ATLAS OF EDDIES IN MEDITERRANEAN SEA FROM SATELLITE IMAGERY

Briac Le Vu [1]*, Alexandre Stegner [1] and Thomas Arsouze [2]
[1] LMD - Ecole Polytechnique, Paliseau, France - briac.le-vu@lmd.polytechnique.fr
[2] UME - ENSTA-ParisTech, Palaiseau, France

Abstract
We present an atlas of surface eddies in Mediterranean sea from 2000 to 2015 with their features: trajectory, size and intensity and also the main area of formation for long-lived eddies. The atlas is build from the Absolute Dynamical Topography (ADT) satellite imagery (AVISO 1/8°) thanks to a new automated eddy detection and tracking algorithm based on the computation of the LNAM (Local and Normalized Angular Momentum).

Keywords: Remote sensing, Mesoscale phenomena, Mediterranean Sea

Introduction

The increasing of resolution in regional model configurations allows to improve mesoscale processes which need to be evaluated at the basin scale. In this context we have developed an automated algorithm able to detect and track eddies from a wide diversity of oceanic velocity with distinct spatial resolution like satellite imagery and numerical models. Thanks to AVISO products[1], providing for the whole Mediterranean sea a time series of ADT at relatively high resolution (1/8°), the main eddies typical features and also formation areas from 2000 to 2015 are computed using the method.

Data

We use the geostrophic velocity fields distributed regional product for the mediterrannean sea derived from the Absolute Dynamical Topography (ADT). This regional product for the mediterrannean sea combines satellite altimetry up-to-date datasets with up to four satellites at a given time, using all missions available at a given time (Topex/ Poseidon, ERS-1 and -2, Jason-1 and -2, Saral, Cryosat-2 and Envisat missions). This merged product is projected on a 1/8° Mercator grid, in time intervals of 24 hours. The horizontal resolution of the 1/8° gridded velocity fields (13km) cannot fully resolve the internal deformation radius which is around $R_d = 8 - 12$km in the Mediterannean sea but is still less coarse than the 1/4° global product.

Method

The method is an improvement of the method by Mkhinini et al.[2], where we remove any geometric parameters. The principle of the method is to avoid the tuning of criteria as usually done in other methods which use the Okubo-Weiss parameter[3] or geometric parameter[4]. To fix parameters we performed several sensitivity test[5] on different velocity fields (satelitte imagery, idealized model, experimental cylindric tank). The only necessary condition is to provide the grid resolution of the velocity field and the typical deformation radius for the regional oceanic area or the experimental field.

3 consecutive steps compose the algorithm:

1) LNAM computation from velocity field to detect centers. This is a key step describe in Mkhinini et al. [2] to identify the centers of rotation in any velocity field and differenciate hyperbolic and elliptic point.

2) Eddy shapes with features computation for eddy centers surrounded by closed streamlines. This is a more classical step. The eddy's edge is the streamline with the higher mean velocity. This is arbitrary but has the advantage to directly provide the Rossby number.

3) Finally eddy tracking is performed by minimizing a coast function depending on difference between centers and features at different time steps [6].

Results

The algorithm applied to the 15 years ADT time serie point out 18900 eddies with 65% are less than 1 month life length. The number of cyclones dominate (60%) but for eddies older than 8 months the proportion between cyclone and anticyclone is equilibrated. Even if the averaged age for cyclones and anticyclones are identical (40 days) the older are antycyclones (11 anticyclones are more than 2 years old but only one cyclone). Also the mean size is similar for cyclones and anticyclone (20km) as well as the rotating speed (10cm/s).

The spatial distribution of the formation area for long-lived anticyclones more than 6 months (figure 1) confirms where the well known anticyclone usually take place (Iera Petra, Lybia, Cyprus, Alboran). Whereas the formation area for long-live cyclones (not shown) is often located at the deep sea water convecting area (Gulf of Lion,...).

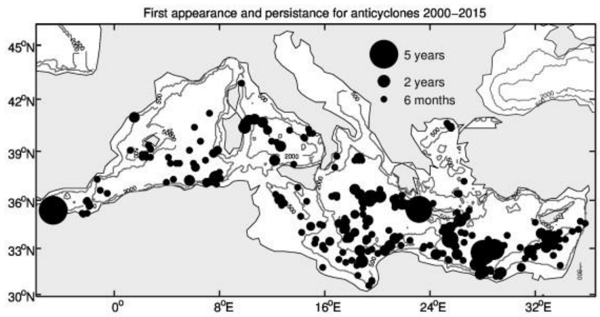

Fig. 1. First detection between january 2000 and december 2015 of long-life anticyclones.

Acknowledgements

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