SEA LEVEL RESPONSE TO PRESSURE AND WIND FORCING IN A SHALLOW ESTUARY: VALIDATION OF TWO BAROTROPIC MODELS WITH TIDE GAUGE AND ALTIMETRY DATA

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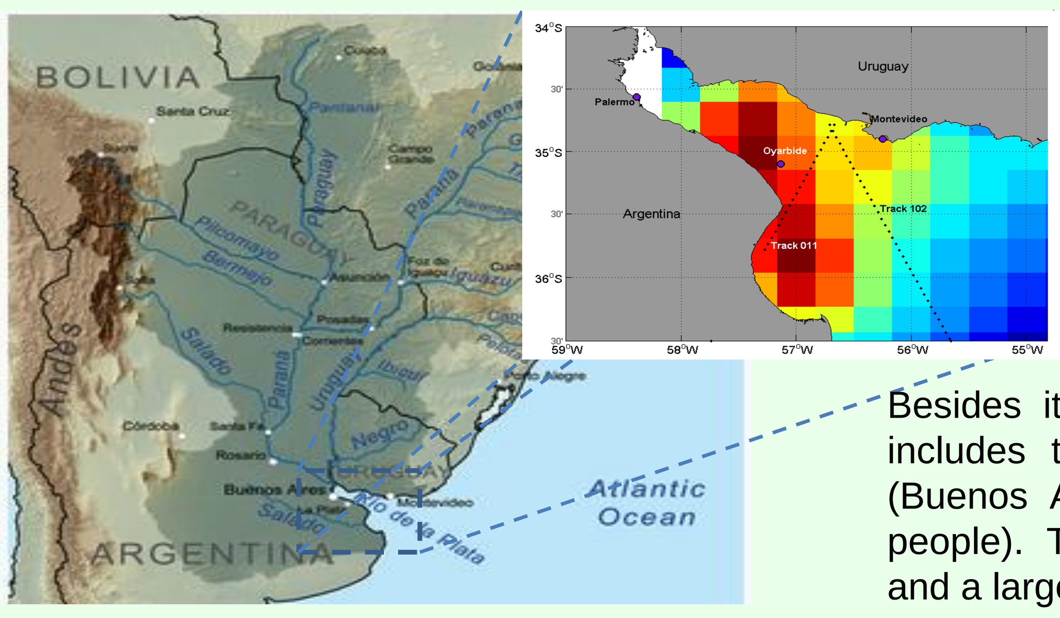
Introduction



The Río de la Plata estuary is formed by the confluence of the Uruguay River and the Paraná River on the border between Argentina and Uruguay. It is one of the largest estuaries of the world.

Besides its geographical extension, the area includes the capital cities of both countries (Buenos Aires, Montevideo, + than 30million people). The estuary has important fisheries and a large biodiversity.

Previous studies have shown that in this extensive and shallow region the estuarine circulation is mainly forced by the wind variability, especially at subannual scales (Simionato et al., 2006ab, 2007; Meccia et al., 2009, 2013a, Saraceno et al., 2014). Thus the atmospheric model correction that must be applied to the altimetry data is crucial in this region.

The objective of this work it to compare two validated regional models with the global model used in the altimetry products.

Data

Models

- ❖ Global
  1) *DAC (AVISO):* Mog2D (Carrère and Lyard 2003) + IB (>20days) period 1/1/1993-31/12/2012, 6-hourly, ¼ºx ¼º, forced by ECMWF.
- ❖ Regional
  1) *HAMSOM (validated by Simionato et al. 2006):* period 1/1/1993-31/12/2004, 6-hourly, 3x3 km, forced by NCEP.
  2) *SMARA (Etala et al. 2009):* period 1/1/2007-29/2/2012, 3-hourly, 1/20ºx1/20º forced by NCEP.

In-situ data

1) *TG Buenos Aires (SHN):* hourly time series, period 1/1/1965-31/12/2012
2) *TG Oyarbide (SHN):* hourly time series, period 1994-2008
3) *TG Montevideo (PSMSL)*: monthly time series, period 1993-2004

Altimetry data

1) Jason 1 along track from RADS.
2) Jason 1-2-TP along track from CTOH

Result 1: spatial patterns of atmospheric-induced sea level variance

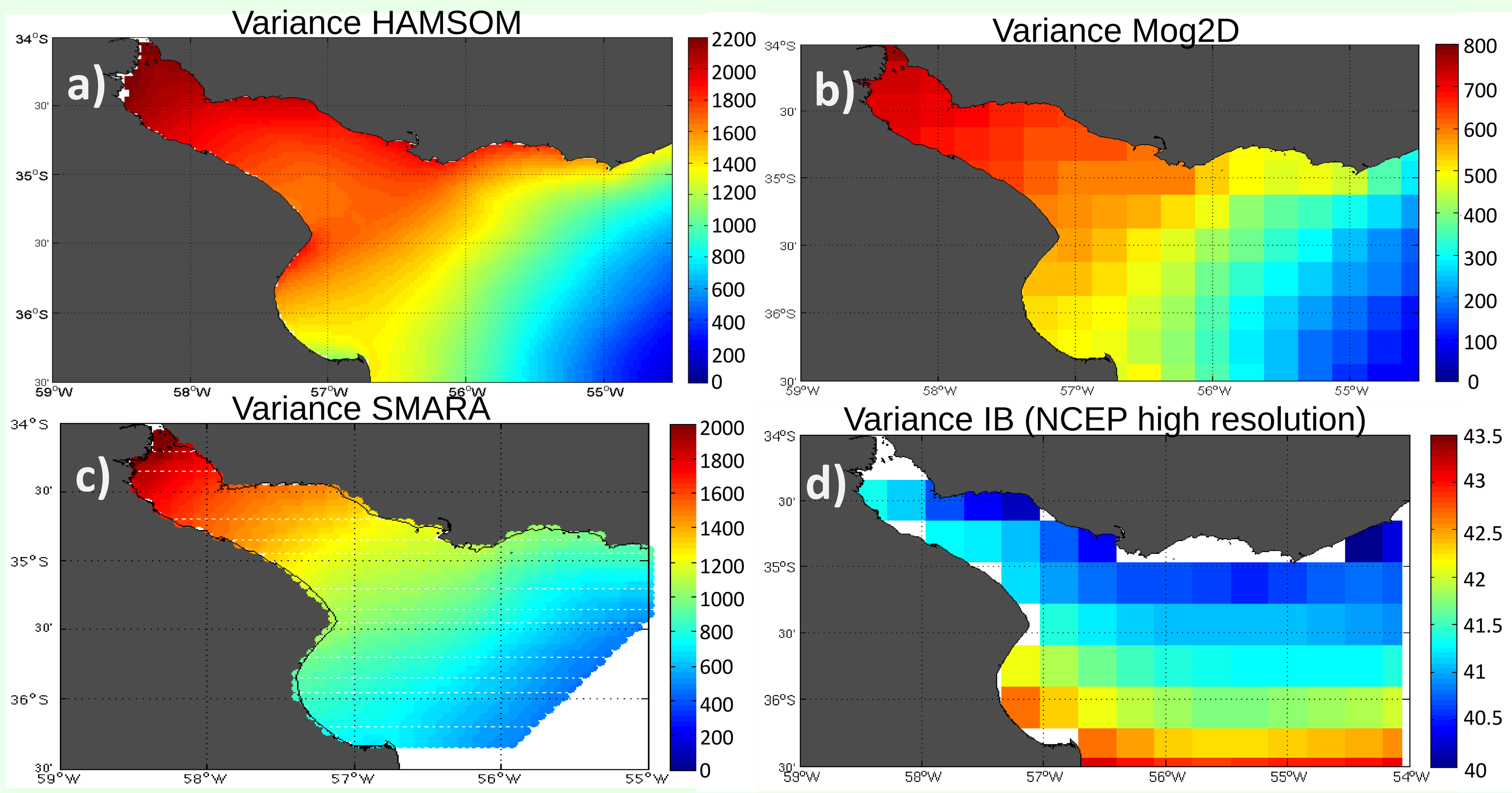


Figure 1: Variance of the sea level response to atmospheric wind and pressure forcing as given by (a) HAMSOM, (b) Mog2D and c) SMARA. d) Variance of the sea level response to isostatic Inverted Barometer (IB). Units: cm².

The spatial patterns of the variance of the sea level simulated by the three models are similar, showing high values in the upper part of the Rio de la Plata Estuarine, and low values toward the mouth of the river. The magnitude of the sea level variability observed by HAMSOM and SMARA is two times bigger than the magnitude observed by Mog2D.

Result 2: atmospheric correction applied to in-situ data

Table 1: Variance of hourly in-situ sea level (cm²) with corrections as indicated in the first row.

Variance (cm²)	No correction	Tide	Hamsom	Mog2D	SLA Tide + Hamsom	SLA Tide + Mog2D
Palermo	2939.0	650.2	2090.6	710.0	<u>**756.5**</u>	973.9
Oyarbide	2348.6	757.9	1657.6	706.3	611.3	<u>**519.8**</u>

The variability of the sea level in Palermo station decreases more when we correct the time series with HAMSOM instead of Mog2D (Table 1). The opposite is observed in Oyarbide station. Results suggest that HAMSOM represents better the sea level response to wind and pressure forcings in the upper estuarine (Table 1).

At monthly scales, the study area is better represented by HAMSOM than by Mog2D (Table 2).

Table 2: Variance of monthly in-situ sea level (cm²) with corrections as indicated in the first row.

Variance (cm²)	No correction	Hamsom	Mog2D	SLA Hamsom	SLA Mog2D
Palermo	152.2	118.4	8.7	<u>78.3</u>	131.6
Oyarbide	133.8	58.6	8.2	<u>114.6</u>	126.0
Montevideo	198.7	55.0	7.9	<u>148.3</u>	194.6

Result 3: atmospheric correction applied to satellite data

RADS (J1)

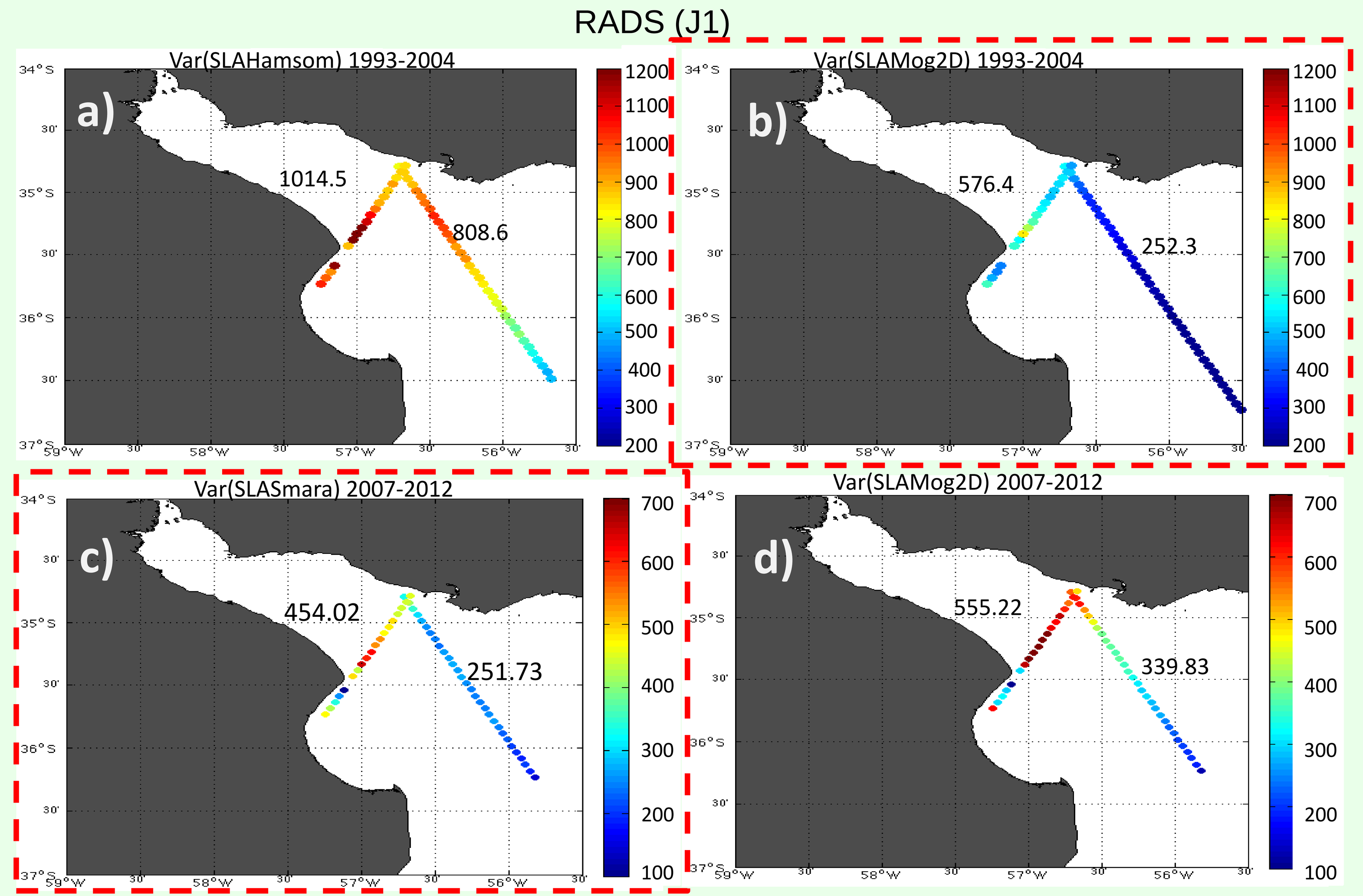


Figure 2: Variance of the along-track sea level anomaly corrected by HAMSOM (a), Mog2D (b and d) and SMARA (c). The numbers in each images represent the mean variance along the track 11 and 102. Units: cm².

The variability of the SLA along-track from RADS and CTOH decreases more when the atmospheric correction modelled by SMARA (regional model) is applied.

CTOH (J1+J2+TP)

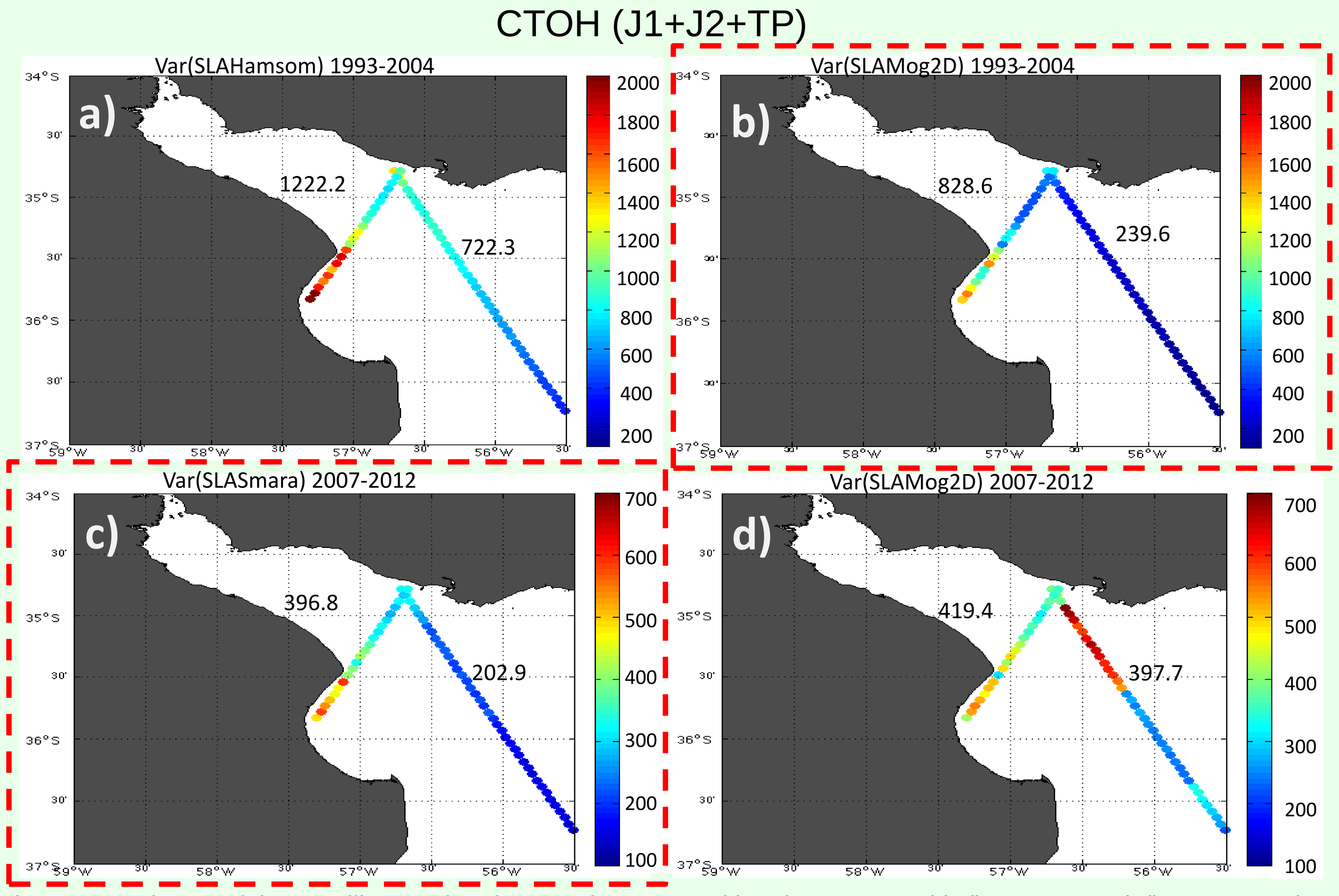


Figure 3: Variance of the satellite sea level anomaly corrected by a)HAMSOM, b) d) Mog2D and d) SMARA. The numbers in each images represent the mean variance along the track 11 and 102 Units: cm².

Conclusions

- ✧ The atmospheric models analysed show a similar spatial distribution of the variance of the sea level: High variability is observed in the upper Estuary and decreases towards the Lower part.
- ✧ DAC models show an order of magnitude larger variances than IB correction, confirming that wind effects dominate SLA variability in the region.
- ✧ Mog2D underestimates the variability of the sea level response to wind and pressure forcing. HAMSOM and SMARA represent it more accurately.
- ✧ At monthly scales, the variance of the in-situ sea level from Palermo, Oyarbide and Montevideo is reduced more significantly using HAMSOM.
- ✧ Results suggests that SMARA regional model is the most adequate correction to remove the atmospheric variability in the altimetry data.

Working progress: Analysis of Envisat tracks in the upper part of the Estuary.

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