

# Towards long-term (2002-present) reconstruction of northern Indian Ocean Sea Surface Salinity based on AMSR-E and L-band Radiometer data

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JC<sup>2</sup> - 6,7,8 October 2021

## 1 Overview

### Why are we focusing on salinity?

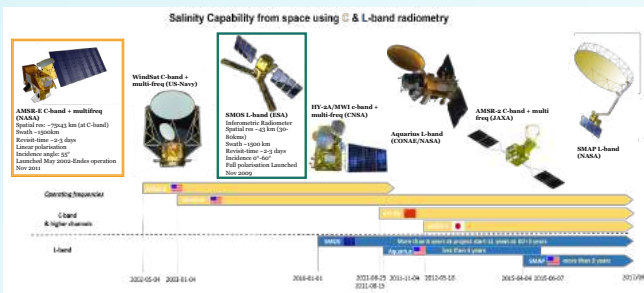
**Sea Surface Salinity (SSS)** plays a fundamental role in the density driven global ocean circulation, the water cycle and climate

#### The Problem:

Few data available: first SSS-satellite (L-band) launched by ESA in 2010 (SMOS)

#### Purpose:

Extend time series with reconstructed data from AMSR-E (NASA), launched in 2002

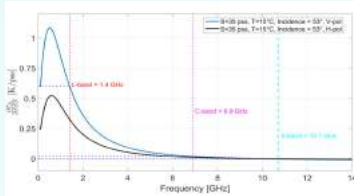


### How to retrieve SSS from AMSR-E (remote) data?

In using satellite retrieved **brilliance temperature** ( $T_B$ ) of the ocean surface to measure the **permittivity** ( $\epsilon$ )

#### The problem:

C- and X-band measurements are weakly sensitive to SSS



#### But:

after Reul et al (2009):

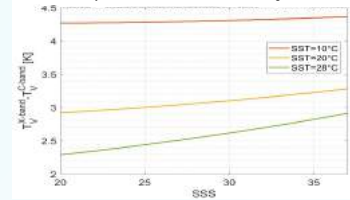
C- / X-band signal dependencies to wind & SST are very close

➔ Difference between the bands allows to eliminate most noises caused by wind & SST

### Why focus on the Bay of Bengal (BoB)?

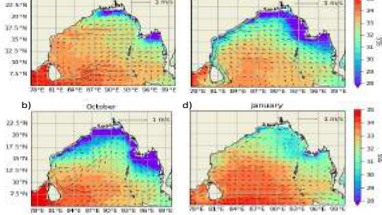
- $\Delta T_B$  is more sensitive to SSS at high SST (Reul et al 2009)
- Monsoon rain — large SSS contrasts
- Vertical stability strongly influenced by SSS

Sensitivity to SSS of the C minus X-band V-pol channels



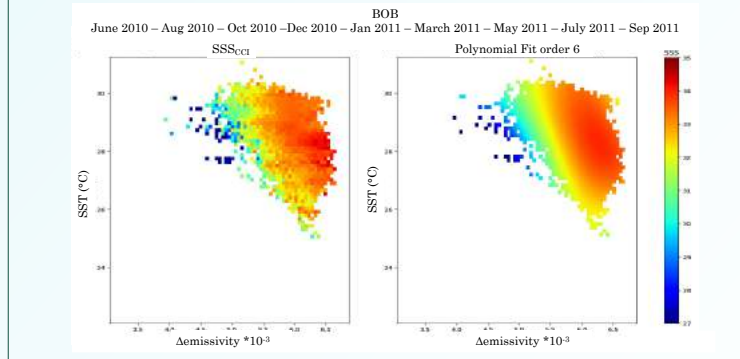
SSS<sub>CCI</sub> from 01/2010-09/2020

Median-Global Current data from 01/1993-12/2016

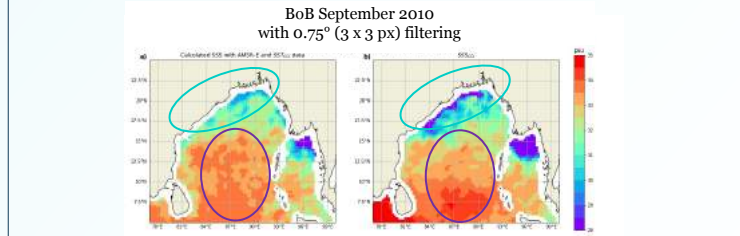


## 2 Methodology

- I. Estimate the sea surface emissivity contrast
  1. Corrections of  $T_{B_{Antenna}}$  to obtain  $T_{B_{Ocean}}$  (Wentz and Meissner 2012)
  2. Calculating further empirical corrections (polynomial and filters) on each band, trying to fit it a maximum to the reference CCI data in function of the **wind**, the **SST**, the **cloud liquid water** and **water vapor**
  3. Retrieving Sea surface emissivity contrast
 
$$\Delta e = (e_x - corr_x) - (e_c - corr_c)$$
- II. Training with L-Band (CCI) data on common period to build empirical model for SSS as a function of  $\Delta e$  and SST



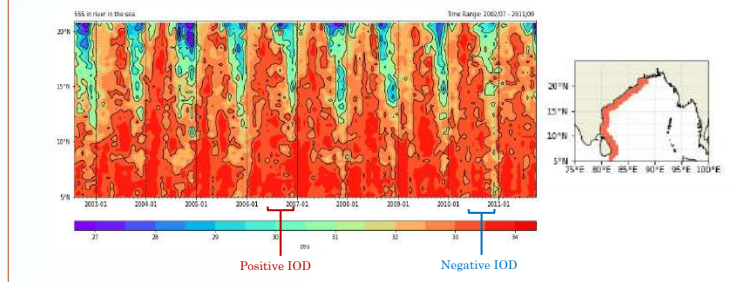
## 3 Results



- Preliminary reconstructions demonstrate the ability of the method to capture low SSS near the Ganges & Irrawaddy estuaries
- Systematic biases & noise issues
  - We are currently exploring how to reduce them (neural network) and what is the potential for this method away from estuaries

## 4 First validation

- Interannual variability of the « river in the sea » SSS : Correct representation of the **Indian Ocean Dipole** (IOD) in 2006 and 2010 (Akhil 2014)



• Reul, Nicolas et al. (2009). Demonstration of ocean surface salinity microwave measurements from space using AMSR-E data over the Amazon plume. Geophysical Research Letters (GRL) (36):G04307 (American Geophysical Union), 2009-07. Vol. 36, P. 1-5. doi: 10.1029/2008GL038890

• T. Meissner and F. J. Wentz. "The Emissivity of the Ocean Surface Between 6 and 30 GHz Over a Large Range of Wind Speeds and Earth Incidence Angles," in IEEE Transactions on Geoscience and Remote Sensing, vol. 50, no. 8, pp. 3014-3026, Aug. 2012. doi: 10.1109/TGRS.2011.2217962

• Akhil, V. P., et al. (2014). A modeling study of the processes of surface salinity seasonal cycle in the Bay of Bengal. J. Geophys. Res. Oceans, 119, 3926-3947. doi:10.1002/2013JC009632

• Chaitanya, AVS et al (2014). Salinity Measurements Collected by Fishermen Reveal a "River in the Sea" Flowing Along the Eastern Coast of India. Bulletin of the American Meteorological Society, 95, 10.1175/BAMS-D-12-00243.1.