CALYPSO South – Extending the operational network of HF radars

Vision, present areas of application and future plans
Wider perspective for an Integrated Ocean Observing System for the Maltese islands

Project coordinated by the

Physical Oceanography Research Group

Department of Geosciences

University of Malta

Prof. Aldo Drago

Project Leader

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CALYPSO South Partners

L-Università ta' Malta · Università degli Studi di Palermo · Transport Malta · ARPA Sicilia – Agenzia Regionale per la Protezione dell'Ambiente · IAMC Istituto per l'Ambiente Marino Costiero – Consiglio Nazionale delle Ricerche

Interreg Italia-Malta Calypso South

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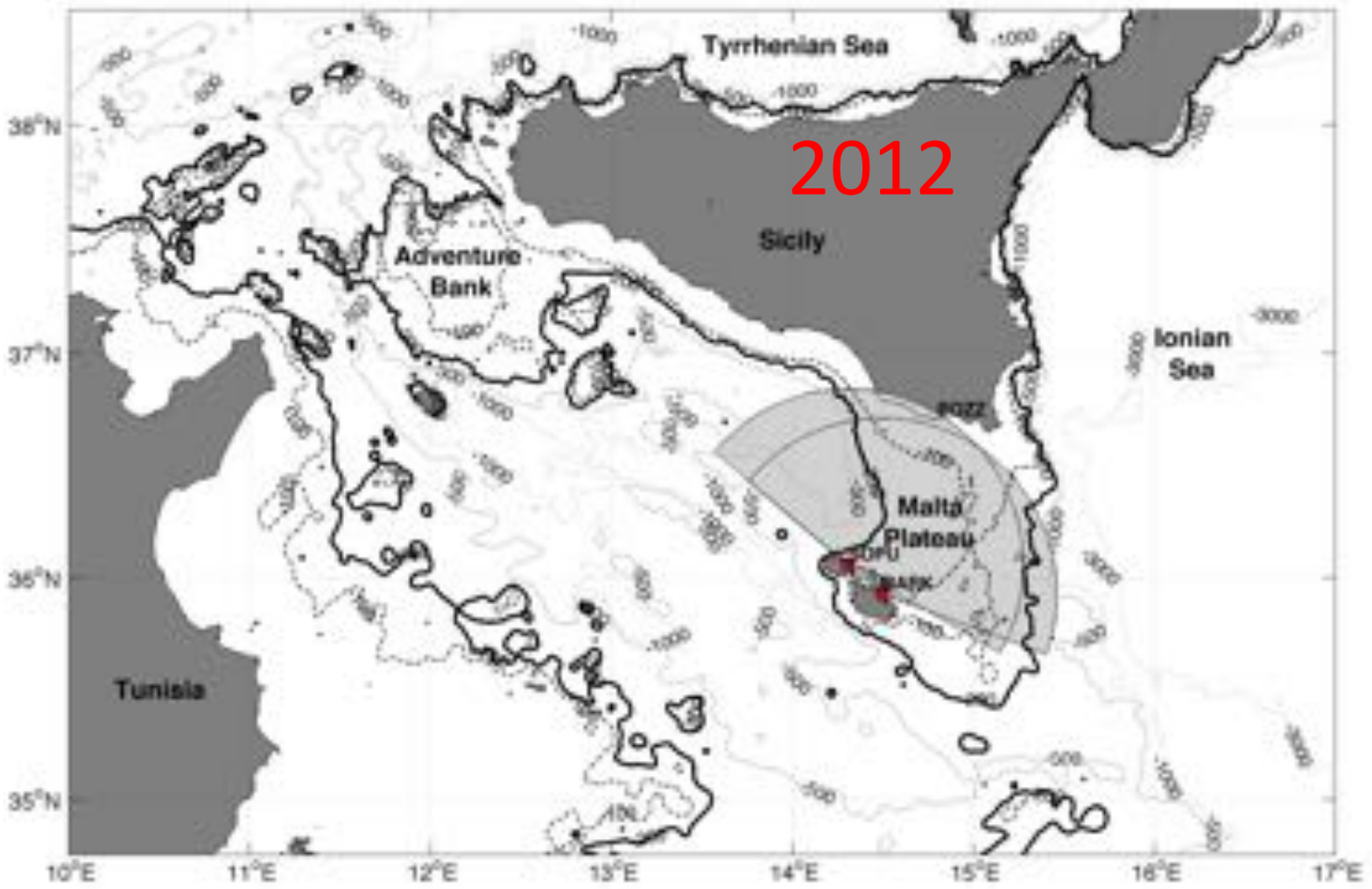
Project partners

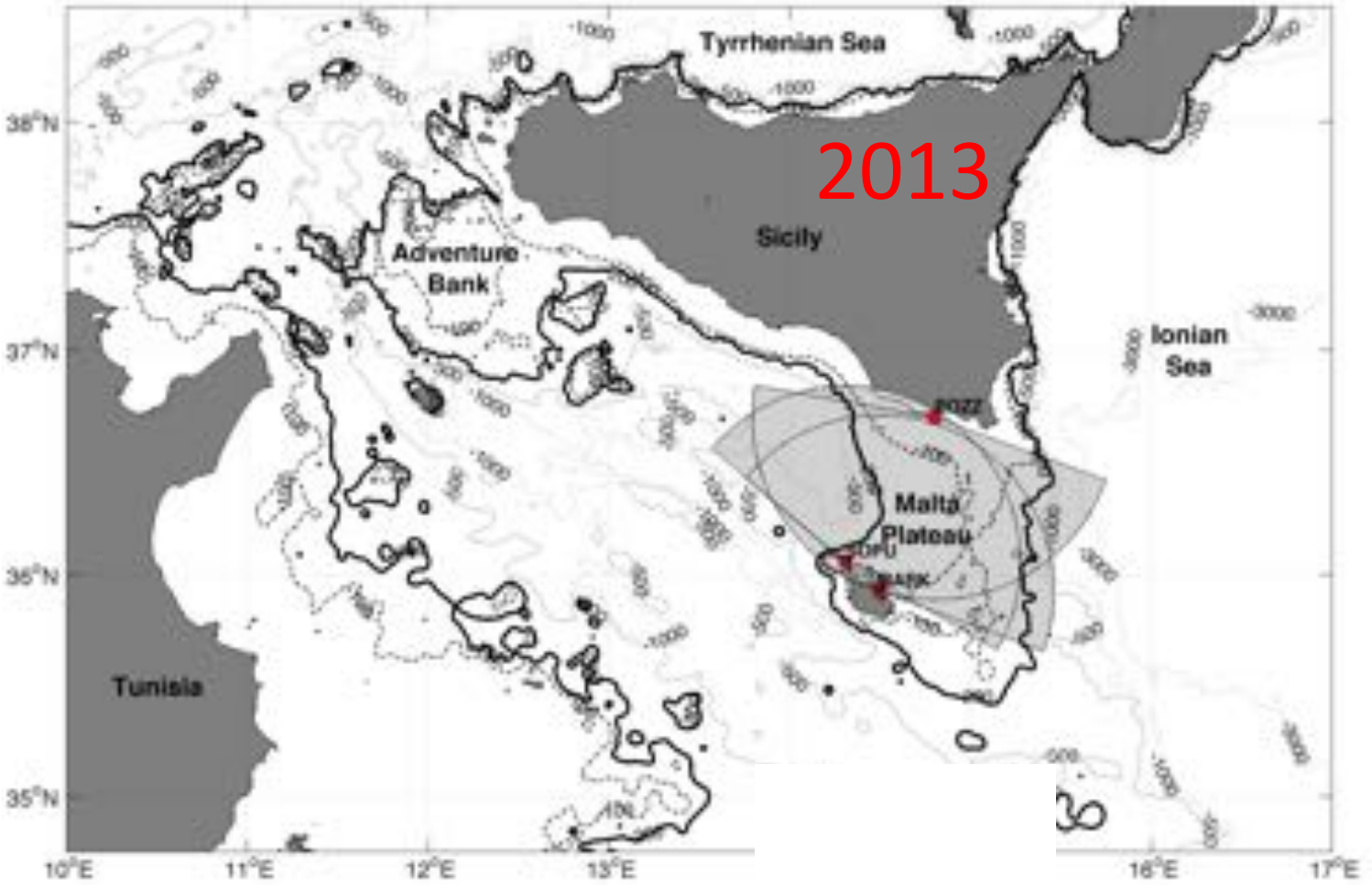
Interreg Italia-Malta Calypso South
Fondo Europeo di Sviluppo Regionale
European Regional Development Fund

- University of Malta (UOM)
- Universita' degli Studi di Palermo (UNIPA)
- Transport Malta (TM)
- Universita' di Catania (UNICT)
- Agenzia Regionale per la Protezione dell'Ambiente della Sicilia (ARPA Sicilia)
- Istituto per l'Ambiente Marino Costiero - Consiglio Nazionale delle Ricerche Sede Secondaria di Capo Granitola (IAMC-CNR)
- Civil Protection Department (CPD)

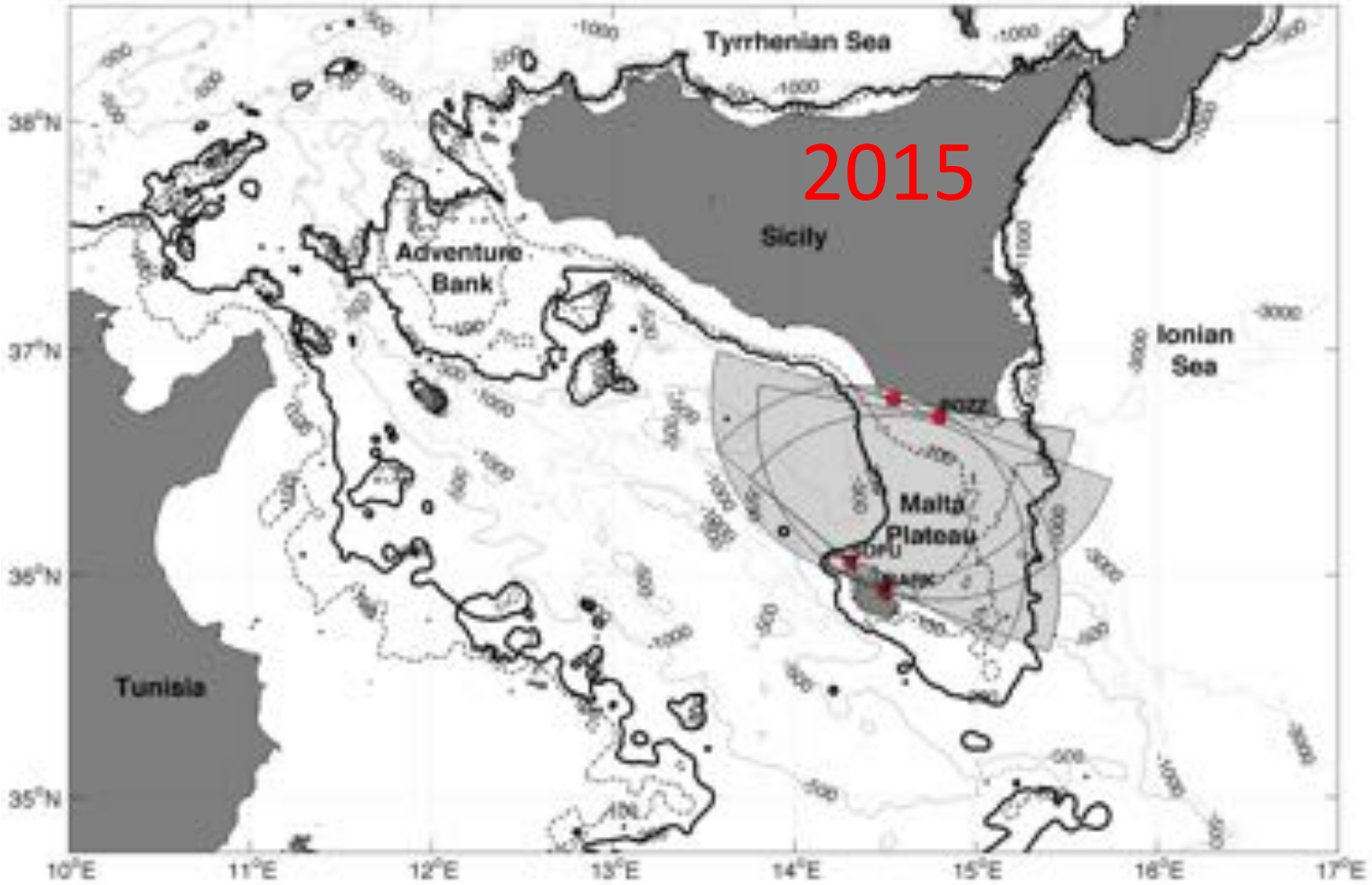
HF Radar network History in Malta



HF Radar network History



HF Radar network History



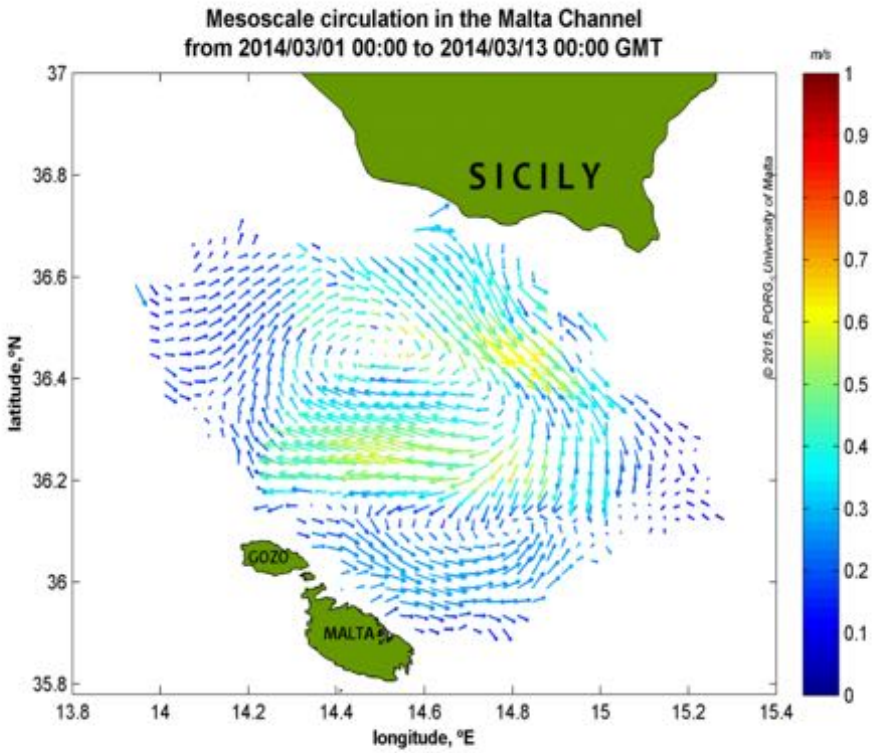
Success of CALYPSO

Operational oceanography in practice

Mapping *sea surface currents*
in real-time
with hourly updates

at 3 km of spatial resolution

in the Malta-Sicily Channel



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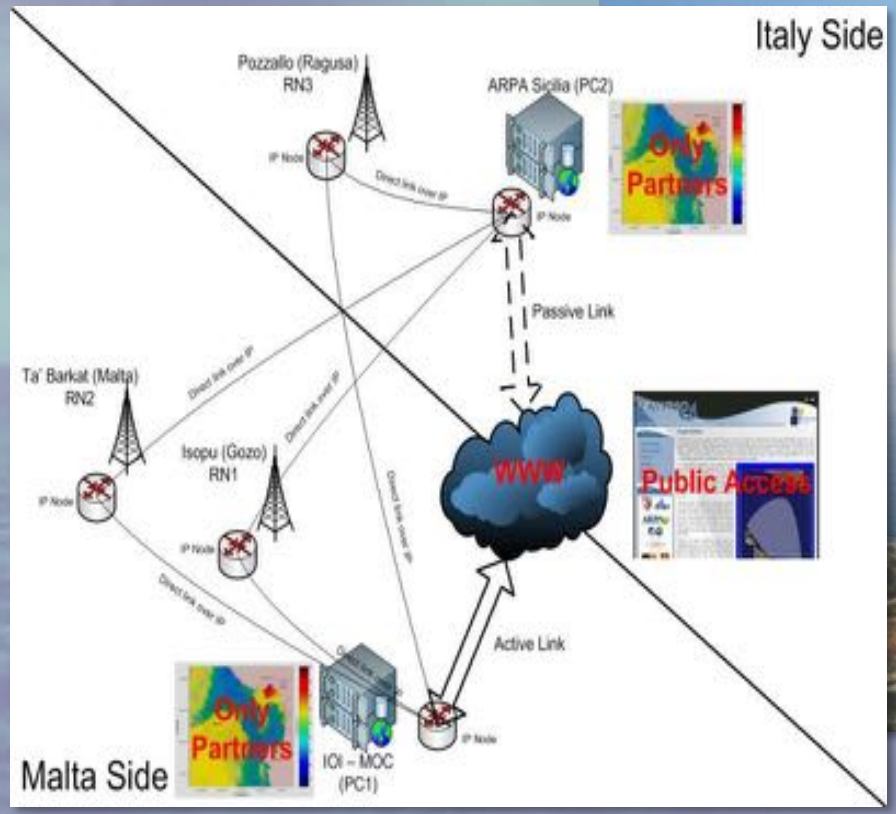
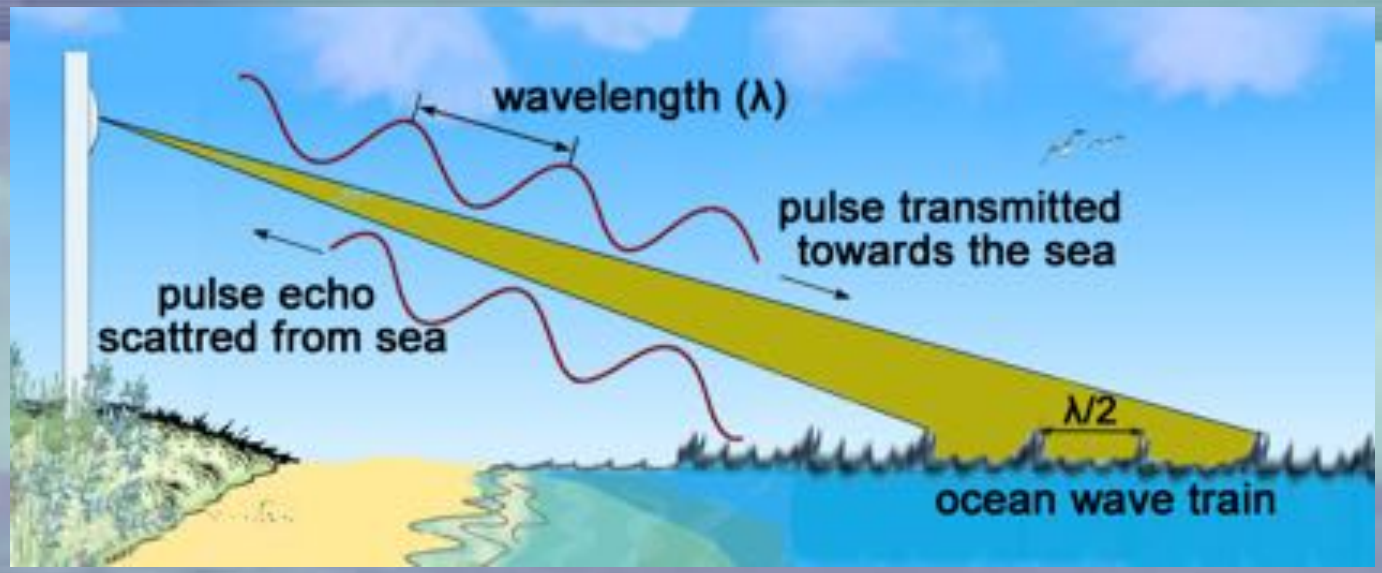
HF radars in Malta Channel



Existing radars are composed of single transmit/receiver systems or a separate line array of receivers

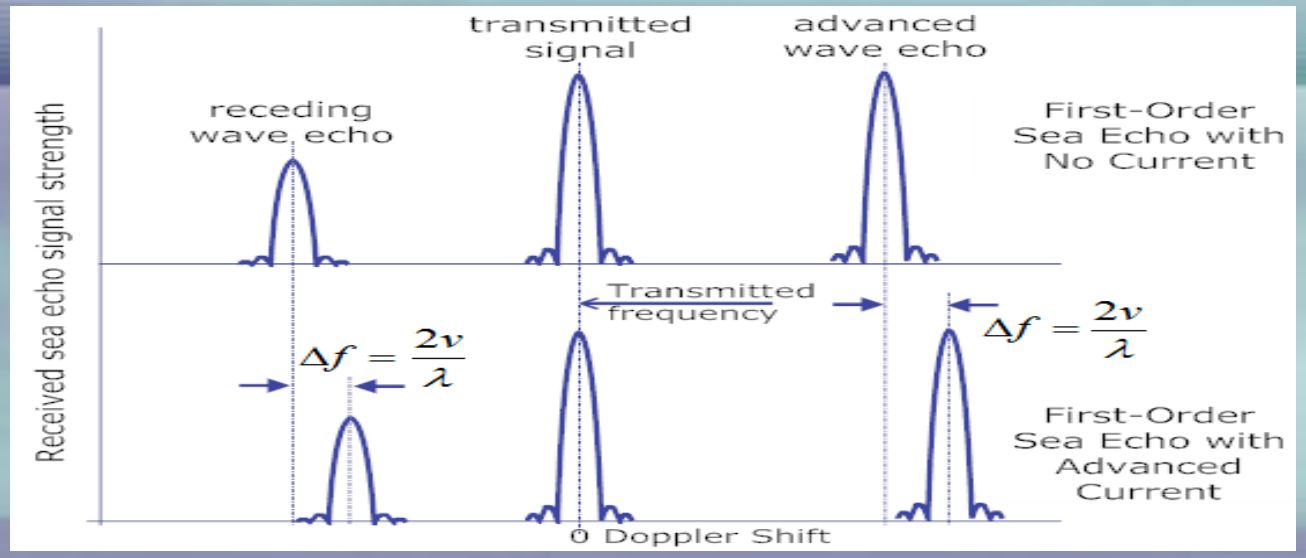
How it works



Vertically polarised radar signal propagates onto the water in a radial path;
It is scattered in many directions with the sea surface acting like a large diffraction grating.

Bragg's principle: the radar signal produces an echo returning directly to its source only when the signal scatters off a sea wave with a wavelength that is exactly half the wavelength of the transmitted radio signal, and when the sea wave is travelling in a radial path either directly away from or towards the radar.

How it works



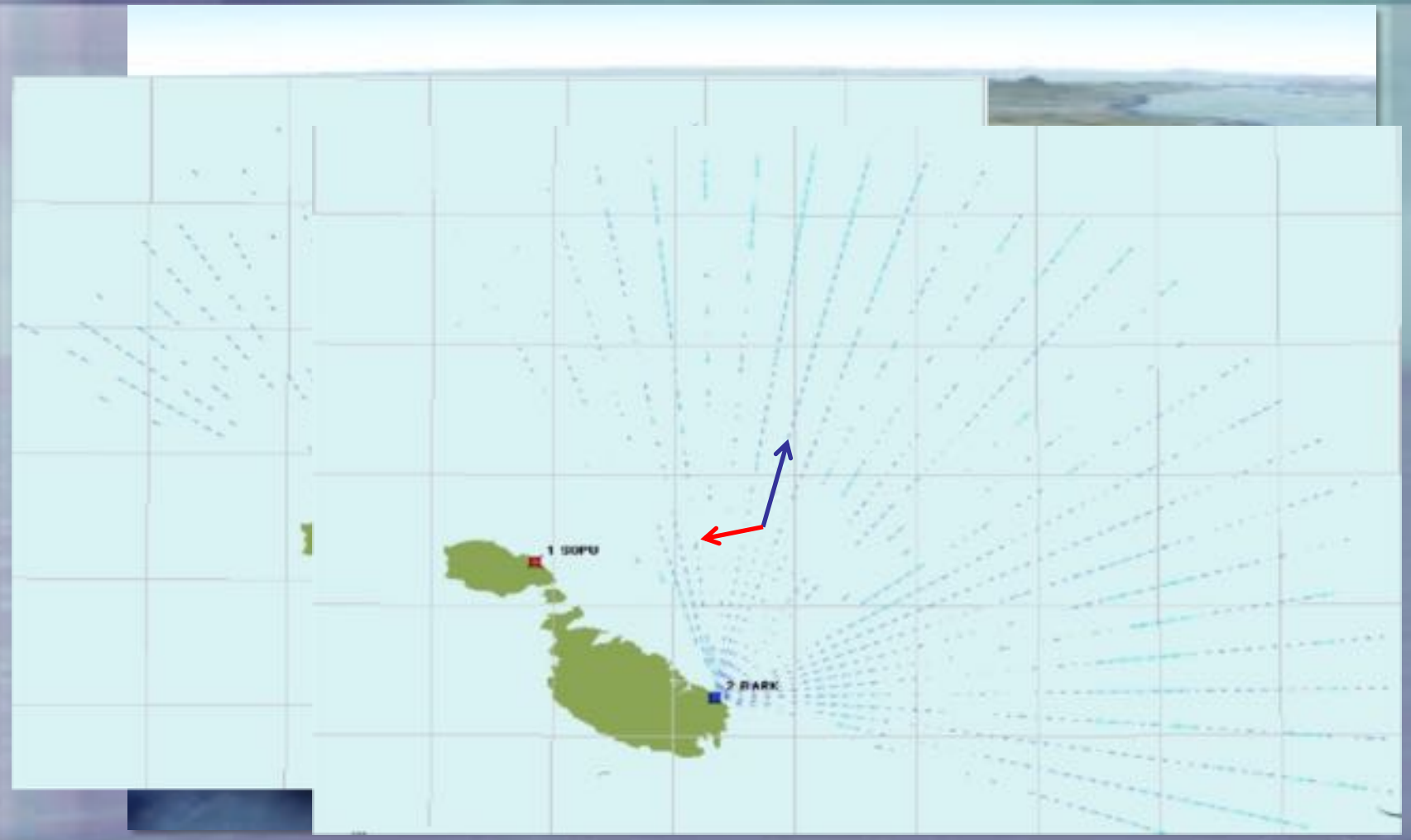
The scattered radar waves add coherently resulting in a strong return of energy at two sharp peaks in the Doppler Spectrum. The detected peak has a variable Doppler shift from which the radial velocity component of the surface current can be found.

Viewing the same patch of water by radars at different locations gives surface current radial velocity components that can be summed to determine the total surface current velocity vector. Data measured simultaneously at different sea points produces hourly maps of current vectors within a regular grid.

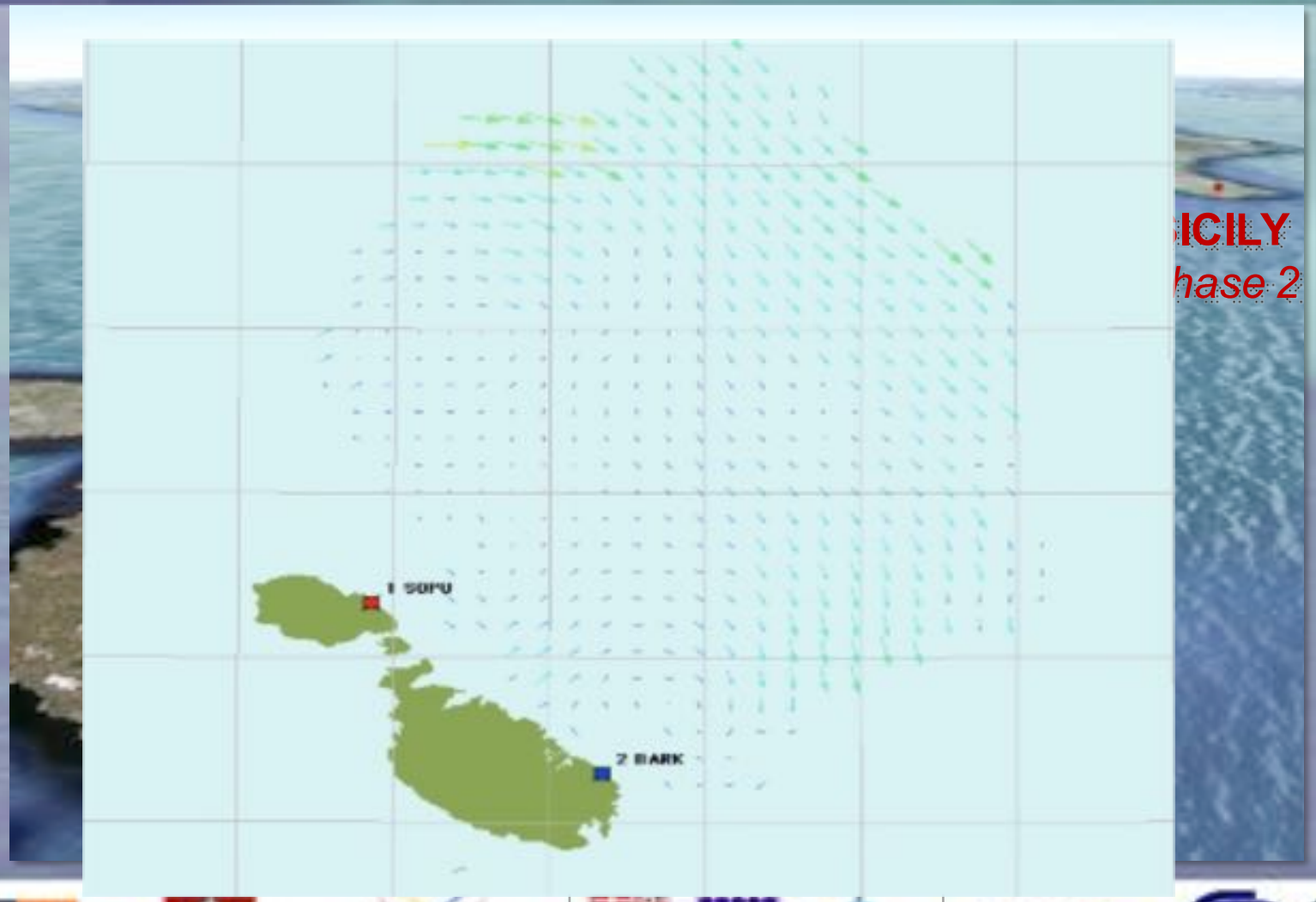
Significant wave height and wave direction are extracted from the second order Doppler Spectrum.

Combining radar signals

Combining radar signals



Combining radar signals



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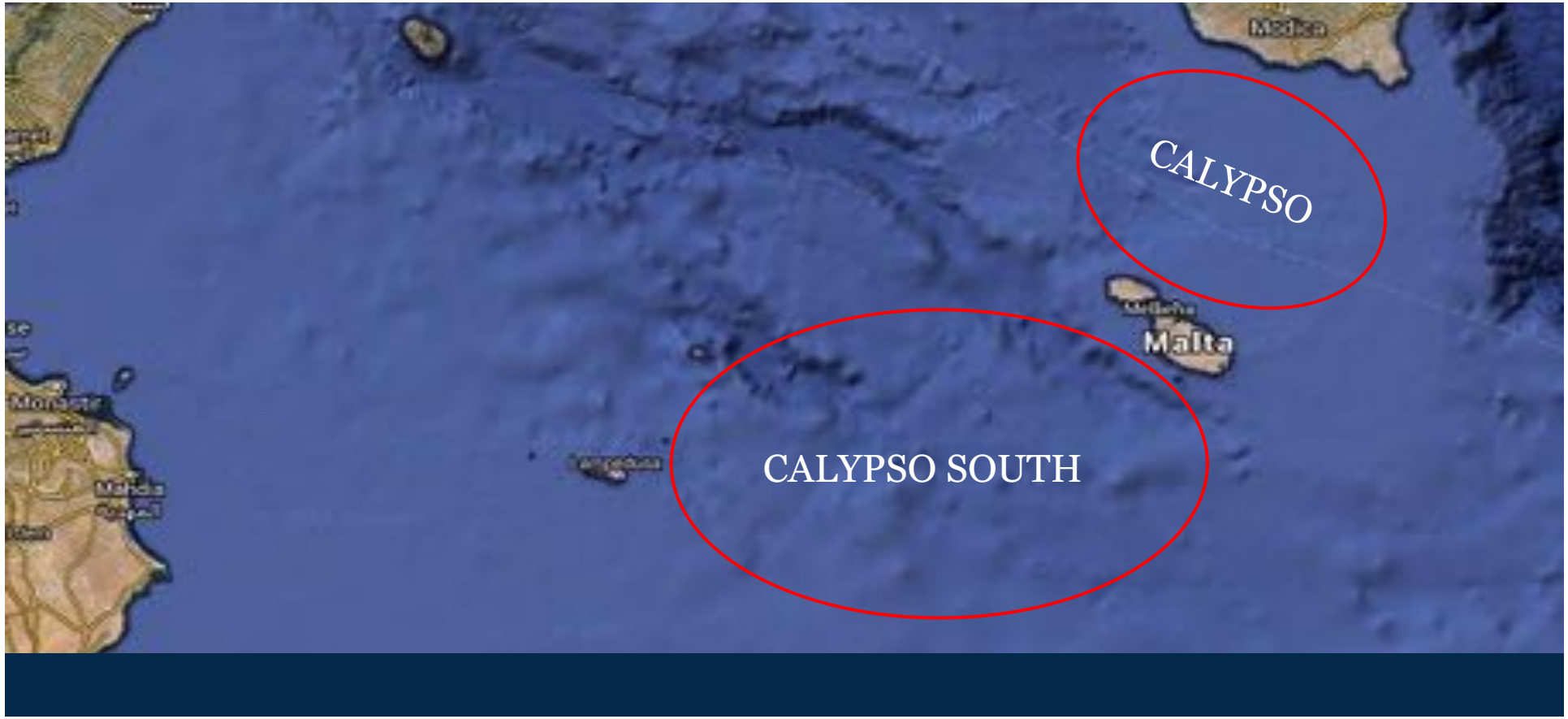
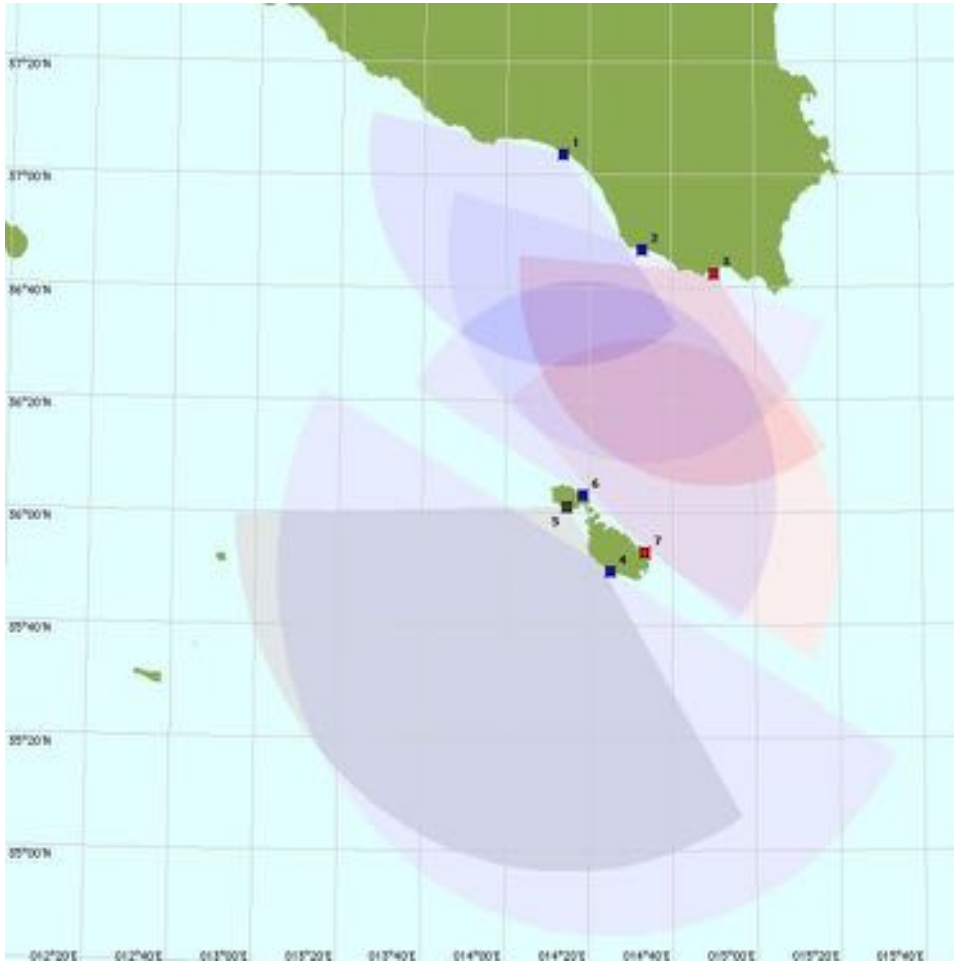
And now…
CALYPSO SOUTH

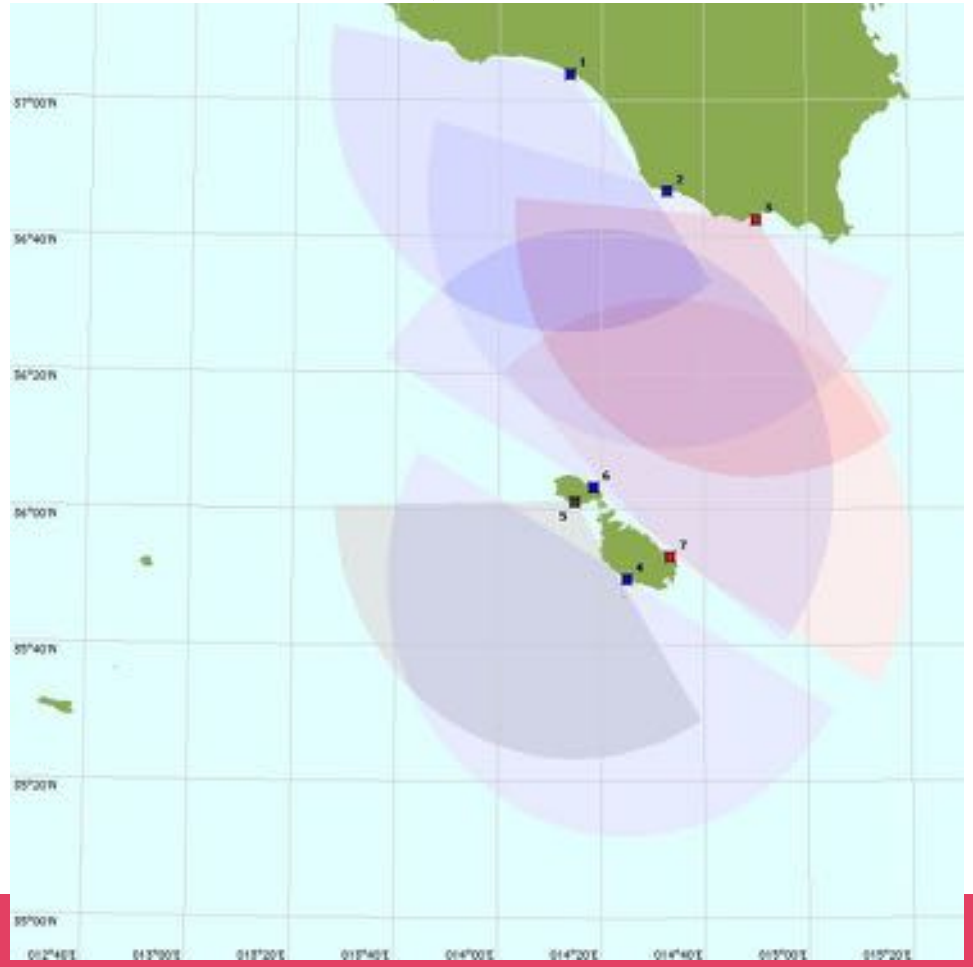


CALYPSO South HF Radar Network in Malta

Ta’ Sopu HF Radar

Extension of the HF Radar Network in 2018/19





and…
CALYPSO SOUTH

Search and rescue in a hot area of illegal immigration

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And now…
CALYPSO SOUTH

Search and rescue in a hot area of illegal immigration

Assisting safer navigation
…..but not only

Italia Malta 2007 - 2013

CALYPSO FOLLOW ON

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Search and rescue in a hot area of illegal immigration

Assisting safer navigation
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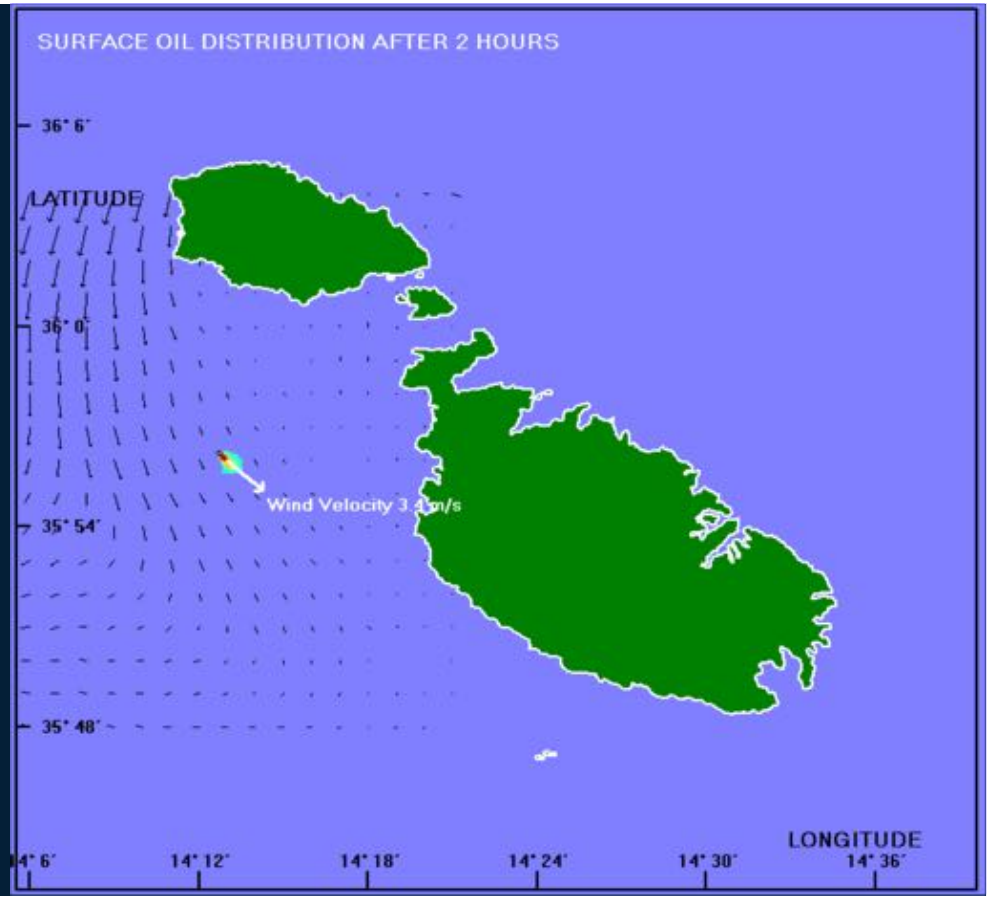
Improving forecasting models and oil spill simulations with HF radar data assimilation and closer to the coast



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Improving forecasting models and oil spill simulations with HF radar data assimilation and closer to the coast

Improve knowledge on circulation patterns south of Malta

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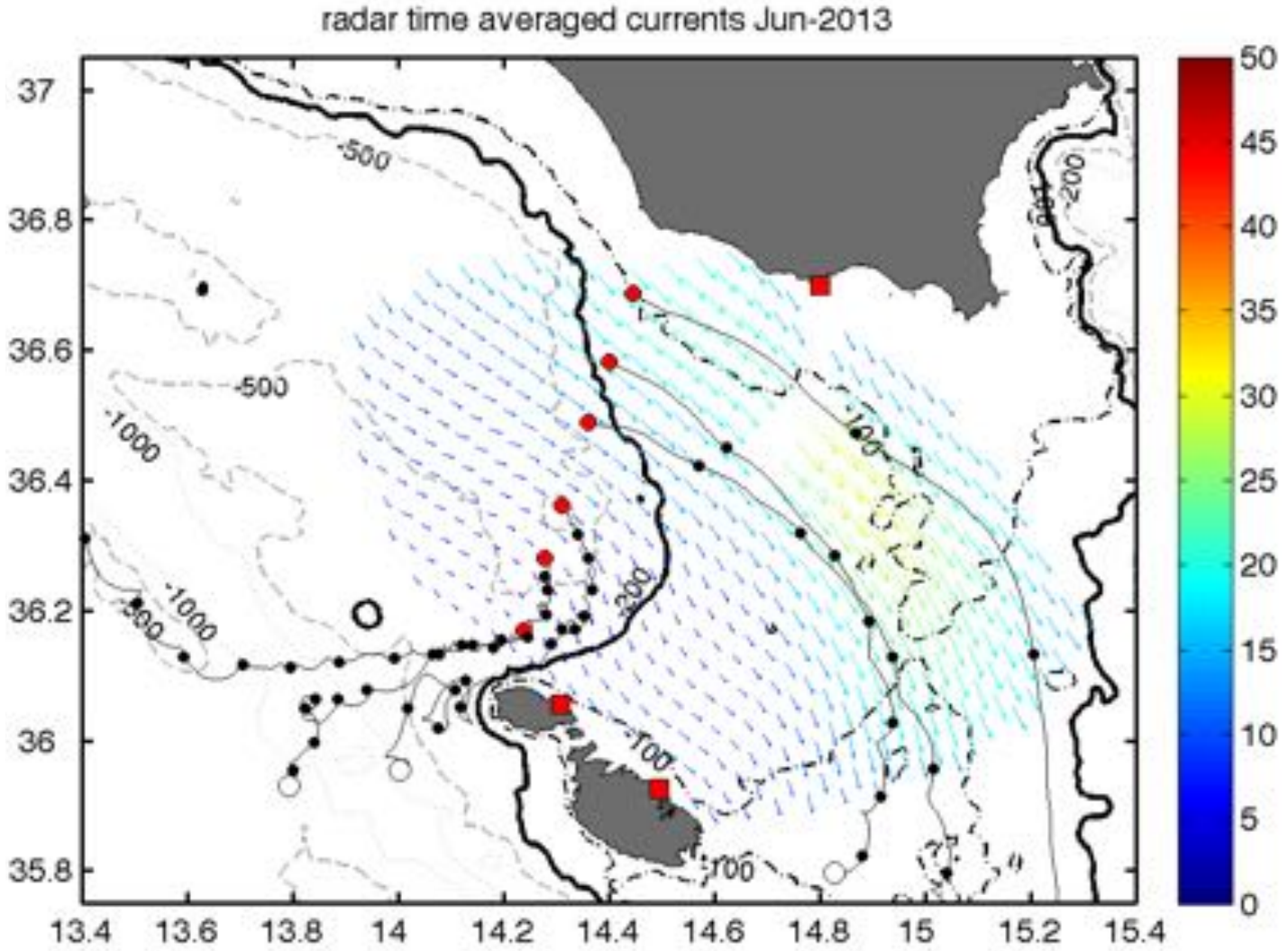
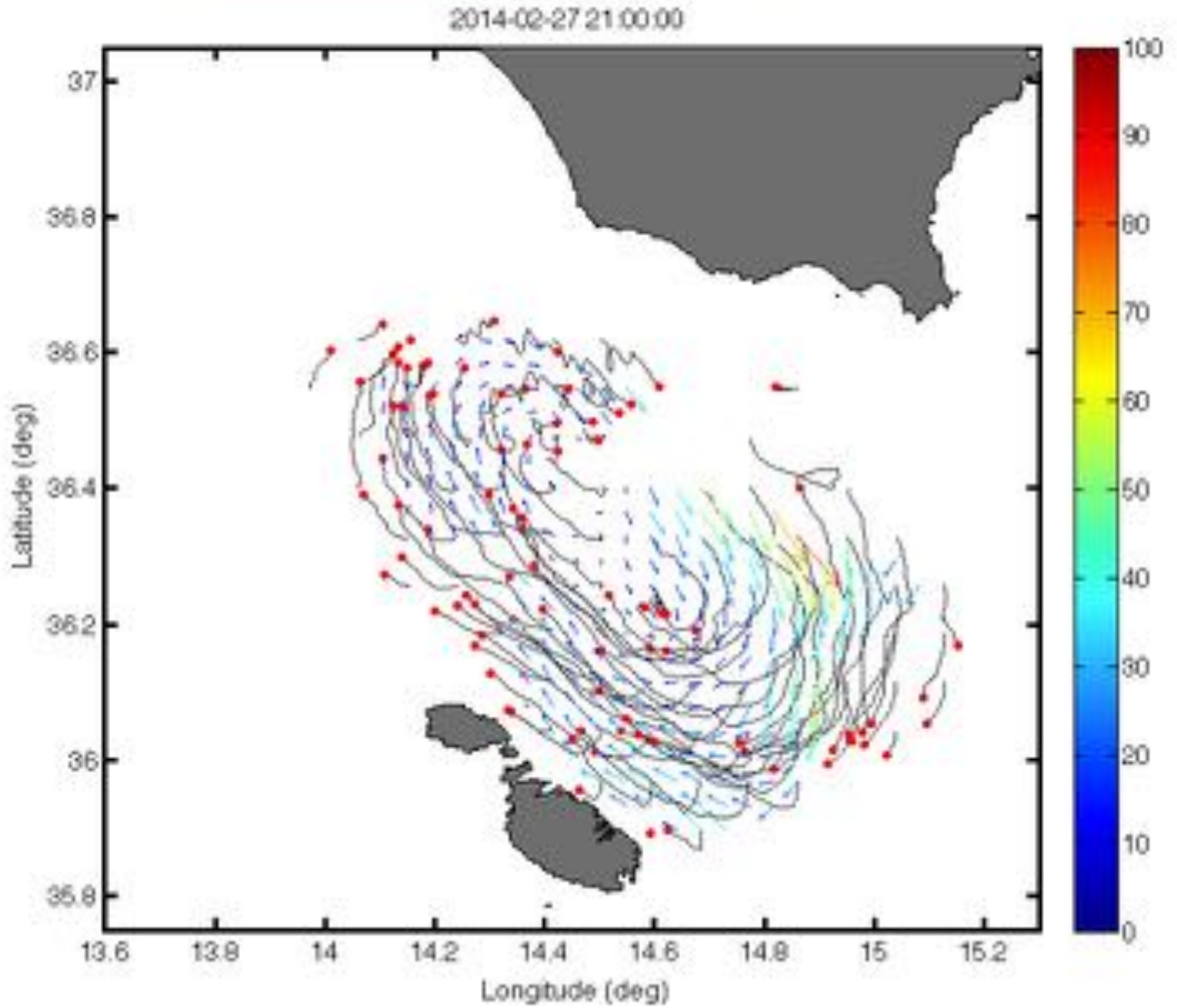
HF Radar data vs drifters



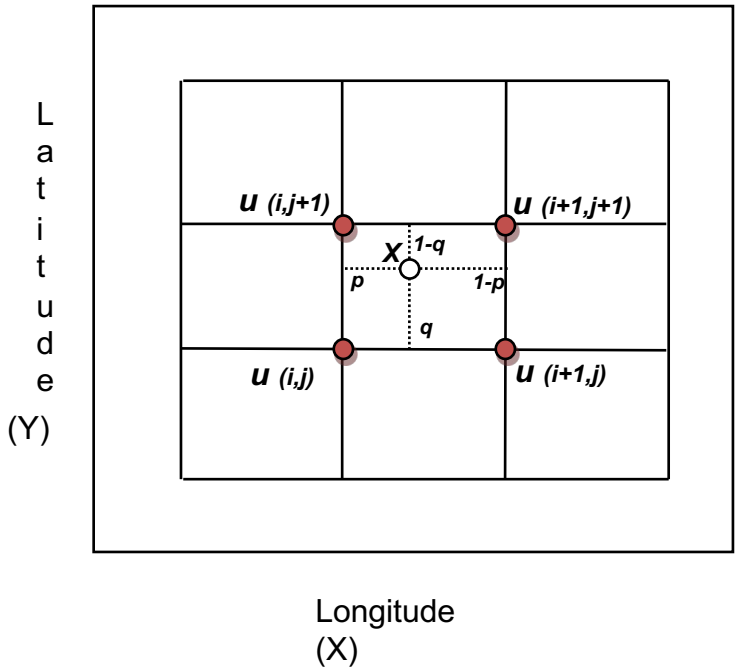
Recirculation and accumulation of



CALYPSO data for EMODnet

The initiative for an overarching EMODnet (European Marine Observation and Data Network) is included in the Marine Strategy Framework Directive (MSFD), adopted in December 2007 by the European Parliament and Council. EMODnet is developing into a network of existing and developing European observation systems, linked by a data management structure covering all European coastal waters, shelf seas and surrounding ocean basins..

Trajectory of a particle in a Eulerian Field



The horizontal velocity at a particle location is computed by applying a bilinear interpolation in space to the velocities surrounding the particle position

$$u_x^n = (1-p)(1-q)u_{i,j} + p(1-q)u_{i+1,j} + pqu_{i+1,j+1} + (1-p)qu_{i,j+1}$$
$$v_x^n = (1-p)(1-q)v_{i,j} + p(1-q)v_{i+1,j} + pqv_{i+1,j+1} + (1-p)qv_{i,j+1}$$

Trajectory of a particle in a Eulerian Field

Advective component

$$\frac{d\vec{x}_p}{dt} = \vec{v}(\vec{x}_p, t)$$

$\vec{v}$ is the vector velocity with components (u, v, w)

$\vec{x}_p$ is the coordinate of the particle

movement of the particles computed by applying a numerical integration scheme

The velocity field is given by an external hydrodynamic model at a series of fixed-point grid and time instants.

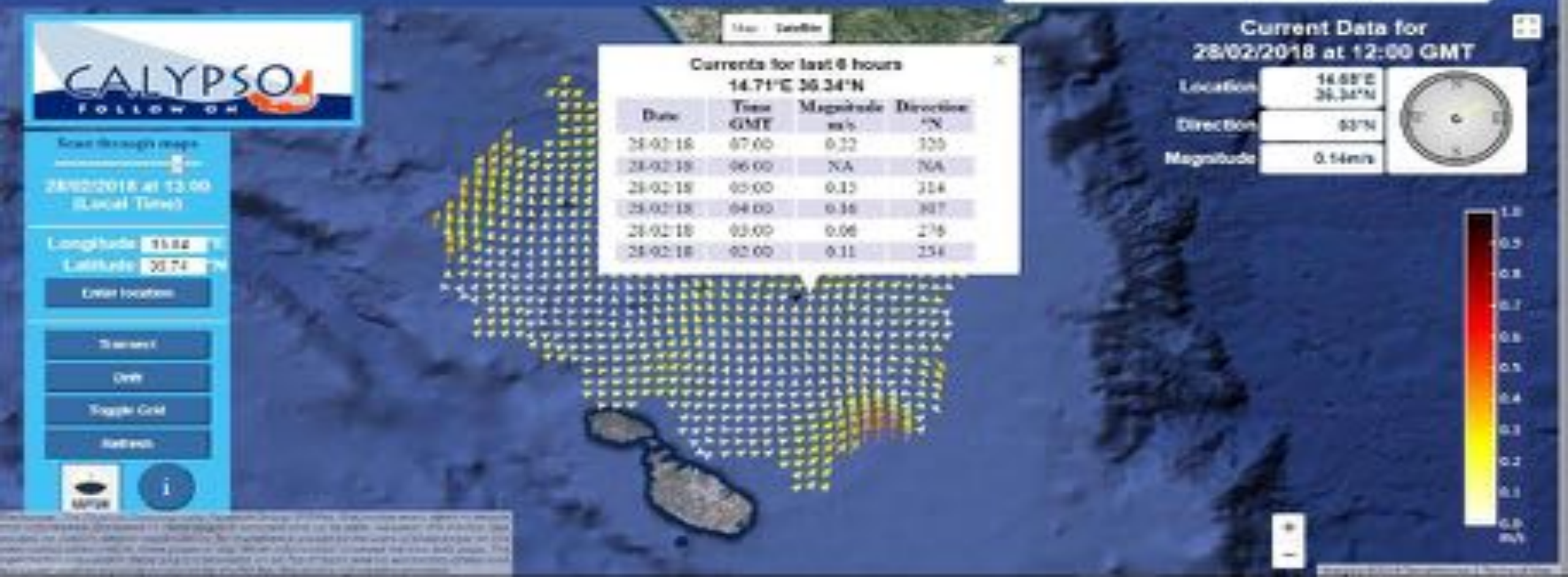
KAPTAN

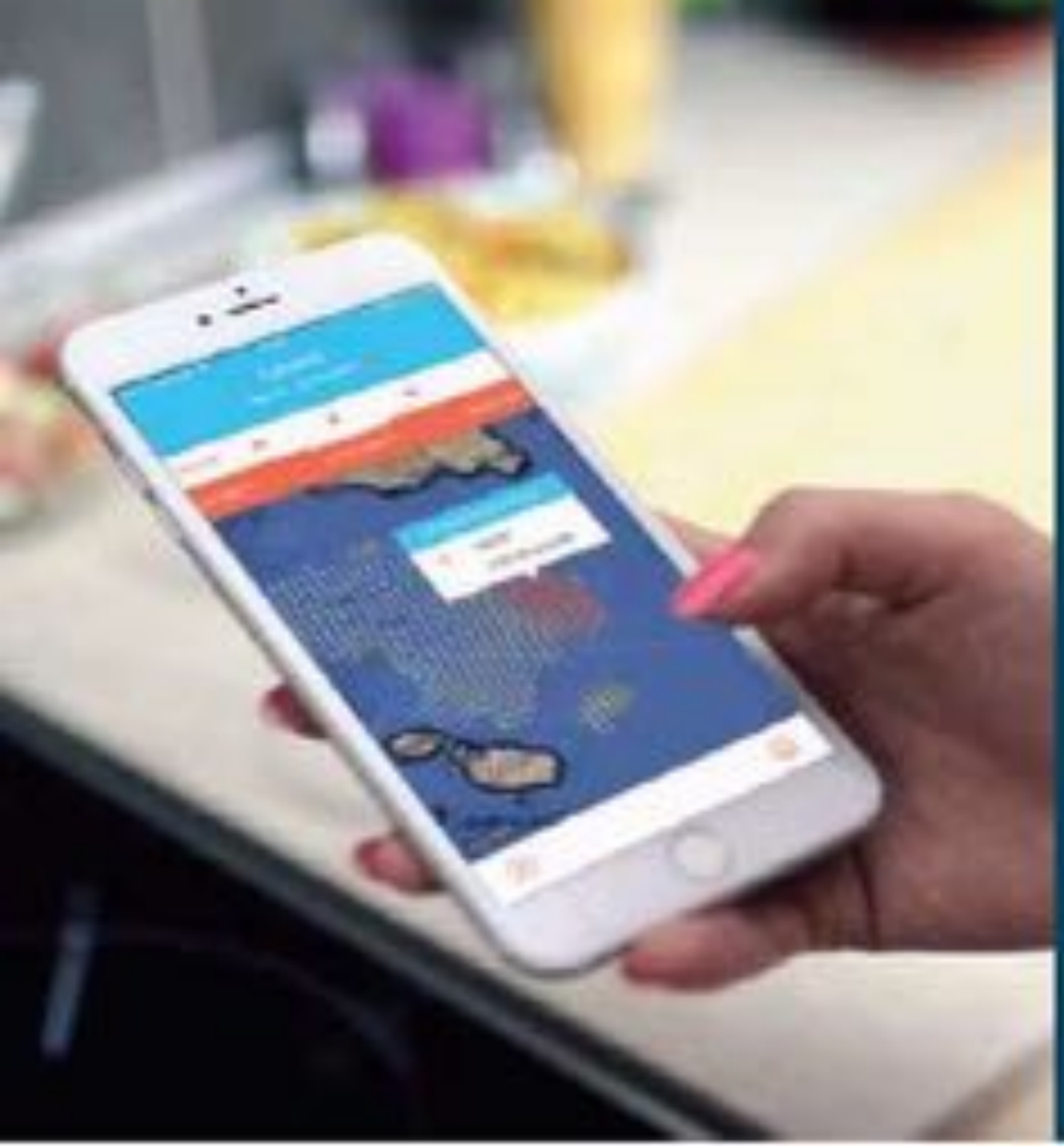
Smartphone application delivering meteo-marine data to the public

L-Università ta' Malta

PHYSICAL OCEANOGRAPHY RESEARCH GROUP

opernicus
Europe's eyes on Earth





KAPTAN MOBILE APPLICATION

- Sea Surface Currents

  Hourly 2D plots | Surface currents across a transect | Trajectory generated by surface currents

- Sea Surface Temperature

  Observed satellite data | 3-hourly forecast maps

- Sea Wave Conditions

  Wave direction and height | Peak period | Mean period

- Atmospheric Forecasts

  3-hourly forecasts for: air temperature | wind | precipitation | atmospheric pressure