CALYPSO - an operational network of HF radars for the real-time monitoring of surface currents in the Malta-Sicily Channel

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EXTENDED ABSTRACT

Following the case in several other areas of the Mediterranean basin, the Sicily Channel is under pressure due to 1) significant migration fluxes (Figure 1, left panel); and 2) intense traffic of commercial vessels (right panel).

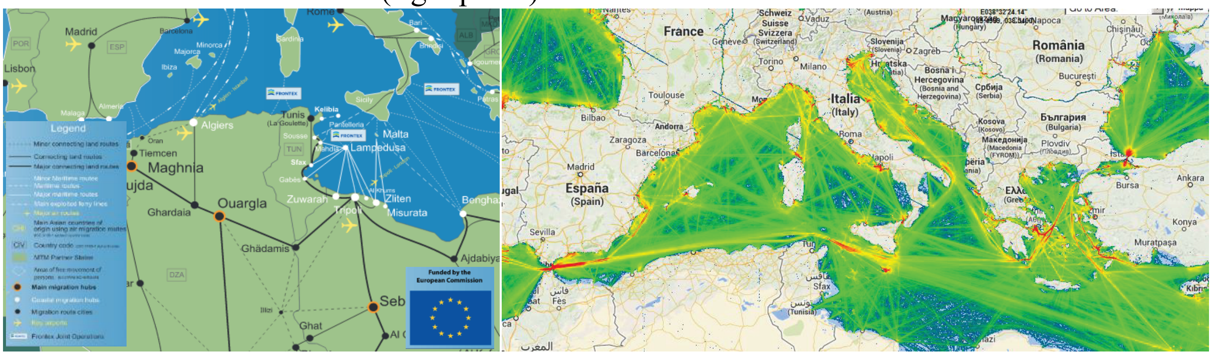

Figure 1. Immigration fluxes along the Central Mediterranean and East Africa Routes (left panel; source: 2012 MTM Mao on Irregular and Mixed Migration Routes); and, vessel traffic density map at 11 UTC of 11th April, 2014 (source: https://www.marinetraffic.com/it/).

Illegal migration often results in dramatic loss of lives that can be avoided with timely Search and Rescue (SAR) interventions; such SAR services require accurate information such as on sea-state and operational tools such as trajectory forecasting for floating objects at sea. The maritime transport of oil crossing this region accounts for 25% of the global maritime traffic and for nearly 7% of the world oil accidents over the last 25 years. In combination with localized oil extraction plants existing in the shelf zones this situation presents a serious threat to both the open-sea and coastal-zone habitats, with consequent impacts on local economic activities as tourism and fisheries, impacts on ecosystems and losses in revenue. In the case of both accidental/deliberate oil spills or drifting-vessel emergency, an operative response chain must include both the detection and the trajectory prediction steps, that take advantage of the most appropriate methodologies and data availability such as: updated meteorological information, near-surface current measurements, and hydrodynamic models with oil spill weathering processes modules. Indeed, both the knowledge of initial positions and an accurate, effective and prompt prediction of their future pathways are of fundamental importance to optimize response activities, shortening the intervention time and increasing their efficacy. In the particular case of oil spills, the knowledge of spill trajectories is very important to anticipate impacts on economic and environmental assets on threatened coasts; the provision of accurate information to decision makers together with training in best practices and damage recovery methods need to be adopted in order to minimize spill impacts.

In this framework, a reliable knowledge of sea-surface currents is a fundamental prerequisite. In both cases of SAR and pollutant mitigation, the detection process is just the first step in the response chain, whereas the most important steps deal with interception and mitigation. Hydrodynamic numerical models require forcing data from other numerical models, that provide the proper meteorological forcing and the initial and boundary conditions. Computer models are however prone to errors due for instance to parametrization of subgrid scale processes. Numerical models can be improved if actual measurements that can map the spatial distribution of the sea surface currents is provided. Indeed, observed sea surface currents can be used i) to provide boundary and initial conditions; ii) for calibrating / validating hydrodynamic numerical models; iii) within a data assimilation process, to drive or correct the model outcome. High-Frequency (HF) coastal radars provide useful information to support sea safety and monitoring, as they are capable of measuring sea-surface currents with high temporal (10 minutes – 3 hours) and spatial (500 m – 6 km) resolution. Designed originally for research purposes, their use ranges from search-and-rescue activities to water quality monitoring in coastal regions where, for instance, wastewater treatment and industrial plants could affect the health of the sea. The use of HF radars is nowadays well established worldwide: sea surface currents on both the eastern and western coasts of the United States are continuously monitored through HF radar networks. In Europe, the number of installations is increasing: several HF networks were already installed in Galicia (North-west Spain), Ría de Vigo (Galicia, Spain), Strait of Gibraltar, Iberian Peninsula, Irish Sea and Northern Scotland. Recently, a network of HF radars was installed in the Malta-Sicily Channel, as part of the CALYPSO project (www.capemalta.net/calypso), conducted under the partial fundingof the EU 2007-2013 Italia-Malta Programme. This project involved the University of Malta (Physical Oceanography Unit, IOI-Malta Operational Centre, in the role of Lead partner), the University of Palermo (Sicilian project focal point), and the expert advice of the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS). The CALYPSO network is providing hourly sea surface current maps with a spatial resolution of 3 km since September 2012 (Figure 2).

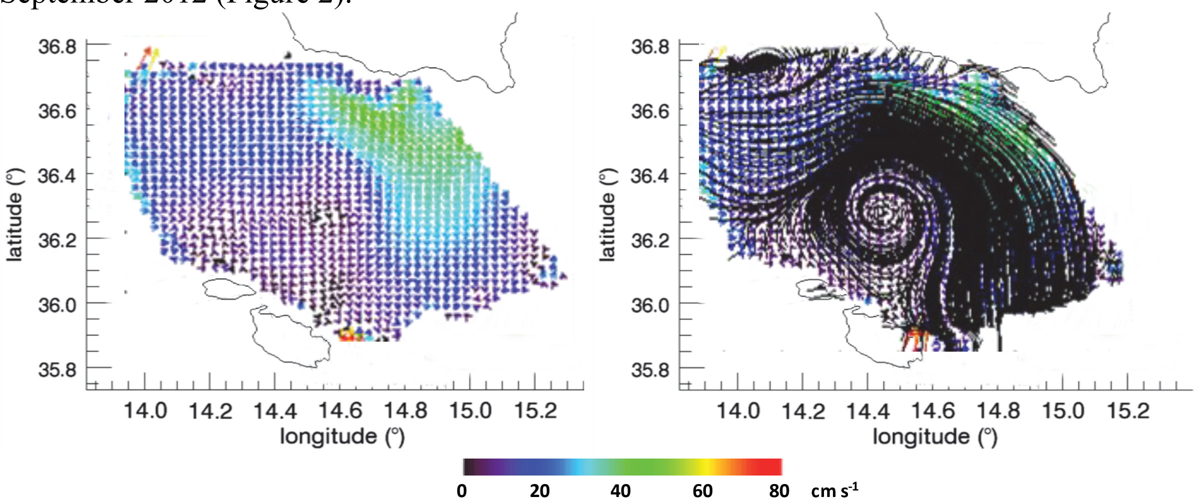

Figure 2. Average currents between 1 and 31 of January, 2014 (left panel) and their streamlines (right panel).

Here in this paper we provide a general review of data collected by the CALYPSO (CALYPSO-HF Radar Monitoring System and Response against Marine Oil Spills in the Malta Channel) system, its validation by means of *in situ* current data collected during 2012-2014 both by drifters and ADCP (Acoustic Doppler Current Profiler), also showing the importance of circulation processes at larger scale on the local dynamics in the Malta-Sicily Channel.