Ocean Surface currents climatology in North Western Mediterranean Sea

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The marine upper layer is basically controlled by wind stress and sun heating with a high temporal variability from the wind gusts to diurnal and seasonal signals, up to climatic time scales. This so called "mixing" or "euphotic" layer constitutes a major source of uncertainty of predictive coupled Ocean - Atmosphere models for both climatic and pollutant or biogeochemical dispersion applications.

Tridimensional analyses of spatio-temporal variability of the sea surface currents, temperature, salinity and sea level have been performed in North Western Mediterranean sea from available pluri-annual data bases of surface currents when measured both in horizontal direction by HF radar mapping [1] and in the vertical from acoustic Doppler current profilers on fixed moorings and drifted buoys [2]. In complement, meteorological and sea state data [3] and high precision sea level probes [4] have been deployed in the framework of the HTM-NET network.

Basic processes occurring in the ocean surface layer in the dedicated microtidal site are considered to explain observed inertial motion, Ekman layer, vortex formation, surface and internal waves fields and sea level [5].

Three main purposes are addressed here concerning i) databases analysis in the objective of detecting rare and extreme events, ii) revisiting physical processes including instabilities and iii) identification of turbulent models parameters commonly used in ocean circulation models.

Extreme and rare events

Data processing techniques based on dynamic systems [6,7] have are applied to identify rare and extreme events in plurennial series of data in the marine surface layer.

Physical processes

This investigation is focusing on the Ekman layer from high resolution vertical profiles of horizontal velocity (Fig. 1) and surface currents maps (Fig2). Spatio-temporal evolution of the Ekman spiral as documented in wind events is investigated by reference to the unsteady Ekman solution [8].

Turbulence models identification

The sensitivity of the velocity profiles to eddy viscosity distribution is investigated using stochastic optimal control techniques based on Simultaneous Perturbation Stochastic Approximation method [9], with and without stratification.

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References

1. J. Marmain, A. Molcard, P. Forget, A. Barth, and Y. Ourmières, *Nonlin. Processes Geophys*., 2014, **21**, 659-675
2. A. Sentchev, P. Forget, P. Fraunié, *Ocean Dynamics*, 2017, **67**, 3-4.
3. D. Bourras et al, *J. Geoph. Res.,* submitted.
4. V. Shrira, P. Forget, *J. Phys. Oceanogr.,* 2015, **45**(10), 2660-2678
5. V. Rey, G. Rougier, D. Mallarino, C. Dufresne, I. Taupier-Letage, *XVèmes Journées Nationales Génie Côtier – Génie Civil*, La Rochelle, 2018.
6. D. Faranda and S. Vaienti, *Geophysical Research Letters*, 2013, **40**:1-5.
7. D. Faranda and S. Vaienti, *Chaos*, 2018, **28**, 0411103.
8. V. W. Ekman, *Arch. Math. Astron. Phys.*, 1905, **2**, 1–52.
9. C. Aldebert, G. Koenig, M. Baklouti, P. Fraunié, and J.L. Devenon, submitted.

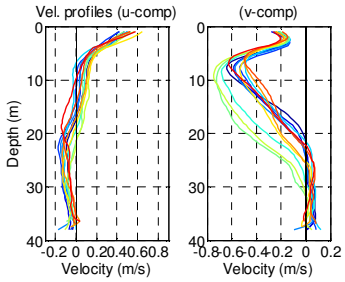

Fig. 1. Horizontal velocity profiles in the surface layer during a wind event

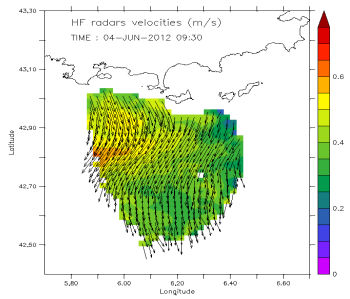

Fig. 2. HF radar surface currents map during the field experiment.