Global and coastal surface current estimation from Synthetic Aperture Radar

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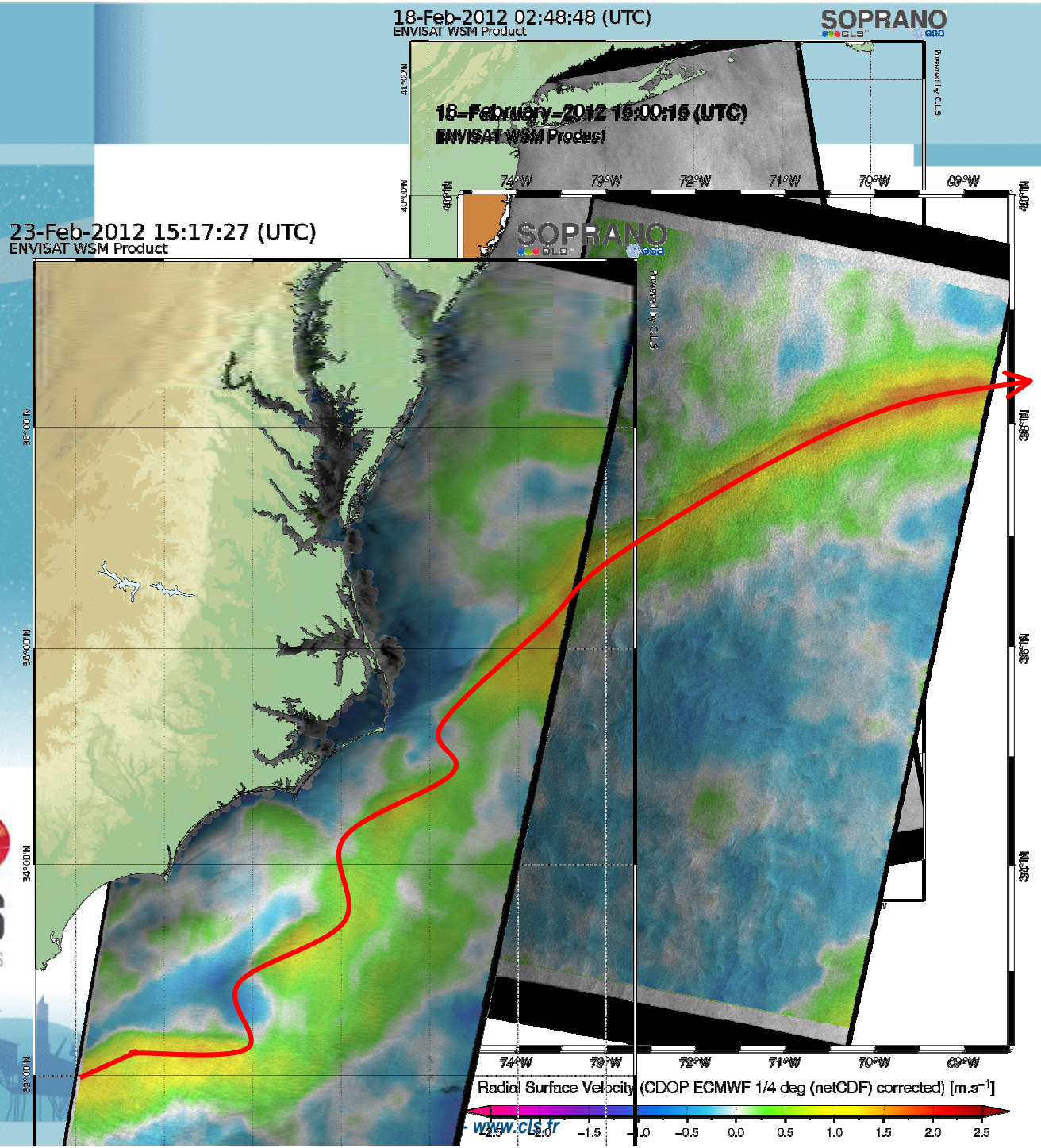

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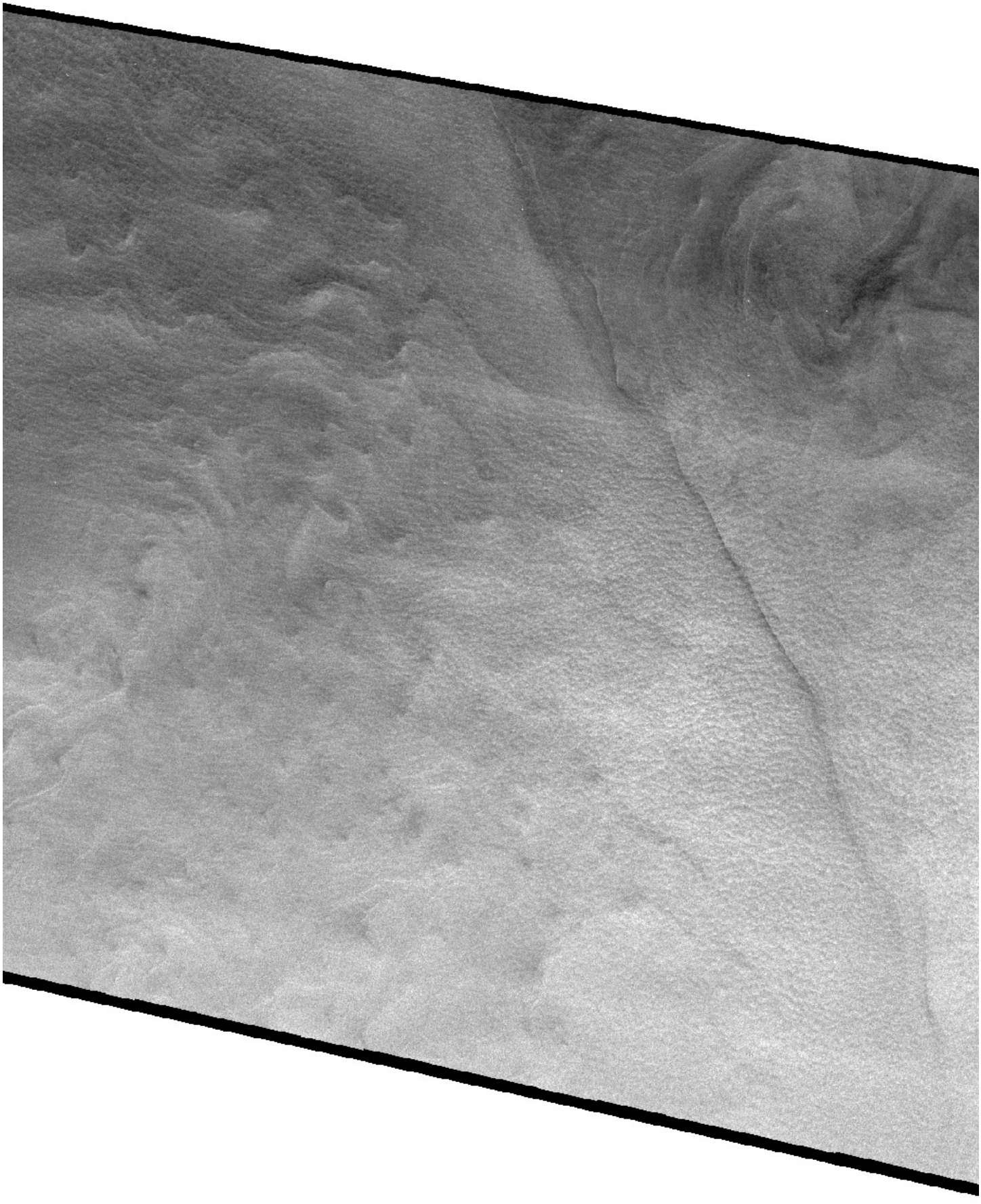
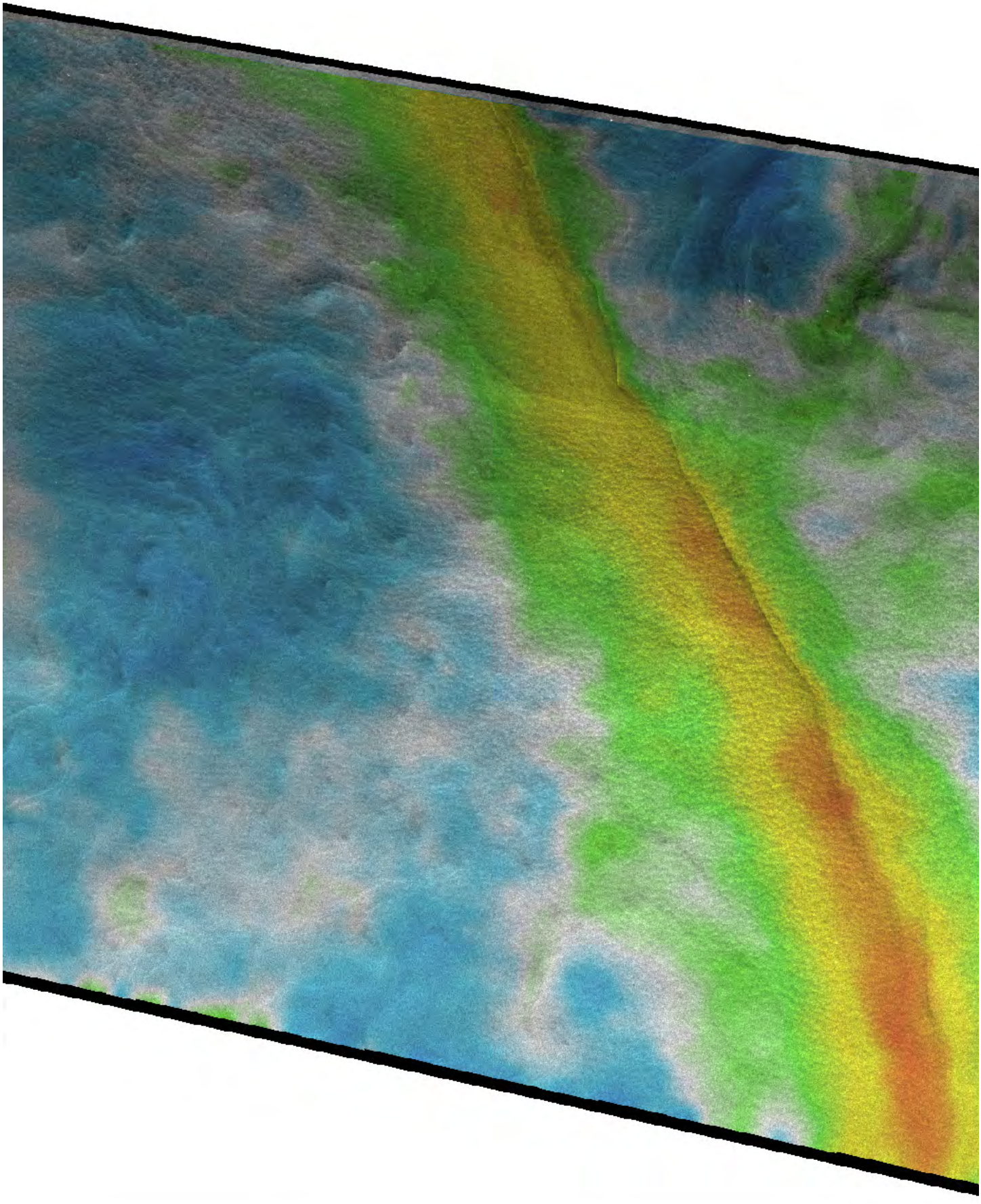

36°N
38°N


36°N
38°N

SAR = intensité + phase

intensity : surface current variations
(current boundaries/current position)

phase : velocities (radial velocities,
including surface current and waves)

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Doppler shift contributions

Observed Doppler velocities = underlying current + background sea state + sea state perturbations by surface current.

First order : only underlying current + background sea state

Hypothesis based on Doppler observation compared to HF radar except in area where tidal current is fast changing due to interaction with bathymetry :

Second order : sea state perturbated by surface current. Advanced models such as Doprim are needed to take into account modification of wave spectrum by surface current gradients.

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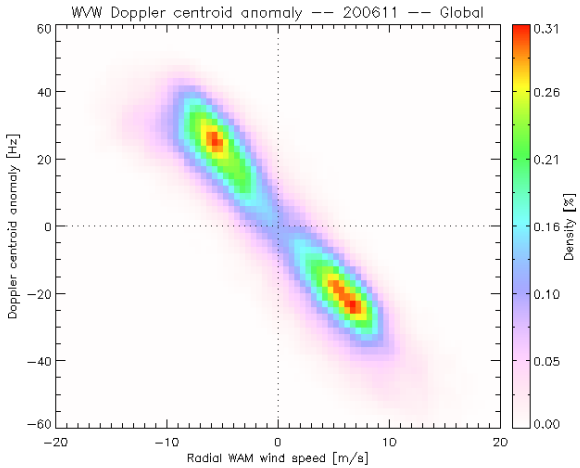
CDOP geophysical model function

First presented at ENVISAT Cal-Val review in 2002, published in JGR 2005 using wave mode at 23° incidence angle.



Modeled using tilt+breaking

largest influence from the largest steepness (typically in equilibrium with the wind stress)

First order : only wind dependance

empirical law only based on wind speed and direction relative to radar look

Neural Network training

CDOP_23 = f(wind speed/direction)

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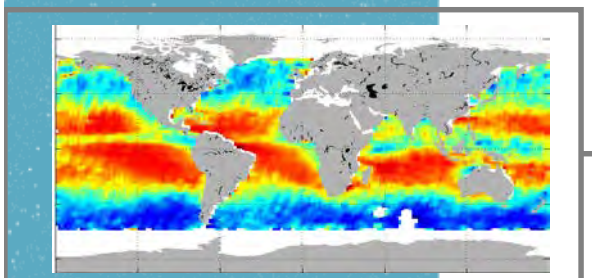
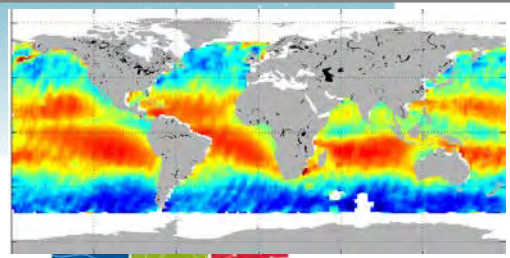
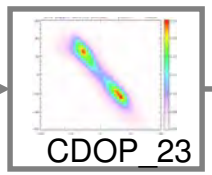
Simple methodology to remove sea state effects



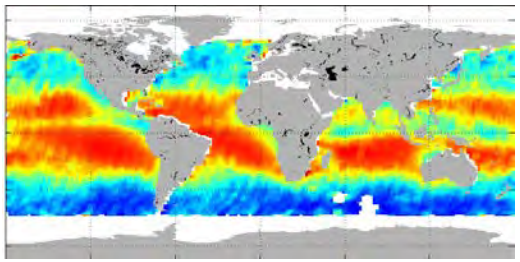
Doppler Anomaly/Velocity (ASAR WM)



Radial Wind Speed (ECMWF)

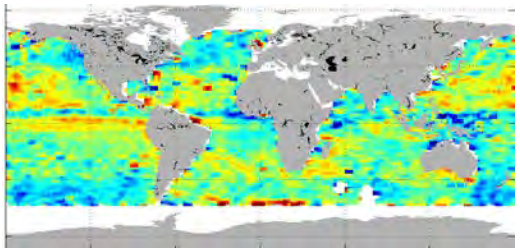


CDOP_23



Doppler Anomaly/Velocity predicted (NNT)

-



Residual Doppler Anomaly (current)

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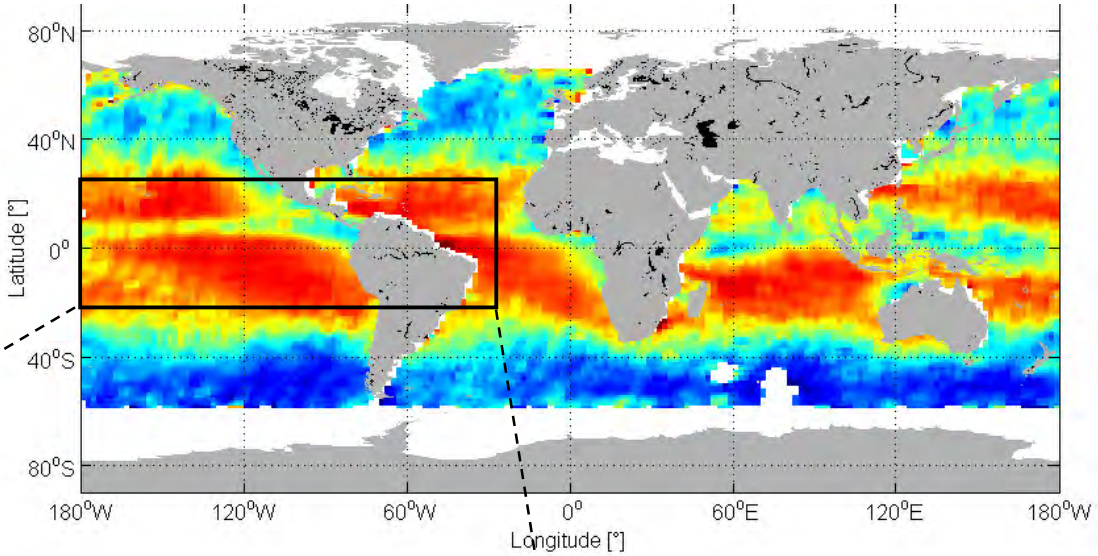
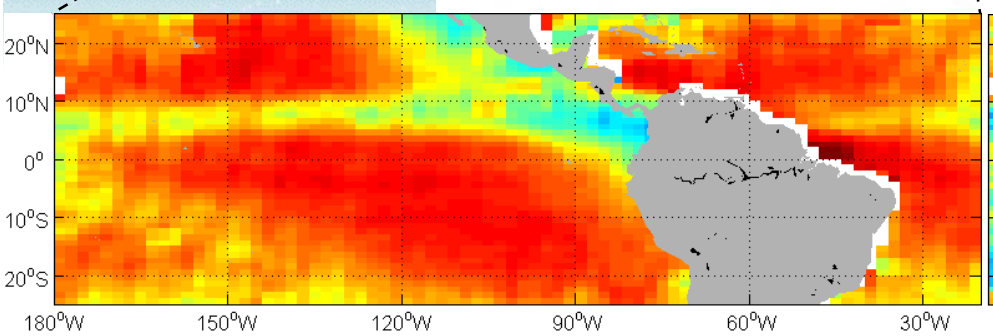
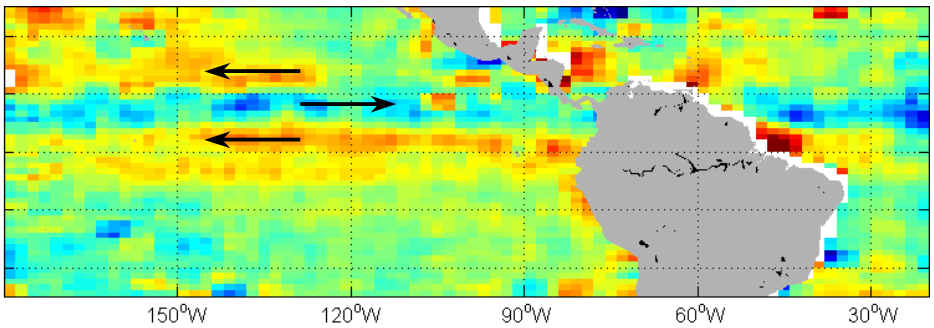
Equatorial Pacific Zone monitoring

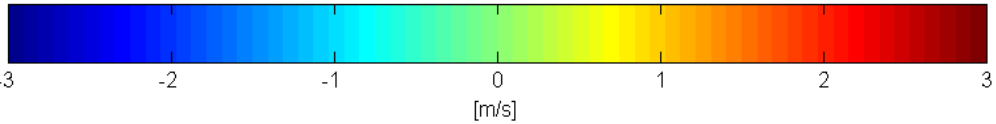




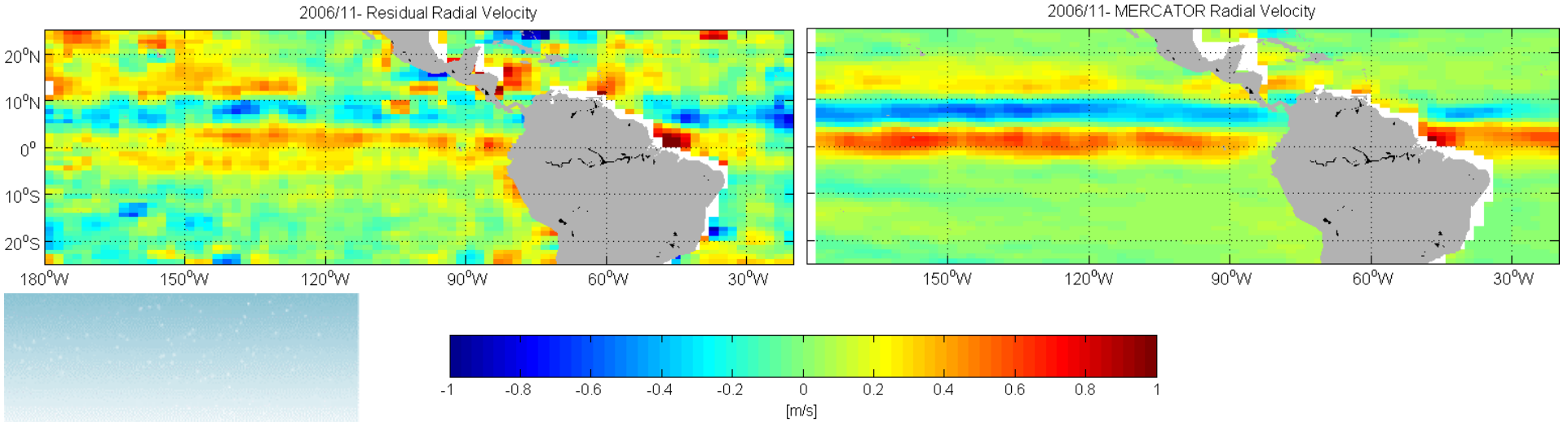


Radial Velocity (wind effect no removed)

Radial Current Velocity (wind effect removed)



Equatorial Pacific Zone monitoring
2D comparisons



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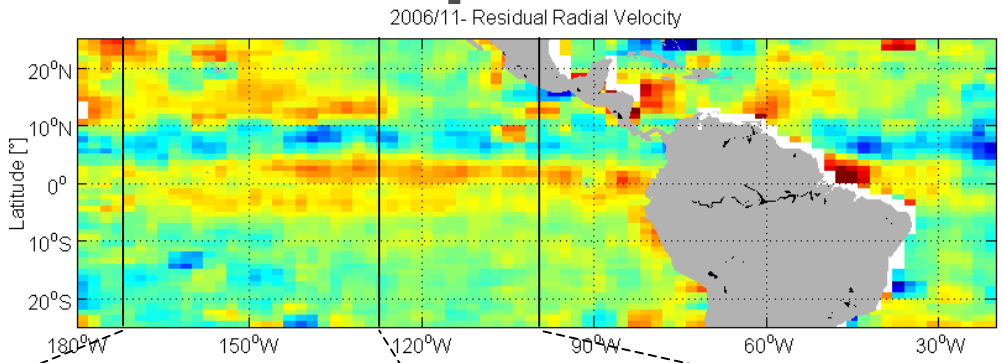
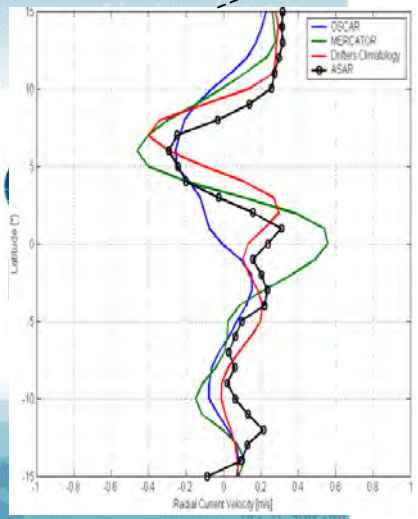
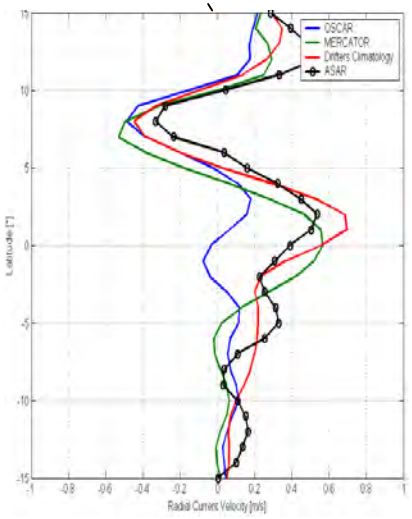
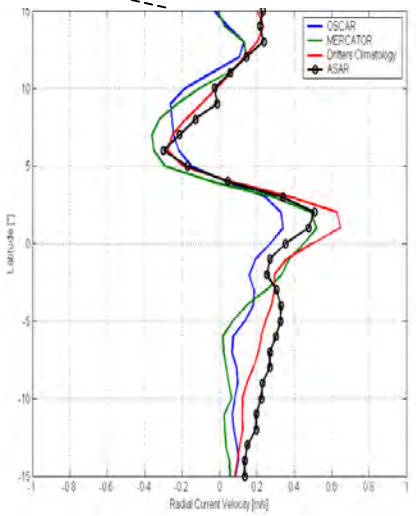
Equatorial Pacific Zone monitoring
1D comparisons









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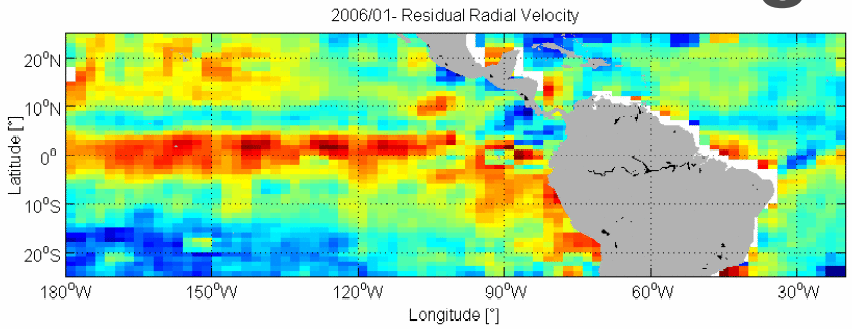
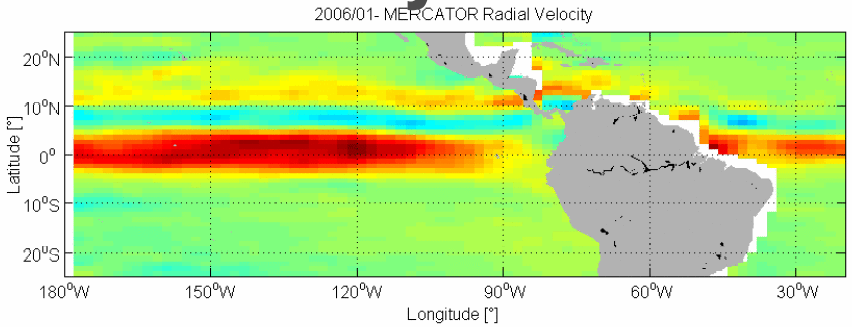
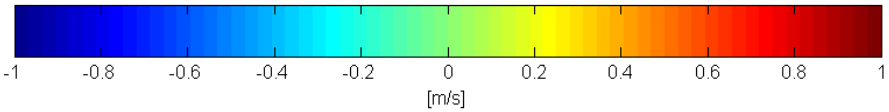
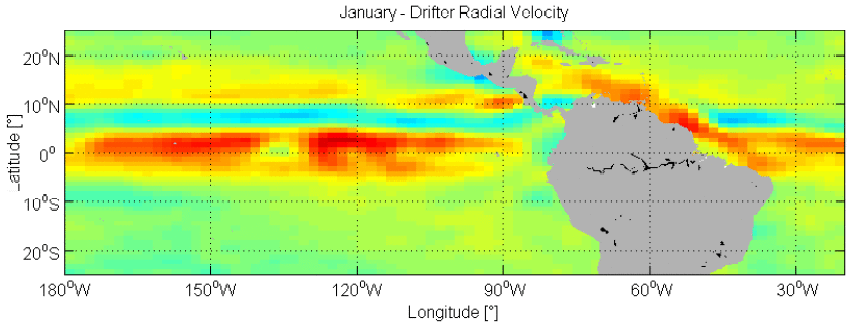
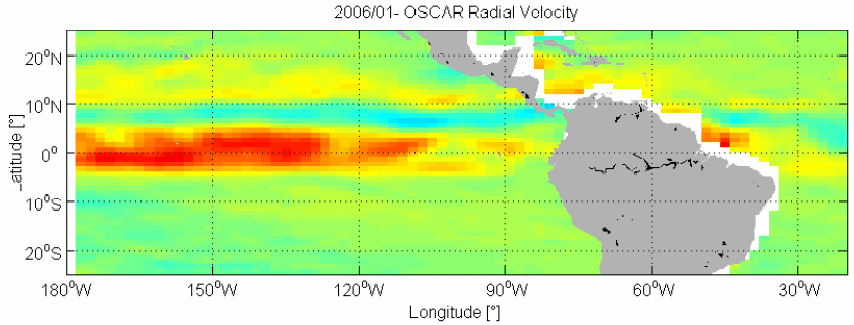
Equatorial Pacific Zone monitoring
Monitoring the seasonal cycle







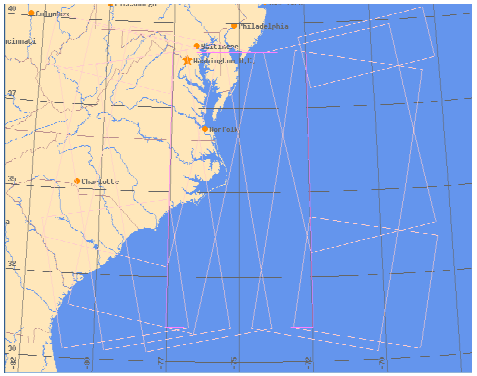




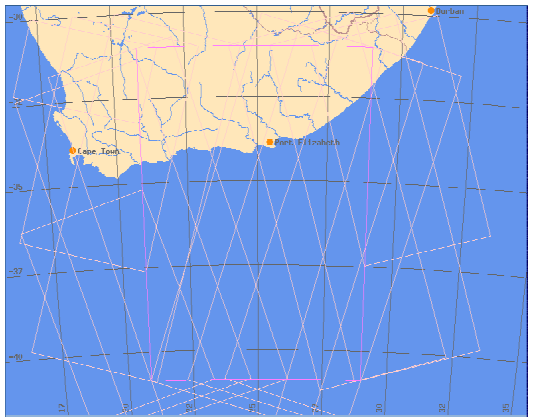
Gulf stream and Agulhas current monitoring demonstration

Supersites for systematic acquisition and processing of ASAR Wide Swath scenes (400km width)
data available on soprano.cls.fr (current section)
in average 2 pass over the same area every 3 days at mid latitude

Gulf stream (North Carolina)



Agulhas current



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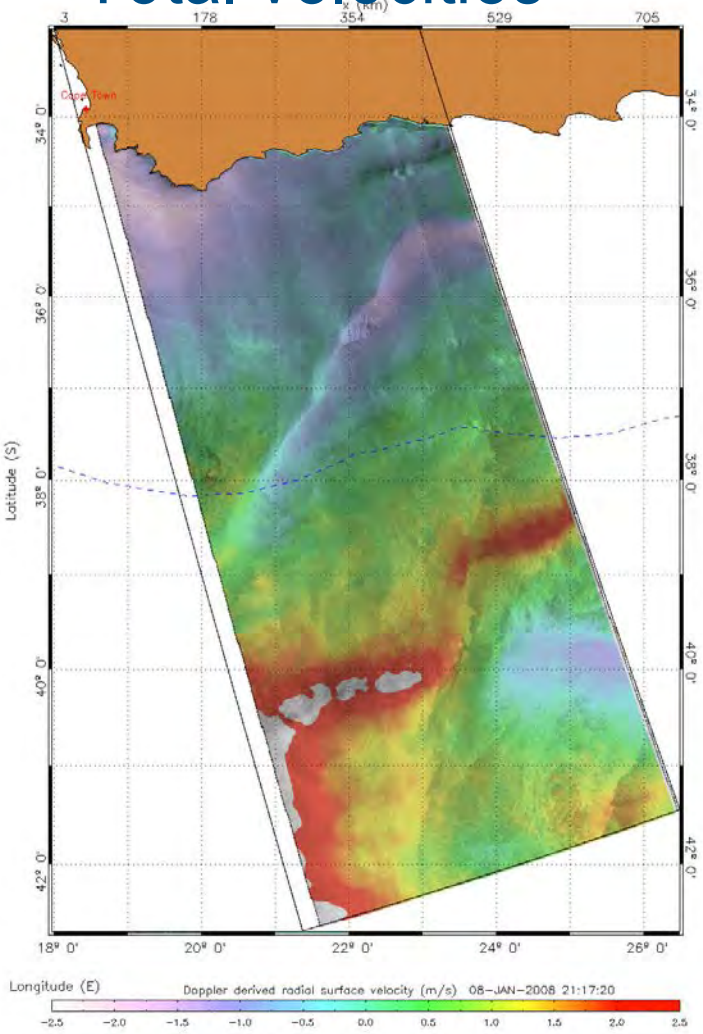
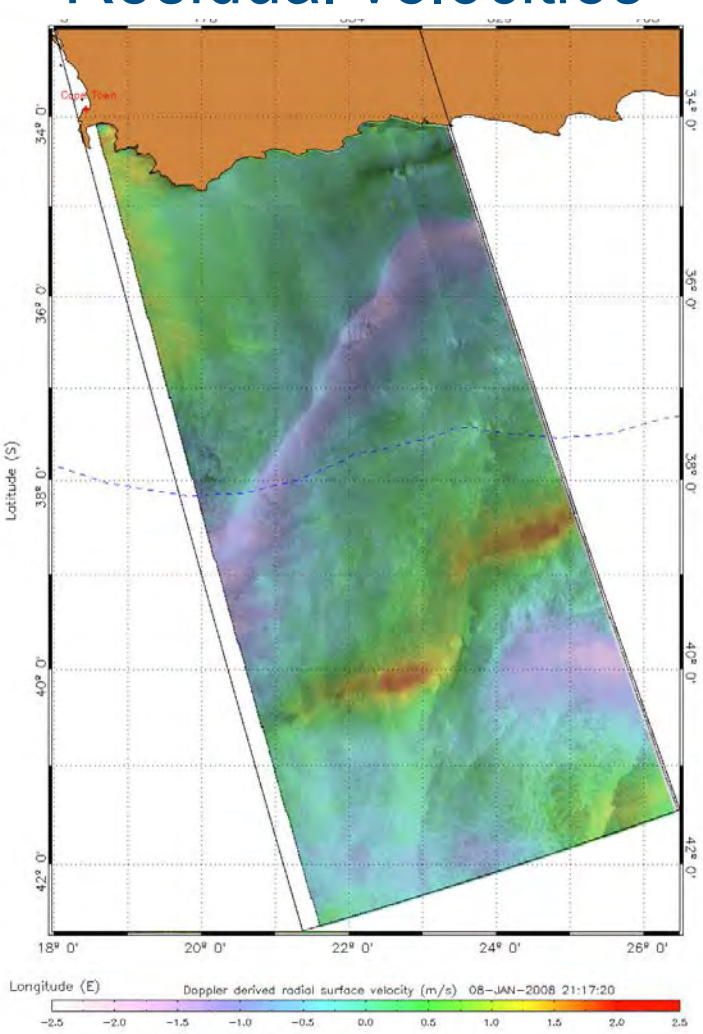
CDOP sea state correction (Mouche et al TGRS 2012)

Total velocities

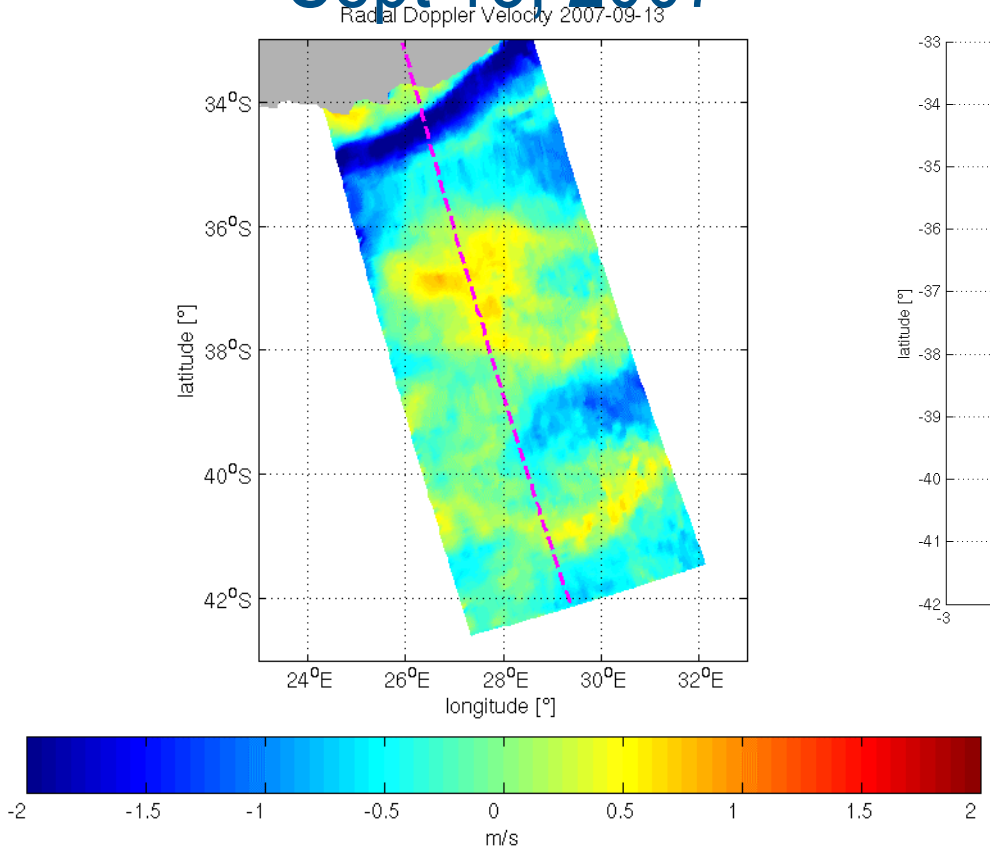


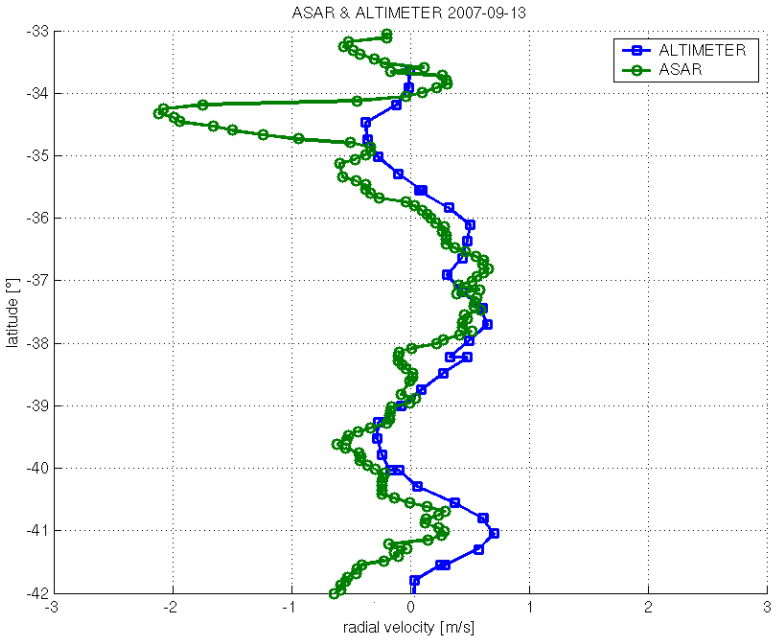
Residual velocities



Comparison with altimetry

Sept 13, 2007





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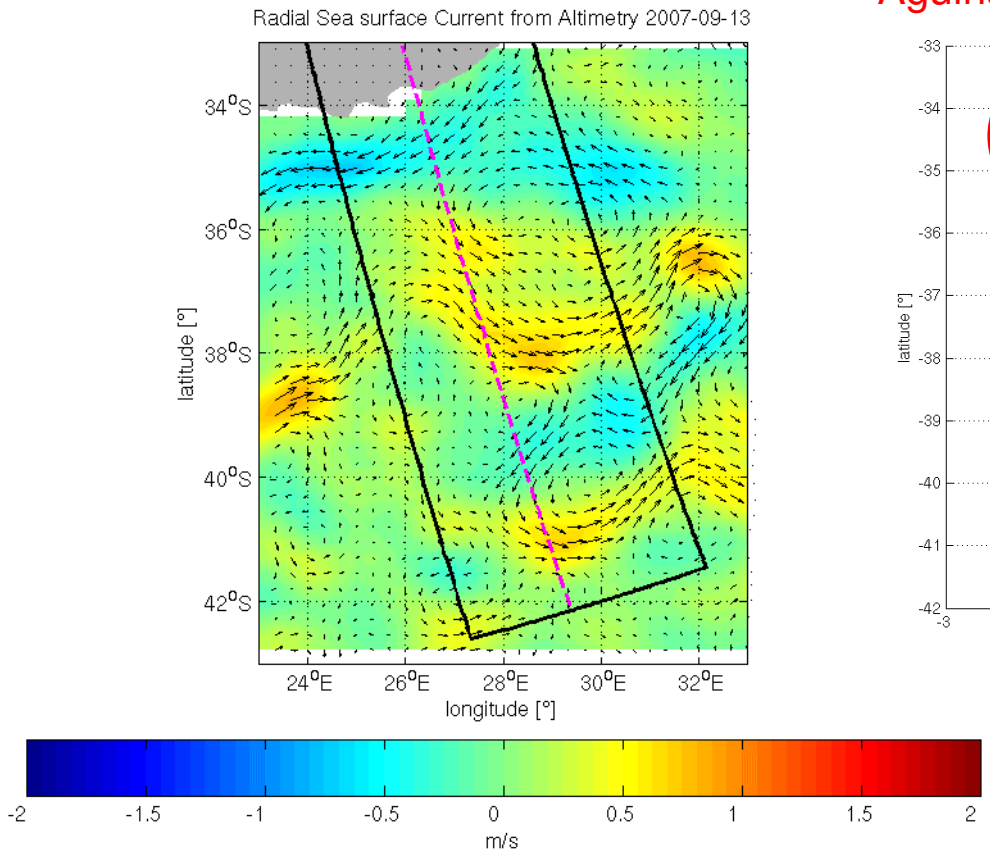
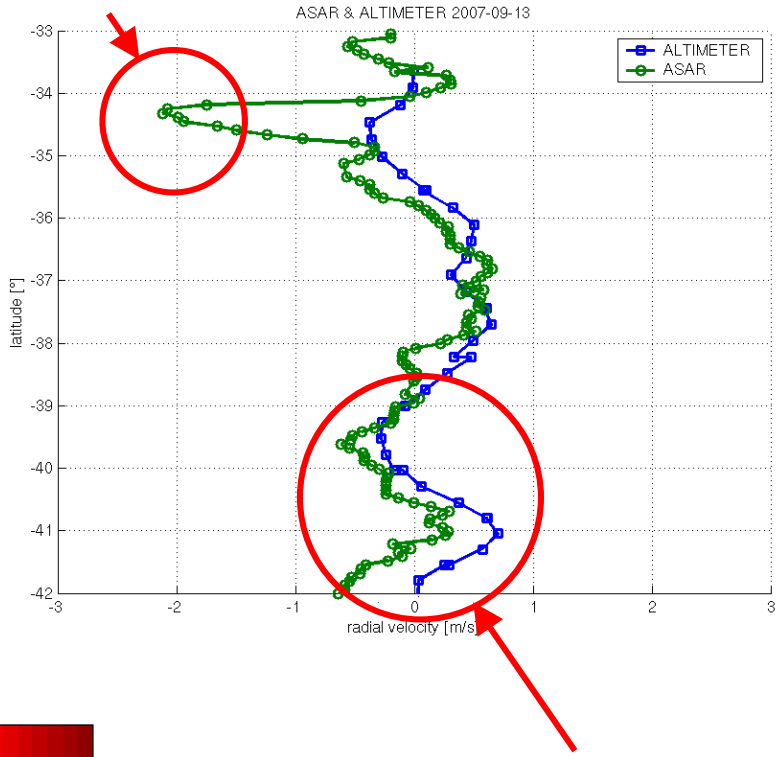
Comparison with altimetry



Agulhas main stream



Mesoscale eddie

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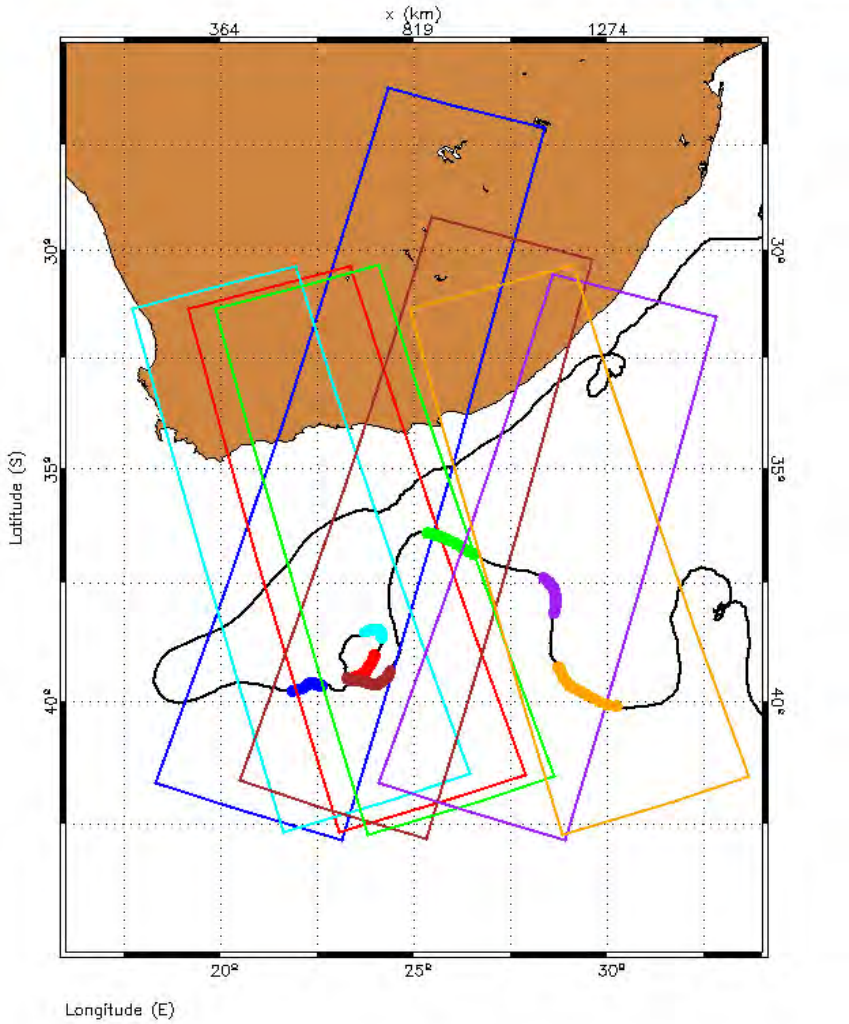
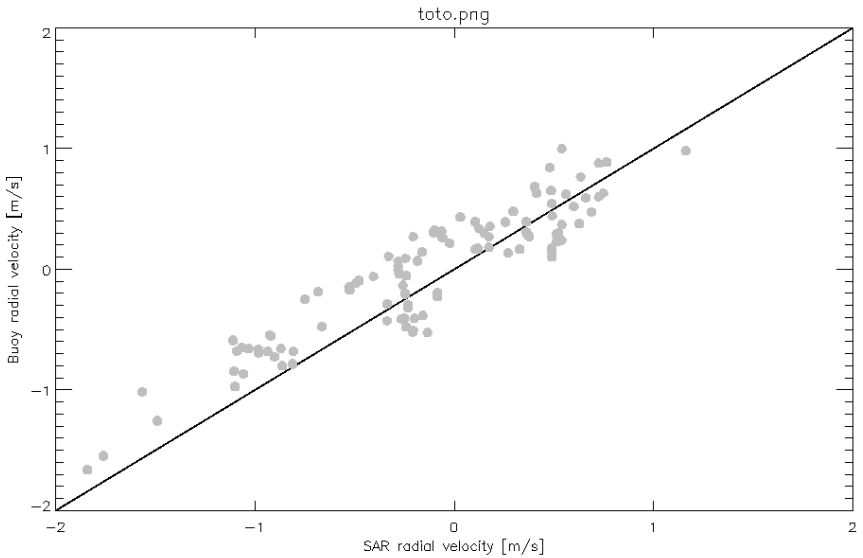
Comparison with a lagrangian drifter (15m depth)





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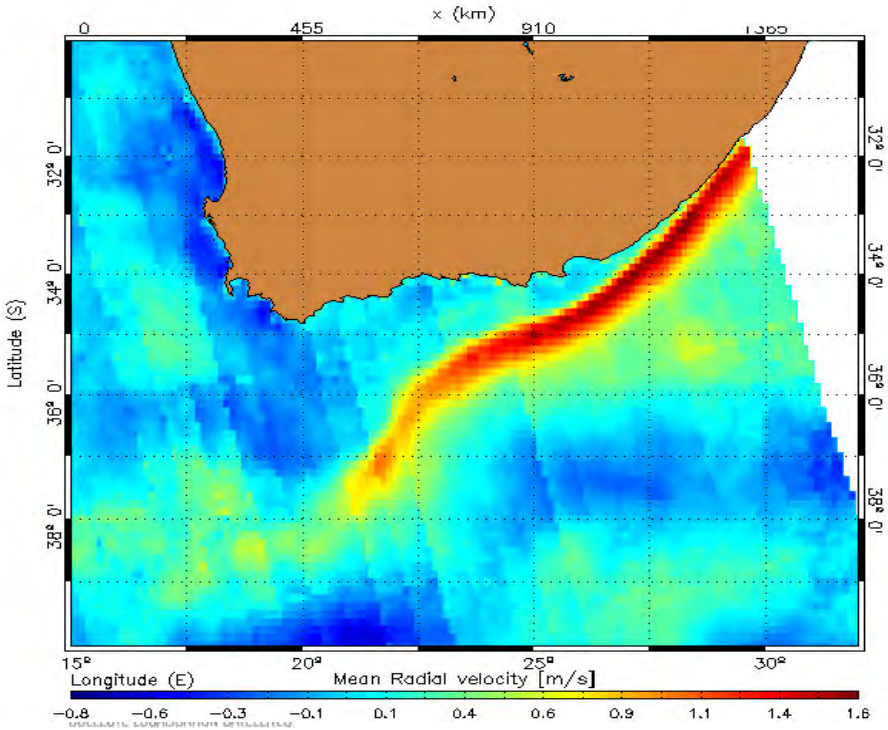
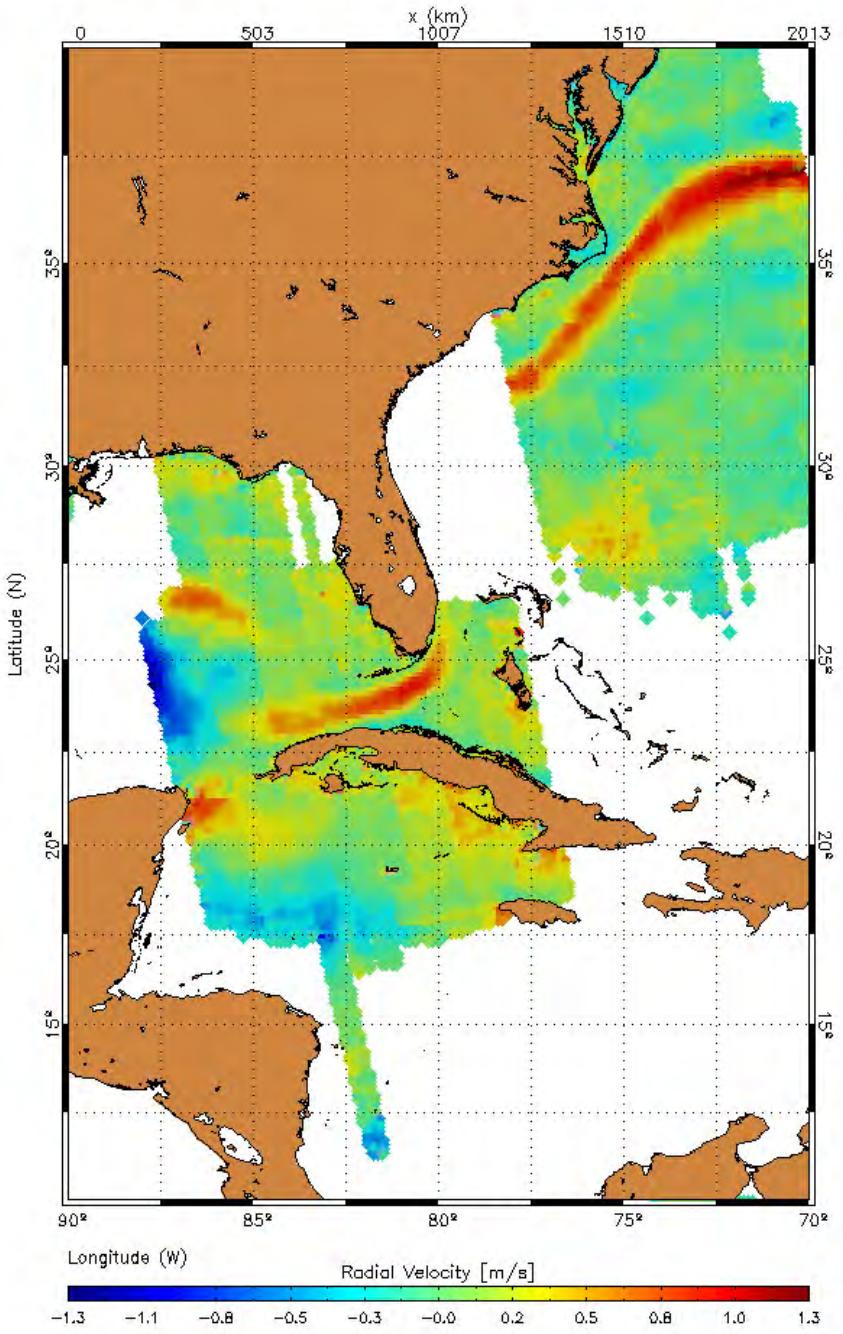
Annual mean over Agulhas and Gulf stream using ASAR Wide swath ascending tracks





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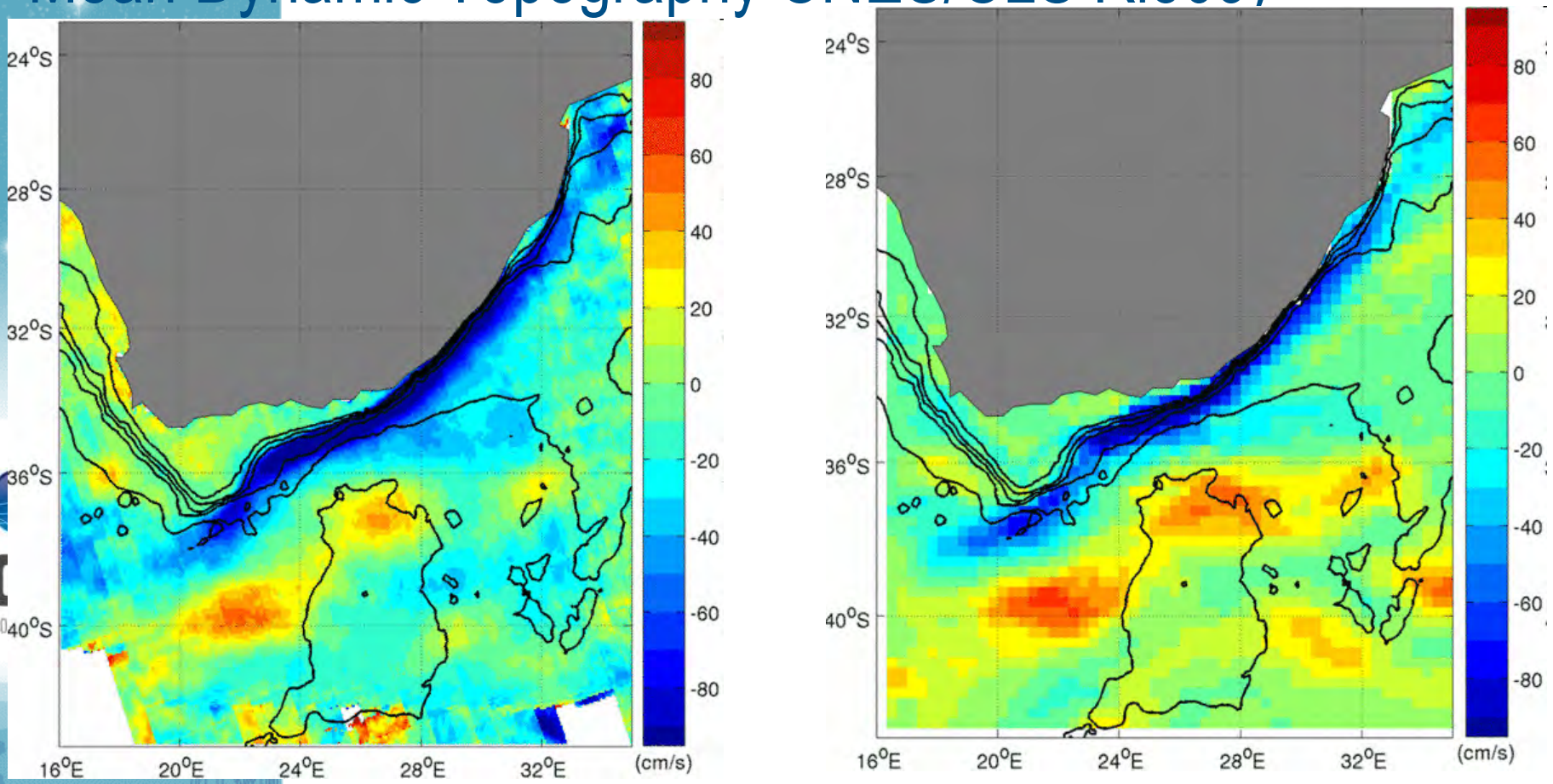
Mean radial velocity of the Agulhas current by ASAR on Envisat (left, 2007-2009 mean) and by altimetry (right, Mean Dynamic Topography CNES/CLS Rio09)



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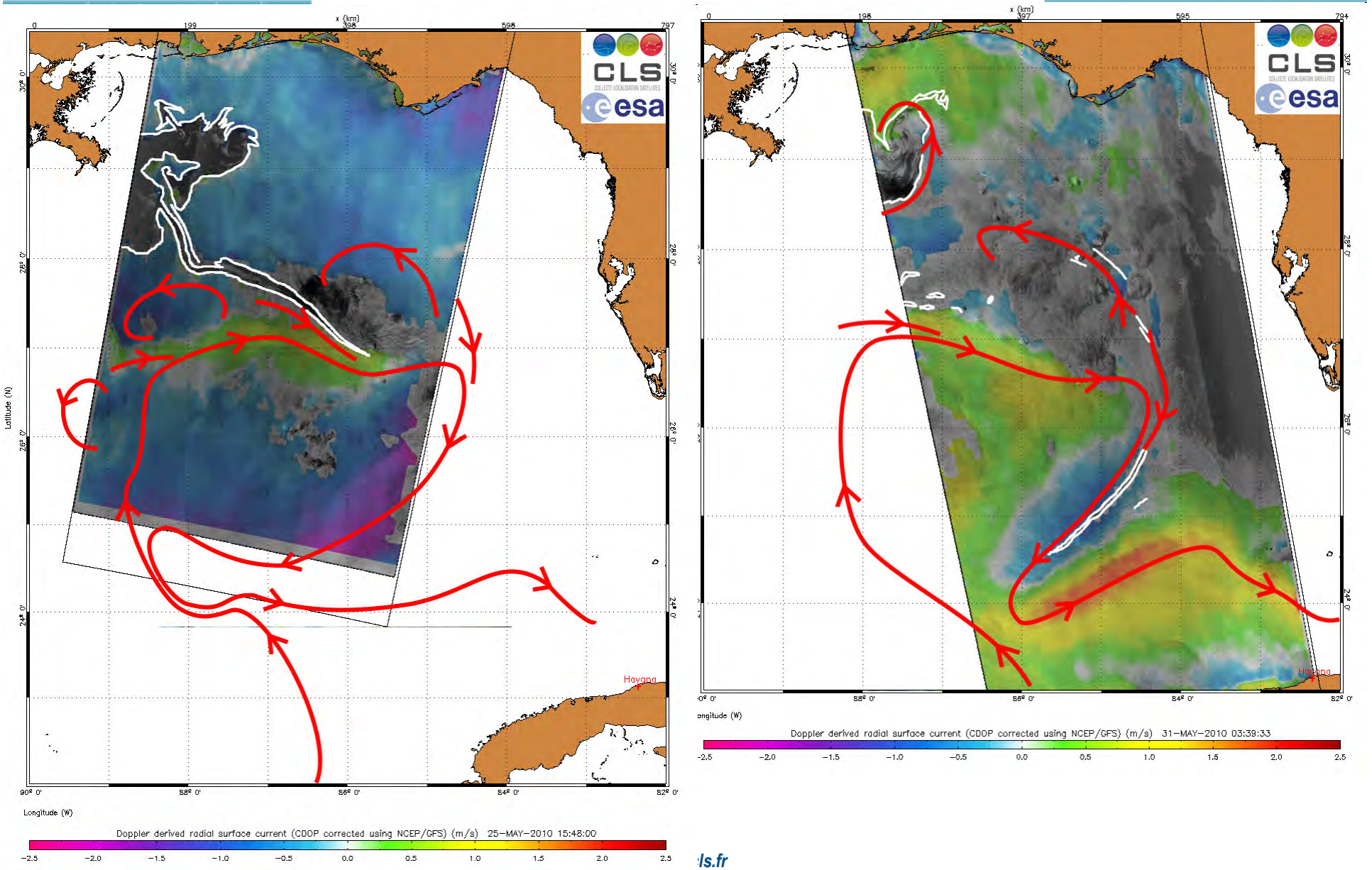
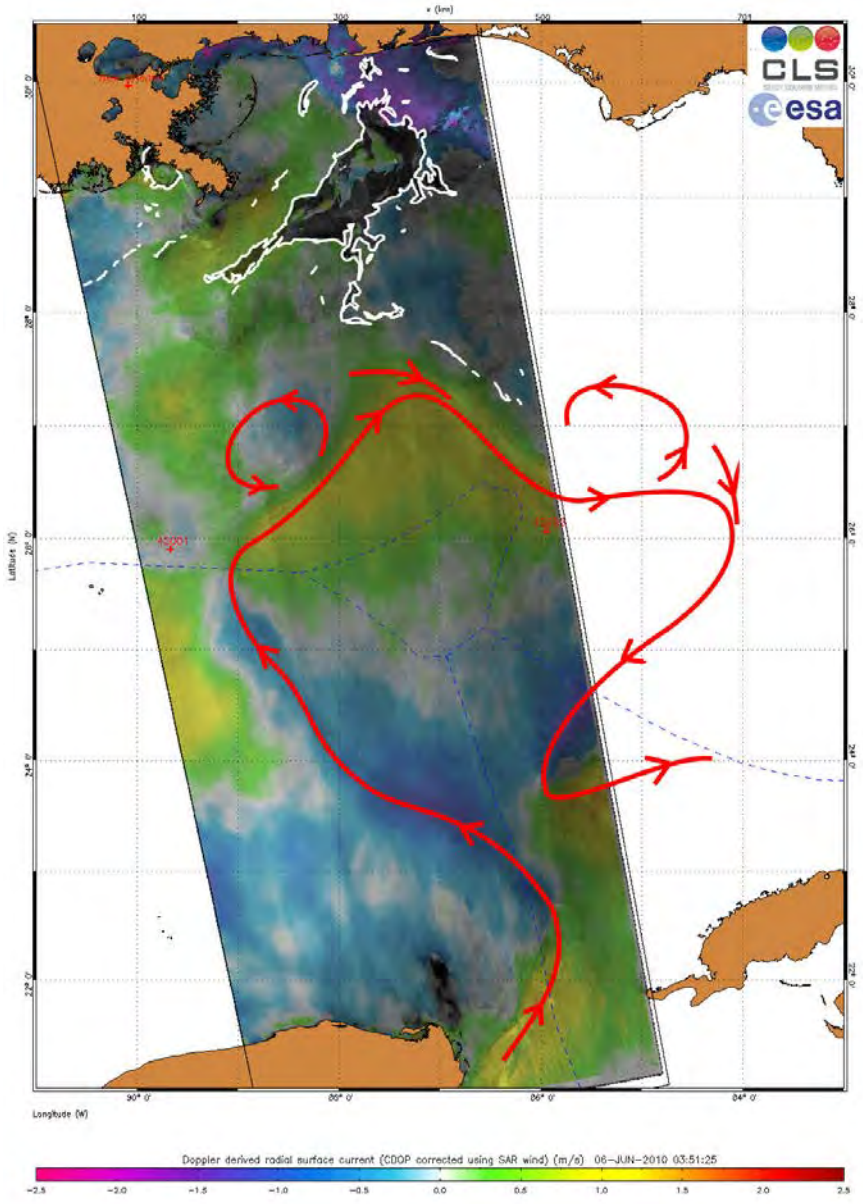
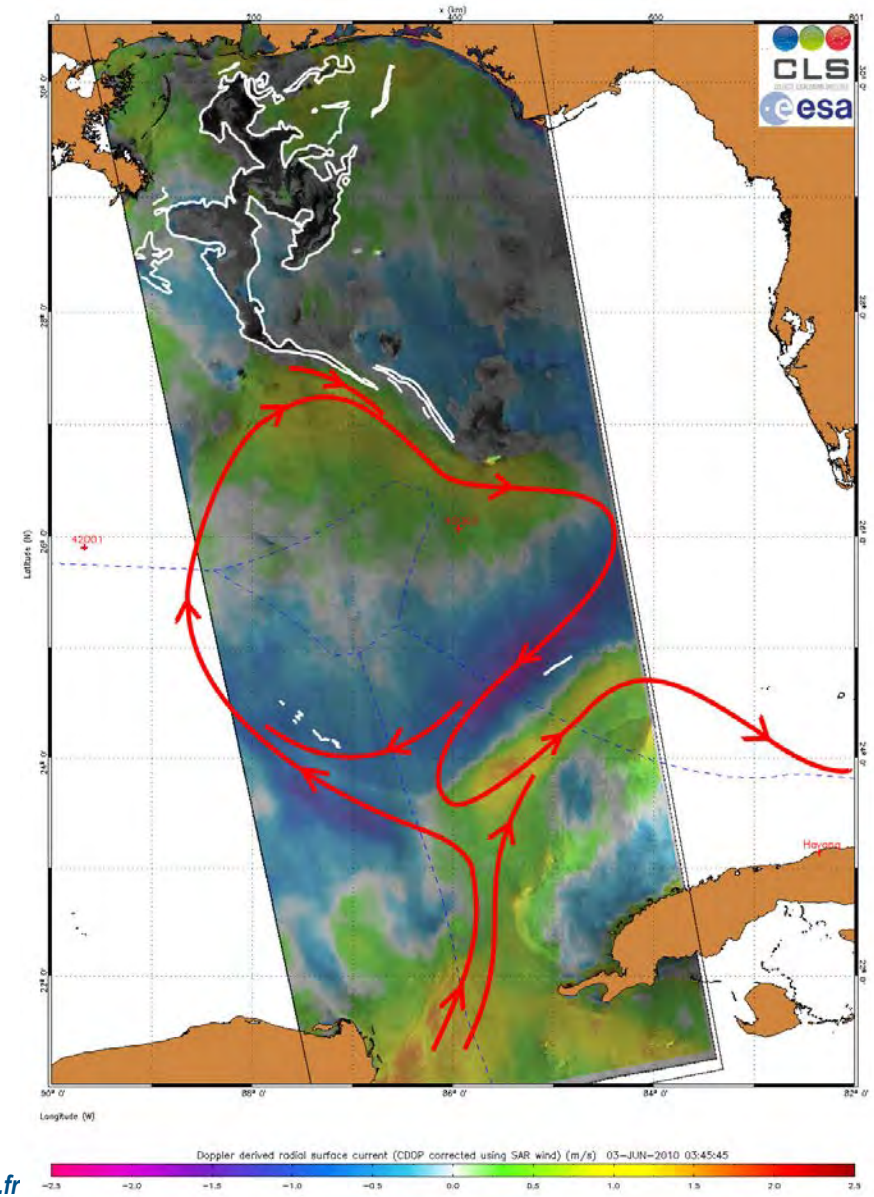
Towards synergetic analysis



Towards synergetic analysis