Synergy between satellite altimetry and other sensors for the study of coastal ocean processes

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Integrated Multi-Platform Observing Systems

(Adapted from D. Chelton)
Relevance of the Mediterranean Sea

The Mediterranean Sea can be considered as a reduced scale ocean laboratory, where processes are characterized with smaller scales than in other oceanic regions (Robinson et al. 2001).

ROMS IMEDEA – salinity output
Balearic Sea: hotspot in biodiversity

30 glider missions from 2007
~17000 full CTD casts
+ oxygen, chlorophyll, turbidity
Multi-sensor experiments

Pascual et al. 2013
Multi-sensor experiments

Do altimeter gridded fields resolve these typical structures of the Mediterranean Sea (Ro ~ 15-20 km)?
Comparison of AVISO gridded velocities and the trajectories of 2 drifting buoys (May 14-16, 2009).
**HR: Optimal interpolation with smaller scales**

\[
C_{ij} = e^{-\frac{|r_i - r_j|^2}{2L^2}} e^{-\frac{\Delta t^2}{T^2}}
\]

Where \( r \) and \( t \) are the spatial and time coordinates of the studied point; \( L \) and \( T \) are the spatial and temporal correlation scales. 

\( L = 30 \text{ km}, \ T = 3 \text{ days} \) and \( \Phi = 0.7 \), and measurement error variance of 3 cm\(^2\).

Dusurget et al. 2012; Escudier et al. GRL 2013
Improving gridded altimetry fields

**HR+bathy:** bathymetry constraint added

\[
C_{ij} = e \frac{|r_i - r_j|^2}{2L^2} e \frac{\Delta t^2}{T^2} e \frac{F^2}{\Phi^2}
\]

\[
F = \frac{|PV_i - PV_j|}{\sqrt{PV_i^2 + PV_j^2}}
\]

PV is potential vorticity, defined as \( PV = \frac{f}{H} \) (Davis et al. 1998)

Escudier et al. GRL 2013
Wavenumber spectral slopes obtained from the new satellite-derived fields reveal a more realistic cascade of eddy energy.
Eddy kinetic energy: comparison with drifters

The HR+Bathy fields yield levels of eddy kinetic energy 25% higher than standard altimetry products, specifically over regions regularly impacted by baroclinic instabilities.
Comparison of HR+Bathy gridded velocities and the trajectories of 2 drifting buoys (May 14-16, 2009).
G-Altika: multi-sensor experiment in the Ibiza Channel

**Location:** Ibiza Channel

**Period:** August 2013

**Sensors:**
- Deep Slocum glider along SARAL-Altika track no. 16
- HF-radar (SOCIB)
- 2 surface drifters (SVP and MLI)
French/Indian satellite mission for the monitoring of the environment

- 2013/02/25: launch
- 2013/06/20: dissemination to all users on the AVISO ftp server
HF radar - drifter data

SOCIB HF Radar - ALTIIKA

0.1 m/s

0 0.05 0.1 0.15 0.2 0.25
Glider observations

Resolution:
~3 km offshore
~1 km in coastal area

Dynamic height:
not sensitive to level of reference level
SARAL/AltiKa is providing reliable data in the coastal area. Need for accurate editing and filtering criteria.
Analysis of 18 years of altimetry data. Circulation through the channels is maximum in winter. The channel data support the hypothesis that the channel circulation may be hindered by the intermittent presence of the Western Intermediate Water mass.
Science based on WMOP-ROMS simulation

Assessment and process study

Glider

WMOP simulation

Gulf of Lions (2011)

Ibiza Channel (2011)

Water masses in observations and WMOP

Lagrangian trajectories of WIW in WMOP

1. Observations are used to highlight the presence of WIW over the NWMED
2. Comparison obs-model to evaluate the capacity of the simulation to reproduce the observed water masses.

Juza et al. JGR, 2013
A New Mean Dynamic Topography

- MDT needed for estimation of absolute currents derived from altimetry (ADT = SLA + MDT).
- Inaccuracies detected in Rio et al. 2007.
- New MDT built in 2013: collaboration (CLS, IMEDEA, OGS, IEO, INGV, SOCIB).
- Integration: model, drifters, gliders, CTD, Argo, altimetry.
Use and integrate new technologies and models to:

- Characterize the interannual and decadal variability at small scales
- Understand the ocean and marine ecosystems response to changes in the coastal climate system.

Requirements:
- Sustained HR in situ observations (gliders, HF radar, drifters, CTD, ARGO, ...)
- Sustained HR satellite constellations (e.g. SWOT)
A Marine Research Infrastructure

**OBSERVING FACILITIES**
- Research vessel
- HF Radar
- Gliders
- Lagrangian platforms
- Fixed stations
- Beach Monitoring

**MODELLING & SATELLITE**
- ROMS, SWAN, SST, OC, Altimetry

**STRATEGIC ISSUES & APPLICATIONS FOR SOCIETY**
- Integrated Coastal Management
- Marine Spatial Planning

**DATA CENTER**
- Data access – Data Repository – Applications
- Spatial data infrastructure – Real time monitor
Acknowledgments


THANKS TO ALL OF YOU!