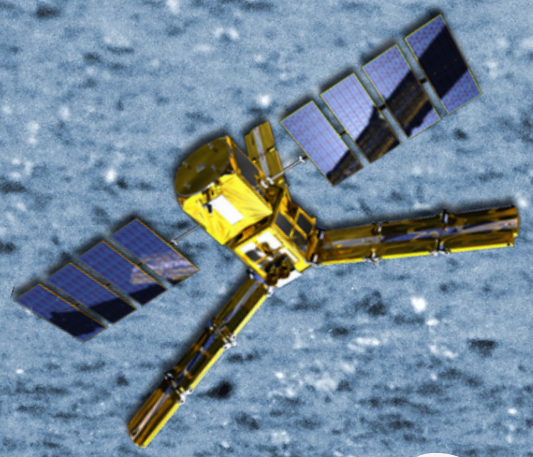


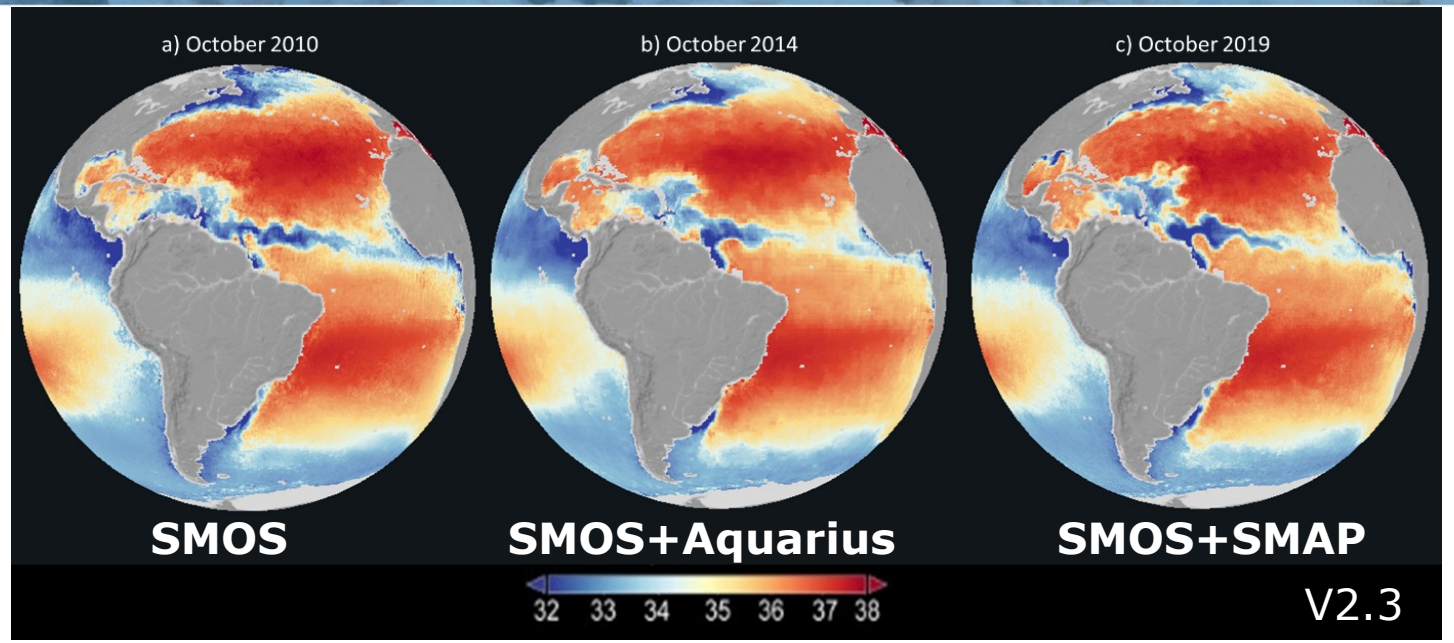
More than 10 years of Sea Surface Salinity monitoring from space

J. Boutin(LOCEAN-IPSL), N. Reul(LOPS),
J. Koehler(U. Hamburg), A. Martin (NOCS), R. Catany (ARGANS),
F. Rouffi (ACRI-st), J. Jouanno (LEGOS) and the CCI+Sea Surface Salinity consortium

esa

CCI Salinity

Climate Change Initiative + Sea Surface Salinity



(Boutin et al, ESSOAR 2021)

Jan 2010---------- Aug 2011 ---------- Apr 2015 ---------- >

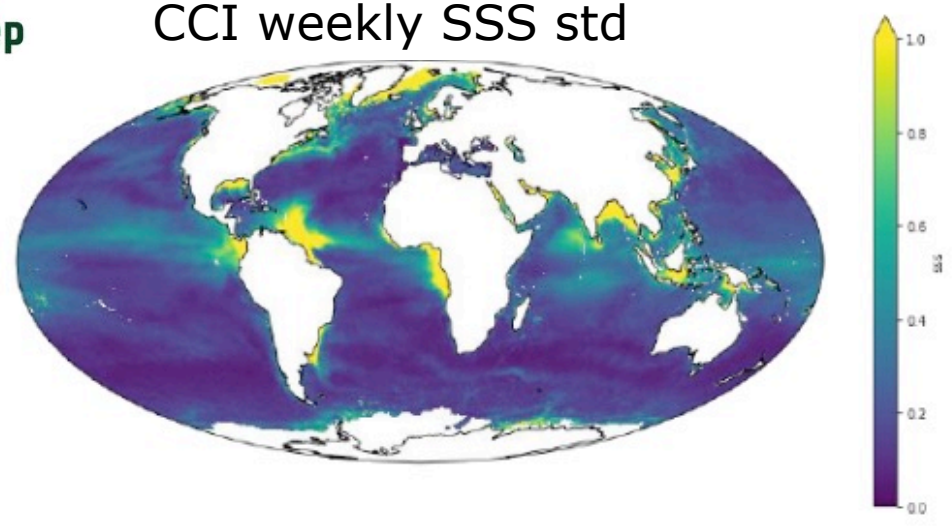
- Take full advantage of SMOS, SMAP and Aquarius missions to create a 10-yr long Climate Data Record of Sea Surface Salinity (SSS) and associated uncertainties (V3.2: 2010-2020)
- Retain high variability sampled by the satellites, i.e., at 50km and one week

(1) (2) (3) (4) (5) (6) (7) (8) (9)

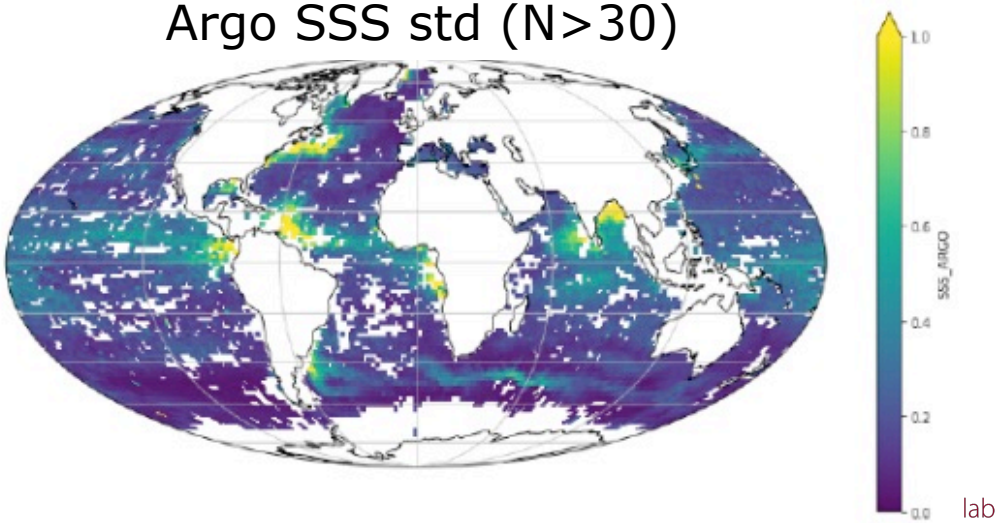
CCI and In situ Sea Surface Salinity variability 2010 to 2020

smos pi-mep

CCI weekly SSS std

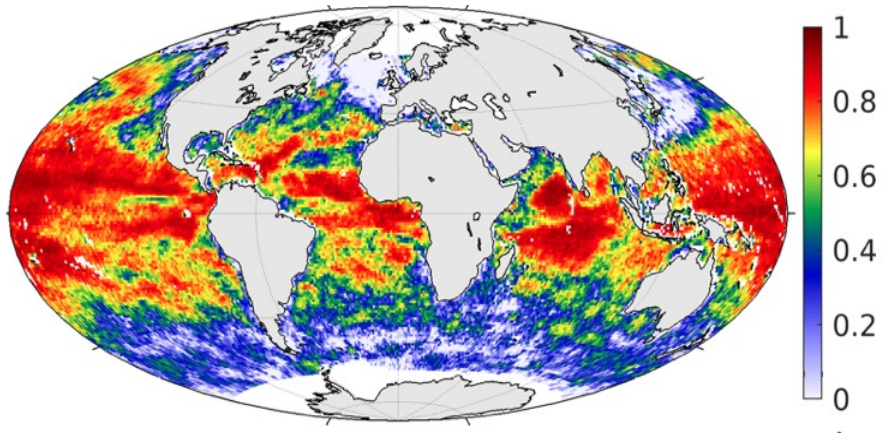


Argo SSS std (N>30)



A. Martin, S. Guimbard, 2020

Correlation of CCI SSS with an ensemble of in situ observations

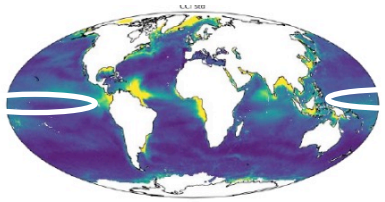


Stammer et al., 2021

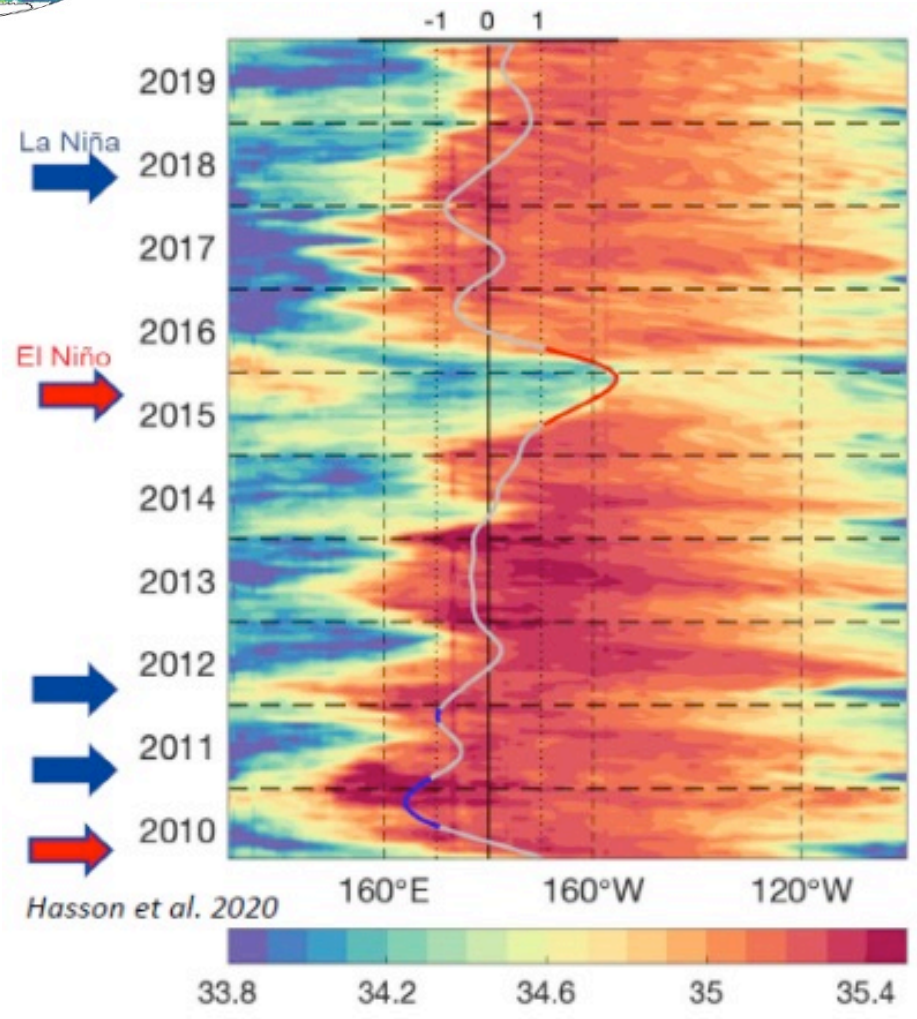
Good agreement in the observed variability:

- Global rms diff. CCI+SSS – Argo SSS ~0.16
- Satellite SSS footprint ~50x50km^2 => allow to detect large mesoscale *at low latitudes not available with in situ punctual SSS*

Monitoring large scale events
SSS signatures of ENSO

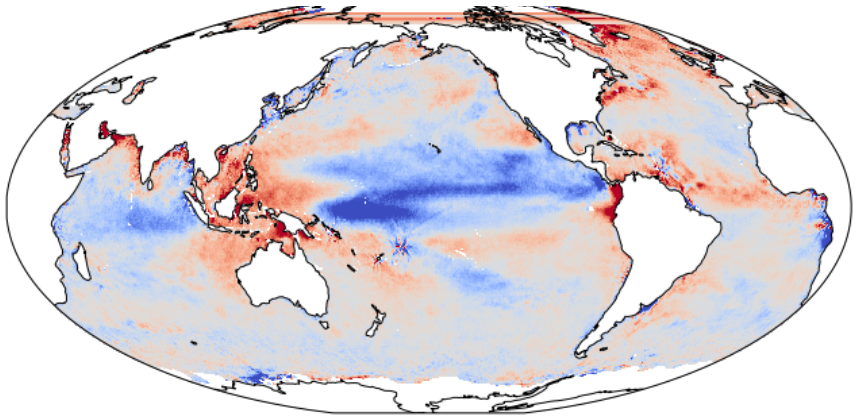


Equatorial Pacific Ocean (2°N-2°S)

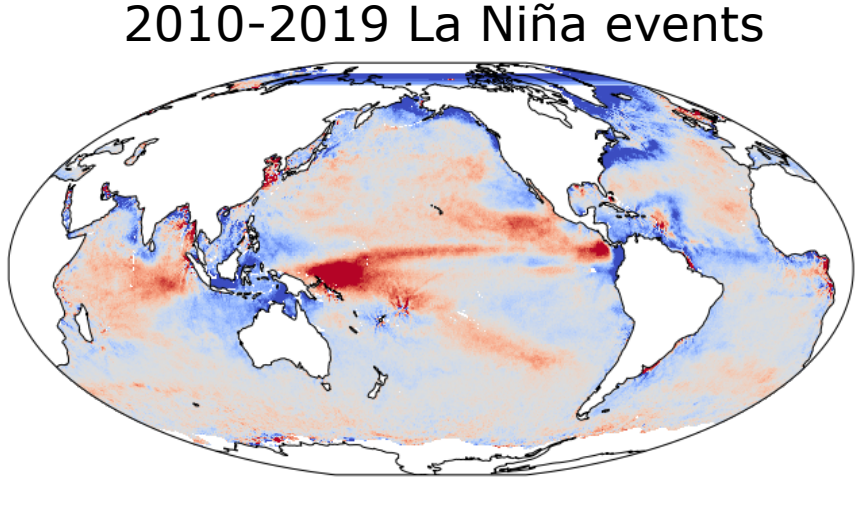


Hasson et al. 2020

Mean SSS anomalies during:
2010-2019 El Niño events

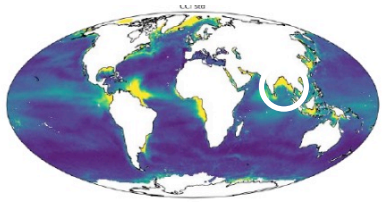


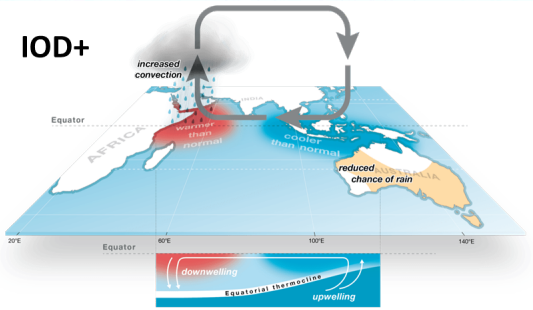
2010-2019 La Niña events



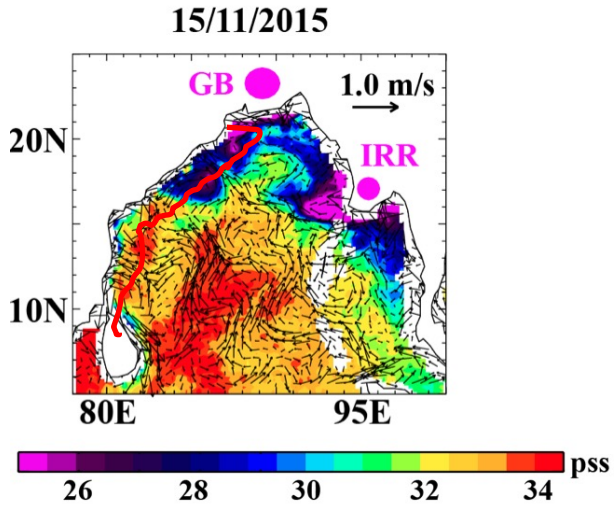
A. Martin , 2020

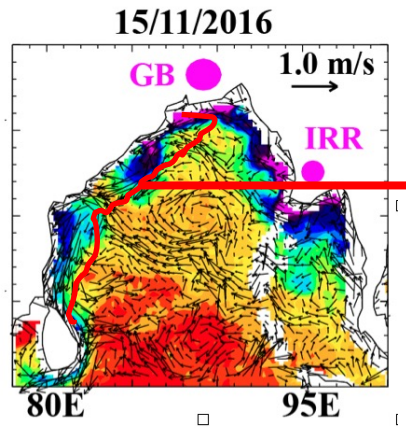
River plumes variability in Bay of Bengal
related to Indian Ocean Dipole ('The El Niño of the Indian Ocean')

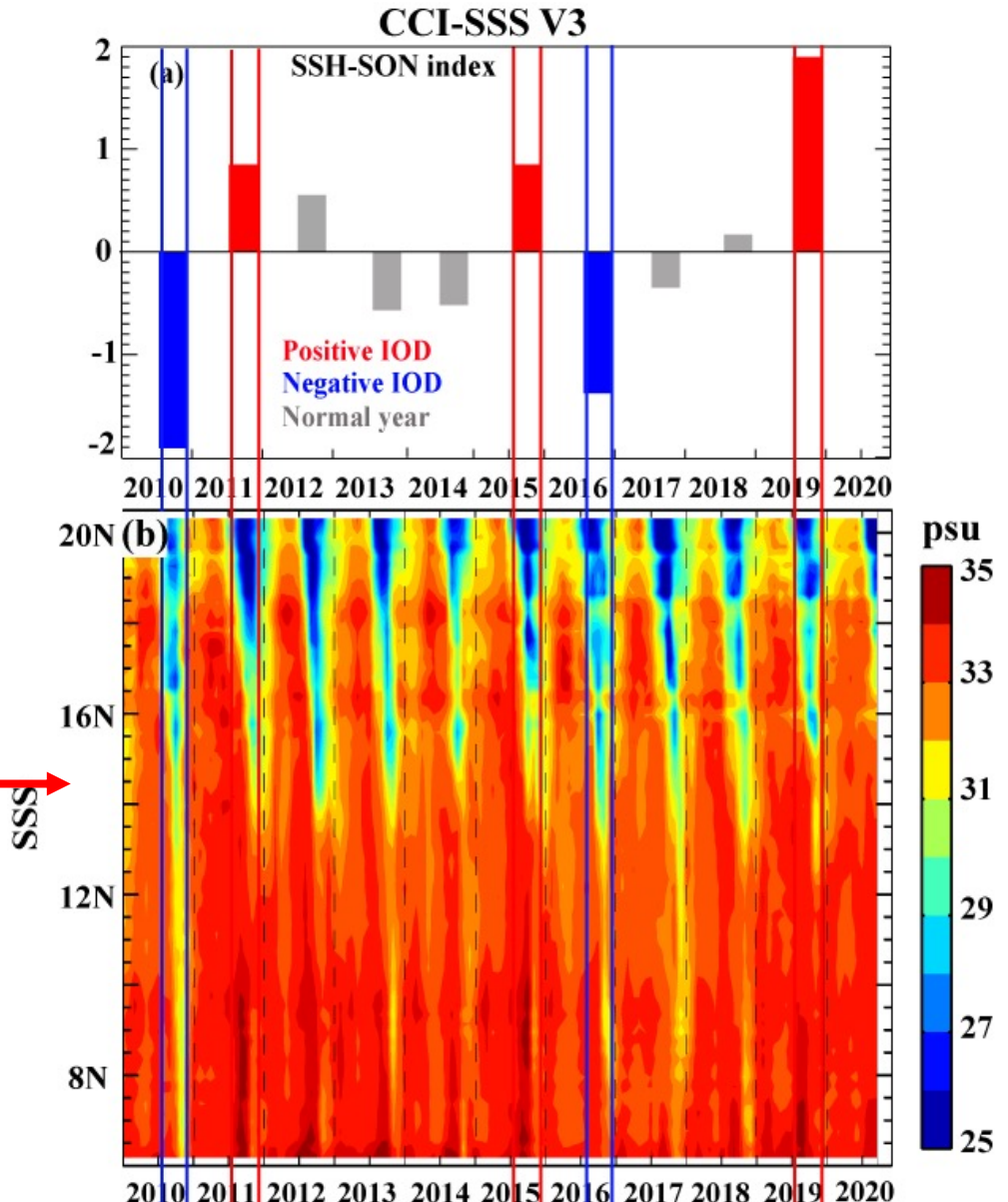




Southern extension of the fresh salinity originating from Ganges-Brahmaputra (GB) along east India coast reduced (increased) during positive negative) Indian Ocean Dipole (currents reversal).







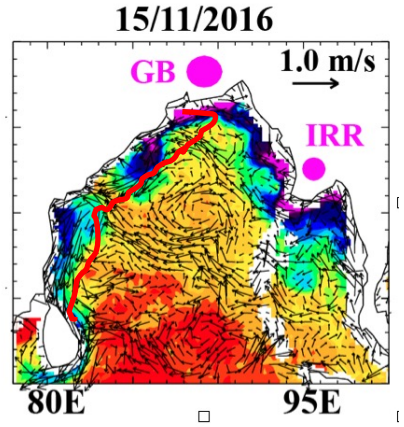
Akhil, Vialard et al.

River plumes variability in Bay of Bengal
related to Indian Ocean Dipole ('The El Niño of the Indian Ocean')

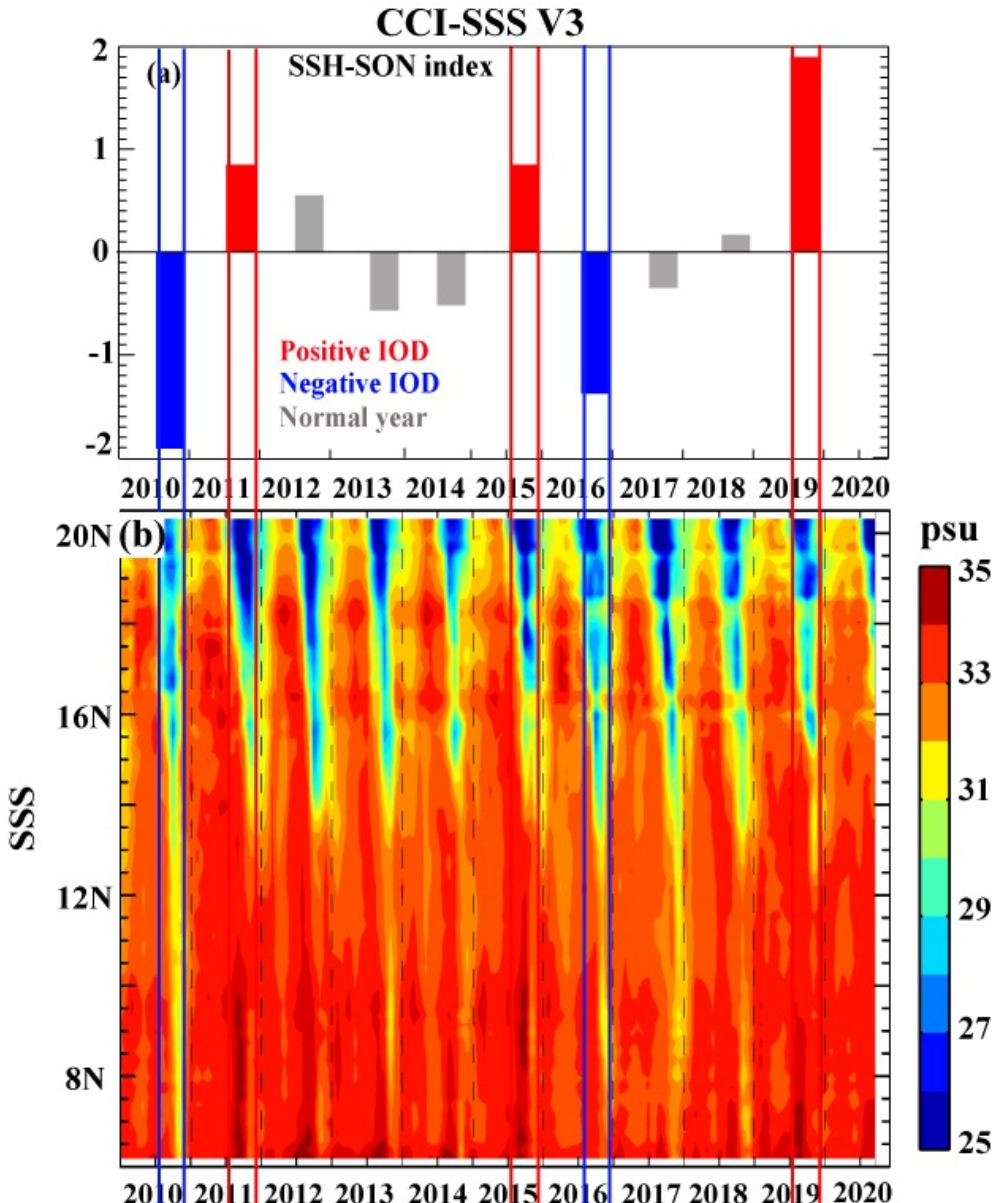
- Some years not associated with clear dipole events display coherent SSS anomalies along the coast of India, as e.g., 2017. Physical processes that cause these anomalies? Eddies or the oceanic dynamical response to atmospheric intraseasonal variability?

- Large interannual anomalies in the Northern BoB? Model analysis suggests that more local anomalies near estuaries are related to interannual variability of the river runoffs, rather than to changes in ocean currents. Need a long time series to be checked

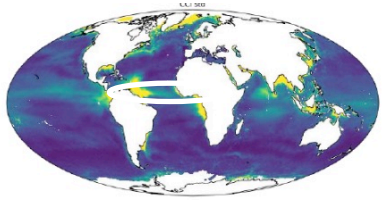
=> *CCI Phase 2: time serie enlarged to 2002 (C-Band) – 2020 & process studies*



Akhil, Vialard et al.



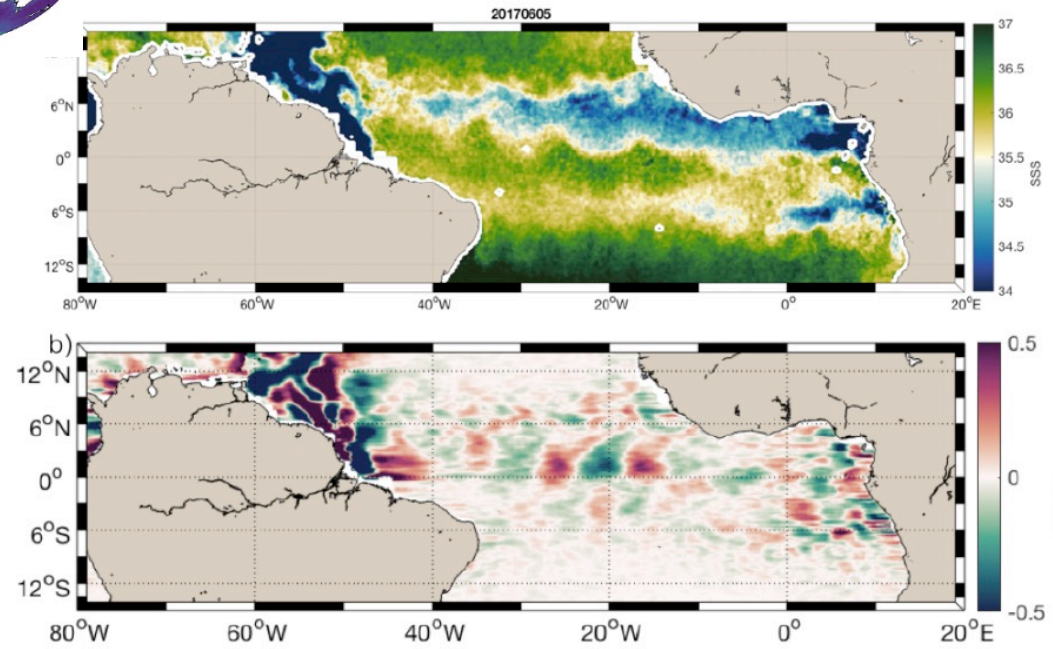
Monitoring large mesoscale Tropical Instability Waves in the Atlantic Ocean



Filtering :

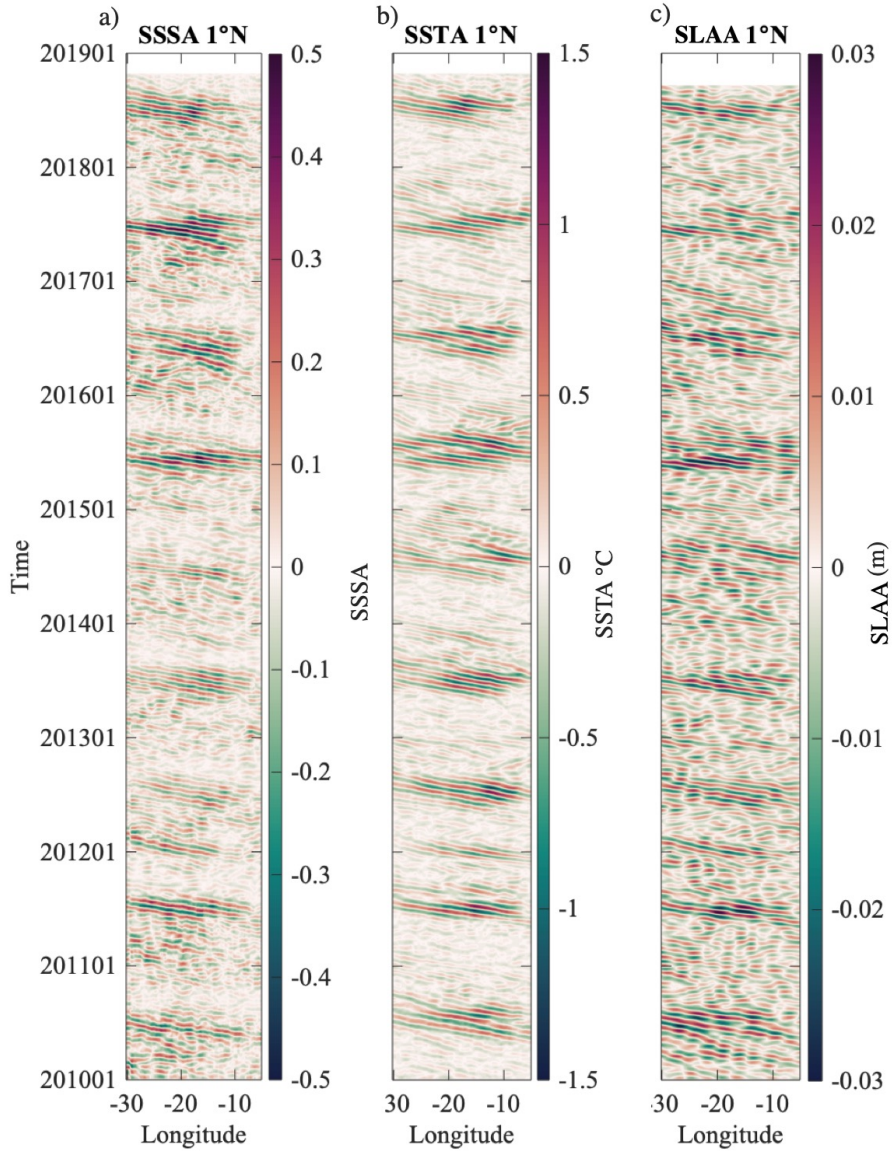
20-50 band pass filter

20° high pass filter

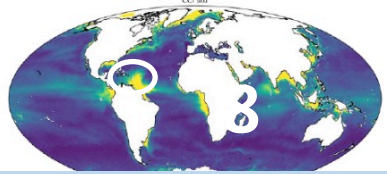


Salinity impacts the energetics of the waves: potential energy generated by the horizontal density gradient in the upper 60m is ~equally due to salinity and temperature gradients

Olivier et al., 2021, JGR-Oceans

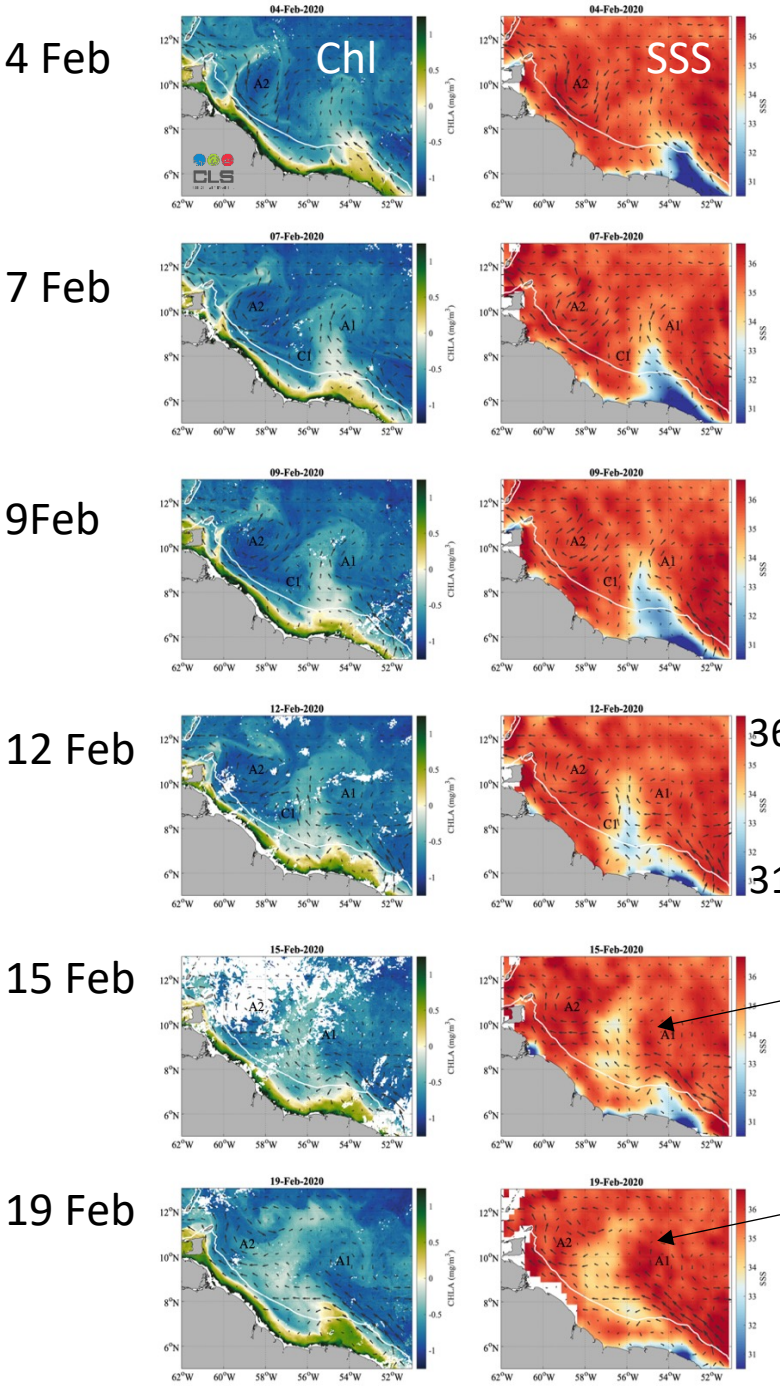


Amazone plume
Terrestrial-Marine Exchange



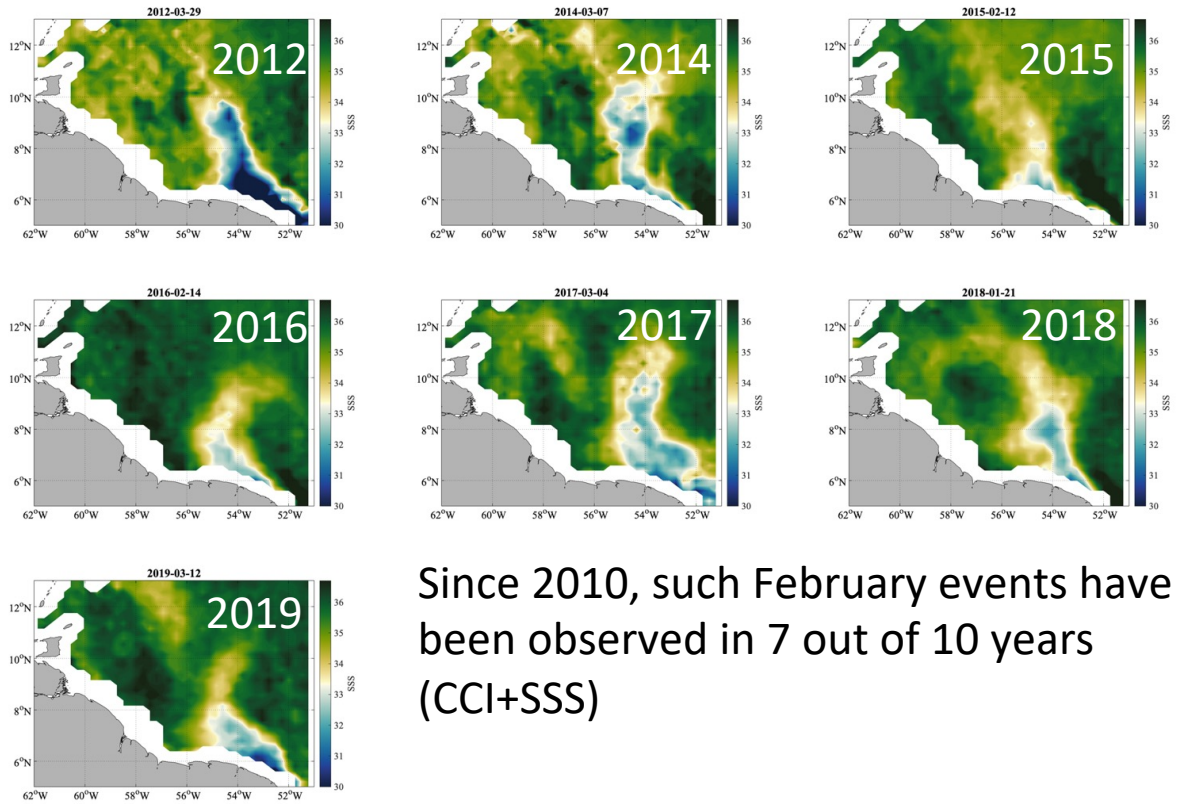
River plume and export with the open ocean

A fresh plume in the northwestern tropical Atlantic during the EUREC4A-OA/ATOMIC program in February 2020, *Reverdin et al., JGR-Ocean, 2021*



Freshplume detected by satellite observations during Eurec4A 2020 campaign at a period (February) when it is not often observed (=>guidance of the ship)

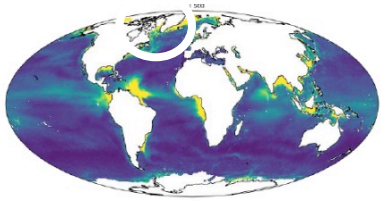
Export of freshwater (and associated biogeochemical properties, e.g. low pCO_2) towards the open ocean



Since 2010, such February events have been observed in 7 out of 10 years (CCI+SSS)

CCI Phase 2: Deepen processes in the Amazon region coupling satellite obs. and physical modelling

North Atlantic Salinity Variability

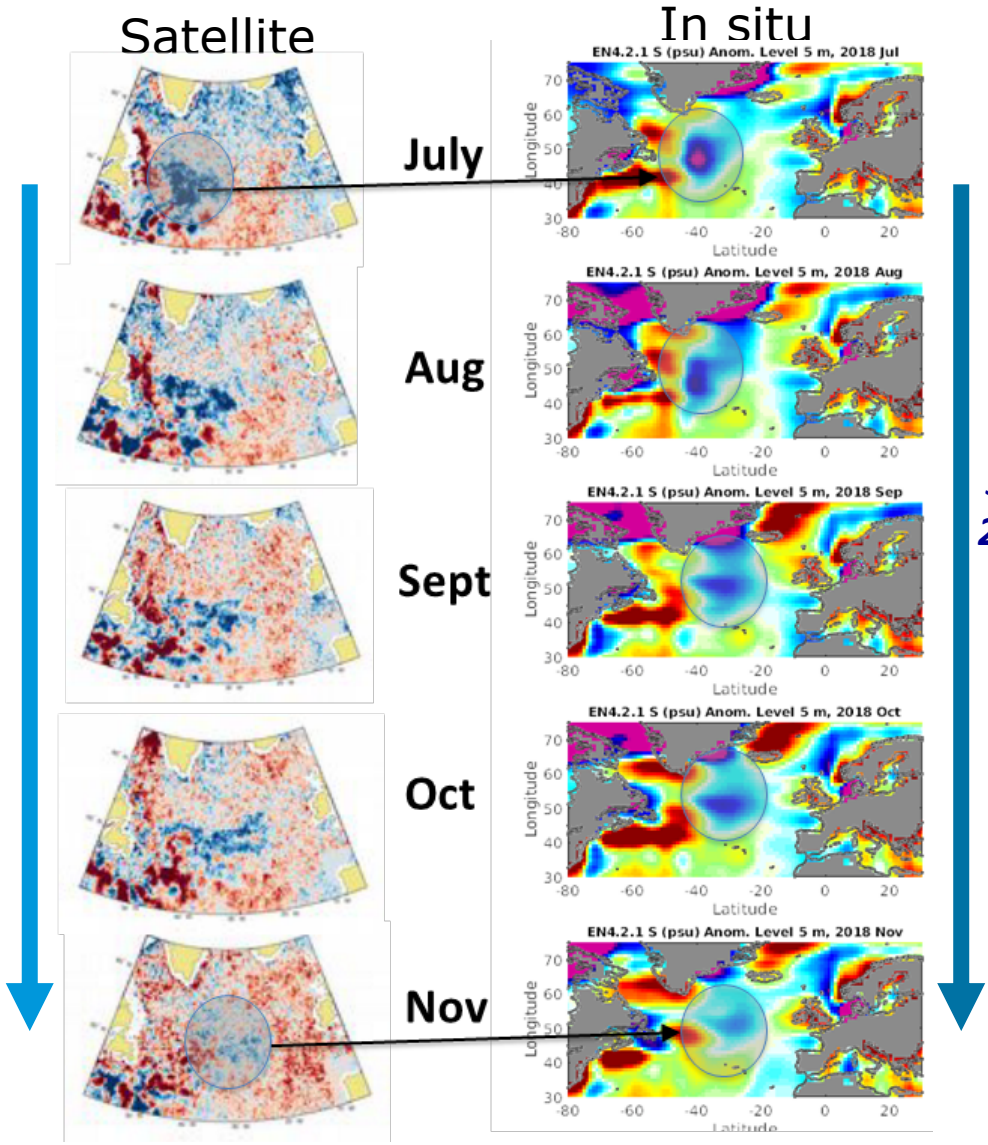


Ongoing work on salinity anomalies in the mid-high latitude North Atlantic (NOC, LOCEAN).

- Strong fresh anomaly in CCI+SSS in June 2018 with some evidence of subsequent eastward propagation.
- $S_{0\text{-}10m}$ in EN4.2.1 reveals similar anomalies in the surface layer
- Signal weakens but still present following eastward propagation at end of 2018.

CCI phase 2: use longer time series and better RFI discrimination

2018 Monthly CCI+SSS anomaly relative to 2015-2019



*EN4.2.1 S_{anom}(0-10m) **2018** monthly salinity anomaly relative to 1981-2010.*

(Lesigne., LOCEAN)

(Josey and Grist, NOC)

Summary and Next steps (Phase 2)

CCI Phase 1 dataset (2010-2020) available @ CEDA

Phase 2: Extend time series (2002 (river)->2020-2022); Polar products

Improve datasets merging, RFI filtering/corrections …

CCI SSS Phase 1 : evidence of large mesoscale signals not detectable by in situ observations/reanalysis

Phase 2: SSS variability & fresh water inputs (river, rainfall, ice melt), ocean circulation & air-sea interactions

Process studies coupling modelling and CCI data in

river plumes (Amazon, Bay of Bengal)

high Latitudes (N. Atl. & Arctic)

at global scale (including assimilation studies)

To know more:

Data (weekly and monthly SSS) and product user guide on CCI Open Data Portal: https://catalogue.ceda.ac.uk/

Detailed documentations available on: http://cci.esa.int/salinity

Systematic validation (matchup reports) available on: https://www.salinity-pimep.org/

Contact: Mngt_CCI-Salinity@argans.co.uk

Final version of CCI Phase 1 data set : *Boutin et al. ESA Sea Surface Salinity Climate Change Initiative (Sea_Surface_Salinity_cci): weekly and monthly sea surface salinity products, v03.21, for 2010 to 2020. Centre for Environmental Data Analysis, http://catalogue.ceda.ac.uk/uuid/5920a2c77e3c45339477acd31ce62c3c.*