



## **CNES/CLS possible contributions to in situ campaigns**



# Context

Since few years, CNES contributes to different cruises with different objectives:

- Help scientists before (preparation), during (operations) and after (analysis) the cruises
- Provide metrics on natural variability (tides, SWH, DAC, SLA, ....)
- Promote CNES experimental products ; test new algorithms (instrument processing or new geophysical corrections : tides, MSS, DAC, ...); develop new products
- Reinforce the collaboration with users / scientists

## Role of CNES/CLS :

**Before the cruise:** Provide useful information for cruise design: position and date of passage of specific altimeter tracks, position of eddies and front through the provision of Satellite based ocean information

**During the cruise:** Facilitate operational access to existing products that can contribute to the cruise activity (Altimeter Level3 and Level4; other products).

**After the cruise:** Provide specific regional products for post cruise data analysis

**TOSCA\***  
CNES program

Scientific cruises



[...] 2011. **KEOPS** (<http://keops2.obs-vlfr.fr>)

[...]

2015: **SPURS1**  
(<http://spurs.jpl.nasa.gov/>)

[...]

2016: **OUTPACE**  
(<https://outpace.mio.univ-amu.fr/>)

2016: **CASSIS-MALVINAS**  
(<http://www.cima.fcen.uba.ar/malvinascurrent/>)

[...]

2018: **Bio-SWOT – Pre-SWOT**

## Feedbacks from users are crucial for us:

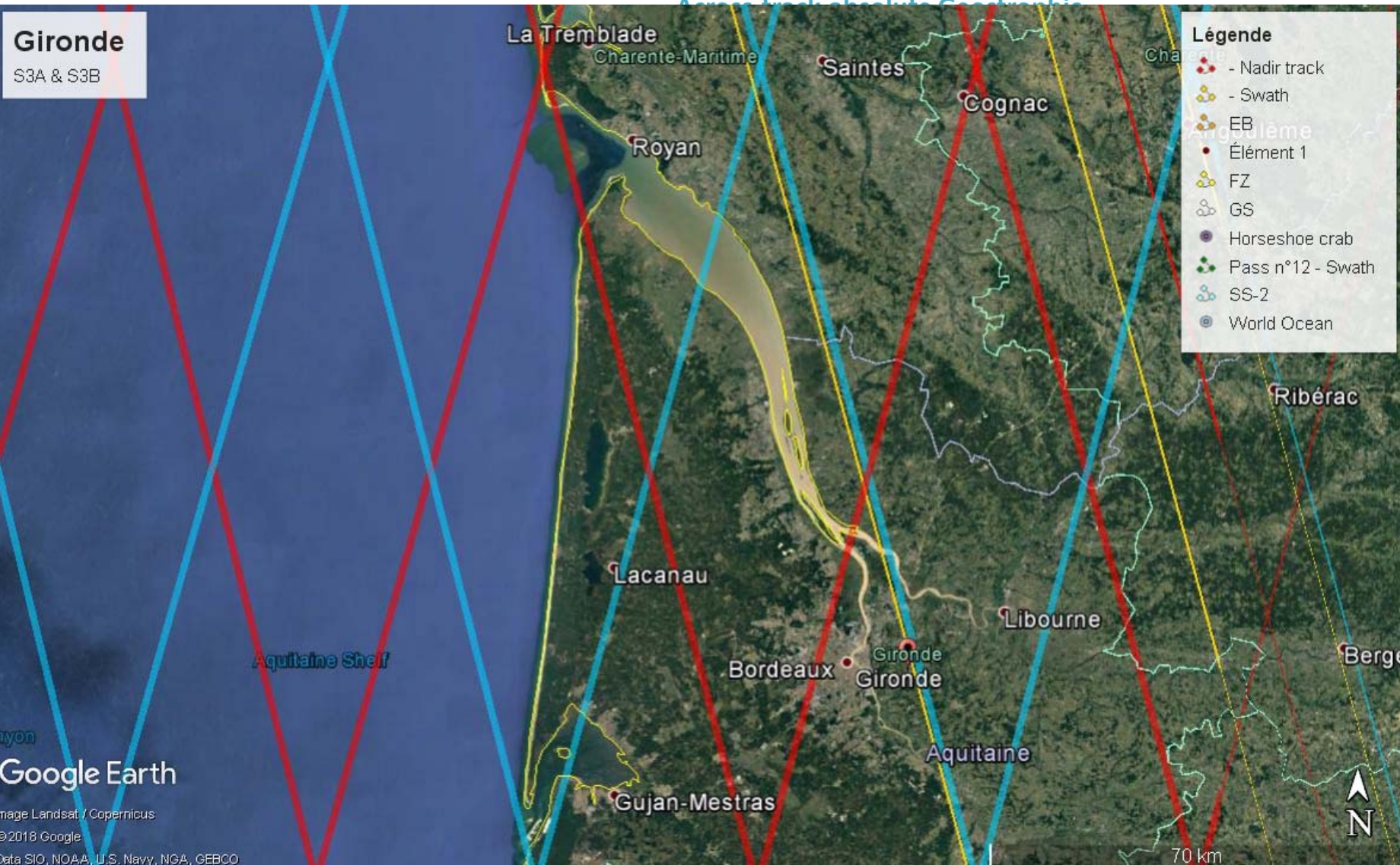
- ❑ Feedbacks on products usefulness and accuracy on specific areas contribute to improve the global product
- ❑ Promotion through papers and contribution to Aviso+ newsletters



# Examples of products delivered

- Altimeters tracks
- Altimeter Level2 products
- High resolution SLA along with altimetry tracks
- Specifically with up-to-date altimetry tracks (e.g. data selection, no data gaps)

Example of Sea Level Anomaly (SLA) derived specifically from altimetry tracks in the Med Sea → combined with glider and ADCIRC data



AGU PUBLICATION

Geophysical Research Letters

RESEARCH LETTER  
10.1002/2017GL076244

**Key Points:**

- This is the first multiplatform evaluation involving data from the Sentinel-3A altimeter SRAL sensor
- New SAR instrument gives an improvement of 42% in the estimation of surface velocities with

Ser...  
Accyon  
E. E. J...  
Y. Fa...

Google Earth

Image Landsat / Copernicus  
UIB), E...  
Franc...

Data SIO, NOAA, U.S. Navy, NGA, GEBCO



# Examples of products delivered

- Altimeters tracks passage prevision (location & time)
- Altimeter Level2 products: High resolution SLA along selected tracks can be processed specifically with up-to-date standards and optimized procedures (e.g. data selection, noise filtering)

Example of Sentinel-3A track specifically processed in the Med Sea → comparison with glider and ADCP measurements



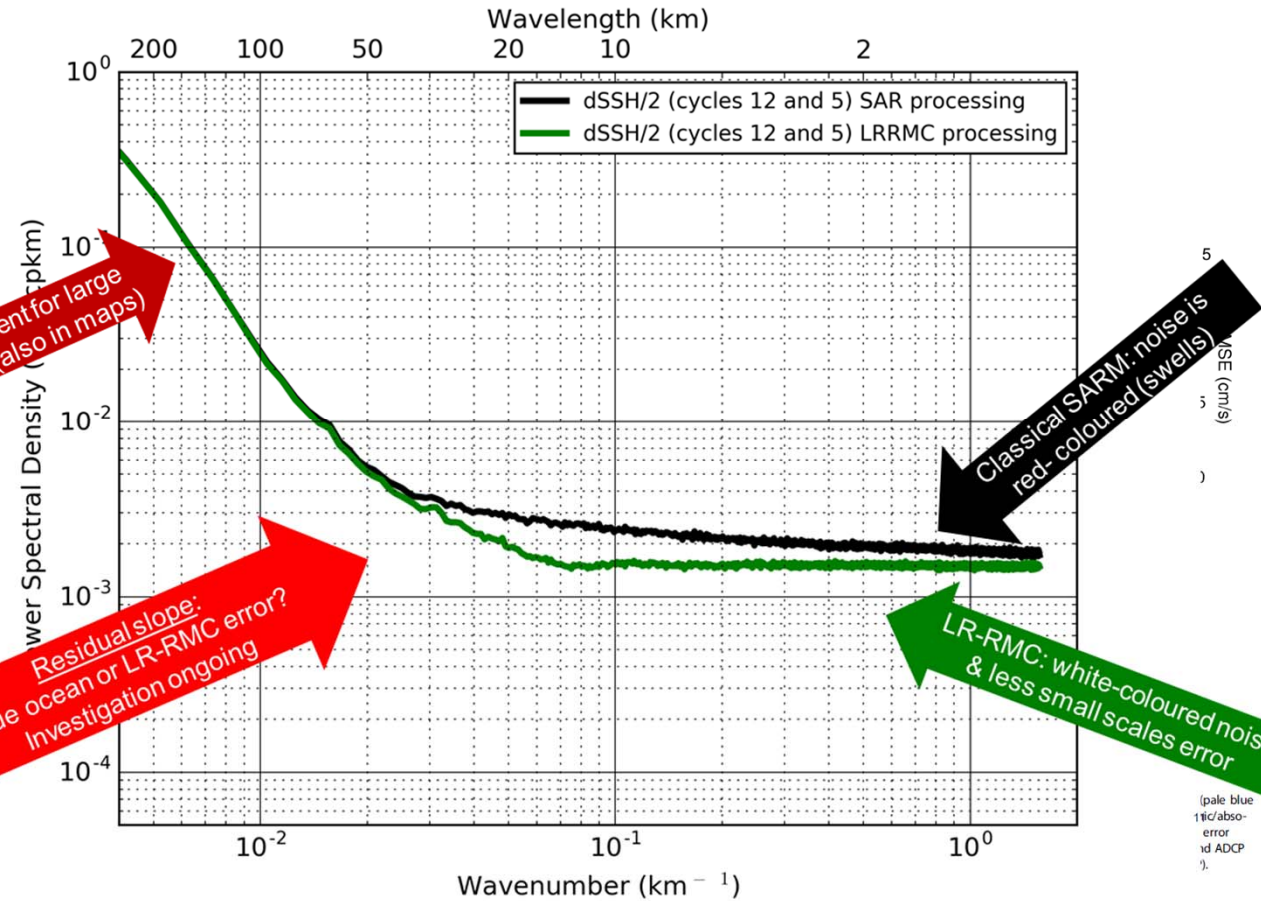
Consistent for large scales (also in maps)

Residual slope: True ocean or LR-RMC error? Investigation ongoing

Classical SAR: noise is red-coloured (swells)

LR-RMC: white-coloured noise & less small scales error

Sentinel-3A [cycles 4 and 11]



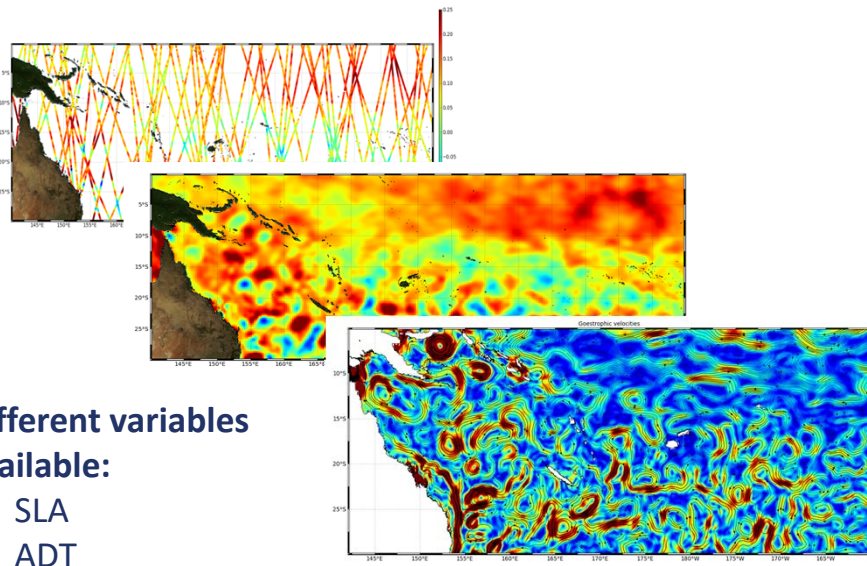
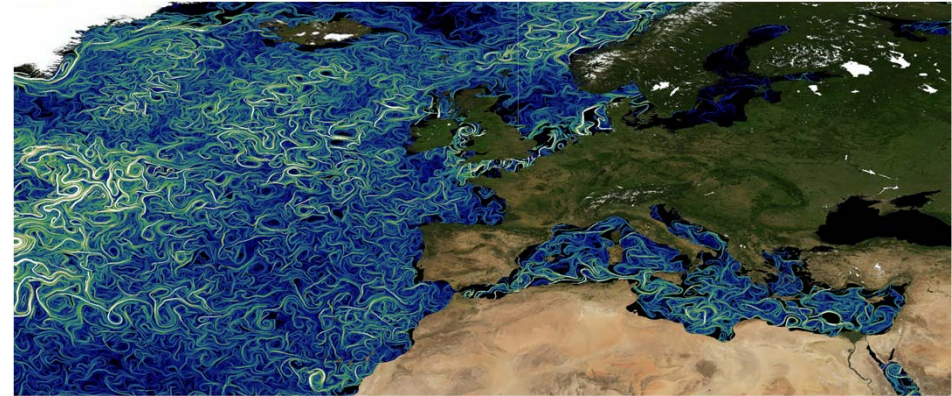
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- This is the first multiplatform evaluation involving data from the Sentinel-3A altimeter SRAL sensor
- New SAR instrument gives an improvement of 42% in the estimation of surface velocities with



# Examples of Altimeter products delivered

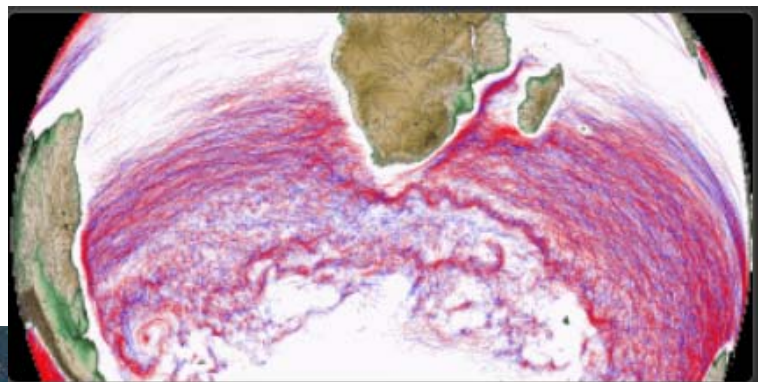
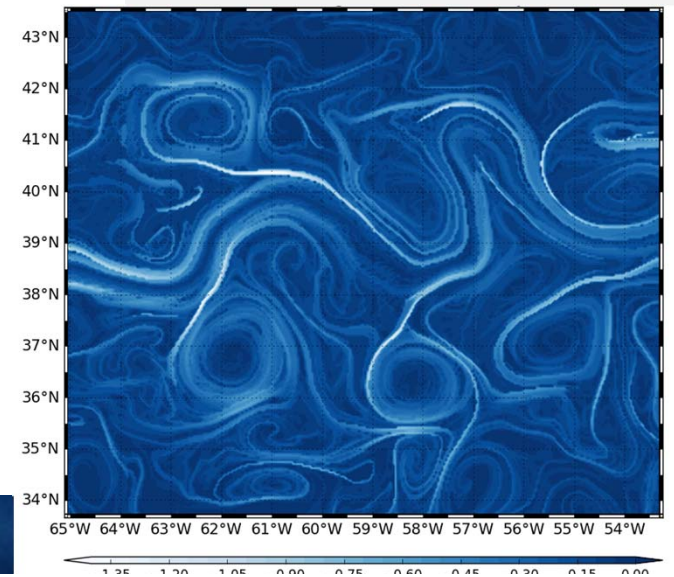
- DUACS altimeter based products (L3: along-track; L4 gridded) → usually experimental processing/parameters used in preparation of future operational versions



## Different variables available:

- SLA
- ADT
- Geostrophic currents (absolute & anomalies)
- Formal mapping error
- Lagrangian FSLE maps
- Eddy tracking

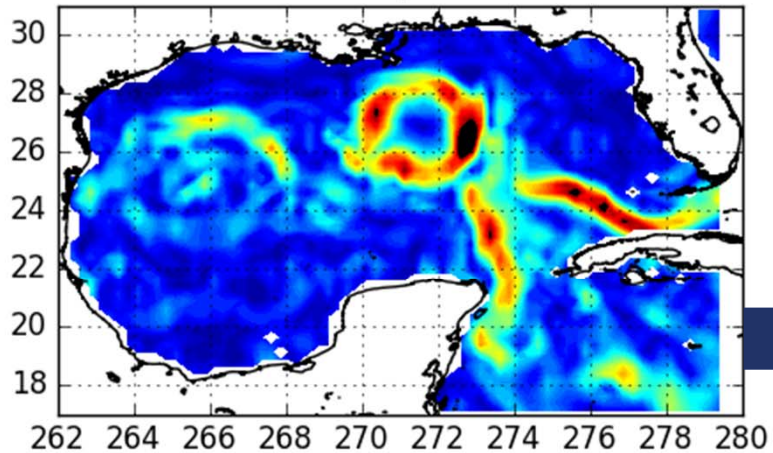
Examples of FSLE maps generated from regional geostrophic current products



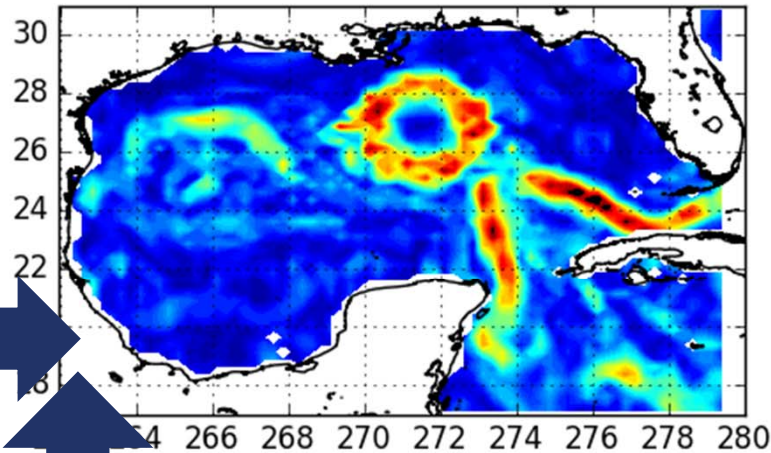
Mesoscale Eddy Trajectory Atlas. Credits CNES/CLS/OSU



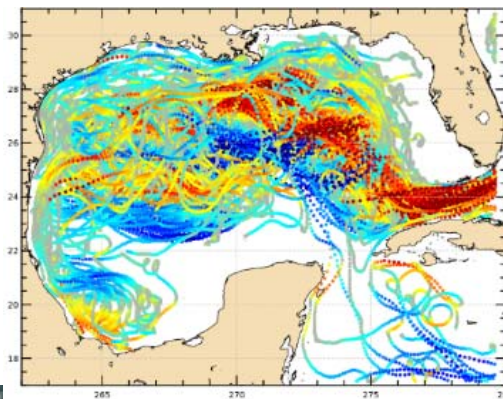
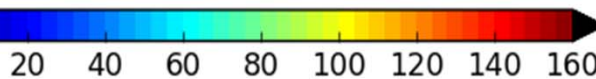
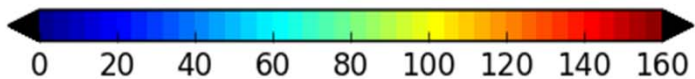
MADT alti only - 20150902



MADT alti + HMI - 20150902



Improvement is primarily on (V) component because of the 1D directionality of altimetry tracks



### Comparison with independent drifters

	Alti only	Alti + Drifters
RMS Diff U / V (cm/s)	14.8 / 16.7	14.4 / 14.7
Correlation	0.61 / 0.63	0.64 / 0.73

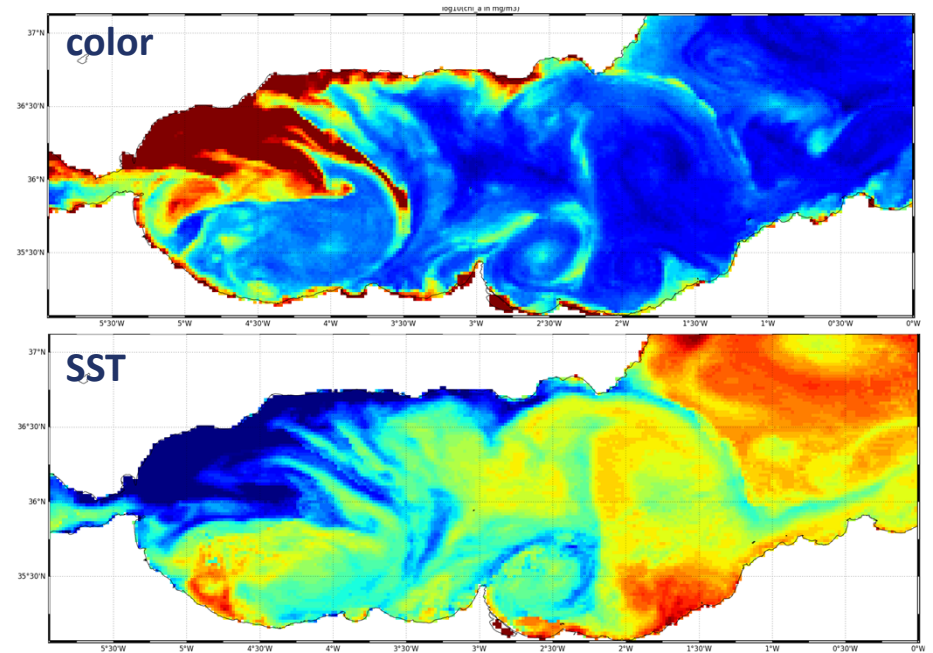
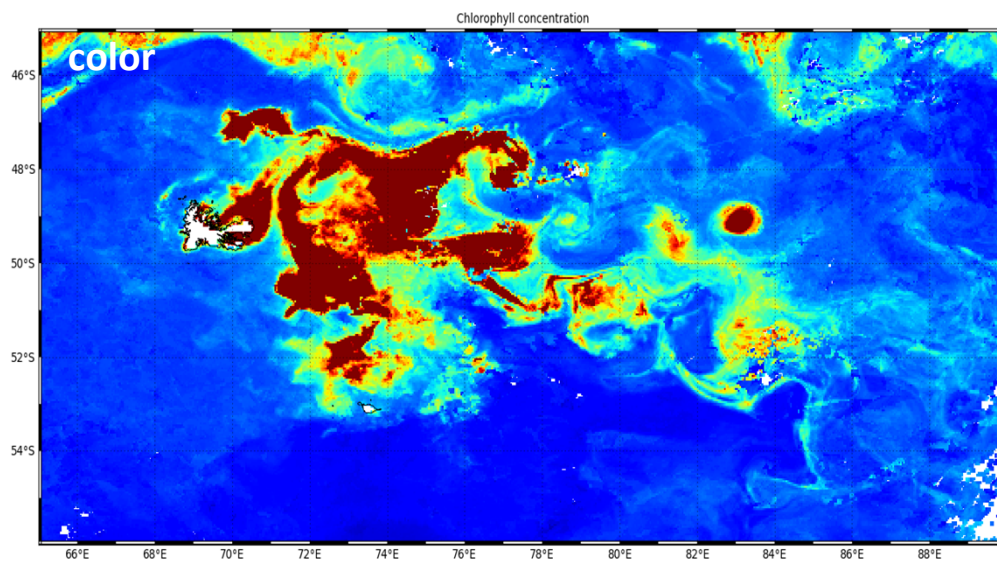
### Comparison with CryoSat-2 (independent altimeter)

	Alti only	Alti + Drifters
RMS Diff SLA (cm)	6.07	5.82
RMS Diff SLA (% var)	32	31

## Examples of other products delivered

- Composite maps of SST and chlorophyll concentration** with multi mission merging for optimization of the spatial coverage (i.e. minimization of gaps induced by the clouds)
  - merging 1 day of measurements → keep the daily resolution with reduced cloud gaps compared to instantaneous images
  - Merging 5 days of measurements → minimize the cloud gap, but slight smoothing of the field

Examples of SST, surface color generated with 0,04° spatial sampling



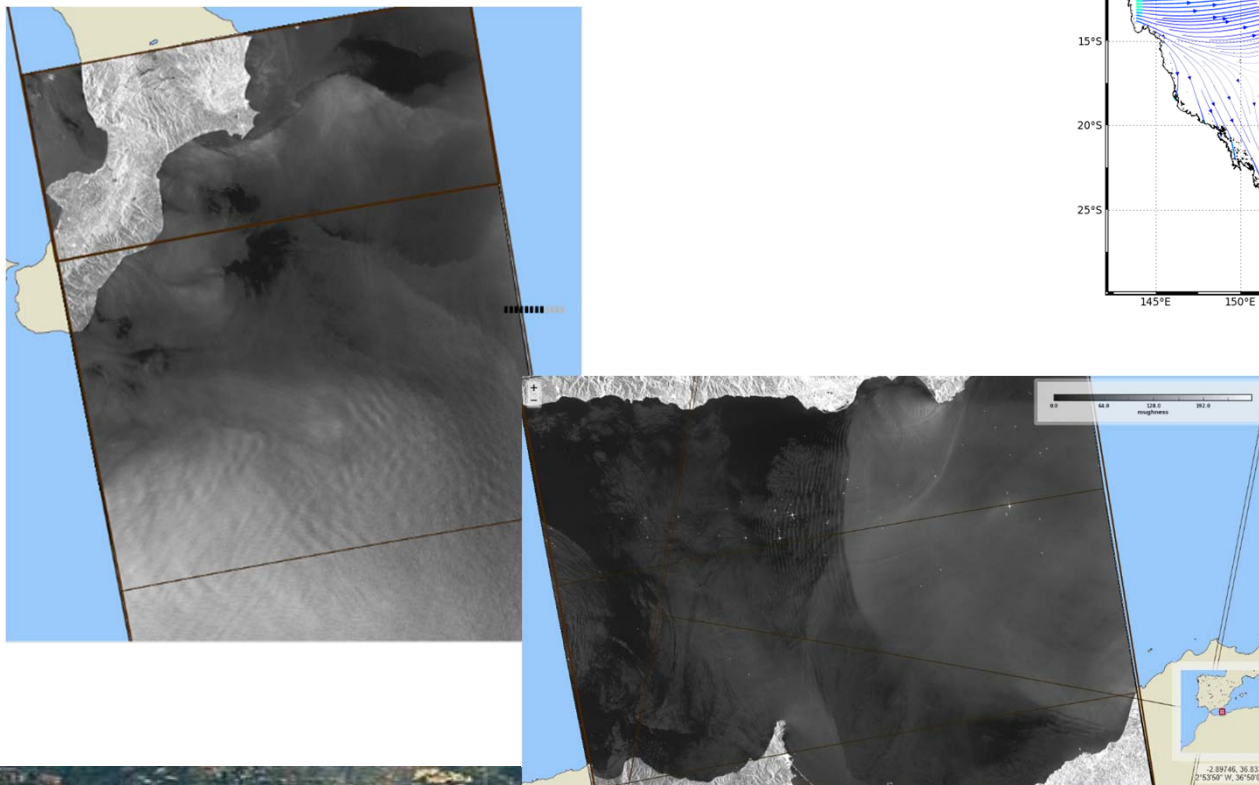


# Examples of other products delivered

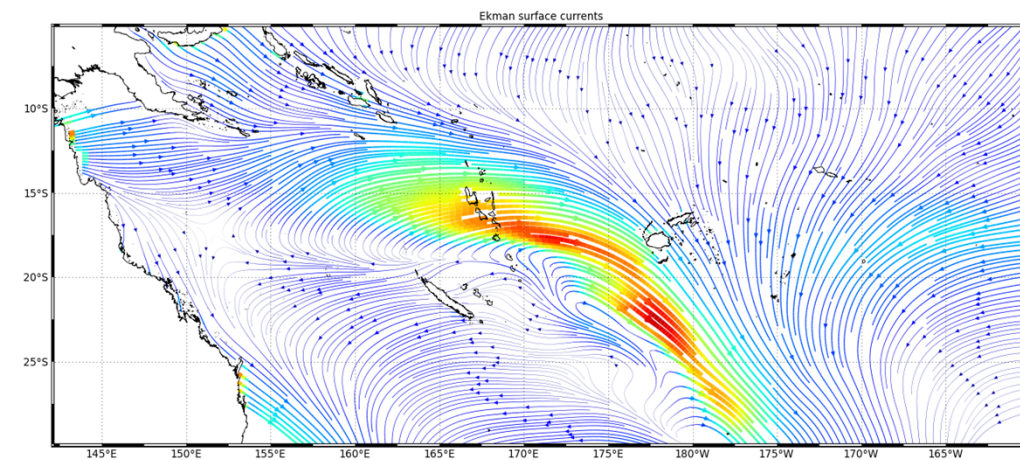
- **SAR images**

With « nice-display » algorithm applied in order to optimize the visualization of the ocean dynamical structures

Examples of Sentinel-1 SAR images



- **Ekman currents**



Example of Ekman current (15m depth)



... And other products according to the area considered and CNES R&D opportunities and constellation status: CFOSAT SWH, Optical (Sentinel-2, Pleiades) imagery also available and could be of interest for SWH variability analysis, etc...

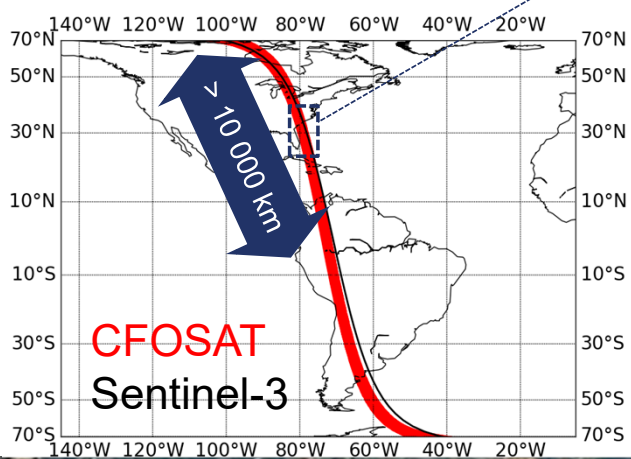
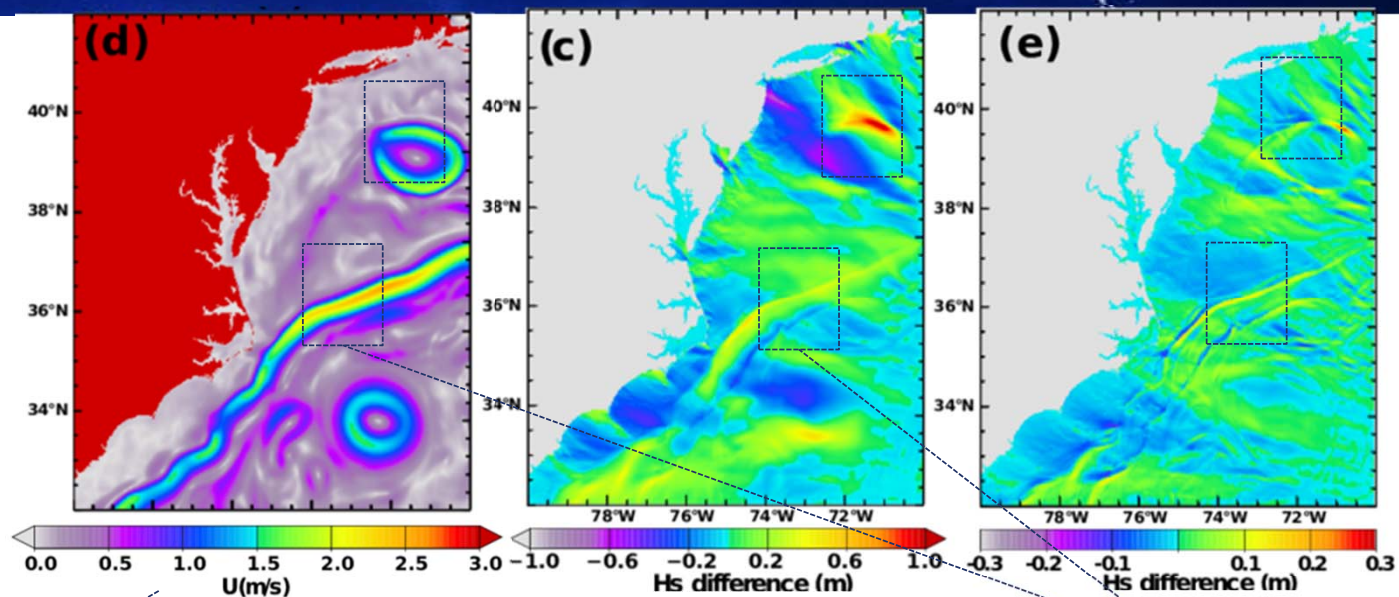
Surface currents

Large scale wavefield

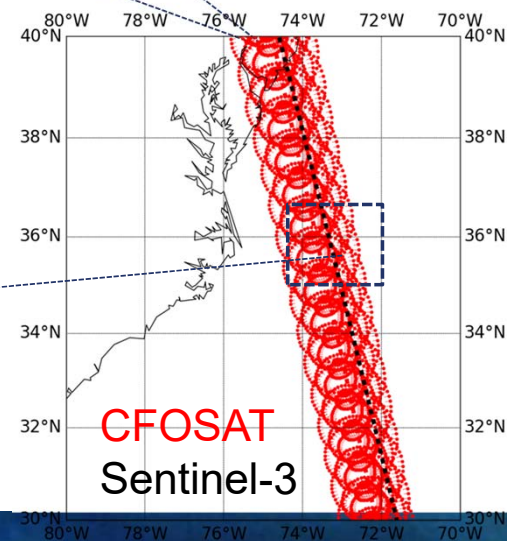
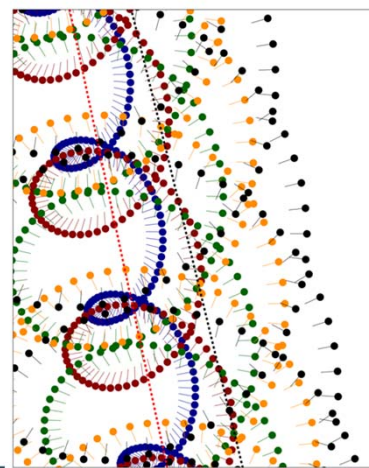
Small scale wavefield

CFOSAT and Sentinel-3 match-ups to validate SWIM measurements and to explore impact of the small scales of the wave field on altimetry

Adapted from Arduin et al. 2016



- 10°
- 8°
- 6°
- 4°
- 2°
- 0°





- **CNES/CLS can contribute to different scientific cruises with delivery of different products**
  - Feedback and collaboration with users contribute to the products development and quality assessment
  - The products delivered can support scientific cruises preparation and data analysis
  
- ➔ **Possible future contribution to the CalVal SWOT with delivery of products over the 1-day cross-over sites of interest**