

Global analysis of coastal gradients of Sea Surface Salinity

Alina N. Dossa^{1,2*}, G. Alory², A. Silva¹, A.M. Dahunsi⁵, A. Bertrand^{3,4,1}

¹ DOCEAN, UFPE, Recife, Brazil

² LEGOS, UPS/IRD/CNRS/CNES, Toulouse, France

³ MARBEC, IRD, Sète, France

⁴ UFRPE, Recife, Brazil

⁵ CIPMA, Cotonou, Benin

*nath2dossa@gmail.com



Introduction

Why studying sea surface salinity?

- SSS: key parameter in ocean-atmosphere interactions, climate variability and water cycle
- Coastal SSS gradients can bear the signature of coastal processes
- Challenges for SSS remote sensing in coastal regions
- Ship thermosalinographs (TSG) provide most continuous SSS *in situ* measurements from open ocean to coast

➔ Comparison of satellite (and model) products with TSG observations in coastal region to quantify their skills

Data

- **In situ** SSS data: global network of TSG onboard Voluntary Observing Ships and research vessels
- 2-3 km alongtrack resolution
- depth: 0-10 m

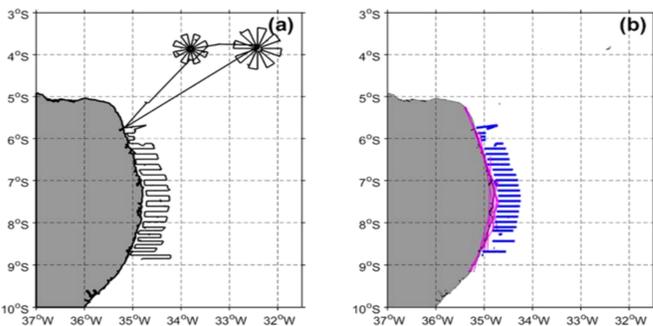
- **Four satellites products from 2 different missions**
 - SMOS LOCEAN (L3 V5)
 - SMOS BEC (L3 V2)
 - SMAP JPL (L3 V4.3)
 - SMAP RSS (L3 V4.0)

- **Reanalysis product**
 - GLORYS12V1 MERCATOR
 - 1/12° x 1/12° x 1 day depth: 0.5 m

Methods

Gradient estimation from TSG data and gridded products

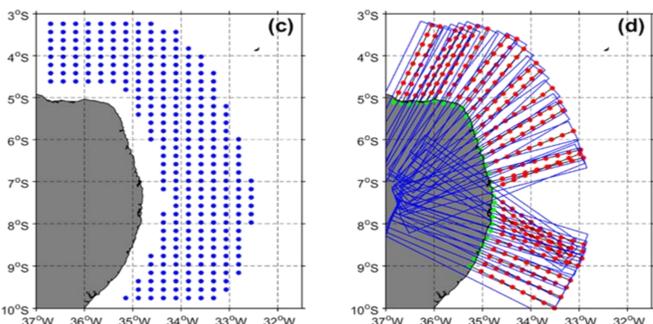
TSG



TSG installation



Satellite



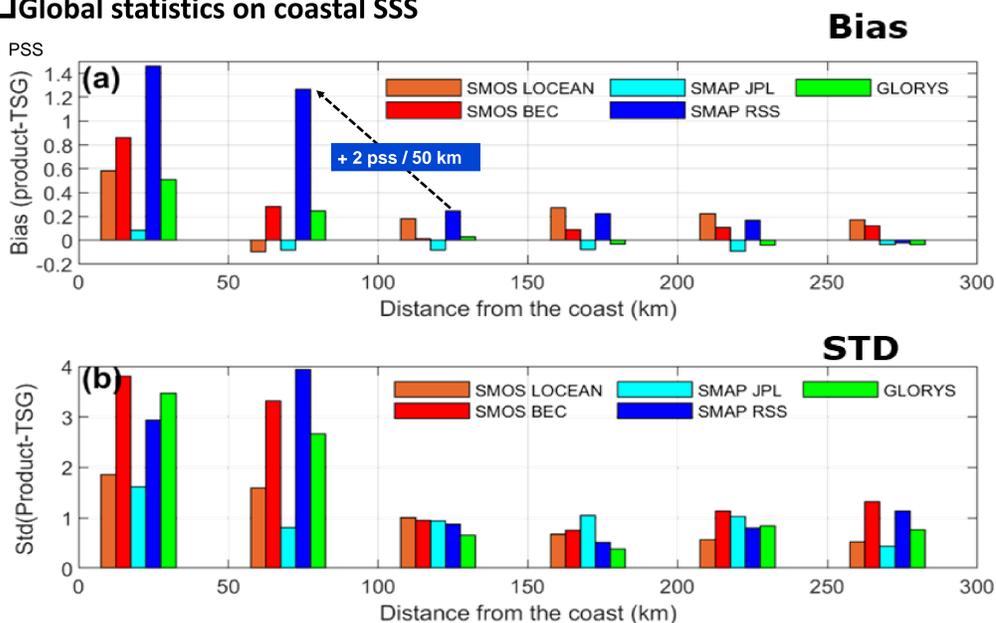
1. Estimation of **coastward SSS cross-shore gradient** by linear fit

Gradient > 0: SSS ↗ at coast
Gradient < 0: SSS ↘ at coast

2. Spatio-temporal collocation of each TSG cross-shore section with nearest satellite/reanalysis cross-shore section

Results

Global statistics on coastal SSS

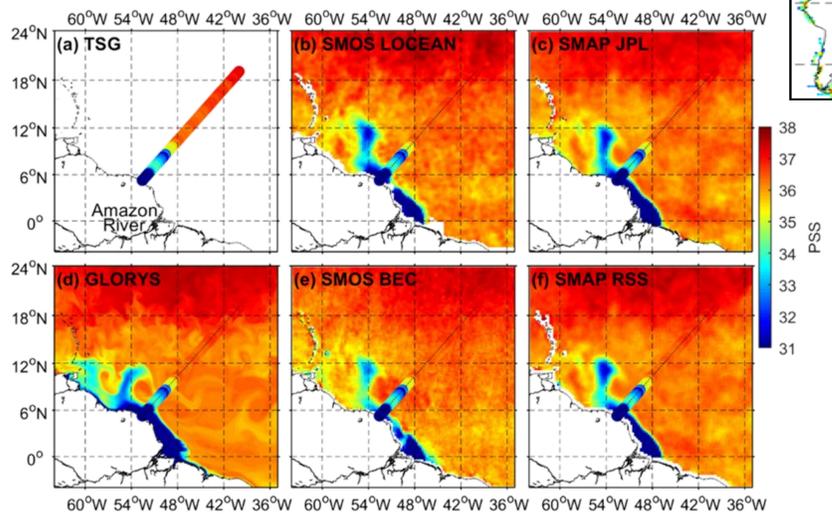


- Higher bias/STD in 0-100 km than 100-300 km → RFI effect
- 100-300 km band:
 - GLORYS has smallest bias/STD
 - SMOS LOCEAN has largest STD
 - SMOS BEC has largest STD
- 0-100 km: SMAP JPL shows best skills, followed by SMOS LOCEAN

REGIONAL CASE STUDIES

Amazon River Plume

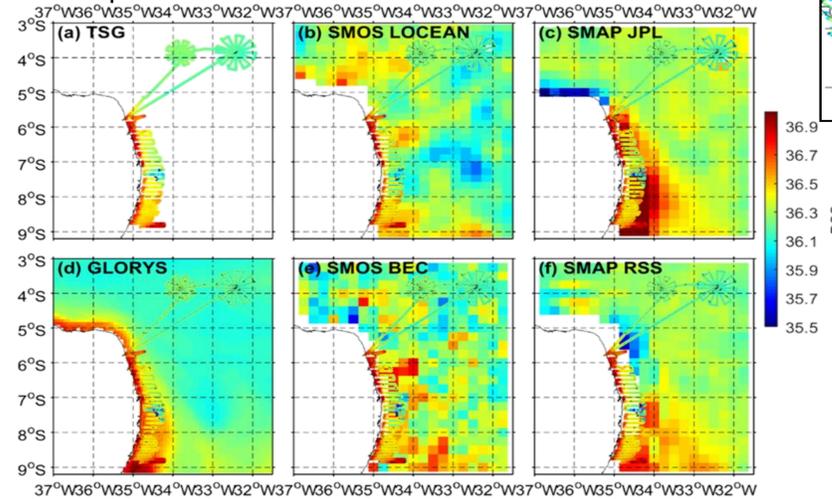
6-9 March 2017



- Amazon plume: **River discharge** → low SSS → transported along the coast by the **NBC + retroflexion + ring formation**

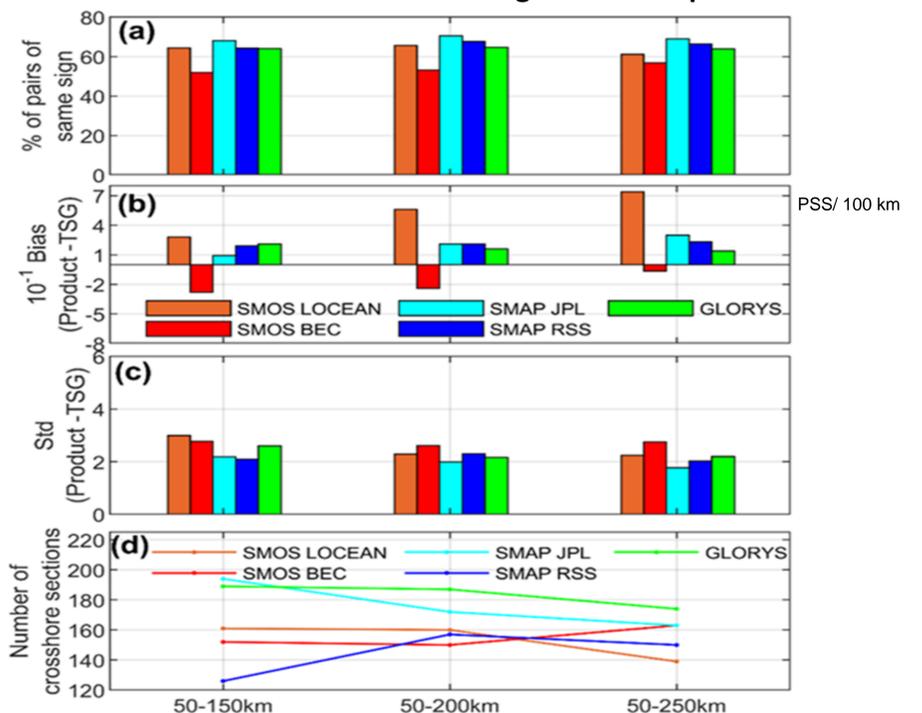
Northeast Brazil

21 Sep-28 Oct 2015



- Surfacing of the northward North Brazil Under-Current **salty** core + evaporation over the shelf

Global statistics on cross-shore SSS gradient comparison



- No relation between bias in SSS and bias in cross-shore SSS gradient (ex: SMOS LOCEAN: <0 vs >0)
- All products fail in estimating the sign of the gradient in a proportion higher to 30%
- Products rankings: (min STD-diff, min bias criteria)

Conclusions

- Satellites reveal global dominance of coastal freshening, related to river runoff over shelves and enhanced coastal precipitation in tropics,
- Skills very dependent on coastal regions, calls for regional validation between exploitation of satellite products for coastal studies
- SMAP products perform better than others products in coastal SSS gradient estimation
- Need for SMOS-HR