Linking sea surface height to (sub)mesoscale ocean dynamics: the SeaGoLSWOT campaign in the northwestern Mediterranean (Fall 2014)

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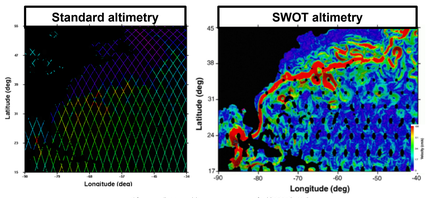
SWOT: Surface Water and Ocean Topography

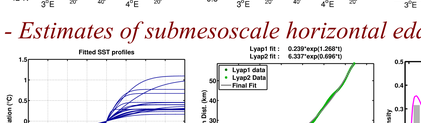
(from http://swot.jpl.nasa.gov/mission/)

- Wide-swath US/French satellite altimetry mission (launch scheduled for Fall 2020)
- Oceanography mission: SSH observations at a resolution of few km (meso- and submeso-scale regimes) over a 100 km swath
- Particularly important for transport analysis in coastal regions where traditional altimetry is inaccurate



(from http://smsc.cnes.fr/SWOT/)

AirSWOT



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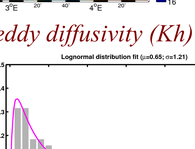


- Before satellite launch, SWOT calibration/validation through the AirSWOT program:
  - ➔ Airborne version of SWOT over key ocean regions
  - ➔ Each flight associated with an accompanying oceanographic campaign

The Gulf of Lion (GoL; North-western Mediterranean)

Regional ocean dynamics influenced by three main forcings:

1. Mistral & Tramontane – wind induced coastal upwelling;
2. Northern Current (NC) – strong dynamical barrier between the GoL continental shelf and the open Mediterranean basin;
3. Rhone delta – river plume and freshwater inputs;

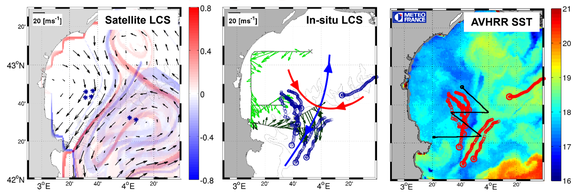
Why an AirSWOT campaign in the GoL

Favorable characteristics for investigating (sub)mesoscale dynamics (key for AirSWOT mission):

- Weak tidal regime – focus on the interpretation of the AirSWOT signal associated with (sub)mesoscale structures
- Intense (sub)mesoscale activity due to NC instabilities and strong wind forcing
- Marked contrast between coastal waters (colder) and open Mediterranean waters (warmer) – (sub)mesoscale structures detectable from remote sensed imagery

Results from the Latex10 campaign (1-24 September 2010)

- In-situ detection of Lagrangian Coherent Structures (LCS)



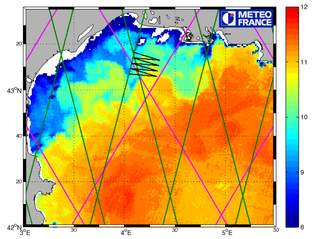
- LCS from AVISO velocities using Finite-Size Lyapunov Exponents (FSLE; d'Ovidio et al., 2004)
- Adaptive sampling strategy (satellite data + Lagrangian drifter releases + ship-based ADCP measurements) to localize *in-situ* LCS (Nencioli et al., 2011)
- Evidenced limitations of standard altimetry over the continental shelf

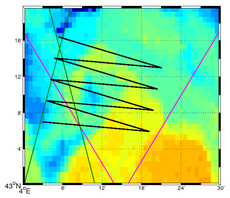
- Estimates of submesoscale horizontal eddy diffusivity (Kh)

- Front widths from thermosalinograph sections were combined with strain rates from drifter arrays to obtain 76 estimates of Kh
- Kh log-normally distributed with 70% of the values between 0.4 and 5 $m^2 s^{-1}$ for front widths of 1-4 km (Nencioli et al., 2013)

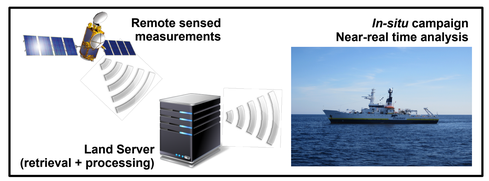
The SeaGoLSWOT campaign (29 October – 10 Novembeer, 2014)

- SeaGoLSWOT is a CNES supported field campaign associated with the AirSWOT mission over the GoL
- AirSWOT will provide high-resolution SSH along operative altimeter tracks (Jason in magenta; Saral/AltiKa in green; Cryosat2 not shown)
- Main goal of the campaign: along-track sections + three-dimensional mappings of physical and biological variables across identified (sub)mesoscale features





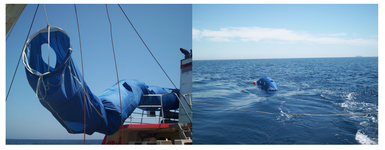
Adaptive sampling strategy



- Focus on small-scale,rapidly-evolving (sub)mesoscale structures, thus *in-situ* sampling based on further refinement of the adaptive strategy developed during the Laetx10 campaign.
- Pattern of each mapping designed/optimized according to the structures identified from the near-real time analysis of satellite imagery (AVHRR, Ocean color etc.) and previous mappings

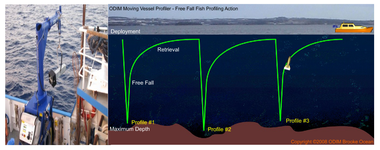
In-situ measurements

1. Lagrangian drifters



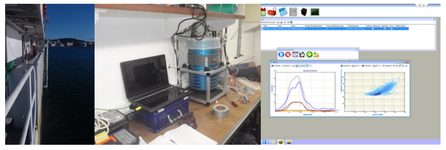
- Drifter arrays released every 3 days
- Lagrangian Coherent Structures
- Validation of larger scale circulation

2. Moving Vessel Profiler (MVP)



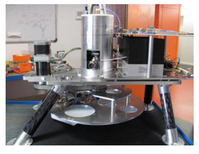
- Vertical sections: CTD (hydrography), Flurometer, LOPC (zooplankton PSD)
- Quasi-synoptic three-dimensional mappings every 10-12 hours

3. Bench-top flow cytometer



- Surface phytoplankton assemblages
- Impact of (sub)mesoscale dynamics on horizontal distribution of ecological communities

Synergy with other platforms of observation



Kuros radar
- Airborne mission
- Surface waves and wind

(PI: D. Hauser)

Gliders
- Concomitant campaign
- Along-track sections

(PI: H. Sekma, F. Birol)

Current wave drifters
- In situ measurements of wave height and direction
- To be defined...

Key objectives within AirSWOT program

(1) Provide AirSWOT measurements with a ground truth of the physics at ~1 km horizontal resolution in the upper 100 m of the water column;

(2) Test and tune novel in-situ sampling strategies and instrument configurations for future mutliplatform campaigns in support of the AirSWOT and SWOT missions;

(3) Investigate the link between the ~10 km horizontal surface structures and the dynamics/biogeochemical processes within the upper layer of the water column;

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LAgrangian Transport EXperiment (LATEX) website: *http://mio.pytheas.univ-amu.fr/?Programme-LATEX*