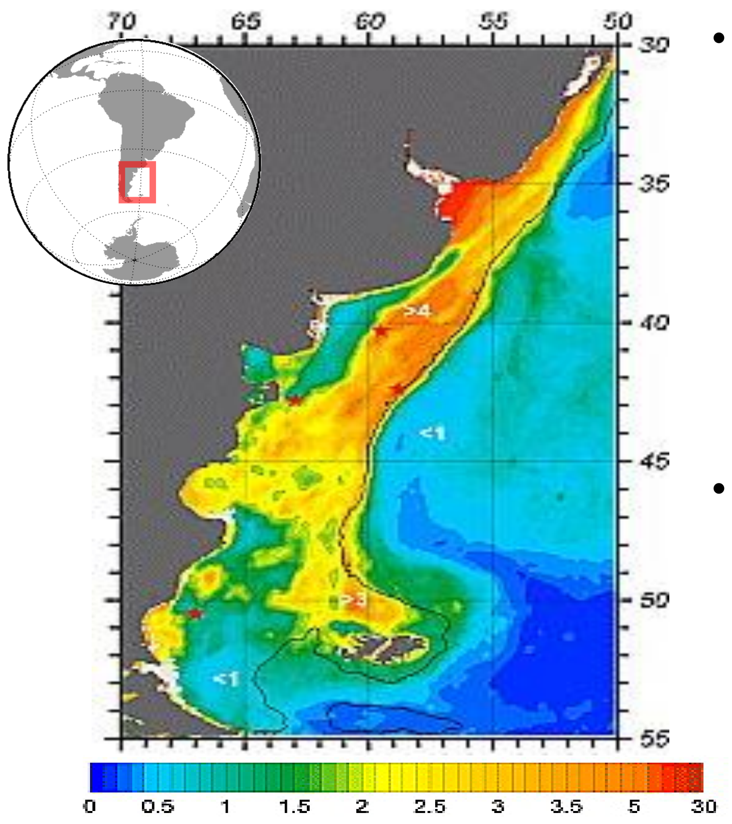
Oceanic Circulation Analysis Over the Patagonian Continental Shelf from In Situ and Satellite Data, and its Relation to Local Fishery Resources

LAGO, Loreley Selene (PhD Student from University of Buenos Aires, INIDEP; Mar del plata, Argentina)

Supervisors: **Martín SARACENO** (CIMA, DCAO FCEN UBA; Buenos Aires, Argentina) and **Patricia MARTOS** (INIDEP, UNMDP; Mar del plata, Argentina)

Authors: Guerrero RA (INIDEP, UNMDP; Mar del plata, Argentina), Piola AR (Servicio de Hidrografía Naval, DCAO FCEN UBA; Buenos Aires, Argentina), Provost C (L'OCEAN, Paris, France), Paniagua GF (CIMA, DCAO FCEN UBA; Buenos Aires, Argentina), Ferrari R (CIMA, DCAO FCEN UBA; Buenos Aires, Argentina), Artana CI (L'OCEAN, Paris, France)

MOTIVATION



SeaWiFS derived surface chl-*a* (mg m^{-3}) in spring (SON) in the western South Atlantic (Romero *et al.*, 2006).

- It is one of the most productive biological areas of the world oceans that harbors many species of commercial importance:
  - Argentinian hake
  - Argentinian Anchovy
  - Squid

- Sustainable marine fishery management can be improved with validated satellite altimetry data:
  - The scarce amount of in situ data makes satellite currents essential to further understand regional circulation.
  - Validated satellite currents can help better understand the behavior of species.

OBJECTIVES

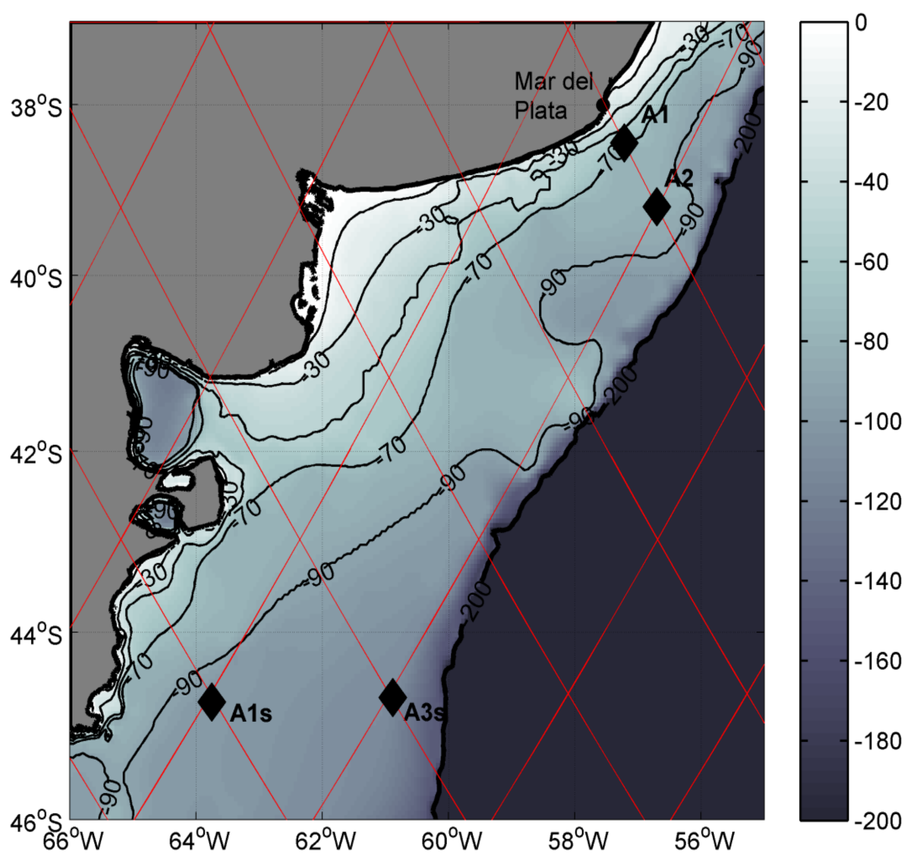
In general:

- Improvement our knowledge of oceanic circulation over the Patagonian Continental Shelf.
- Determination of oceanic conditions and its influence over the recruitment processes in the Patagonian Continental Shelf.

In particular:

- Determination of the spatio-temporal scales in which satellite altimetry data represents accurately in situ time series.
- Characterization of the variability of oceanic conditions from in situ and satellite data.
- Analysis of the link between oceanographic features with local fishery resources.

DATA

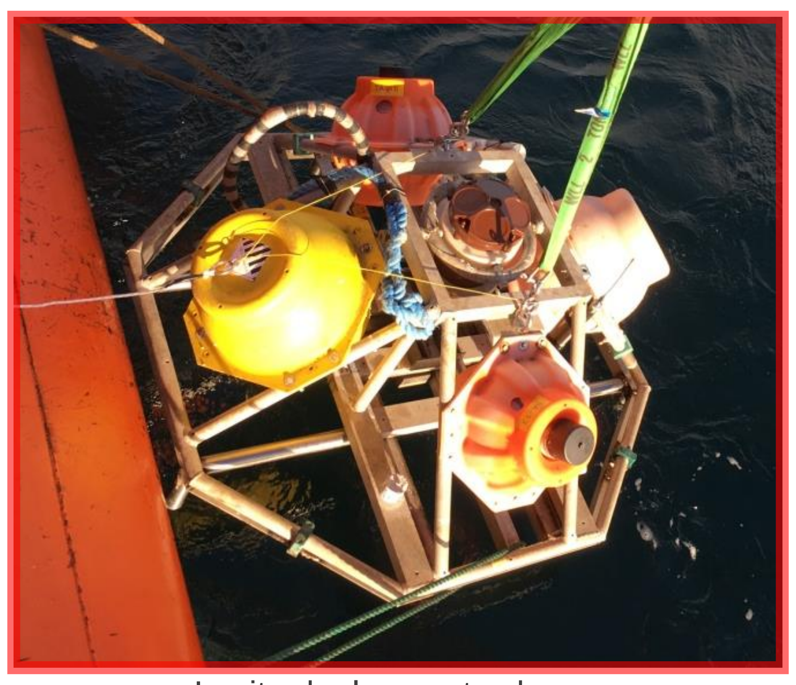


Local GEBCO bathymetry (CONTOURS), Jason-2 satellite mission tracks (red) and location of in situ deployments (black diamond).

In situ data:

Within the French-Argentine CASSIS project
http://www.cima.fcen.uba.ar/malvinascurrent/es/

- Upward-looking ADCP: hourly time series of currents every 4m in the vertical.
- µcat sensors: Hourly bottom pressure, salinity and temperature.
- Historic hydrographic data from CTD stations (provided by INIDEP)



In situ deployment scheme

North Deployments
A1 11 months (nov 2014 – oct 2015)
A2 11 months (dic 2014 – oct 2015)

South Deployments
A1s 5 months (may 2016 – oct 2016)
A3s 18 months (nov 2015 – jun 2017)

Satellite data:

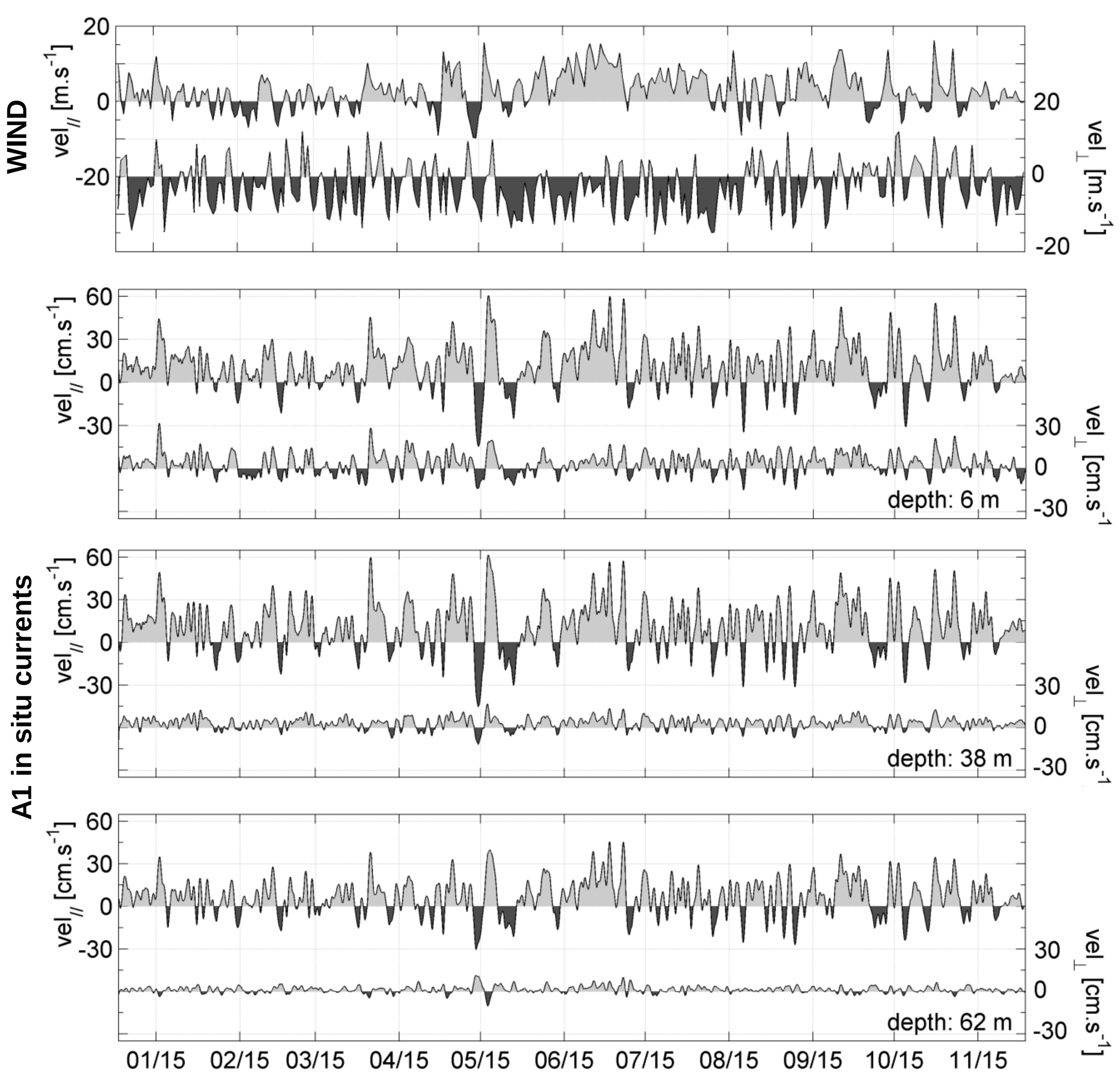
- Currents from Level 4 multi-mission daily data (1/4º resolution) from https://marine.copernicus.eu
- Currents from regional product from CLS (CLS0 version, 1/8º resolution). Daily data that includes the Ekman component.
- Along-track SSH from Jason-2 20Hz data (https://podaac.jpl.nasa.gov).

Wind data:

- 4-times daily surface data (2,5º resolution) from NCEP/NCER Reanalysis (Kalnay *et al*., 1996).

RESULTS

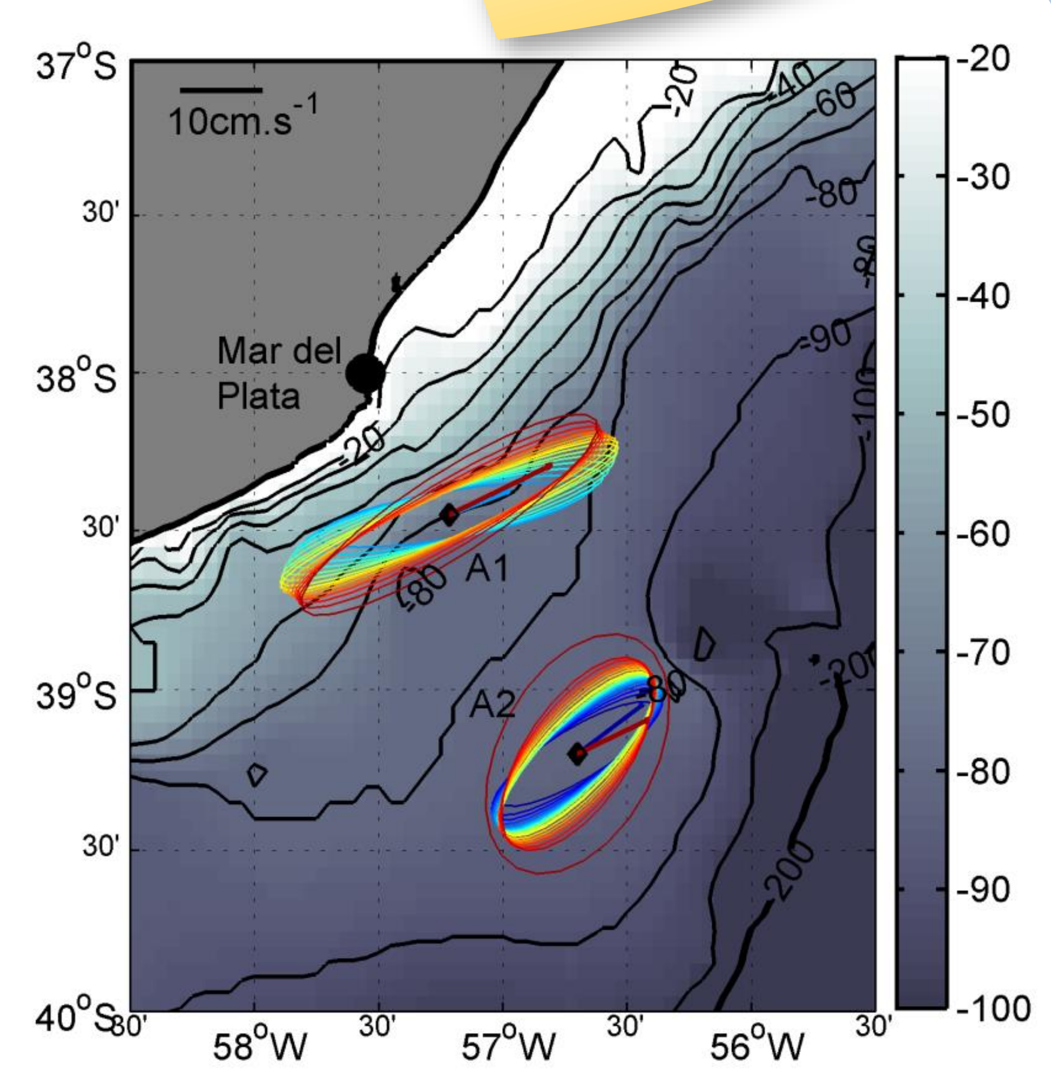
In Situ Data Analysis



A1 local along-slope and across-slope surface winds (up). Below are the along-slope and across-slope in situ currents at different levels of the water column (from the shallowest to the deepest) in A1.

Analysis of in situ north deployments (A1 and A2):

- Velocities present a bathymetry restraint.
  - Variance ellipses are more elongated along isobaths in A1 tan in A2, because the bathymetry gradient is stronger.
  - The along bathymetry component is higher than the across bathymetry one, at all depths.
- Magnitude of in situ currents decreases with depth.
- Winds in this area mostly come from the NW and are moderate (mean of 9m.s^{-1}).
- Variability of in situ currents is coherent with the wind variations, for all levels.
- Correlation between in situ currents and wind is significant (95% confidence level). Highest correlation is found in the shallowest level.



Local GEBCO bathymetry (CONTOURS). In colors mean vector and variance ellipses of in situ currents.

- An EOF analysis of in situ currents (not shown) indicates the 1st mode agrees with t he barotropic component (86.4% of the variance).
  - The barotropic behavior in both in both deployments is similar.

Comparison with Satellite Altimetry

	Vector correlation value	Vector correlation angle [º]	RMSD [cm.s^{-1}]
	A1	A1	A1
L4	0.23	1.2	12.8
CLSO (with Ekman)	0.31	-31.1	6.03

Shallowest in situ velocity vs satellite surface velocity.

- Comparison of in situ currents with satellite gridded data was not successful.
- Correlation coefficients are significant but low, with a small improvement using the product that includes the Ekman component.
- Comparing in situ SSH to satellite data before applying the corrections needed (not shown) the agreement is excellent (correlation above 0.9 and RMSD below 10cm).
- The same analysis adding each correction one by one shows worsened results in particular with:
  - The ocean tide correction.
  - The atmospheric high frequency fluctuations correction.

CONCLUSIONS

Circulation in this area is mainly barotropic (86.4% of the variance) and similar in both north deployments. It is restrained by local bathymetry, maximum variance is found along-bathymetry contours . Winds affect currents at all depths..

Comparison with currents inferred by satellite altimetry measurements did not throw successful results. A small improvement was achieved considering the product from CLS that includes the wind effect by adding the Ekman component. Other results (not shown) indicate that to better represent in situ data some satellite corrections, applied to sea level satellite measurements, need to be more accurate. In particular, the ocean tide correction and the atmospheric high frequency fluctuations correction.