New insights on mesoscale activity in the western Mediterranean Sea

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INTRODUCTION

Motivation

Mesoscale eddies are key drivers of this variability, yet their observation (especially small-scale and coastal structures) has been limited by the resolution and coverage of conventional altimetry.

Objective

Evaluate the new SWOT-integrated product compared to the current CMEMS velocity dataset in the western Mediterranean, a region with a relatively small Rossby radius of deformation.

DATA

DUACS-OI

- Daily, 1/8˚
- Temp. coverage: 01/01/22 - 25/11/24
- Interpolation method: optimal interpolation
- NRT and DT (MY) dataset from CMEMS

MIOST-K

- Daily, 1/8˚
- Temp. coverage: 27/07/23 - 31/12/24
- Interpolation method: MIOST
- From AVISO, includes SWOT KaRIn, v2.0.1

METHODS

1. Py-eddy tracker
2. Lagrangian simulations with OceanParcels

RESULTS

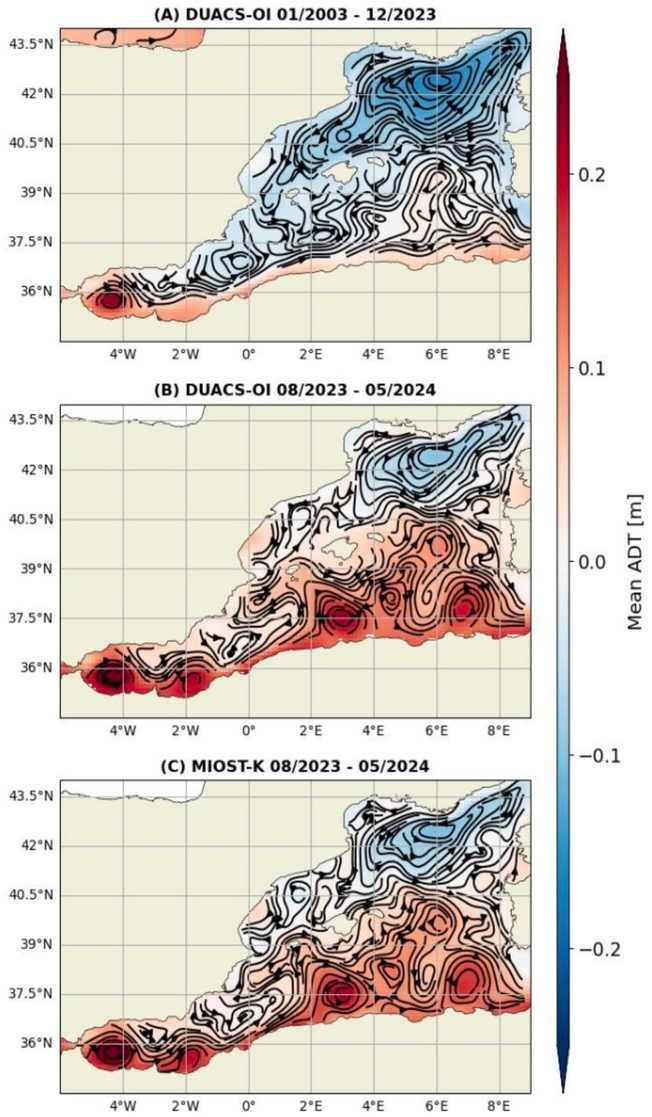

Fig. 1: General circulation represented by the mean Absolute Dynamic Topography (ADT) and the mean velocity field (streamlines) calculated from the different altimetric products: (A) 20 years mean from DUACS-MY, (B) 17 months mean of DUACS-NRT and (C) 17 months mean of MIOST-K.

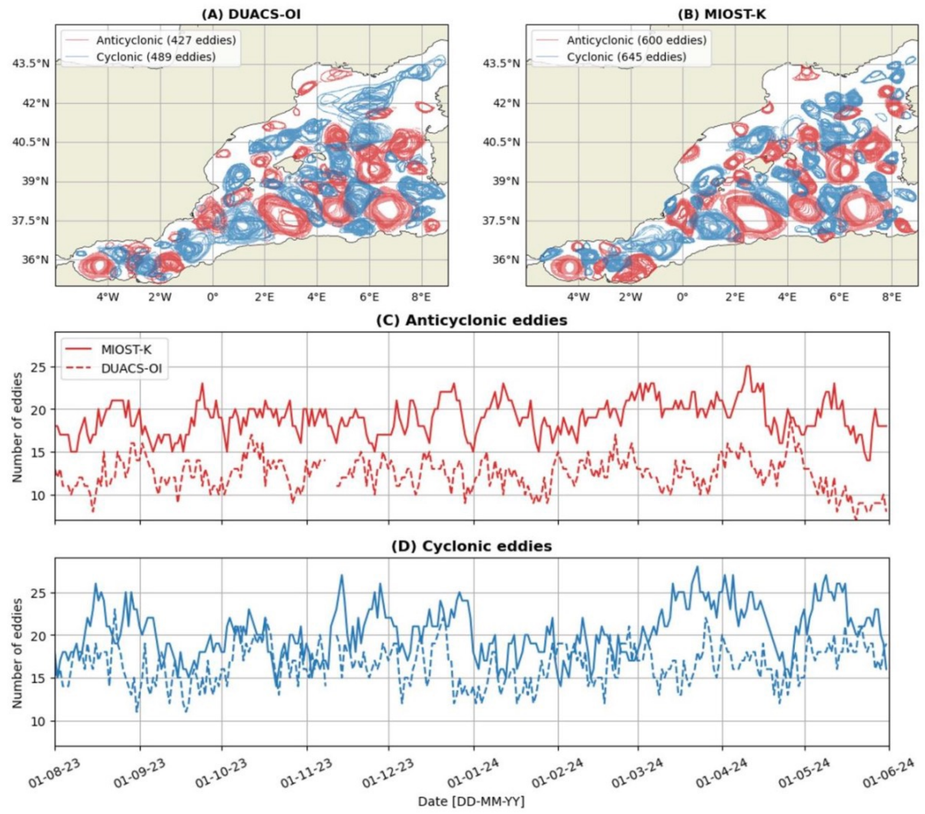

Fig. 2: Number of daily eddy identifications. Panels (A) and (B) show all the daily eddies (outer contours) identified during April 2024 for DUACS-OI and MIOST-K, respectively. Panels (C) and (D) show the temporal variability of the anticyclones and cyclones, respectively, identified throughout the study period.

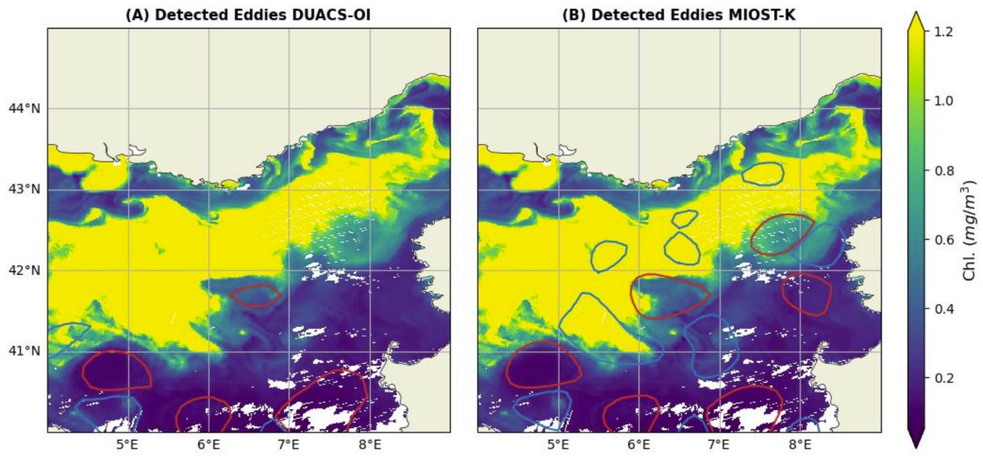

Fig. 5: Chlorophyll fields (Chl.) on 02/04/24 with the corresponding eddy effective contours (anticyclonic red, cyclonic blue) for DUACS-OI (A) and MIOST-K (B).

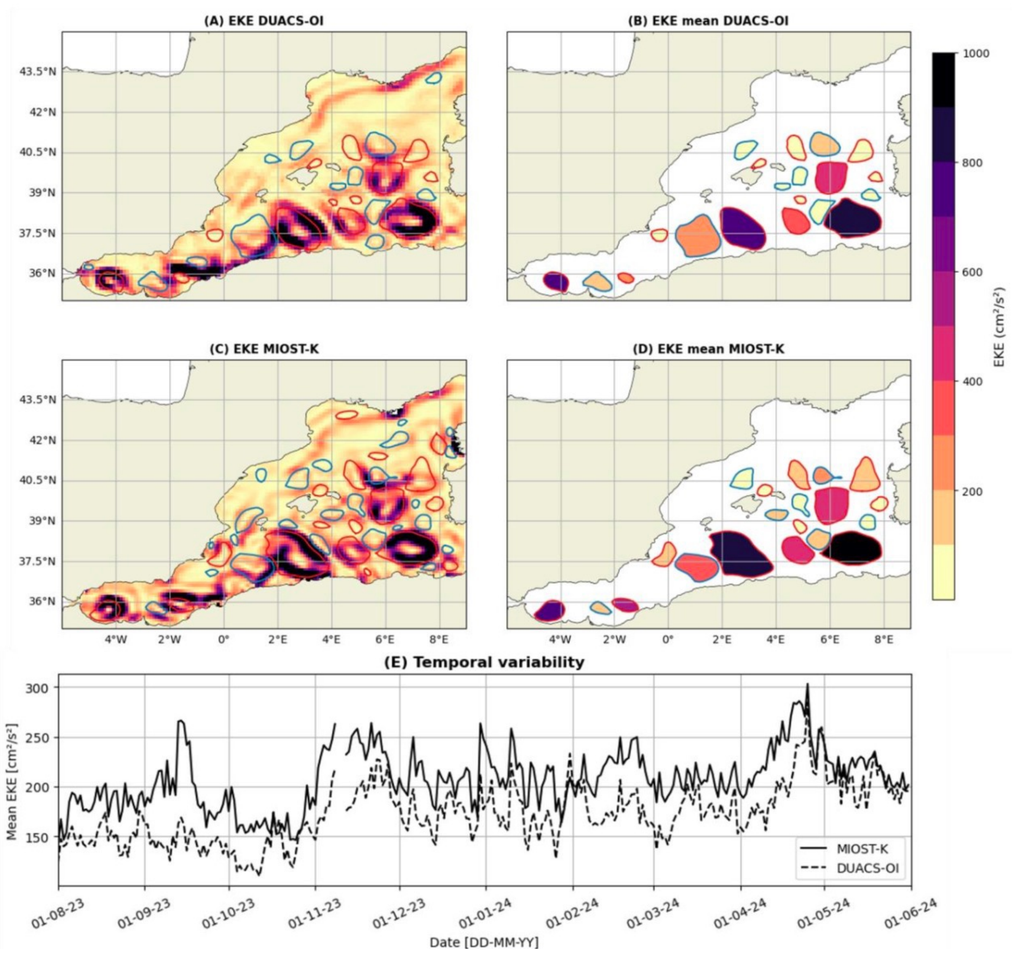

Fig. 3: Temporal variability of the mean Eddy Kinetic Energy (EKE) associated with the detected eddies. Panels (A) and (C) show the EKE field on 20/04/2024 and all the identified (outer eddy contours) anticyclones (red) and cyclones (blue) for DUACS-OI and MIOST-K, respectively. Panels (B) and (D) show the associated mean EKE of only the eddies identified on both datasets. (E) shows the mean EKE temporal variability for DUACS-OI (dashed) and MIOST-K (solid).

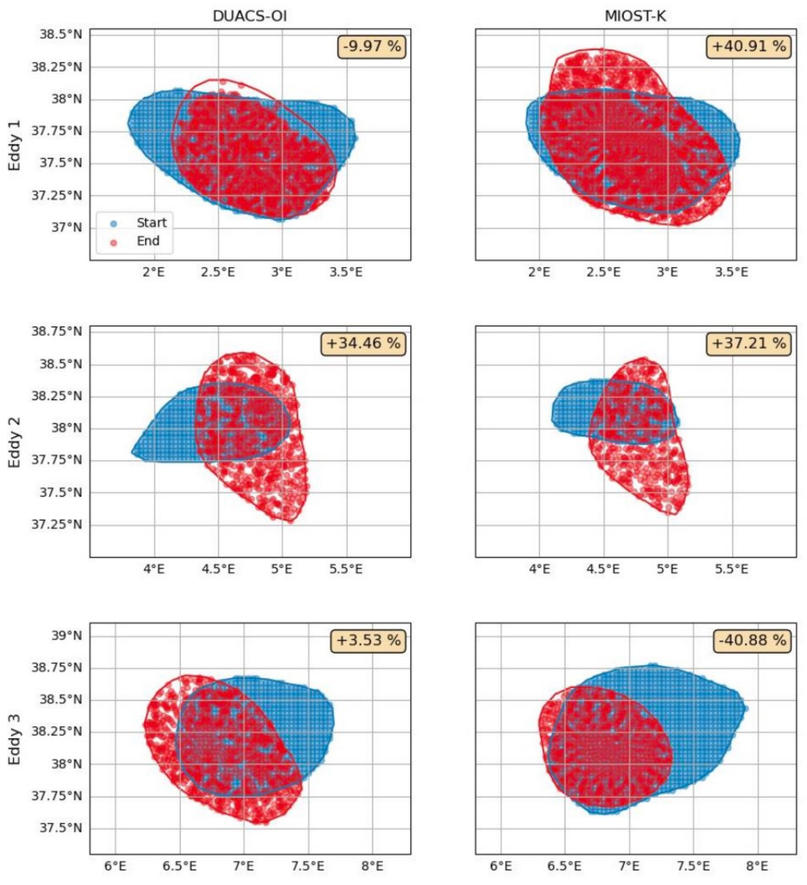

Fig. 4: Eddy retention capacity of three Algerian Eddies examples for DUACS-OI (left panels) and MIOST-K (right panels). Blue (red) particles and contours (inner eddy contours) correspond to the initial (final) dates. Only particles inside the eddy contours are shown. The top right box indicates the eddy retention percentage, with positive (negative) values indicating retention (leakage).

CONCLUSIONS

- The SWOT-KaRIn dataset reveals differences in eddy number and also their characteristics compared to previous CMEMS data.
- EKE of MIOST-K is higher than DUACS-OI throughout most of the study period
- Important differences detected in eddy representation, particularly Algerian Eddies, affects derived retention capacity and transport pathways between North Africa and the Balearic Islands.
- SWOT-KaRIn datasets (MIOST-K) can help improve ocean monitoring, climate studies, and marine ecosystem management, enhancing our ability to observe and predict mesoscale dynamics.

Link to GitHub repository and preprint here:

This study is part of the Ocean State Report 10.

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