Data management at the CATDS-PDC, the operational processing center for high level data of the SMOS satellite

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Outline

- Part I : The system (S. Tarot)
  - The SMOS satellite
  - The CATDS
  - The operational production
  - The production center architecture
  - Products information and distribution

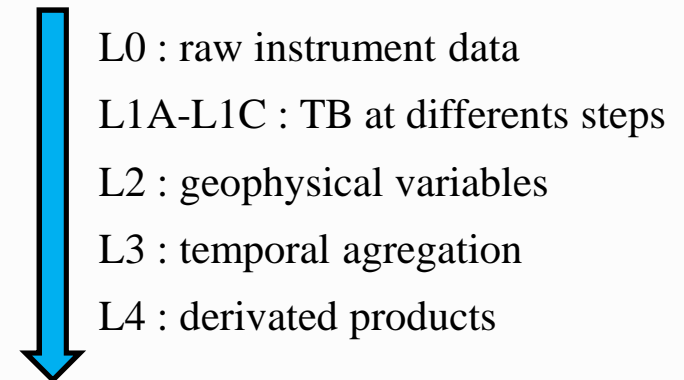- Part II : The scientific results (J. Boutin)

The SMOS satellite & CATDS

- SM : Soil Moisture
- OS : Ocean Salinity

- Launched november 2nd, 2009
- Fully operational since may 2010
- Mesures the Brightness Temperature (TB)
- Spatial resolution : 43 km
- Global coverage : 3 days

- 2 data processing facilities
  - The ESA DPGS
    - level 1 & level 2 products
  - The CATDS
    - level 3 (& level 4) products

L0 : raw instrument data

L1A-L1C : TB at differents steps

L2 : geophysical variables

L3 : temporal agregation

L4 : derivated products

The CATDS

- **1 production center (C-PDC)**
  - At Ifremer/ Sismer (Brest)
  - Operational production and dissemination
  - Relation with users : web, helpdesk (basic)
  - Reprocessings

- **2 expertise centers (C-EC)**
  - SM at Cesbio (Toulouse)
  - OS at Ifremer/Los (Brest/Toulon) & Locean (Paris)
  - Algorithms definition, scientific validation, helpdesk (expertise)

The operational production

- Inputs
  - 28 half-orbits / day of TB (L1B)

The operational production

- Inputs
  - 28 half-orbits / day of TB (L1B)
  - Static or dynamic auxiliary data files (e.g. : meteo from ECMWF)
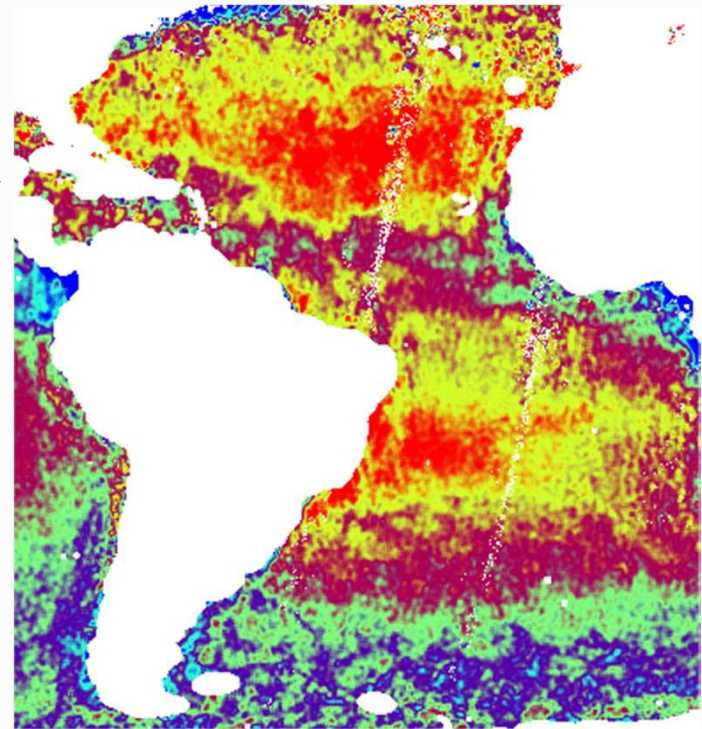
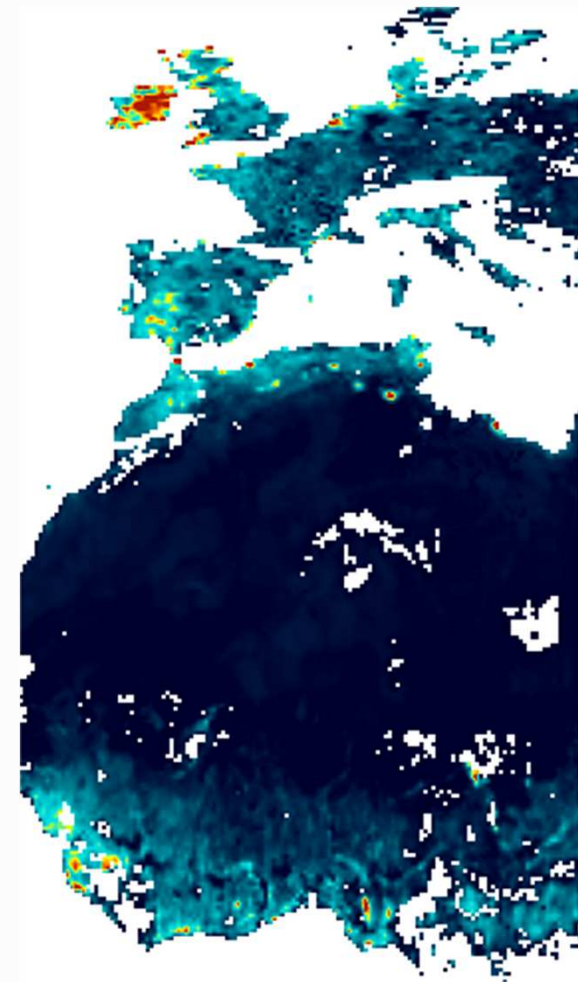# The operational production

- Inputs
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- Outputs
  - 1 day, 10 days and monthly maps of OS

The operational production

- **Inputs**
  - 28 half-orbits / day of TB (L1B)
  - Static or dynamic auxiliary data files (e.g. : meteo from ECMWF)
- **Outputs**
  - 1 day, 10 days and monthly maps of OS
  - 1 day, 3 days, 10 days and monthly maps of SM

The operational production

- Inputs
  - 28 half-orbits / day of TB (L1B)
  - Static or dynamic auxiliary data files (e.g. : meteo from ECMWF)
- Outputs
  - 1 day, 10 days and monthly maps of OS
  - 1 day, 3 days, 10 days and monthly maps of SM
  - 1 day of TB arranged by incidence angle
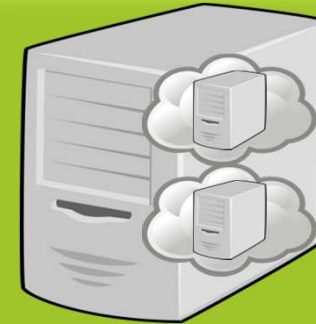
The operational production

- One day of operational production :
  - ~40 jobs & ~120 hours (on a supercomputer)
  - ~80 Gb of data

- Reprocessing
  - Implied by algorithms improvements
  - To provide an homogeneous dataset
  - Goal : 1 year in 3 months
  - Achieved : 1 year in 1,5 month
  - 1st reprocessing : spring 2012
  - 2nd reprocessing : beginning of 2014 ?

The architecture

Ingestion
Processing
Simple QC
Archiving
Operation
Scheduler

Dedicated components

Physical server (operational)
2 virtual machines

Physical server (reprocessing)
2 virtual machines

Disk servers
60 Tb

Supercomputer
100 quad core CPU

RDBMS
Indexation
System state

HSM
120 Tb
+ 45 Tb/year

Shared components

Products information & distribution

Satellite SMOS

www.catds.fr
- Presentation of the CATDS
- Description of the products
- Documentation / FAQ
- News

FTP
- Direct access to the products
- Products are available as soon as they are produced
- Access is given upon request
- Research products from CEC are also available
- NetCDF

Products information & distribution

- www.catds.fr/sipad (oct. 2013)
  - Web-based interactive tool to select and download the data
  - Allows agregations and subsettings
  - Requested data needs to be prepared before download
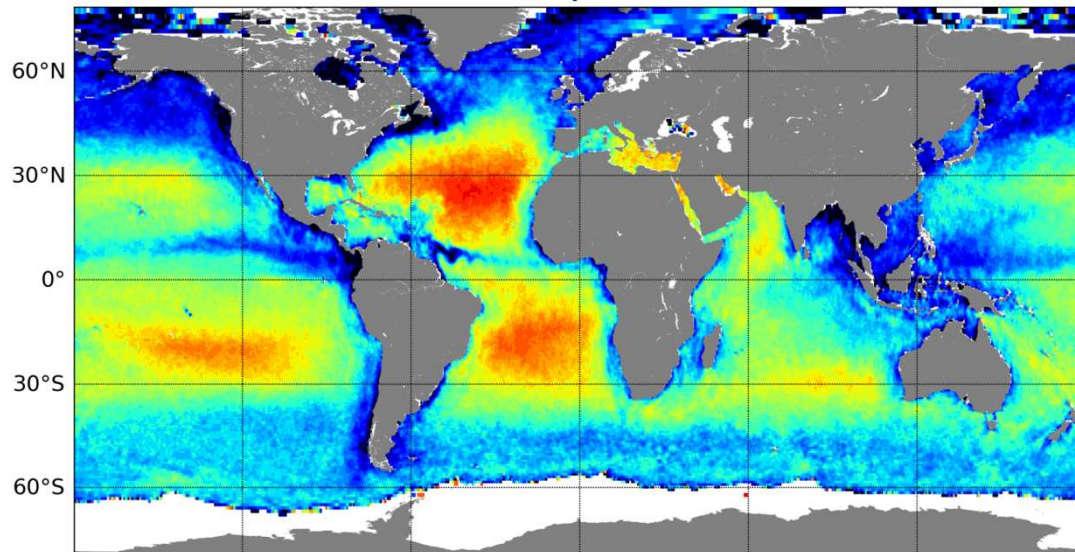 - Online registration
  - NetCDF
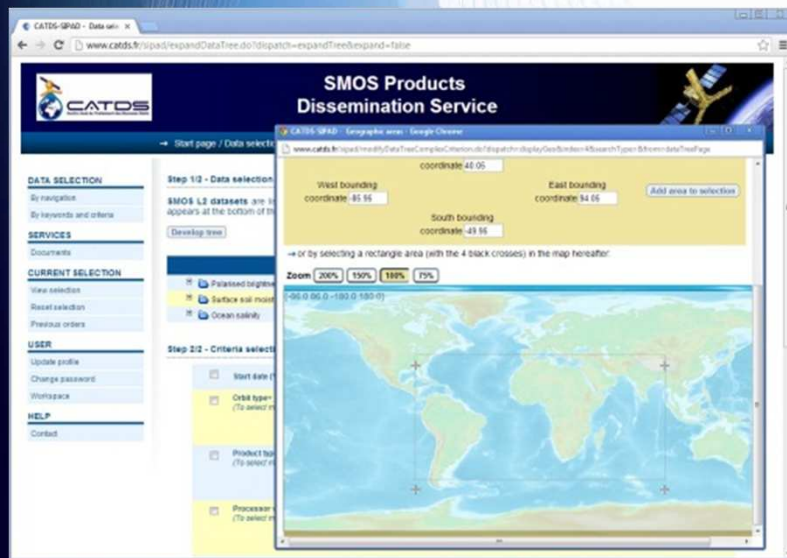
SMOS-CATDS ocean salinity: Scientific results

J. Boutin, N. Reul, J.L. Vergely, O. Hernandez, N. Martin, X. Yin, N. Kolodziejczyk, F. Gaillard

LOCEAN/CNRS Paris, IFREMER Brest & Toulon,
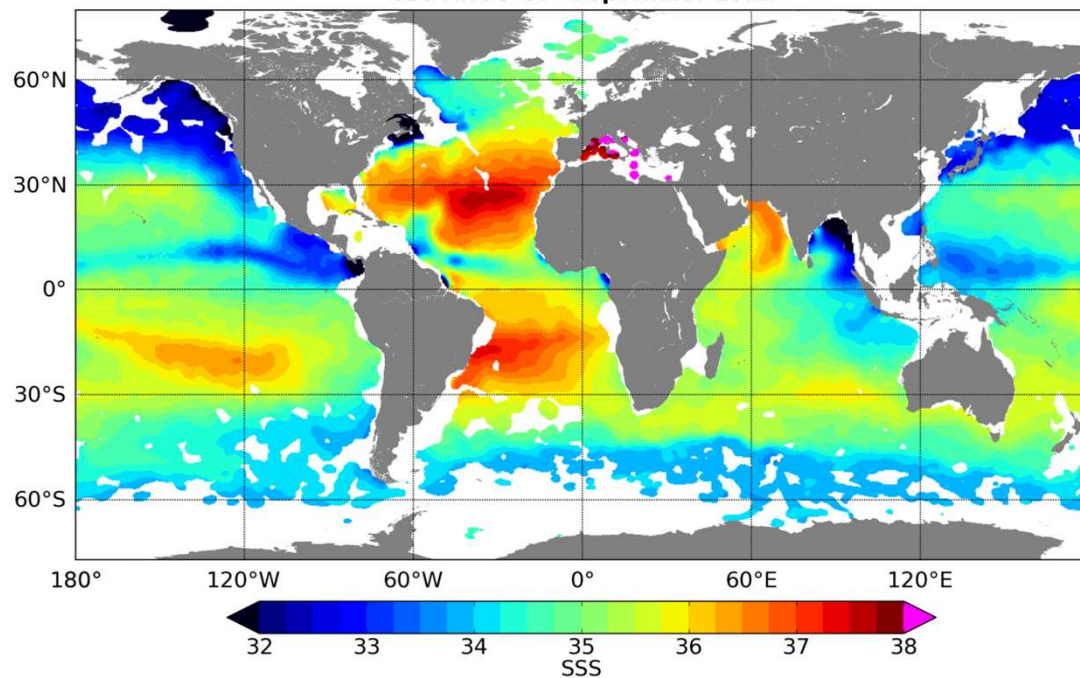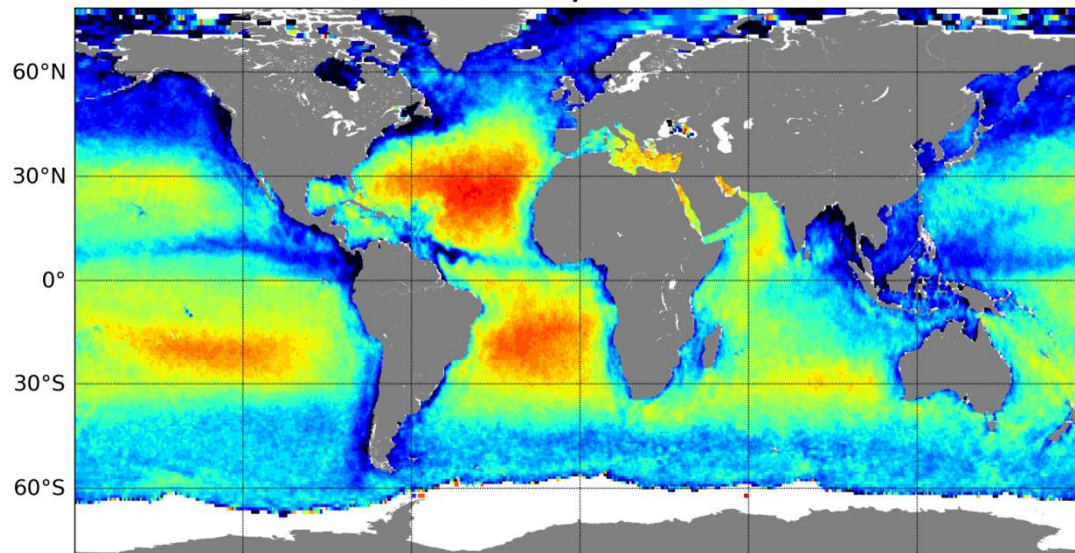*ACRI-ST Sophia-Antipolis*

SSS CATDS OPE - September 2011 -

SMOS monthly SSS

SSS ARGO OI - September 2011

Optimal interpolation of
In situ SSS (ISAS, Gaillard et al.)

2013

SSS CATDS OPE - September 2011 -

SMOS monthly SSS => much better resolution of **river plumes** very unsampled by in situ measurements (e.g. Amazone plume) and of **mesoscale variability** (next slide)
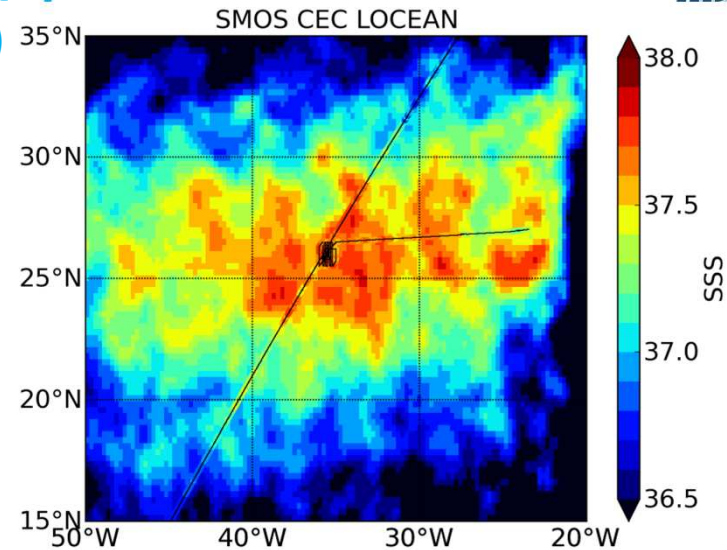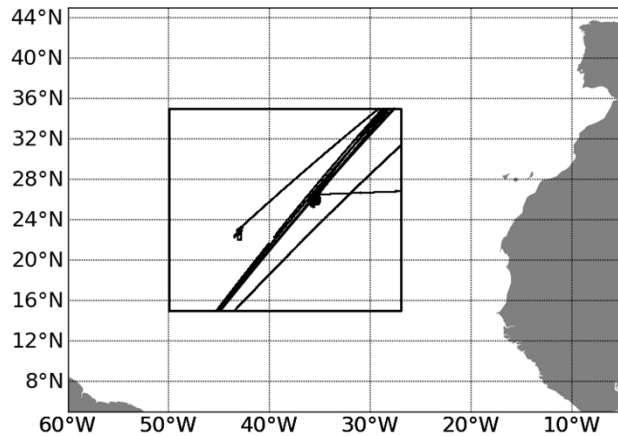
SSS ARGO OI - September 2011

Optimal interpolation of In situ SSS (ISAS, Gaillard et al.)
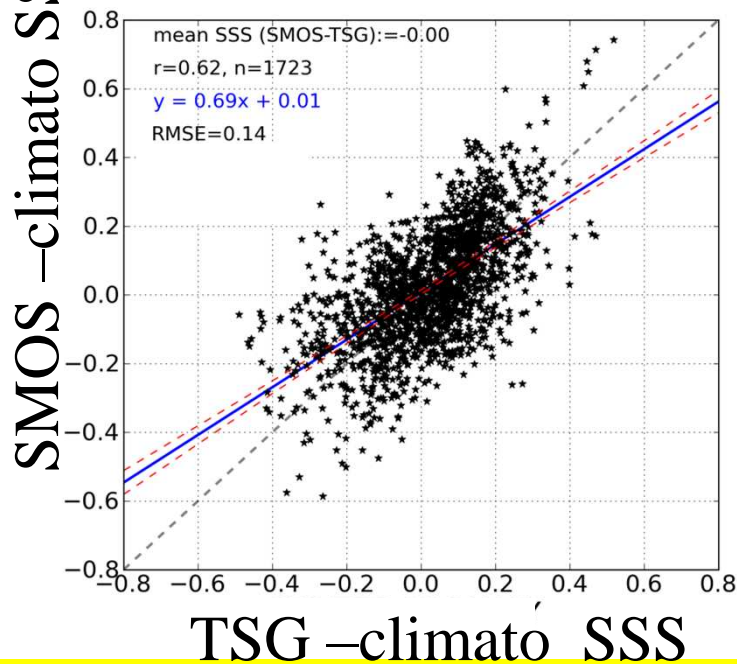
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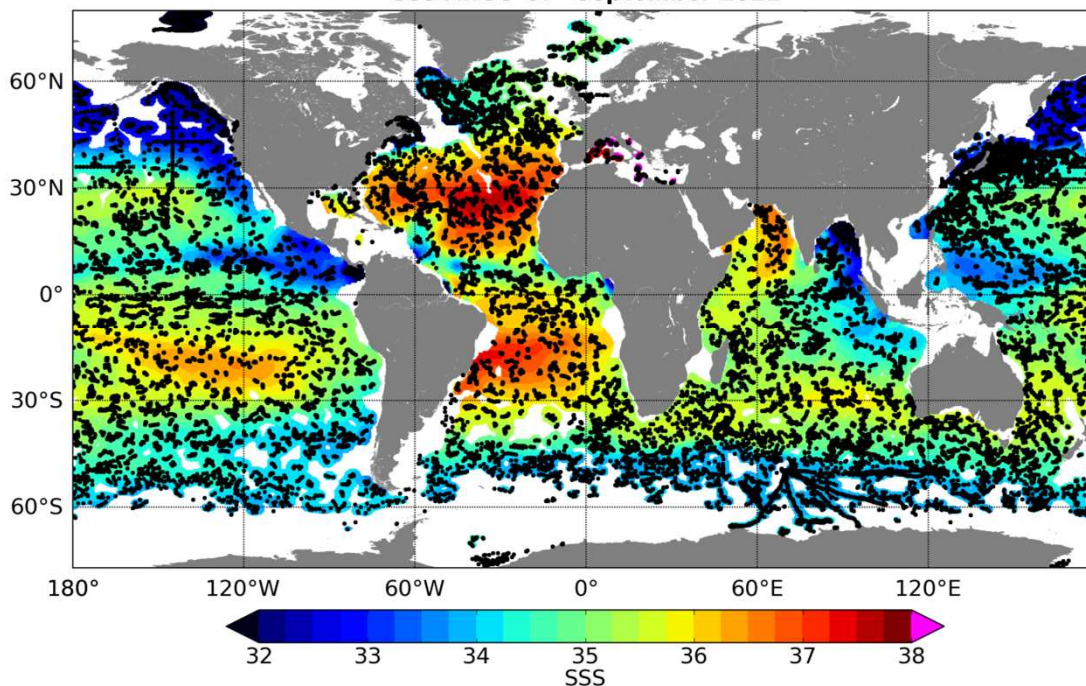
SMOS senses mesoscale variability (≠ ISAS)

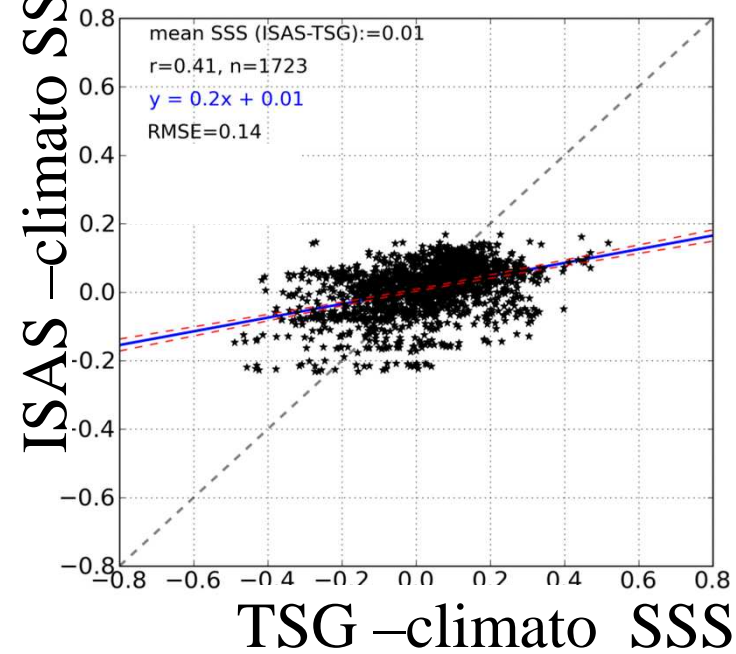*(Hernandez et al., Kolodziejczyk et al., 2013, in prep.)*

Ship data from 07/2011 to 12/2012: 14 transects

SMOS CEC LOCEAN

SMOS vs TSG SSS anomaly (.25° resol.)

mean SSS (SMOS-TSG):=-0.00
r=0.62, n=1723
y = 0.69x + 0.01
RMSE=0.14

SMOS –climato SSS

TSG –climato SSS

ISAS vs TSG SSS anomaly (25° resol.)

mean SSS (ISAS-TSG):=0.01
r=0.41, n=1723
y = 0.2x + 0.01
RMSE=0.14

ISAS –climato SSS

TSG –climato SSS

Once monthly biases are corrected, SMOS senses variability with a RMSE= 0.14
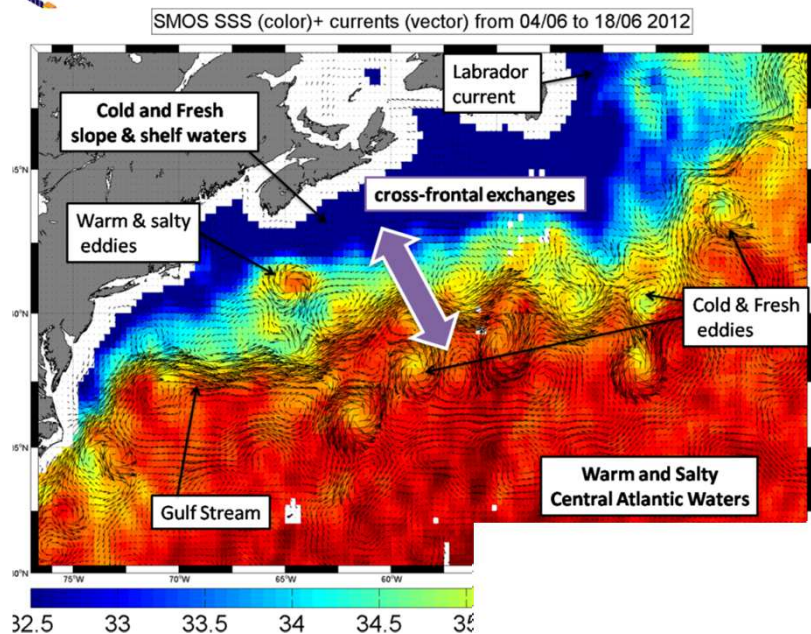
Very good monitoring of Fresh water plumes
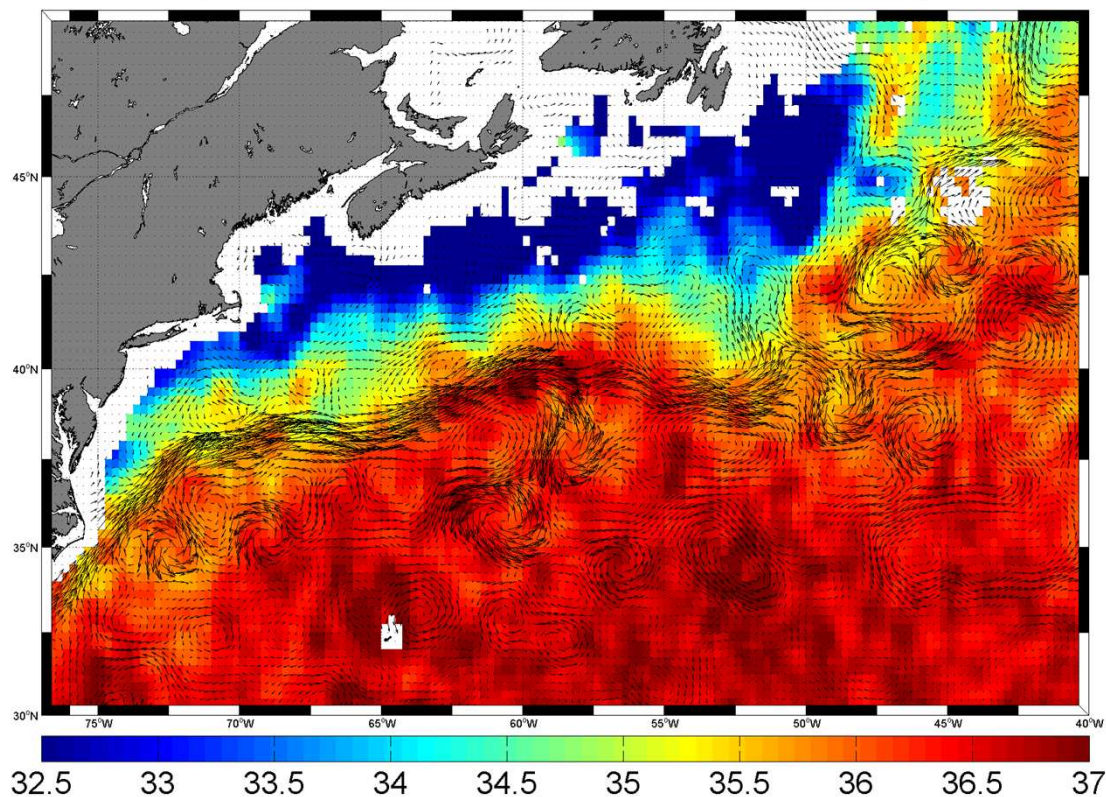

SSS Averaged from Feb 26 through Mar 08
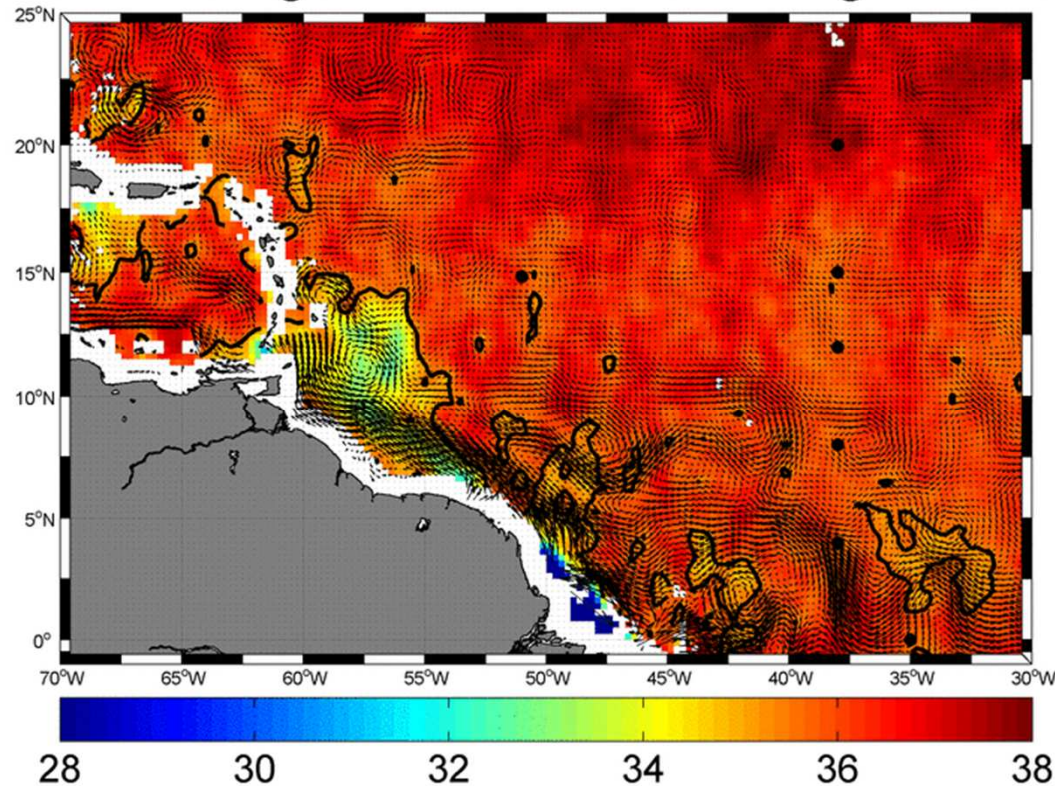
Dispersal patterns of the freshwater ouflow from large tropical rivers
(Amazon, Orinoco, Congo, Ganges, Mississipi rivers…)

=>Better Monitoring the **exchanges of water between the land masses & the ocean** and their subsequent **transport offshore by surface currents**
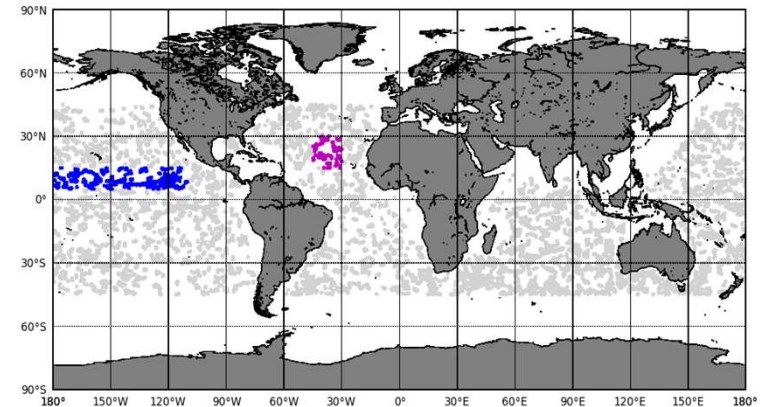
The Gulf Stream region

SMOS SSS (color)+ currents (vector) from 04/06 to 18/06 2012

- Cold and Fresh slope & shelf waters
- Labrador current
- cross-frontal exchanges
- Warm & salty eddies
- Cold & Fresh eddies
- Gulf Stream
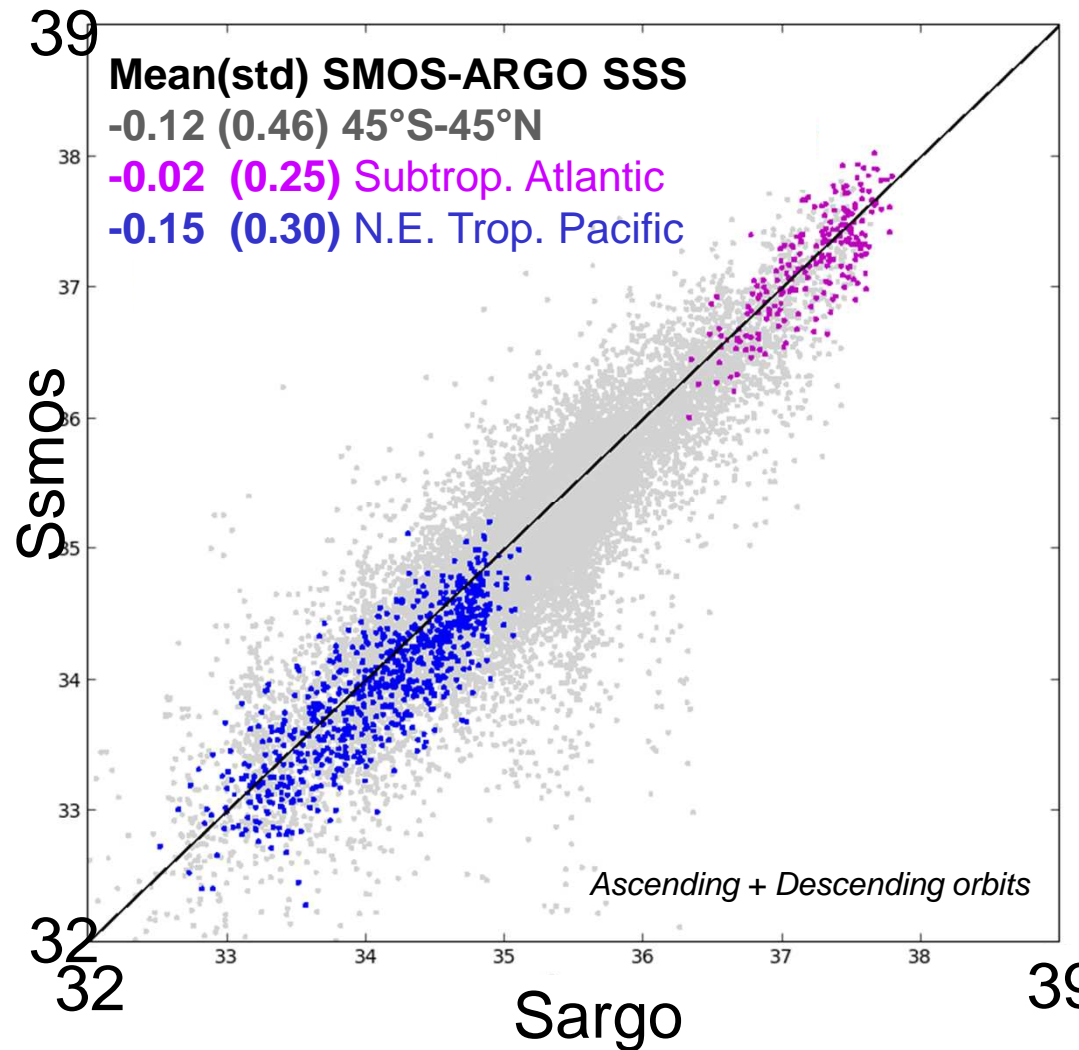- Warm and Salty Central Atlantic Waters

SMOS SSS (color)+ currents (vector) from 03/03 to 17/03 2012

See more on smos blog

SMOS - ARGO (Jul-Sep 2010)

SMOS SSS averaged within +/-50km & +/- 5days around ARGO SSS

Mean(std) SMOS-ARGO SSS
-0.12 (0.46) 45°S-45°N
-0.02 (0.25) Subtrop. Atlantic
-0.15 (0.30) N.E. Trop. Pacific

Ascending + Descending orbits

RMSE (SMOS – ARGO SSS) in subtropics & tropics close to 0.2-0.3
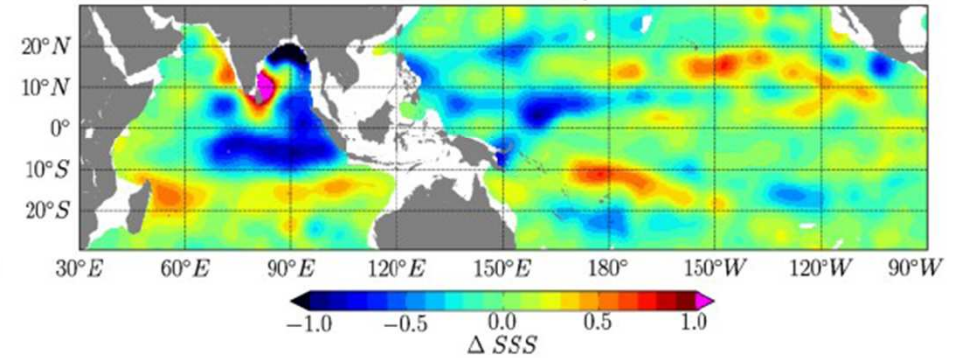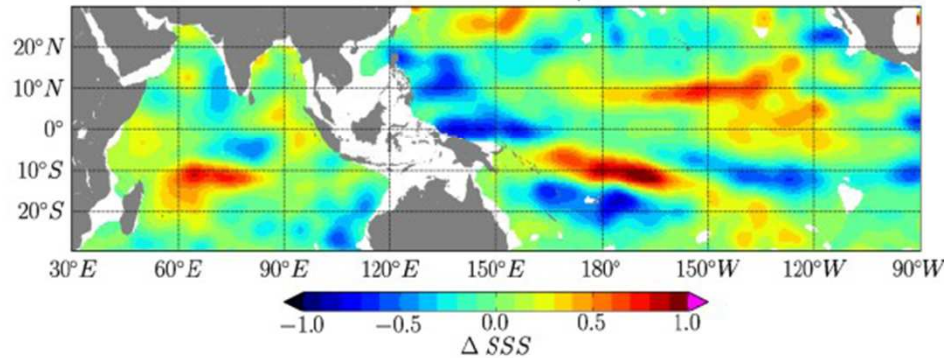
Negative bias seen in N.Trop. Pac. likely an effect of the stratification between 5m. depth (ARGO) and 1cm depth (SMOS)

Boutin et al. - IMDIS 2013

Boutin et al. Ocean Science 2013

High contrasted SSS signal in the tropics between 2010 and 2011

Observed in situ

July 2011-2010

November 2011-2010

Observed by SMOS
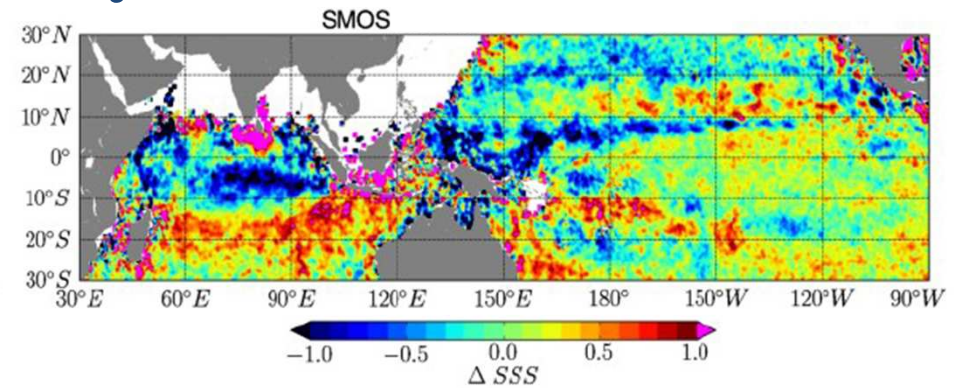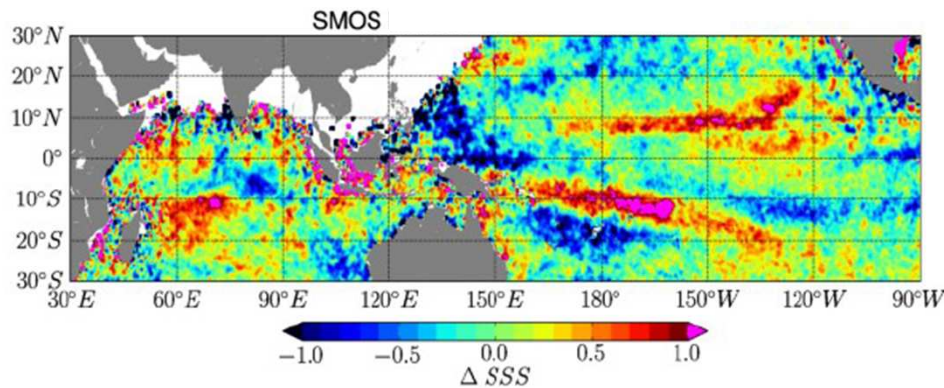
See film & more on SMOS blog & CATDS news

SUMMARY

SMOS has demonstrated the capability of an L-band interferometer at providing new SSS information, especially concerning **spatial variability of SSS related to river discharges, ocean circulation and air-sea interaction (eddies, cyclones, mesoscale features, large scale anomalies...).**

At present in subtropical/tropical regions precision ~.2/~0.3, far from land between 45N-45S ~.5 but still biases in the vicinity of land and ice and close to RFI polluted region (RFI sorting is going to improve in version 6)

More about some scientific studies that used CATDS products:

- Reul et al. , Sea Surface Salinity Observations from Space with SMOS satellite: a new tool to better monitor the marine branch of the water cycle, *Surveys in Geophysics, 2013.*

- Boutin et al., Sea surface freshening inferred from SMOS and ARGO salinity: Impact of rain, *Ocean Sci*, 2013.

- Hasson et al, Formation and Variability of the South Pacific Sea Surface Salinity Maximum in Recent Decade, JGR-Ocean, 2013, in press.

- Alory et al. Seasonal dynamics of sea surface salinity off Panama: the far eastern Pacific fresh pool. J. Geophys. Res., 2012.

- Grodsky, Reul, et al., Haline hurricane wake in the Amazon/Orinoco plume: AQUARIUS/SACD and SMOS observations, Geophys. Res. Lett., 2012.

Thank you for your attention

Contacts
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