Assessment of operational ocean forecasting systems in the Western Mediterranean using multiplatform in situ data and an eddy tracker

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Outline

1. Context
2. MedSub project
   - Objective
   - Methodology
3. Results
   - Eddy tracker
   - Assessment based on multi-platform experiments
4. Summary and work in progress
The Mediterranean Sea is a complex area with basin, sub-basin, mesoscale and submesoscale structures interacting.
Context

Know-how & Data availability

- Multi-sensor experiments (gliders, drifters, ship, radar, argo, satellite)

Bouffard et al. (2010, 2012)
Escudier et al. (2013)
Heslop et al. (2013)
Ruiz et al. (2009a,b, 2012)
Pascual et al. (2010, 2013, 2015)
Tintoré et al. (2013)
Mason et al. (2014)
Troupin et al. (2015)
Juza et al. (2015)

60 glider missions
From 2006 to 2015 in the Wmed

12753 nautical miles - 1081 days
33069 full CTD casts
+ oxygen, chlorophyll, turbidity
(from surface to 200m or 1000 m)
MedSub project

Understanding meso and submesoscale ocean interactions to improve Mediterranean CMEMS products (MedSUB)

Objective:

Improve our understanding of ocean circulation (2D and 3D) associated with oceanic mesoscale and submesoscale features (e.g., fronts, meanders, eddies, and filaments) through the combined use of in-situ and satellite data in synergy with numerical models.

Improve the CMEMS products based on new understanding of the mesoscale and fine-scale ocean circulation.
CMEEMS products


- IBI_ANALYSIS_FORECAST_PHYS_005_001_b: Atlantic-Iberian Biscay Irish ocean physics analysis and forecast (1/36, ~2 km) March 2013-March 2016. Daily mean

- GLOBAL_ANALYSIS_FORECAST_PHYS_001_024 Global ocean 1/12 physics analysis and forecast (1/12, ~9 km) March 2013-March 2016. Daily mean. New version available since October 2016
CMEMS products

- SEALEVEL_MED_SLA_MAP_L4_REP_OBSERVATIONS_008_029: Mediterranean Sea L4 gridded maps rep sla

Complementary database

Multi-platform observations from IMEDEA and regional coastal observatories (e.g. SOCIB).

Argo floats  drifters  CTDs  gliders
Assessment of 2D ocean circulation from CMEMS products

Statistics from model-model and model-observations (altimetry, in-situ) inter-comparison

- Mean surface circulation and Eddy Kinetic Energy

- 2D eddy identification (position, radius, amplitude, azimuthal (geostrophic) speed.

Using sequential maps: eddy center and track.

Results: Mean Surface circulation –  Jan 2013 - Jan 2016

AVISO MDT

Altimetry

MFS MDT

GLO MDT

GLOBAL

MFS

IBI MDT

IBI
Results: EKE – Jan 2013- Jan 2016

AVISO EKE

Altimetry

MFS EKE

GLO EKE

GLOBAL

MFS

IBI EKE

IBI
Results: - New approach based on an eddy tracker

Standard approach based on statistic analysis (MDT, EKE, etc)

New approach to characterize and assess the mesoscale content of the models based on a automated eddy tracker tool.

i) Eddy identification and  ii) tracking
Results: 2D eddy identification and eddy properties
Results: 2D eddy identification and eddy properties

Eddy centers and tracks
Results: 2D eddy identification and eddy properties
Results: 2D eddy identification and eddy properties
Results: 2D eddy identification and eddy properties
Assessment based on particular events using in-situ observations from multi-platform experiments

Multi-platform experiments:
1. Eastern Alboran Sea
2. Balearic Sea
3. Algerian Basin
Assessment based on particular events using in-situ observations from multi-platform experiments

Alborex Multi-platform experiment
Eastern Alboran Sea, 25-30 May 2014

Pascual et al., FMS, 2017
Assessment based on particular events using in-situ observations from multi-platform experiments.
Assessment based on particular events using in-situ observations from multi-platform experiments

MFS-MFC Feedback
(Jenny Pistoia; Nadia Pinardi)

- Argo profiler in the red area? 3DVAR rebuilt a field westerly shifted.

- Representativeness error of different satellites (assimilation of multi-altimeter data)

SSH from MFS 30 May 2014 and drifter trajectories
Assessment based on particular events using in-situ observations from multi-platform experiments

key element: Interactions/feedbacks with CMEMS Monitoring and Forecasting Centers (MFC)

Contacts with MFC providers:

• MFS-MFC: Jenny Pistoia

• GLOBAL-MFC: Jean-Michel Lellouche, Romain Bourdalle, Guillaume Reffray

• IBI-MFC: Marcos García-Sotillo
Summary

• Eddy tracker represents a valuable additional tool: Implementation of this new tool will have a high impact and benefit for the CMEMS operational services since it enriches actual CMEMS products with additional properties of the 2D circulation.

  • Sub-regional analysis is needed to understand differences between the different models.

• Assessment of model outputs based on multi-platform experiments are contributing to understand/improve operational model forecasting systems.
  • Case of Alboran Sea (2014). Improvement in the new product (altimetry assimilation)
  • Key element: feedback between users and providers
Work in progress: Sub-regional and 3D composite analysis

Tracks of Cyclones (blue)/Anticyclones (red) 1998-2013

Based on ARMOR-3D

Subregional characterization of mesoscale eddies across the Brazil-Malvinas Confluence, J. Geophys. Res. (in press)
Work in progress: Sub-regional and 3D composite analysis

Tracks of Cyclones (blue)/Anticyclones (red) 1998-2013

Based on ARMOR-3D

Mason et al., JGR, 2017.

Regional topography

Sub-regional analysis

3D composite
Work in progress: Subregional and 3D composite

Approach to follow in MedSUB:
- ARMOR-3D for Med
- CMEEMS models

From Juza et al. (2015)
Thank you
Extra
Work packages

Tasks and subtasks

WP1
Task 1.1 Identification of CMEMS products from TACs and MFCs
Task 1.2 Compilation of complementary database (in-situ data from IMEDEA and regional observatories)

WP2
Task 2.1 Assessment of 2D ocean circulation from CMEMS products
SubTask 2.1.1 Statistics from model-model and model-observations inter-comparison, altimetry, in-situ, SST
SubTask 2.1.2 Assessment for particular events using in-situ observations from multi-platform experiments
Task 2.2 Assessment of 3D circulation from CMEMS products
Subtask 2.2.1 Estimation of new variables for fine scale processes

WP3
Task 3.1 Recommendations for CMEMS product improvements
• New derived variables to characterize fine scale processes.
• Feeding TACs with new observations
• About the use of high-resolution observations for data assimilation
• Design of multi-platform experiment to anticipate the impact of future high-resolution SWOT observations into the operational CMEMS MFCs systems
Results: 2D eddy identification and eddy properties