DYNAMICS OF THE NORTH BALEARIC FRONT WITH SATELLITE DATA, IN-SITU DATA AND A HIGH-RESOLUTION AIR-SEA COUPLED MODEL : A CASE-STUDY FROM HYMEX IOP16

Léo Seyfried [1]*, Claude Estournel [1], Patrick Marsaleix [1] and Evelyne Richard [1]
[1] Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, Toulouse, France - leo.seyfried@aero.obs-mip.fr

Abstract
The objective of this study is to describe the dynamics of the North Balearic Front during a strong wind event (SWE) of Mistral and Tramontane. This study focus on an Intensive Observation Period (IOP16), of the HyMeX program, dedicated to SWE. During this SWE the SST shows a rapid displacement of the surface front to the south (50-60 km in 7 days). As satellite data shows only a partial view of the frontal dynamics, in order to better understand this process, a new high resolution air-sea coupled model (Meso-NH - SURFEX - Symphonie) was used at kilometric scale and in-situ data collected during HyMeX program were analysed.

Keywords: Air-sea interactions, Fronts, Models, North-Western Mediterranean

The North Balearic Front forms the south branch of the cyclonic gyre [1] of the North Western Mediterranean Sea (NWMS). This front separates the Atlantic Water (AW) present in the south of the basin from the Modified Atlantic Water (MAW) to the North. The cyclonic gyre plays a major role on the oceanic deep convection observed in NWMS [2].
This study focuses on an Intense Observation Period (IOP16) of the first Special Observation Period (SOP1) [3] of the HyMeX program (http://www.hymex.org). IOP16 starts on 25 October 2012 and ends three days later. Its first phase was dedicated to the study of an Heavy Precipitation Event (HPE). The consequence of this event was clear on the surface salinity measured at the Lion buoy (4.64E - 42.06N) the 26 October (Fig. 1.). The second phase of the IOP was dedicated to the study of an SWE (Tramontane and Mistral) with wind velocities up to 26m.s-1 at the Lion buoy (Fig. 1.). The SWE produced a sea surface temperature drop of 4°C in few hours (Fig. 1.).

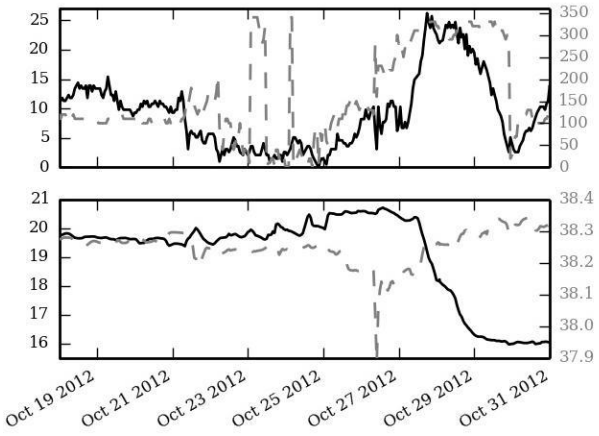

Fig. 1. Time series of surface parameters measured at the Lion buoy. Top : Wind speed in black line and wind direction in gray dashed line. Bottom : Sea surface temperature in black line and sea surface salinity in gray dashed line.

The HyMeX in-situ data have been completed by gliders observations of the MOOSE (http://www.moose-network.fr) and SOCIB (http://www.socib.eu) French and Spanish monitoring programs. Fig. 2 shows the position of all in-situ data available from 16/10/2012 to 06/10/2012 as well as the positions of the North Balearic Front derived from satellite SST [4] for three differents days (18/10/2012, 24/10/2012 and 31/10/2012). Before the SWE (between 18 and 24 October) the front moved to the North. This is confirmed by in-situ surface temperature and salinity measurements at the Lion buoy (Fig. 1.). During the SWE (from 24 to 31 October the satellite data showed a rapid displacement of the surface front to the south (50-60 km in 7 days).

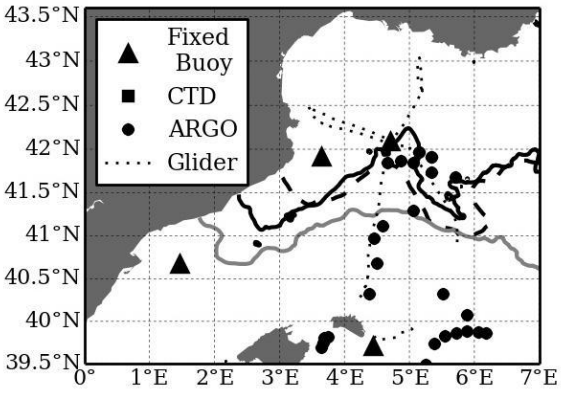

Fig. 2. Positions of the in-situ measurements (Fixed buoy, CTD, ARGO, Glider) represented with symbols and positions of the North Balearic Front obtained with satellite SST for different days (18 October : black dashed line, 24 October: black solid line and 31 October : gray line).

To better describe the frontal dynamics during SWE, we used an approach combining satellite data, in-situ data and an air-sea coupled model at kilometric scale based on the Meso-NH atmospheric model [5], the SURFEX surface model [6] and the Symphonie oceanic model [7] coupled with OASIS3-MCT coupleur [8]. Sensitivity studies of this coupled model to initial conditions, coupling frequency, air-sea fluxes parameterizations ...) were performed and discussed.

References

1 - Millot C., 1999. Circulation in the western mediterranean sea J. Mar. Syst., 20 (1–4), pp. 423–442.
2 - Marshall J., and Schott F., 1999. Open-ocean convection: Observations, theory, and models, Rev. Geophys., 37(1), 1–64.
3 - Ducrocq V., et al., 2014. Hymex-sop1: the field campaign dedicated to heavy precipitation and flash flooding in the northwestern mediterranean. Bull. Amer. Meteor. Soc., 95, 1083–1100.
4 - Buongiorno Nardelli B., et al., 2013. High and Ultra-High resolution processing of satellite Sea Surface Temperature data over Southern European Seas in the framework of MyOcean project, Rem. Sens. Env., 129, 1-16.
5 - Lafore J. P., et al., 1998. The Meso-NH Atmospheric Simulation System. Part I: Adiabatic formulation and control simulations. Annales Geophysicae, 16, 90-109.
6 - Masson V., et al., 2013. the SURFEXv7.2 land and ocean surface platform for coupled or offline simulation of earth surface variables and fluxes, Geosci. Model Dev., 6, 929-960.
7 - Marsaleix P., et al., 2008. Energy conservation issues in sigma-coordinate free-surface ocean models. Ocean Modelling. 20, 61-89.
8 - Valcke S.,et al., 2015.OASIS3-MCT 3.0, Technical Report, TR/CMGC/15/38, CERFACS/CNRS SUC URA No 1875, Toulouse, France.