Search and Rescue Planning

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Contents

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List of acronyms

CECMED	"**C**ommandant **E**n **C**hef pour la **Méd**iterranée" (French Commander-in-chief for the Mediterranean
CROSS	Centre Régional Opérationnel de Surveillance et Sauvetage (French MRCC)
CODE	Coastal Dynamics Experiment
GMMA	Special Service of European Union Structural Funds for the Ministry of Maritime Affairs and Insular Policy
HCG	Hellenic Coast Guard
ICM-CSIC	Institut de Ciències del Mar – Consejo Superior de Investigaciones Científicas
MEDOSMOSIS	Mediterranean governance for Strategic Maritime Surveillance and Safety issues
MRCC	Maritime Rescue Coordination Center
PREMAR	Préfecture Maritime de la Méditerranée
SASEMAR	Agencia Estatal de Salvamento Marítimo (Spanish State Agency on Search and Rescue)
SAR	Search and Rescue
SHOM	Service Hydrographique et Océanographique de la Marine (French Hydrographic Service)
SNSM	Société Nationale de Sauvetage en Mer
SVP	Surface Velocity Program

1 Introduction and Objectives

In the frame of the WP4 in MEDOSMOSIS project, transnational pilot exercises on search and rescue (SAR) have been promoted to test the procedures and tools for such emergencies on different sites in the Mediterranean Basin. The SAR exercises here presented, corresponds to: i) one developed in cooperation between the French and Spanish authorities, with the participation of the "*Prefecture Maritime de la Méditerranée*" (PREMAR) and the Spanish agency of search and rescue (SASEMAR) and ii) a second exercise developed in cooperation between ICM-CSIC and the Hellenic Coast Guard (HCG). The exercises took place in the line of separation of the French and Spanish SAR regions in the North-western Mediterranean area and in Greek waters respectively (see figures 1 and 2). In this report we describe the field strategy to simulate a SAR emergency, the data collection and finally, the results and major outcomes from these exercises.

Fig 1: Regions selected for the development of the SAR exercises.

1.1 Objectives

The main objectives of this Pilot study are:

- To improve collaboration with external organisations and to promote international SAR exercises on transborder situations when possible.
- To test the flow information between two country based services during a SAR emergency.
- Intercomparison between SAR tools and forecasting metocean products
- To explore the integration of SAR tools (drift modelling, search planning) into the webGIS operational platforms
- To assess and compare the effectiveness of different available standalone software
- To correlate data from other sources (like T-AIS, S-AIS, LRIT, VMS) and find ways to enrich the decision-making process during a SAR operation
- To integrate sources of meteorological and oceanographic data and evaluate ways to improve their appearance and user friendliness
- To enhance personnel's expertise through training and conducting the regional exercise/pilot experiment

To these objectives we have considered some additional points related with specific developments carried out in the project. Thus we have:

- To validate the climatological products on surface and subsurface currents, and to test the capabilities of the COSMO-View tool developed in WP3.
- To test the integration of the PING S-124 navigation warning system developed by SHOM in the Pilot Study X of WP4.

2 Preparation

The preparation of the activities developed in both exercises has been conceived considering a common strategy in terms of how the SAR emergency is simulated. For logistics reasons the strategy was not exactly the same in both exercises in terms of the deployed devices as we detail in the following.

2.1 SAR emergency simulation: Description and procedures

Very synthetically, the SAR simulation will consist of supposing an accidental wreck. In figure 2 we show the maps with the selected areas in the North-Western and Eastern Mediterranean basin. In the North-Western the area crosses the line separation of the Spanish-French SAR zones around 4º 30’ N. close to the main traffic lines. In the Eastern basin the selected area is located inside a complex region surrounded by several islands in the middle of high regional and local **traffic** lines centred at 38° 4.327' N and 21° 2.968' E.

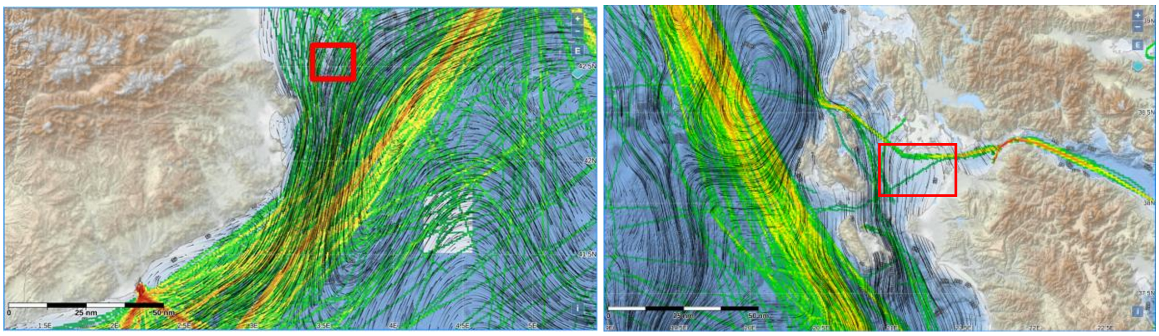

Fig 2: Monthly climatological currents overlapped with main traffic lines and the approximate location of the simulated wreck. Left: French-Spanish SAR zone. Right: Greek waters.

The wreck was simulated using several devices, dummies, a life raft, a beacon and two kinds of drifters: surface CODE like drifters and subsurface SVP drifters. The use of two dummies is particularly relevant to distinguish the drift of people at sea. A dummy in vertical configuration may represent a person alive within the hypothesis that for some time, after the wreck, he can face the risk of hypothermal conditions. On the other hand, a dummy in the horizontal conditions may compare the drift of a corpse

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floating at the surface. This is an oversimplification of the real evolution of a corpse, that first deepens and stays submerged until it recovers the surface by buoyancy. In order to test and verify the differences we prepared an exercise tracking two dummies with such configurations (see figure 3).

Fig. 3: Two SAR dummies in vertical configuration (left) and horizontal configuration (right).

The field test was carried out on June 10th of 2021, 5 miles offshore Barcelona where two dummies were deployed and tracked during 24 h before being rescued. The test was done in collaboration with SASEMAR that proceeded with the usual protocols to forecast their trajectory (figure 4).

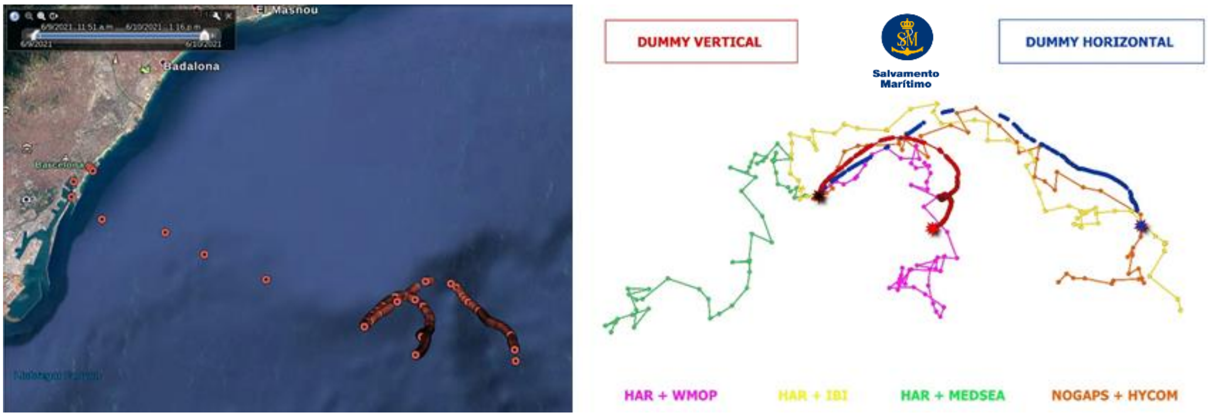


Fig. 4: Left: Real trajectories during the field test on 2021/06/10. Right: Real and simulated trajectories for both dummies

After 6 hours, trajectories clearly diverged and after 24 h both dummies were separated by 3.4 nm (~ 6.3 km). The forecasting for three of the four models used was reasonably good although all models ran slightly faster than observations. This test confirmed the need of considering both configurations to analyse the drifting of a human body. With these results in mind the basic actions in designing the strategy consisted on:

Day 1: Deployment of equipment and emergency notification. In each exercise we used slightly different equipment:

French-Spanish exercise: 10 drifters (5 CODE and 5 SVP), two dummies (vertical and horizontal configuration and a life raft ballasted)

Greek exercise: 10 drifters (5 CODE and 5 SVP), one dummy in vertical configuration and a beacon.

At the end of the deployment an emergency notification was issued triggering the formal procedures by the corresponding SAR services to respond. In the particular case of the French-Spanish exercise the PING S-124 system developed by SHOM was also used through the INFONAUT office (CECMED) that issues “AVURNAV Toulon”.

Day 2-4: Tracking and SAR activities to recover the dummies and the life raft. These activities will be in charge by SASEMAR and the HCG In each exercise respectively. Tracking and forecasting the searching areas were in charge of PREMAR, SASEMAR, HCG and ICM simultaneously.

Day 7: Debriefing meeting to put in common the results. In the French-Spanish case this was organised at the MCGC of Barcelona (SASEMAR) and in the Greek exercise at the HCG headquarters to put in common the results.

2.2 Equipment

In the exercise, four kinds of devices were used: 2 types of drifters, dummies, a life raft and a beacon. Here below are the technical characteristics:

CODE drifter: Receives its name from the American research program CODE on tracking the surface circulation in coastal areas at the end of the 19th century (Davies, 1985). The CODE drifter consists of a cylinder of around 1 m of length and 10 cm of diameter. It is attached to a system of four sails forming a cross structure to be dragged by currents in the upper 2m of the ocean. Buoyancy is controlled by four floats allowing the drifter to be entirely submerged except the telemetry antenna, emerging about 30-45 cm from the sea surface (see the figure 5). The wind drag is quite negligible so they are supposed to be good for tracking sea surface currents.

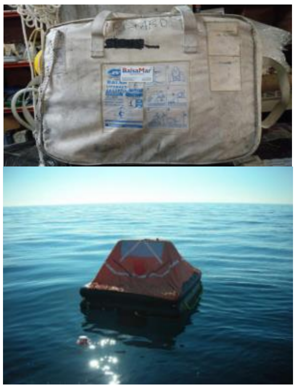
 Fig. 5. CODE drifter	The devices that will be used in the pilot experiment are similar to those shown in the figure 1 manufactured by METOCEAN Telematics. The main characteristics are: * Telemetry: Iridum satellite constellation (Short Bus Data, SBD) * Tracking rate: 30 min * Additional Sensor: Water temperature * Positioning: GPS * Dimensions (cylinder): 102 mm (diameter) x 100 mm (height) * Antenna (height): 400 mm * Weight: 10 kg * Drogue vain: 50 x 70 cm

SVP drifter: This drifter receives its name as the acronym of the Surface Velocity Program (SVP, https://www.aoml.noaa.gov/phod/gdp/data.php) promoted by the World Meteorological Organisation to provide standardised data on ocean subsurface currents and sea surface temperature for assessment and assimilation in weather forecasting models. The SVP drifter is composed of a sphere of about 30 cm of diameter containing all the electronics (batteries, GPS, sensor data logger, etc.) tethered to a holey sock drogue centred at 15 m depth. The devices to be used in the pilot study have been manufactured at the ICM-CSIC (fig 6).

 Fig 6. SVP drifter	The main characteristics are: * Telemetry: SPOT (GLOBALSTAR system) * Tracking rate: 30 min * Additional Sensors: None * Positioning: GPS * Dimensions: sphere diameter 40 cm * Drogue vain: 6 m x 70 cm * Weight: XX kg

Dummy and Life raft (availability to be confirmed): The third device is a OTAN certified dummy used specifically for SAR rescue exercises in marine environments. The dummy is a structure with a dry weight of 40 kg including a buoyancy system allowing two configurations: horizontal and vertical.

Dummies in the pilot study will be equipped with the same telemetry and characteristics as for the SVP drifters or attached to a small surface drifter carrying all the electronics. The fourth device is a real life raft used for emergencies. The main characteristics are: (see the figure 7):

	• Telemetry: SPOT (GLOBALSTAR 1610-1620 Mhz constellation) • Tracking rate: 20 min (configurable between 5 -60 min) • Sensors: None • Positioning: GPS • Dimensions (drifter): 11*43 cm
	• Telemetry: SPOT (GLOBALSTAR 1610-1620 Mhz constellation) • Tracking rate: 30 min • Sensors: None • Positioning: GPS • Dimensions: capacity for 6 people • Manufacturer: EUROVINIL (Italy) • The life raft will be lasted with 3 water filled plastic bottles of 30 l and to avoid the tip over a submerged holey sock will be added.
 Fig 7. Dummy, life raft and Personal Locator Beacon (PLB)	• Personal locator Beacon (PLB) • Freq: 406 Mhz

2.3 Deployment strategy

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The deployment strategy is represented in figure 8. It is based on a square area where the SAR targets (dummies and life raft) are deployed in the centre and drifters are located in the square vertex around the centre and in the centre itself. At each point a CODE and a SVP are released just to have some knowledge on the vertical current shear and eventually to provide data for validation purposes. The deployment was slightly different in the French-Spanish exercise compared with the Greek exercise. In the Greek exercise, it was not possible to have two dummies and a life raft, so only one dummy in vertical configuration was available and released. Apart from the SAR targets the number of drifters was the same.

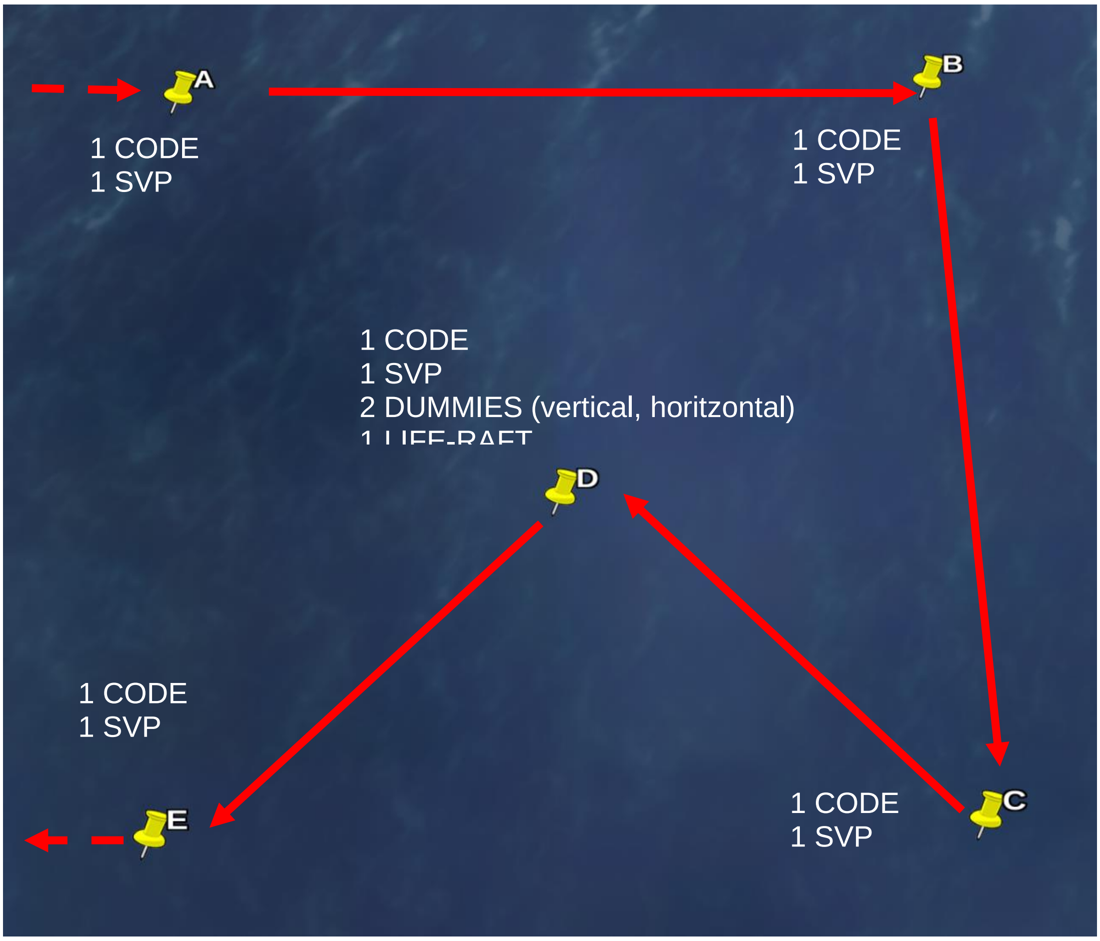

Fig.8. General deployment strategy. The target devices released differ from both exercises. The path between way points is arbitrary.

The spatial separation between the square vertex was around 0.5 km (~ 0.27nm) well below the typical characteristic scale of mesoscale eddies in the Mediterranean. Thus we expected a quite uniform

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initial pattern of trajectories for initial times and separation as time goes on due to small scale motions below the mesoscale activity.

2.4 Data Access and Dissemination

All devices used in the SAR exercises are tracked using a satellite telemetry system from two separated services. Thus, data services from CODE drifters are received from Iridium system while for the rest of devices (SVP drifters, dummies and life raft) the telemetry tracking system is obtained through Globalstar system. In figure 9 we represent a scheme of the flow information to get all data under an unified and unique distribution system.

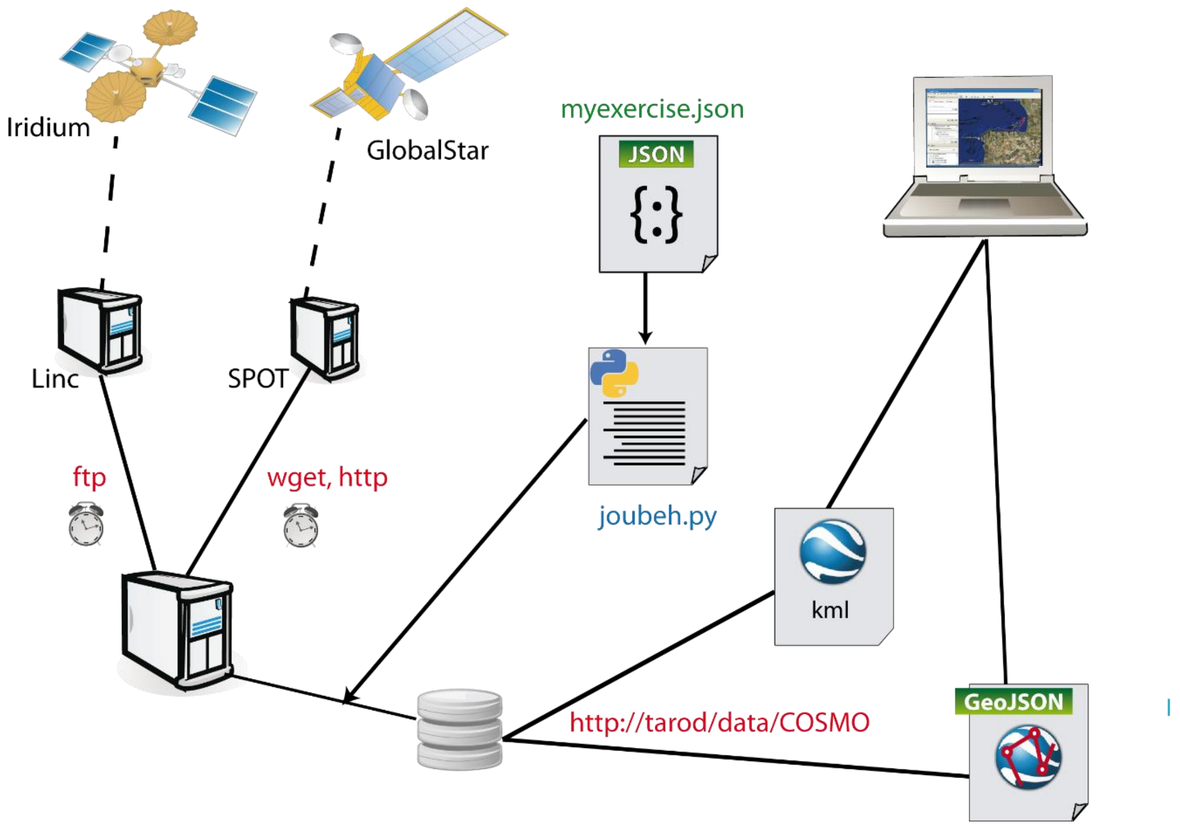

Fig. 9: Schema of the data acquisition during the exercises

Data is downloaded from both Iridium and Globalstar services and are processed in order to archive and redistribute the data. Data are made available for any user through a website:

French-Spanish exercise: http://hermes14.cmima.csic.es/pub/COSMO/Pilot_1/

Greek exercise: http://hermes14.cmima.csic.es/pub/COSMO/Pilot_2/

Their data files are available in three formats, KML, CSV and GeoJSON and refreshed every 30 minutes. In the particular case of the French-Spanish exercise the data corresponding to the dummy in horizontal position is provided from SASEMAR access.

In order to facilitate the access here are some tips to manage automatically the access to these files:

- **WGET**: with this command is easy to download all the files at once doing the following commands in a console (either on windows o Linux):

```
prompt> wget -nd --no-cache -N –no-parent -r -A '*.kml' http://hermes14.cmima.csic.es/pub/COSMO/Pilot_1/

prompt> wget -nd --no-cache -N –no-parent -r -A '*.geojson' http://hermes14.cmima.csic.es/pub/COSMO/Pilot_1/

prompt> wget -nd --no-cache -N –no-parent -r -A '*.csv' http://hermes14.cmima.csic.es/pub/COSMO/Pilot_1/
```

depending on which type of files you want to download, csv, kml or geoJSON. The “wget” through the console in Windows is available at https://eternallybored.org/misc/wget/. For Linux is a native command included within gnu utilities. The options are necessary to avoid the cache versions and to overwritten files from previous downloads.

- **Python**: If you have installed Python language in Windows or Linux you can exploit the “requests” module. As an example let us download remotely all the trajectories in geoJSON format (Garcia-Ladona *et al.*, 2022) and load into a Python session.

```
import requests
import json

# We define the remote path
url = "http://hermes14.cmima.csic.es/pub/COSMO/Pilot_2/"

# We define a list of drifters files to retrieve
drifts= ["MEDOSC-6_300534061787380.geojson","MEDOSC-7_300534061782370.geojson",
"MEDOSC-8_300534061786400.geojson","medosmosis10_0-4422610.geojson","medosmosis11_0-
3196871.geojson"]

# We define an empty list to store all trajectory
```

```
data=[]
for drifter in drifts:
        r = requests.get(path+drifter)
        data.append(r.json())

# To access the trajectory of the third drifter
feat=0
while feat < 3:
    if data[2]["features"][feat]['geometry']['type'] == 'LineString':
        ndata = len(data[2]["features"][feat]['geometry']['coordinates'])
        lon.append([data[2]["features"][feat]['geometry']['coordinates'][i][0] for i in range(ndata)])
        lat.append([data[2]["features"][feat]['geometry']['coordinates'][i][1] for i in range(ndata)])
        tim.append([ data[2]["features"][feat]['properties']['time']['data'][i] for i in range(ndata)])
        timts.append([datetime.strptime(data[2]["features"][feat]['properties']['time']['data'][i],
            '%Y-%m-%dT%H:%M:%S%z').replace(tzinfo=timezone.utc).timestamp() for i in range(ndata)])
        break
    feat = feat+1
```

3 Results

3.1 French-Spanish exercise

The exercise took place on February 3-7 of 2022, in the line of separation of the French and Spanish SAR regions in the North-western Mediterranean area (see fig. 8).

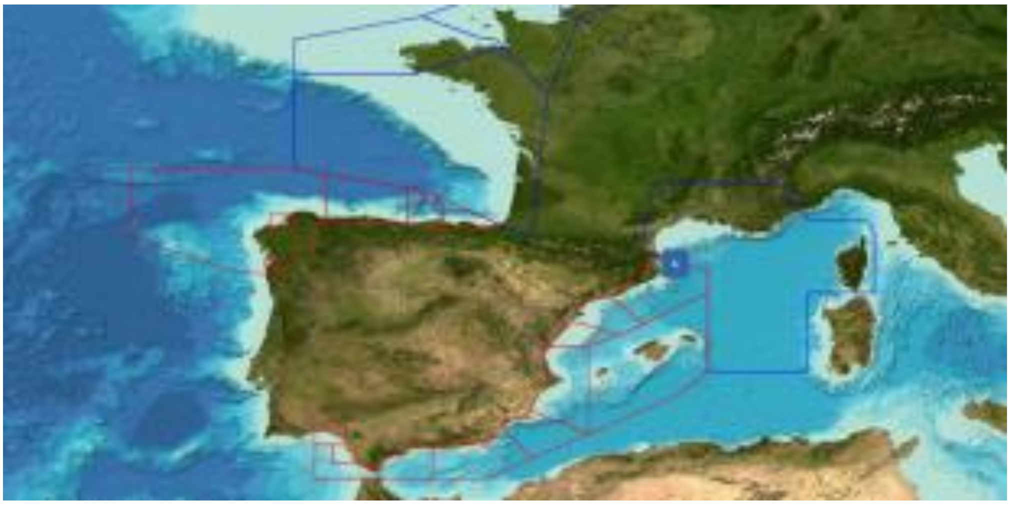

Fig. 8: SAR regions for France and Spain and the approximate location of the pilot study. The blue square is the chosen location for the French-Spanish exercise.

The aim was to simulate a transnational emergency in which both authorities execute the corresponding protocols on SAR. This is a kind of emergency where authorities require carrying out accurate meteo-oceanic forecasting in order to determine searching probability maps to program the corresponding aerial and naval operations. The main objective is to compare, share and exchange the experience and results from both country systems. Three additional objectives were added regarding other related Med OSMoSIS developments:

1. To Test the capabilities of the Lagrangian tracking tool integrated within the COSMO-VIEW tool: an open source tool to access multiple data sources (in situ data, remote sensing, HF radar observations, forecasting products,…) with focus SAR operations and pollution emergencies.

2. Validate climatological products on surface and subsurface currents started within the frame of the COSMO project (CTM2016-79474-R) and complemented with further developments made on the MEDOSMOSIS project.
3. Integration of the PING-124 NAV System developed by SHOM (WP4 Testing) into the COSMO-VIEW tool and other web-mapping services

3.1.1 Field Activities

Very synthetically, the SAR simulation consisted on supposing an accidental wreck in the North-Western Mediterranean area along the separation of the Spanish-French SAR zones around 4º 30’ N (see fig 2 and 8). The wreck was simulated using a ballasted life raft and two dummies as SAR targets. One dummy was configured with horizontally buoyancy to represent a dead body and a second one in vertical configuration to represent an alive person (see fig. 3). The SAR targets were complemented with the deployment of two types of drifters, surface CODE like drifters (R. Davies, 1985) and standard SVP drifters (SVP Program, https://www.aoml.noaa.gov/phod/gdp/data.php). CODE like drifters are the usual devices to provide measurements of near sea surface velocities with relatively small wind slippage. SVP drifters are attached to a drogue centred at 15 m depth so they are supposed to be free of the direct wind affectation.

Ten CODE drifters and ten SVP drifters disposed of in the vertices of a square with a central point where the two dummies and the life raft were deployed. In figure 10 we have represented the true deployment disposition during the MEDOS exercise and in table 1 we list the positions and present status of all devices.

Fig 9: French SAR vessel SNS 092 (at left) used in exercise

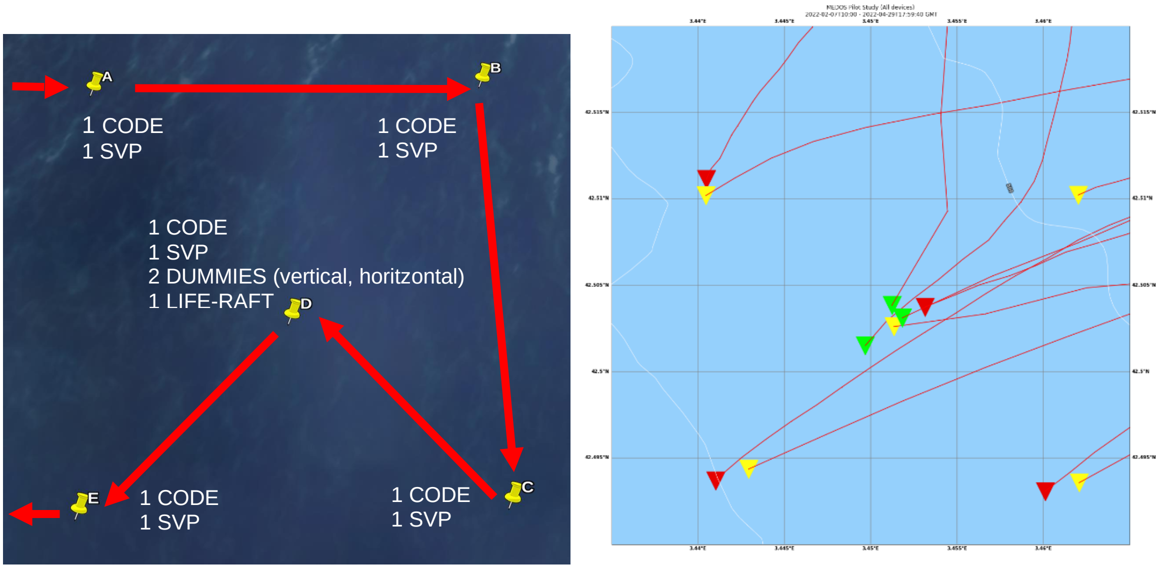

Fig. 10: *Left*: Original design of equipment deployment, the same as figure 3. *Right*: Real deployment on February 3. CODE drifters are represented by red markers, SVP by yellow markers and green markers correspond to SAR targets. Red lines are initial drifts of each device.

Fig. 11: Rescue of the dummy with horizontal configuration (left) and the life raft (center) and survey of the operations in the control rooms at CCS Barcelona during the MEDOS exercise.

In figure 12, we have represented an overview of the trajectories followed by all devices during the first month after the deployment. The general pattern is characterised by an initial eastward drift of all the devices, more marked for the SVP drifters than for the CODE drifters and SAR targets, they turned southward. After some time, the SVP drifters completely diverged compared with the trajectories of the rest of devices being almost systematically southward.

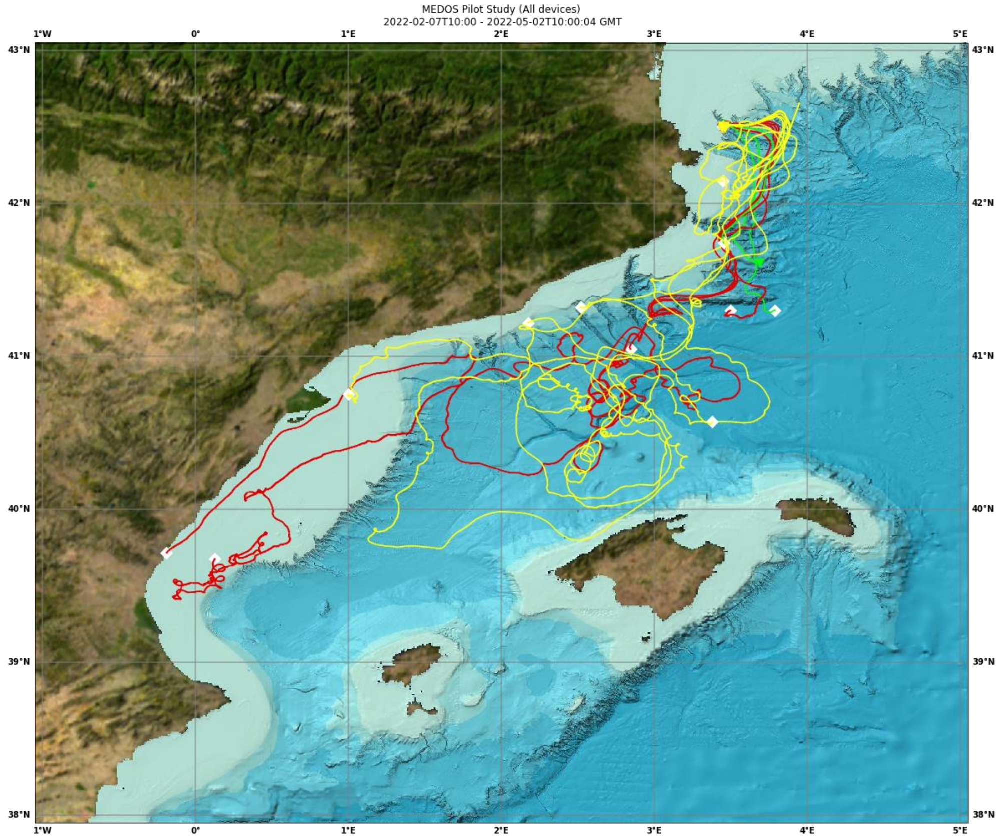

Fig 12. Trajectories made by all devices during the SAR exercise. White markers are the endpoints of each device. Red lines correspond to CODE drifters, yellow to SVP drifters and green to SAR targets.

If we represent the first 36 h of drift (fig. 13) we can appreciate several interesting features. The SVP drifters progressed eastward from the beginning until near 3.8 E. Almost all the CODE drifters progressed similarly except that they turned southward sooner. The vertically configured dummy made a quite similar path than the CODE drifters while the horizontally configured dummy turned sooner than CODE being its drift more south-eastward since the beginning. Finally, the life raft was the fastest target with an initial drift to the North and then a general south-eastward direction. Coherently those devices more exposed to the wind slippage progressed faster, probably correlated with the wind direction, than the vertical dummy, the CODE or the SVP. The differences between SVP and CODE drifts follow characteristic patterns of the existence of a wind-wave forced mixed layer at least over the first hours (see the right picture of figure 10).

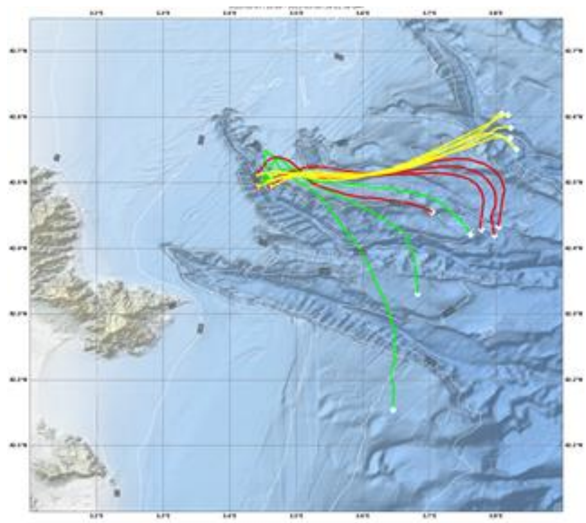

Fig 13. Observations 36 hours after deployment. Colour lines represent the same devices as in fig.12.

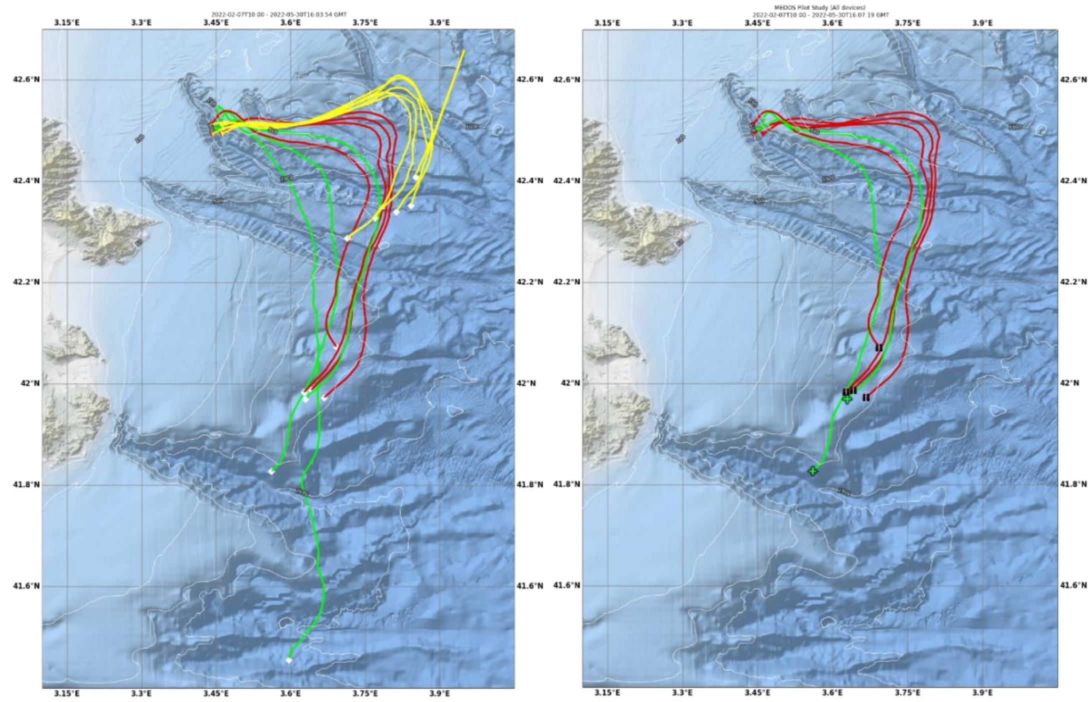

Fig 14. Observations up to 72 h after deployment. Colour lines represent the same devices as in fig.12.

After 72 hours since the deployment, all devices progressed clearly southward at different speeds, once again consistent with their theoretical exposure to wind-waves forcing. Perhaps, the most notable aspect is the behaviour of the vertically configured dummy, whose trajectory is highly correlated with the trajectories of CODE drifters. The horizontally configured drifter followed an intermediate path between the CODE and the life raft paths.

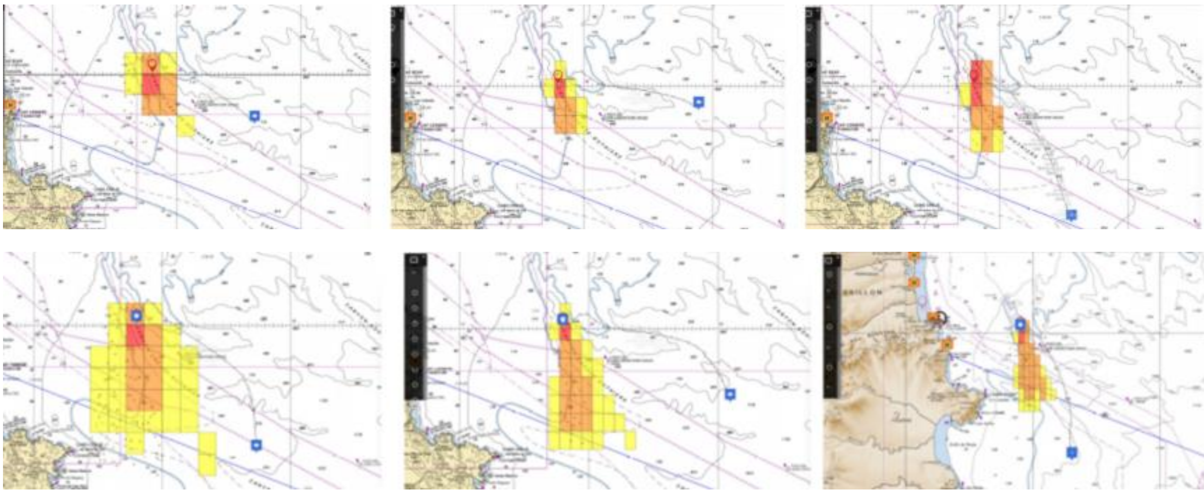

FIg 15: 36 hours (upper row) and 72 hours (lower row) forecasting made by the French authorities (PREMAR). From left to right the forecasting of the first dummy (horizontal), the second dummy (vertical) and life raft.

During the exercise it was agreed to carry simulations of the three SAR targets in order to intercompare the output of the current tolos and the meteo-oceanic data. Fiigures 15-18 summarise the results obtained by the French (figs. 15-16) and the Spanish (figs. 17-18) services.The simulations consisted in providing the forecast at 36 h and 72 h since the initial deployment and in the case of the French service to provide a 36 h forecasting taking as the initial time the exact positions of the targets at 36 h after the deployment. The French service worked with one single model configuration while the Spanish service ran 3 different model configuration:

- **GFS/IBI**: combines meteorological output from NCEP global model and ocean currents from IBI regional model of Coperncus
- **HARMONY/WMOP**: combines meteorological output from the Spanish Meteorology Agency (AEMET) model and ocean currents from WMOP model.

- **NOGAPS/HYCOM**: combines meteorological output from US Navy model and ocean currents from HYCOM model

In figure 15, it is shown how the real trajectories of SAR targets (blue markers) compared with the probability areas for funding a target predicted by the French authority. As we can appreciate, the target locations are always outside the probability region. This occurs for both the 36 h and 72 h forecast. However, the mismatch is more apparent for the east drift than the south drift mainly at the initial times. The forecast predicts a marked south drift for all targets.

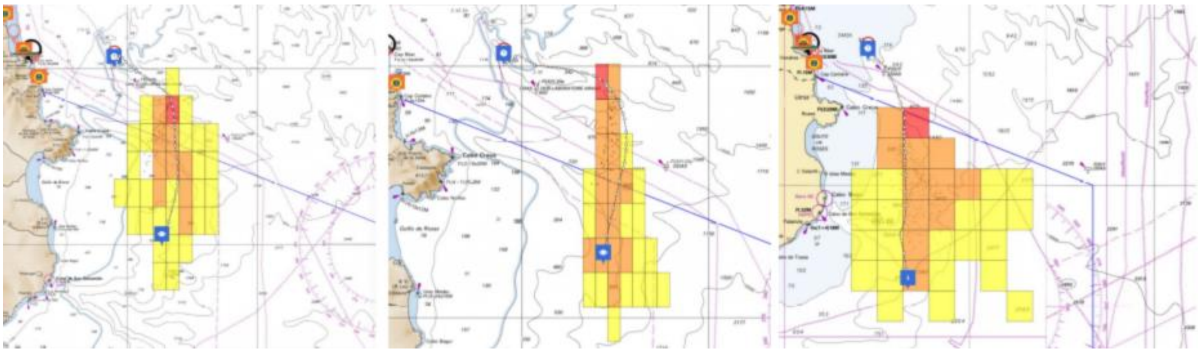

Fig. 16: 36 hours forecasting considering as the initial points the position of real targets their location at 36 h after deployment.

The situation is better for the second set of simulations where the initial point was set based on the last position of each target after 36 h since the deployment (figure 16). In this case the simulations run for 36 h and we can appreciate how SAR targets are marginally inside the probability regions.

The Spanish authority produced the simulations for three forecasting systems (figures 17-18). At 36 hours, the best solution was the HARMONY/WMOP that represented the initial west drift, although the live raft evolved more southward than foreseen. The initial evolution of the life raft was better captured by the GFS/IBIB system. At 72 h wast quite well captured by both configurations while for the dummy the real observation is between both configurations. To note that in any of the three SAR targets the real evolution was faster than the simulations in accordance with the French configuration.

Finally, in terms of probability each configuration is able to capture a different SAR target within the probability region but there is not a configuration that is able to capture more than one target.

Fig 17: 36 hours (upper row) and 72 h simulations (lower row) simulations made by the Spanish authorities (SASEMAR) for the three SAR targets and for three model configurations (upper row) and for two model configurations (lower row) GFS/HYCOM and HARMONIE/WMOP.

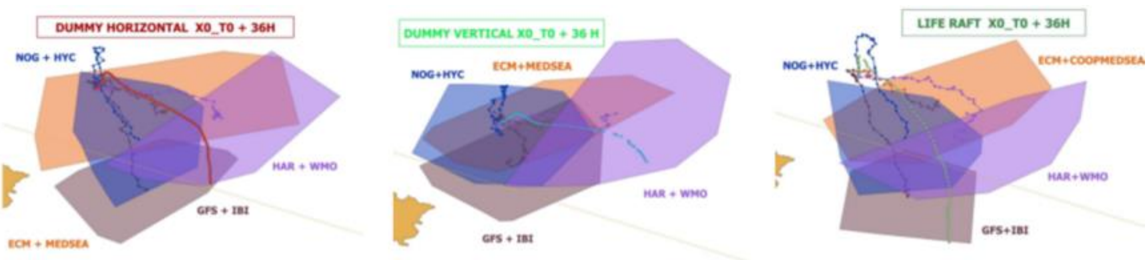

Fig 18: Searching areas for each target according to the three configurations produced by the Spanish authority.

3.2 Greek exercise

The Greek exercise took place on May 24th, 2022 under the coordination of Ltnt Cdr HCG (T) ZACHARAKOPOULOS Christos in Greek waters close to Killini city. The chosen location is in the Western side of Greece within Ionian waters surrounded by two islands (Agostini and Zachintos) and Greece inland (figure 19) where local and regional regular ferry lines between island and inland cross each other (fig. 2).

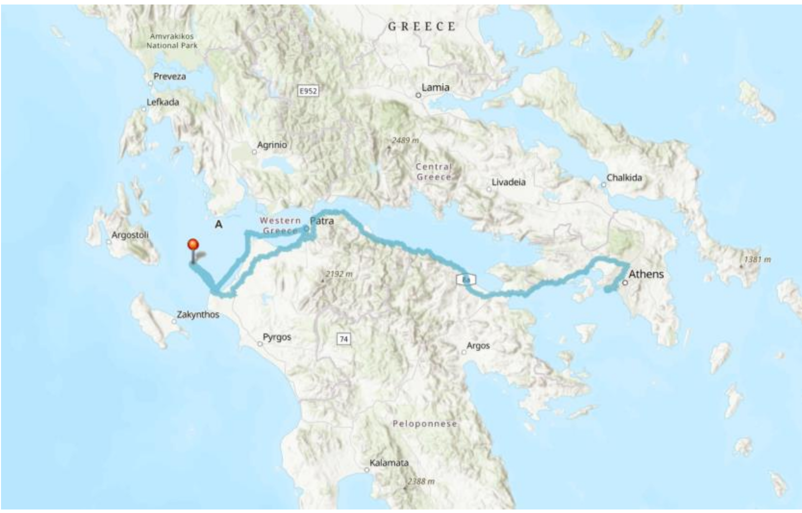

Fig. 19: Location of the deployment point during the Greek exercise. The blue line is the GPS path from Athens of the different steps to carry the field activity.

3.2.1 Field Activities

The total activity consisted in three phases: i) Equipment preparation in Patra HGC Local Port Authority (figure 20), ii) transportation to Killini port and iii) deployment of the equipment. The equipment was first transported to Patra port where some technical adjustments were done to prepare the dummy tracking system and load everything on board the HCG fast patrol boat PLS1045. Finally, the equipment was transported to Killini Port where the full crew and participants embarked.

The equipment deployment was quite successful except for a confusion and mismatch with respect to the general strategy (figure 10) concerning the starting point of the deployment. Compare the point A of figure 10 with point A in Figure 21.

Fig 20: Left: HCG fast patrol boat PLS1045. Fast boat patrol used during the exercise. Center: Dummy preparation at Patra HCG local port authority. Right: Equipment ready at Killini port.

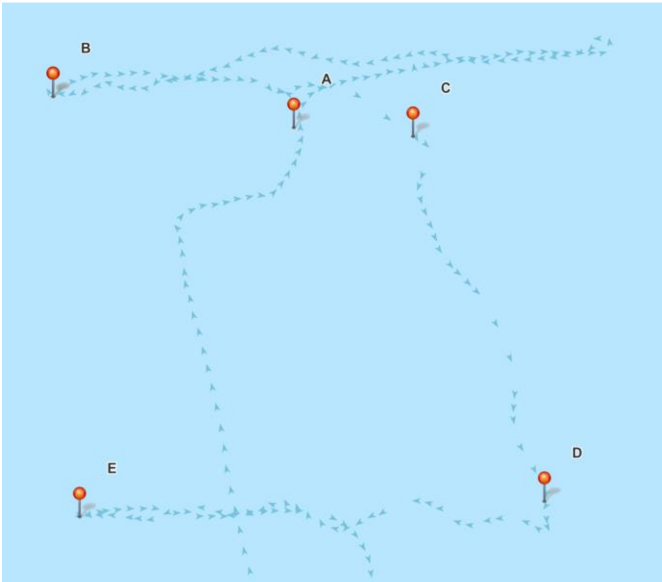

Fig. 21: Real deployment made during the Greek exercise. Point A was the position where the SAR target was finally deployed.

In each deployment we took care of releasing first the SVP drifter, then the dummy and the CODE drifter consecutively. As we show in the images of figure 22, the separation was a few metres between all devices.

To note that the water conditions constraint the expected behaviour of the different devices. The fact of saltier and warmer water in the area, and the flat sea surface conditions due to the absence of wind extended the set up of the different devices. The dummy took much more to become in a vertical position due to the total absence of waves and the excess of water buoyancy.

The same happened with the CODE drifter which is packed inside a biodegradable cartoon. Usually, in less than 10-15 min the packaging is unpaged. Once the drifter is unpaged and the antenna deployed the tracking system is activated. In our case it also took more time than it should.

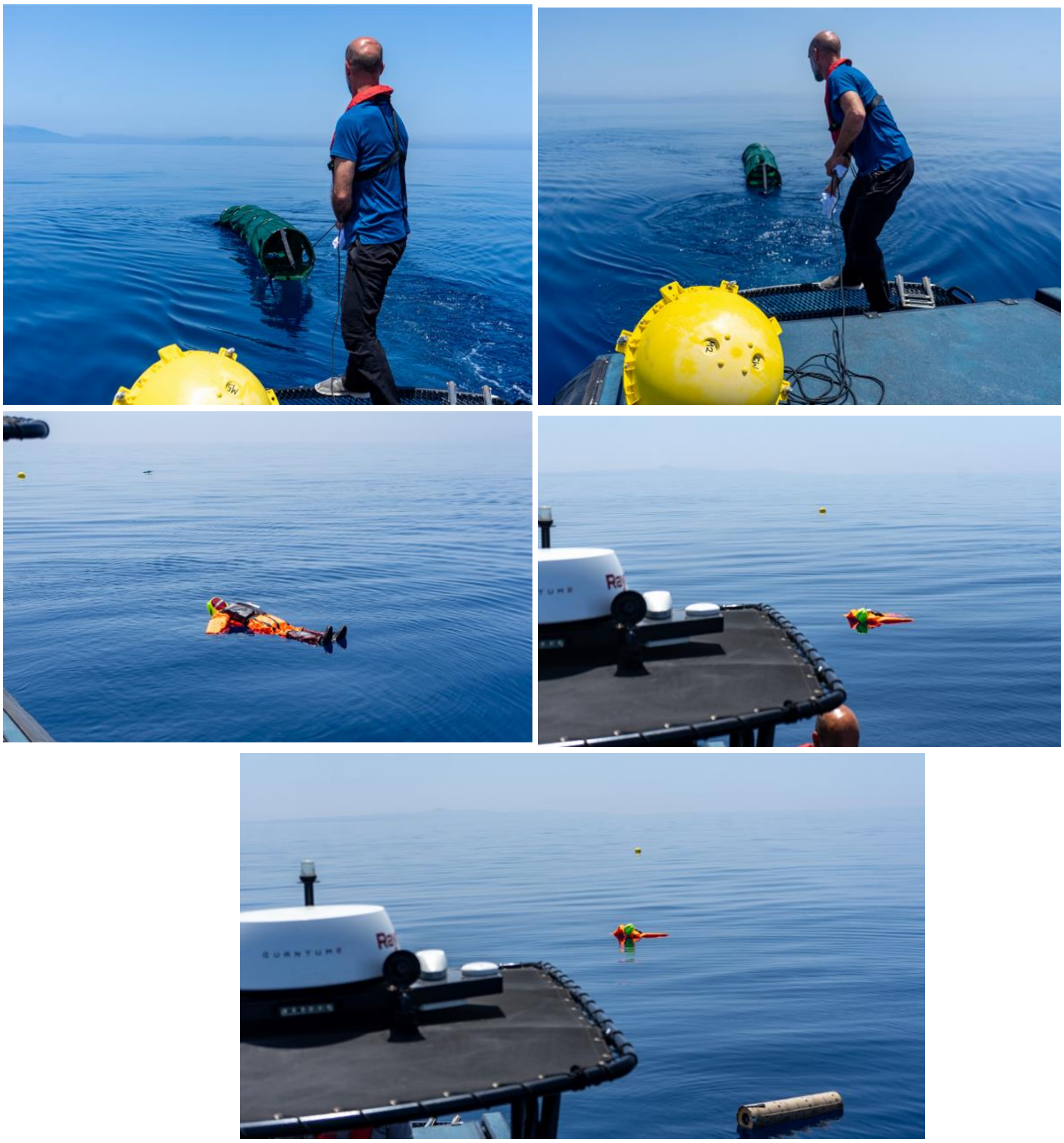

Fig 22: Deployment at the way point D

The deployment took a few hours in total where many way points were recorded with a PLB to test the integration of such low cost devices into the GIS tools (figure 23).

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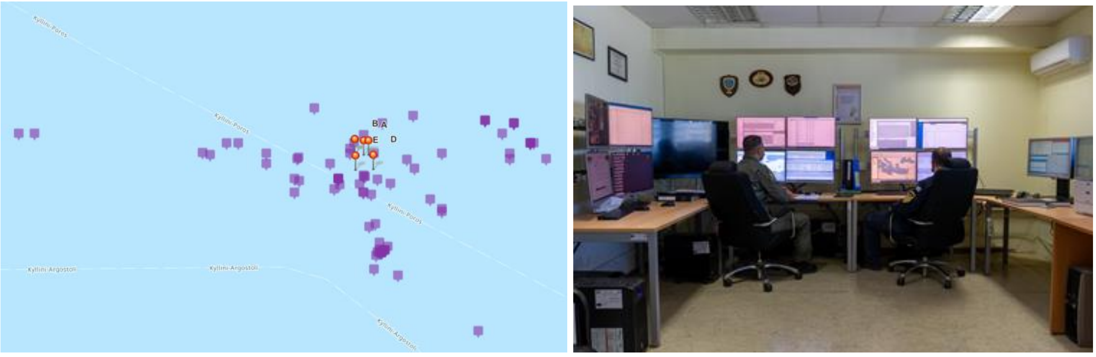

Fig 23: Left: Way points recorde with the PLB during the deployment activity. Right: The Greek Mission Control Centre (GRMCC) for COSPAS-SARSAT where all information was integrated.

3.2.2 Results

In figure 24 we show the tracking observations of some devices deployed in the Greek exercise during approximately the first 48 hours (CODE drifters and the dummy with vertical configuration) . The first thing to note is the gap of data transmissions that affected both satellite systems simultaneously. The vertically configured dummy was equipped with a SPOT tracking system belonging to the Globalstar constellation while the CODE are tracked using the Iridium constellation. Probably a problem with the land satellite relay stations affected all platforms.

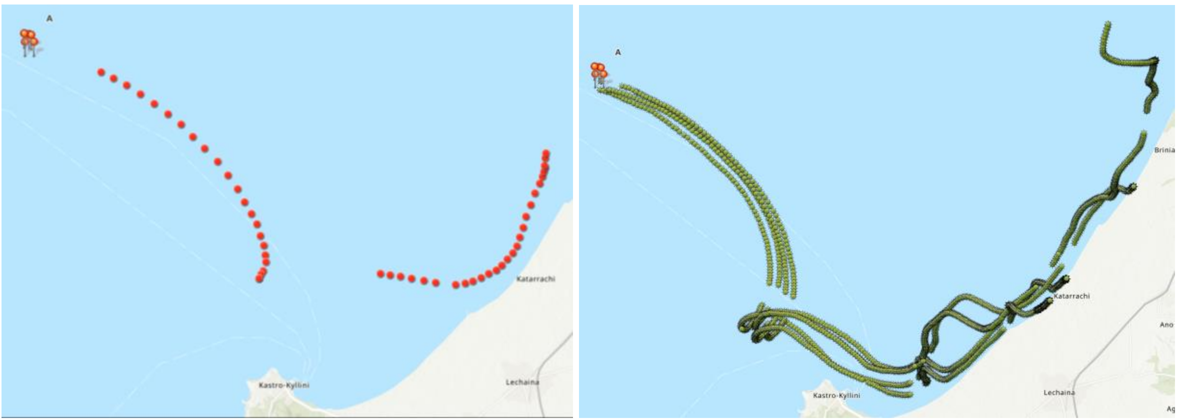

Fig 24: Left: trajectory followed by the dummy between 2022-05-24 10:40 (approximately) and 2022-05-26, 2:21:02. Right: Trajectories followed by the CODE drifters between 2022-05-24, 10:41 and 2022-05-28, 22:00 (UTC)

The gap in the dummy trajectory separates the drift pattern that can be clarified by comparing with the CODE trajectories. The dummy path stopped at the instant where there was a loop that deviated the southward progression towards the east reaching the coast and drifting along the coast.

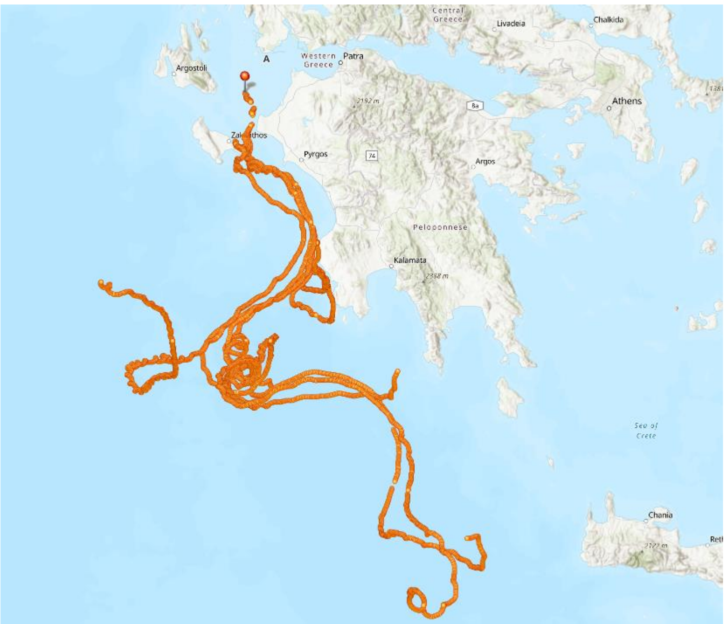

Fig 25: Trajectory followed by SVP drifters between 2022-05-24 at 11:04:28 and 2022-07-11 at 06:57:56 (UTC)

The drift of SVP drifters was completely different with respect to the CODE. At the time when the loop occurred, the SVP continued to drift more southward leaving the semi-enclosed region and going to the open sea area west of Greece (figure 25). At the time of writing this report there are still two SVP drifting in the Ionian basin south of the Greece coast and a third one that reached and breached recently in the Libyan coast.

Unfortunately, the SAR forecasting activities in this exercise were more limited. Two model configurations were executed providing the trajectory of the centroid from a cloud of particles. In figure 26 we show the results of 24 h and 48 h for both configurations. As it can be seen the simulations fail to capture the drift of the devices. Both systems foresee a drift towards the south that avoids the eastern part of the semi-enclosed region separated by the cap west of Killini.

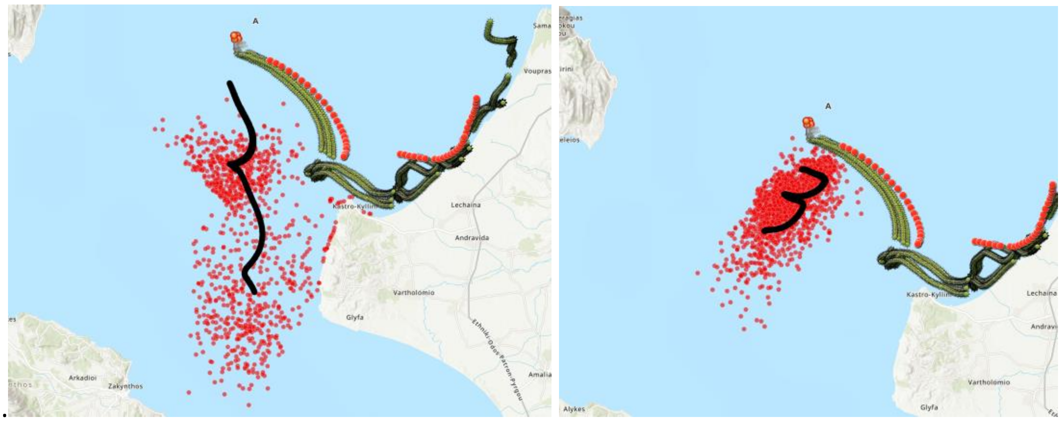

Fig 26: SAR forecasting made by the Greek authorities with two model configurations for 24 h and 48 h. The solid red and green dots issued from the deployment indicate the real observations of the dummy and CODE drifters. The black line corresponds to the trajectory made by the centroid of a cloud of particles issuing from the initial position. The set of small dots around the black line are the final positions of the cloud of virtual particles issuing from the initial release.

3.3 Climatological Atlas and COSMO-View tool

In WP3 a climatological atlas of surface and subsurface currents was compiled for the whole Mediterranean basin (see the deliverable *D3.1.1 Data Collection: Climatological Atlas and Drifting Objects Database*, and https://cosmo.icm.csic.es/currents/). One of the objectives of the Pilot study was to validate the added value of the atlas to assess SAR activities as a first guess of the characteristics of currents in the emergency location. A climatology field is the result of a mathematical procedure to find a characteristic representation of a field over a period of time. Such representation can be defined and obtained by different methods. In our case climatology is defined by the statistical median of a daily time series of 33 years long from a state of the art of Copernicus reanalysis (Martínez *et al*., 2022). The SAR exercises are an opportunity for dealing with a validation of this product.

French-Spanish exercise: In figure 27 we have represented the climatological surface currents provided by the Atlas and the trajectories of SAR targets and CODE drifters. Except for the initial drift the general southward progression is in reasonable agreement. If we compare the trajectories of all devices and the intensity of the climatological currents (fig. 28) we can observe that, even for the SVP drifters, once the devices reached the core of the climatological Liguro-Provençal current (orange and red colours) they turned southward. The core of the current acting as a natural barrier limiting the east progression.

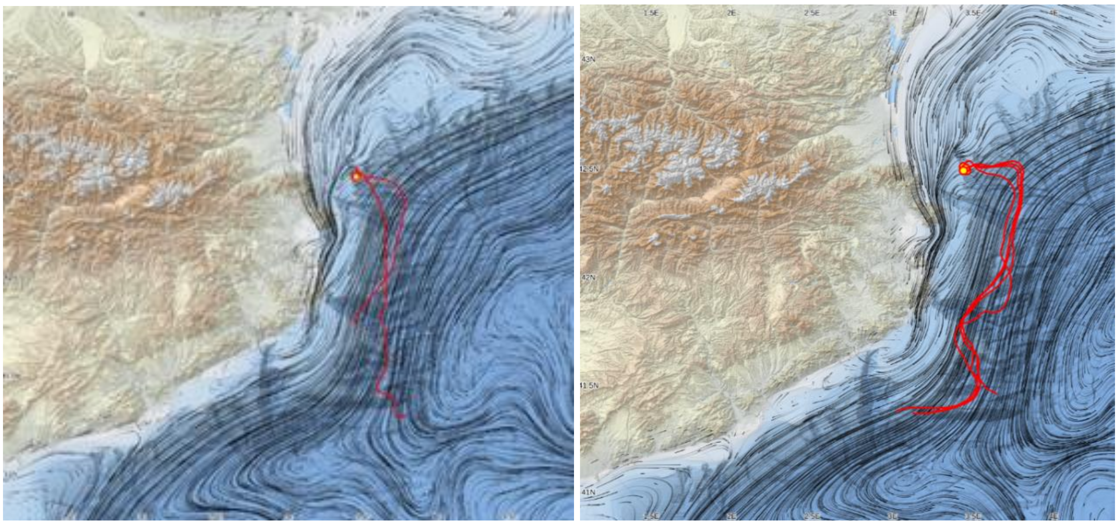

Fig. 27: Climatological surface of currents of February. Black lines are a Lagrangian representation of the water motion from particles released uniformly through the whole domain. The red overlapping trajectories are those of the life raft and horizontal dummy (left) and CODE drifters and vertical dummy (right) during the first 72 h approximately.

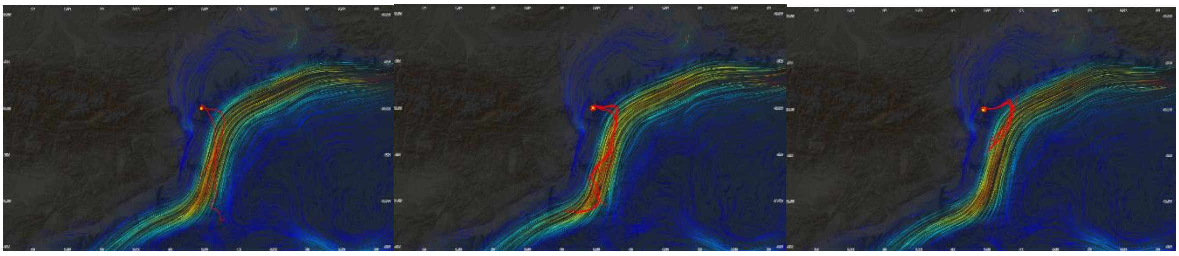

Fig. 28: Current intensity of the climatological currents and trajectories made by the life raft and horizontal dummy (left), CODE drifters and vertical dummy (centre) and SVP drifters (right)

G**reek exercise**: Similar to the previous case, in figure 29 we have represented the climatological surface and subsurface currents provided by the Atlas and the trajectories of all devices. The situation is more complex than in the French-Spanish exercise because several elements concur. First, the region of the exercise is a small semi-enclosed shallow area, where present ocean circulation models have many limitations. There is a much marked seasonality of surface currents in the Eastern Mediterranean basin than in the Western basin with remarkable differences between surface and subsurface currents.

As it can be appreciated the patterns of both, the surface and subsurface currents, are similar close to the Western area of the deployment location along the Kefalonia and Zachintos coasts. East of the deployment location, the flow pattern differs notably between the surface and subsurface currents. The flow enters the eastern area making a loop before going southwest along the land coats of Peloponnese land (fig. 29 right). The SVP agrees well with both patterns while the CODE drifters and the dummy fit better the flow shape of the subsurface currents and differs when they reach the coastal area moving counter current.

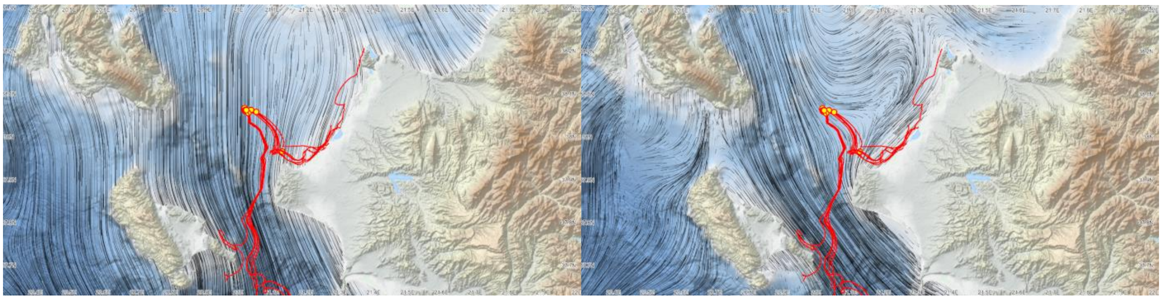

Fig 29: Climatological surface (left) and subsurface (right) currents for May overlapping the trajectories made by all devices since the deployment until the end of May.

If we compare the patterns for the SVP drifters which still continue to drift, the matching of their trajectories and the patterns of climatological current match quite well. In figure 30 we show the trajectories of the SVP compared with the subsurface currents characteristic of May and June. During May they were satisfactorily in agreement with the atlas. In June, the SVP trajectories fit quite well a number of features seen in the Atlas (big eddies and large scale gyres). The major discrepancies appear at the time SVP drifters moved offshore from the west coast of Peloponnese peninsula (right of fig. 30) at approximately 37º N - 21.5 E.

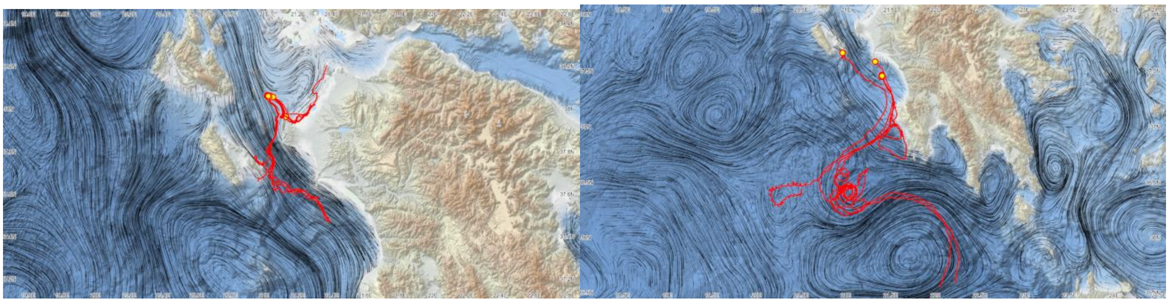

Fig 29: Climatological subsurface currents for May (left) and June (right) overlapping the trajectories made by all devices during May and June respectively.

Finally, the COSMO-View tool was mostly used in the French-Spanish exercise because, in the current state of development, it may provide access to many products delivered only for the Western Mediterranean basin (figure 30).

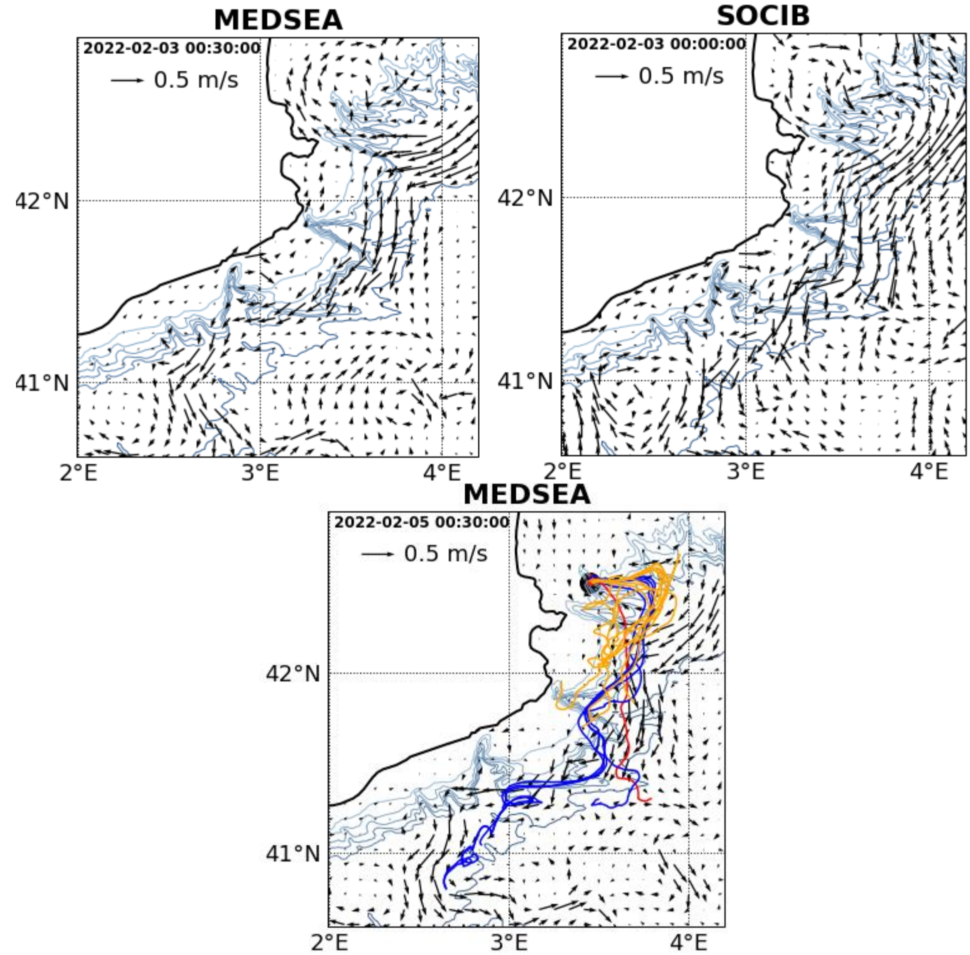

Fig. 30: Visualisation example combining forecast surface currents from two models and observations.

The tool is able to manage multiple products of current fields. In the case shown in the figure the forecast fields of surface currents from two models were loaded and overlapped with the observations. The lower map of figure 30 corresponds to the initial condition for a simulation of a cloud of particles located at the deployment point using the Lagrangian particle model included in the COSMO-View tool. Some movies exist of such simulations but cannot be included here.

3.4 Outreach and Dissemination activities

The SAR exercises were coordinated with several dissemination and outreach activities. During the Greek exercise a live streaming connection was organised by the HCG authority to describe the procedures of the field activity during the preparation and the deployment phase (fig.31). Several partners and interested stakeholders were allowed to make a live connection with participants at Killini port and they could interact.

Fig 31: Left: Dr. E. García-Ladona explaining by streaming the different equipment prepared for the exercise in Killini port. Right: A picture with the equipment on board the boat ready to depart toward the deployment area.

In the French-Spanish exercise the outreach activities were focused on educational content. Thus, ICM-CSIC contributed with general presentations to several schools within the project "*Petits Oceanògrafs*" aiming to bring knowledge about ocean physics to 10-12 years old kids. In such presentations it was proposed to survey the SAR exercise to approach the complexity of the regional currents. The kids will try to think over the causes behind the differences in the drifting trajectories. In addition, each class prepared a welcome message in several languages from around the Mediterranean that were inserted into a glass bottle that was released during the deployment (fig. 32). These activities were also disseminated through social networks (Tweeter, Instagram and Facebook)

Fig. 32: The *message in the bottle* written by school kids in several Mediterranean languages that was released during the French-Spanish exercise.

4 Summary and conclusions

Facing SAR emergencies is one of the most challenging topics for the current ocean forecasting systems. Even if most of the SAR emergencies occur close to coastal areas, and besides the improvements on safety measures and technological advances in safety devices, when a distress comes out with a certain degree of incertitude, the prediction tools and data used for running the rescue strategies must be precise in space and time. Apart from the necessary availability of high performance technologies in searching and rescue (drones, radars, optical captors, automatic detection, fast boats, etc.), the basic elements to establish a searching strategy require the combination of meteo-oceanographic data and forecasting models.

Ocean forecasting models are under continuous development to increase the spatial resolution by including more and more physical processes. Observation technologies have also increased and improved the sources of ocean data and their quality but the predictions are still far from the necessary requirements of SAR activities. Thus, it is recommended to make continuous tests and validation exercises in order to get feedback, not only over the potential deficiencies or failures but to build cumulative knowledge.

In MEDOSMOSIS project, we have proposed to carry a thematic Pilot study on SAR activities with a double aim, to test current tools and available data for SAR needs and to promote transnational cooperation exercises in the Mediterranean basin in order to improve the governance in the area. The two SAR exercises here described have provided a set of interesting results on a technical level and have been very successful to promote transnational cooperation.

On a technical side, we have a number of items to highlight:

- The preliminary exercise with two dummies in different configurations have served to test the performance of the satellite tracking system and have emerged the different drifting behaviour of both configurations. These are normally assumed to be an approach to a corpse for the horizontal configuration and a person alive for the vertical one. The divergence of their trajectories from the initial location, where dummies were deployed a few metres apart, is quite fast (around 6 h) and in 24 h they were separated around 6.3 km under very mild sea state conditions. The forecasting was reasonably successful although simulated trajectories were longer in length and noisy (this probably related with the turbulent parametrization) compared with the smoothness of the real ones.

- We have used different SAR targets and drifters with different tracking systems. All the equipment used worked fine. Only one device, a CODE drifter, failed to transmit data. The tracking system and the data distribution worked mostly correctly except for some gaping transmissions of Iridium telemetry in the Greek exercise. Curiously, It seemed a problem related with the satellite data relays because gaps appeared simultaneously on the SPOT and Iridium systems. The tracking system for dummies also performed very well with almost no information loss. At the time of writing this there is a SVP drifter still providing data from the French-Spanish exercise and three SVP drifters from the Greek exercise.

- The system of data sharing and data distribution among all the participants was very satisfactory in both exercises. The integration of all the information into the different GIS tools, including such of the Personal Locator Beacon (PLB) in the Greek exercise, was straightforward.

- From both exercises, we could appreciate the differences between the behaviour of CODE drifters and such as the SVP drifters. It stresses the role of the wind, the vertical shear and probably the wave action, in determining the currents close to the surface with respect to those at the subsurface (~15 m). In the Greek exercise, where initially there was no wind and no wave, the separation is quite noticeable. CODE drifters released very close to SVP drifters completely diverged in such a way that their trajectories at intermediate times drastically separated. The causes for such distinct behaviour are difficult to determine and more careful and in depth quantitative analysis are needed to elucidate it.

- A very relevant result, confirmed in both exercises, is the close correlation of the CODE trajectories and such of dummies in vertical configuration. In the French-Spanish exercise, and during 72 h, the dummy in vertical configuration made a trajectory almost indistinguishable from CODE drifters. This implies that CODE drifters are devices behaving as good simulators of the trajectory followed by a person alive. There seems to be a good equivalence in terms of the trajectory’s shape while in terms of the speed values a rescaling is needed.

- One may wonder about the interest of using SVP drifters and their relevance to SAR operations. Certainly, the CODE is the most relevant practical device regarding SAR operations. However The SVP drifters are at the core of the Surface Velocity Program, an international program focused on the ocean surface currents that are releasing drifters operationally at global scale. They can be used for validation purposes, and thus indicators of the goodness of the current forecasting products at any time. In SAR exercises, combined with the use of CODE drifters may supply the complementary information to establish the practical parameters for Lagrangian simulations, as those needed in SAR forecasting.

- The tests of the drifting models and tools have been very illuminating. In the French-Spanish exercise several aspects must be remarked. Firstly, the initial simulated drifts of target devices failed to reproduce the observations for short times (36 hours). In some cases, a specific combination of meteorological and oceanographic models is able to approach the observations in the sense that the target is found within the foreseen searching area. Another important result is that different combinations may produce reasonable results for different targets, but that there is not a unique combination that can be used for all targets. In the Greek exercise, it was not possible to run a very detailed comparison between observations and simulations but the two obtained runs failed to predict or approach the real behaviour of the SAR target. All these results reinforce what we have said before, that SAR prediction is still a challenging problem for current operational systems and that more research is needed in this area.

- Regarding the use of the monthly climatological atlas of currents as a rapid and first guess to respond to a SAR emergency, the results are inconclusive. The surface currents of the atlas for the French-Spanish exercise were in "*reasonable agreement*" with the general drift of the targets except at the beginning. Discrepancies may be due to several aspects, the most evident is that besides the climatology is based on a relatively well documented and long reanalysis it fails to tackle the particular conditions, both meteorological and oceanographic, during the exercise. We must recall that the initial location was inside the axis of a submarine canyon close to the coastal boundary. It is a known limitation that current oceanographic models are not able to simulate the complex dynamics close to the coast. However, the south general drift was captured because the atlas captured the location of the main southward current. In the Greek exercise the southward flow was clearly established by the atlas but the drift of CODE drifters and the dummy was not captured at all. Once again the chosen area is quite complex to expect that climatological current may represent the detailed patterns. For the SVP drifters, once they escaped from the semi-enclosed region and entered the open sea area, many observed patterns are closely correlated with the climatological data. With only these two cases it is difficult to assess if the atlas fields can be useful for operational activities. More validation work is needed to verify it.

- To end with the technical aspects, we must mention the use of the COSMO-VIEW tool which has been possible to test only in the French-Spanish exercise. We have provided several examples of the performance and capabilities of the tool to deal with the complete ingestion of observational environmental data, and particularly relevant for SAR operations the ingestion of ocean current from several sources. Some Lagrangian simulations were carried out with the Lagrangian module from several forecasting products of ocean current. On the other side the tool is able to integrate many sources of ancillary data. A proof of that was the satisfactory ingestion of the PING S-124 navigation warning information from the WFS services provided by SHOM testing website.

Finally, regarding the collaboration/governance aspects of this pilot study we must highlight the following:

- The coordination to develop the Pilot study was difficult, complex but very successful. These exercises may contribute to shed some light on the performance of current SAR tools. Strategies of SAR exercises based on the use of several devices may help to understand in a more comprehensible way the whole performance of models, the key parameters and the procedures to improve SAR activities.

Acknowledgements: The authors want to thank all the authorities from the countries involved in the SAR exercises that have provided the opportune permissions and technical support to the field activities and the forecasting activities. A special acknowledgement to the crews of the HCG patrol boat PLS1045 and the French SNS 092 vessel, and the participants that worked for having successful deployments.

Right: The crew of the and participants during the French-Spanish exercise: Left: The crew of the HCG fast patrol boat PLS1045 and participants in the Greek exercise.

5 References

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Martínez J., García-Ladona E. and J. Ballabrera-Poy (2021). Atlas of Mediterranean and Canary/Iberian/Biscay Atlantic currents (V.1.0). DOI: https://doi.org/10.20350/digitalCSIC/13834

Appendix A: Deployment strategy

In the following, we list the set of devices and their corresponding way points (A-B-C-D) appearing in the figure 6 for both exercises. Devices for the French-Spanish exercise are listed in tables A1-A2 and those for the Greek exercise are listed in tables A3-A4. The tables correspond to the initial planning and the real deployment respectively. The differences arise because the tracking system for the devices may not be activated exactly at the same time frame as the deployment instant so, a certain delay may appear between the real deployment time and the first tracking datum.

As indicated previously, the devices released in the square vertices were similar in both exercises. Thus, 1 CODE and 1 SVP drift on each vertex (**A, B, C, E**). At the centre point (**D**), and for the French-Spanish exercise we released 1 CODE, 1 SVP, 2 dummies, and a life raft ballasted, while for the Greek exercise one dummy.

To clarify the nomenclature used for some columns in tables A2-A4 are:

Tini: Time corresponding to the initial deployment either if the position is manually recorded or delivered by the tracking system.

Lonini: Longitude of the initial deployment location

Latini: Latitude of the initial deployment location

Tfin: Time corresponding to the final location recorded by the tracking system. In the case of beaching a manual selection of the most logical ending point is done.

Lonfin: Longitude of the last recorded location

Latfin: Latitude of the last recorded location.

Status: Defines the current status of the device

Point	Target name	Target type	Lat	Lon	IMEI/SN
A	MEDOSC-1	CODE	42.509990 N 42° 30.599'N	3.440235 E 3° 26.414' E	**300534061787380**
	medosmosis07	SVP	42.509990 N 42° 30.599'N	3.440235 E 3° 26.414' E	**0-3196877**
B	MEDOSC-2	CODE	42.509990 N 42° 30.599'N	3.459831 E 3° 27.590' E	**300534061785360**
	medosmosis08	SVP	42.509990 N 42° 30.599'N	3.459831 E 3° 27.590' E	**0-4422624**
C	MEDOSC-3	CODE	42.4927 N 42° 29.562'N	3.459831 E 3° 27.590' E	**300534061782370**
	medosmosis09	SVP	42.4927 N 42° 29.562'N	3.459831 E 3° 27.590' E	**0-4425822**
D	COSMOE2	Life Raft	42.5 N 42° 30.000'N	3.45 E 3° 27.000'E	**0-2574900**
	medosmosis12	Dummy V	42.5 N 42° 30.000'N	3.45 E 3° 27.000'E	**0-4422609**
	Findspot-SLDMB030_BARCELONA	Dummy H	42.5 N 42° 30.000'N	3.45 E 3° 27.000'E	0-3124637
	MEDOSC-4	CODE	42.5 N 42° 30.000'N	3.45 E 3° 27.000'E	**300534061786400**
	medosmosis10	SVP	42.5 N 42° 30.000'N	3.45 E 3° 27.000'E	**0-4422610**
E	MEDOSC-5	CODE	42.4927 N 42° 29.562'N	3.440235 E 3° 26.414'E	**300534061788360**
	medosmosis11	SVP	42.4927 N 42° 29.562'N	3.440235 E 3° 26.414'E	**0-3196871**

Table A1: List of devices, positions and IMEIS corresponding to the points in figure 6 and for the French-Spanish exercise

Description				Deployment			End/Recovery			
NAME	IMEI	Type	Telemetry	tini	lonini	latini	tfin	lonfin	latfin	status
COSMOE2_0	0-2574900	Life_raft	GLOBALSTAR	2022-02-03T09:55:00	3.44975	42.50177	2022-02-07T13:25:00	3.79333	41.30333	Degraded
MEDOSC_1	300534061787380	CODE	Iridium	2022-02-03T09:27:00	3.440317	42.5101	2022-02-13T18:20:00	3.496394	41.29964	Lost
MEDOSC_2	300534061785360	CODE	Iridium	2022-02-03T09:27:00	--------------	---------------	--------------------------------	------------	--------------	Lost
MEDOSC_3	300534061782370	CODE	Iridium	2022-02-03T09:36:00	3.45927	42.49195	2022-02-11T10:10:00	2.845202	41.047316	Lost
MEDOSC_4	300534061786400	CODE	Iridium	2022-02-03T09:57:00	3.45103	42.50257	2022-03-21T14:10:00	-0.190168	39.716466	Degraded
MEDOSC_5	300534061788360	CODE	Iridium	2022-02-03T10:06:00	3.43957	42.49227	2022-05-05T08:50:00	-0.121282	39.045322	Degraded
medosmosis7	0-3196877	SVP	GLOBALSTAR	2022-02-03T09:27:00	3.44032	42.5101	2022-05-12T00:30:44	0.59779	40.51168	Degraded
medosmosis8	0-4422624	SVP	GLOBALSTAR	2022-02-03T09:36:00	3.46112	42.51005	2022-03-11T09:24:00	2.174900	41.22117	Degraded
medosmosis9	0-4425822	SVP	GLOBALSTAR	2022-02-03T09:36:00	3.45927	42.49195				Alive
medosmosis10	0-4422610	SVP	GLOBALSTAR	2022-02-03T09:57:00	3.45103	42.5021	2022-02-21T09:13:19	3.44756	42.14979	Degraded
medosmosis11	0-3196871	SVP	GLOBALSTAR	2022-02-03T10:06:00	3.43957	42.49227	2022-03-07T09:32:12	2.17293	41.22041	Degraded
medosmosis12	0-4422609	Dummy_v	GLOBALSTAR	2022-02-03T09:55:00	3.44925	42.5019	2022-02-07T09:34:00	3.45167	41.74	Degraded
Findspot-SLDMB030_BARCELONA	0-3124637	Dummy_h	GLOBALSTAR	2022-02-03T09:55:00	3.44925	42.5019	2022-02-07T11:10:00	3.68667	41.61167	Degraded

Table A2: List of all the devices for the French-Spanish deployment and their status updated on 2022-09-08 at 12:25 pm.

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Point	Target name	Target type	Lat	Lon	IMEI/SN
A	MEDOSC-6	CODE	N	E	**300534061786370**
	medosmosis1	SVP	N	E	**0-4421909**
B	MEDOSC-7	CODE	N	E	**300534061782130**
	medosmosis2	SVP	N	E	**0-4426357**
C	MEDOSC-8	CODE	N	E	**300534061785360**
	medosmosis3	SVP	N	E	**0-4422619**
D	medosmosis6	Dummy_V	N	E	**0-4423366**
	medosmosis12	Dummy_H	N	E	**0-4422609**
	MEDOSC-9	CODE	N	E	**300534061783340**
	medosmosis4	SVP	N	E	**0-4425617**
E	MEDOSC-10	CODE	N	E	**300534061783350**
	medosmosis5	SVP	N	E	**0-4423374**

Table A3: List of devices, positions and IMEIS corresponding to the way points of figure 6, and for the Greek exercise

Description				Deployment			End/Recovering			
NAME	**IMEI**	**type**	**Telemetry**	**tini (UTC)**	**lonini**	**latini**	**tfin (UTC)**	**lonfin**	**latfin**	**Status**
MEDOSC_1	300534061786370	CODE	Iridium	2022-05-24T10:19:14	38,06516667	21,01531667	2022-05-29T16:10:00	21.257802	37.97617	Beached
MEDOSC_2	300534061782130	CODE	Iridium	2022-05-24T10:26:28	38,06505	21,01983333	2022-05-28T22:00:00	21.266832	37.985372	Beached
MEDOSC_3	300534061783320	CODE	Iridium	2022-05-24T10:00:32	38,06825	21,01505	2022-05-29T16:10:00	21.37287	38.206478	Beached
MEDOSC_4	300534061783350	CODE	Iridium	2022-05-24T09:41:05	38,06801667	21,0174	2022-05-27T20:10:00	21.302694	38.024072	Beached
MEDOSC_5	300534061783340	CODE	Iridium	2022-05-24T10:14:46	38,06795	21,01855	2022-05-27T20:10:00	21.302694	38.024072	Beached
medosmosis1	0-4421909	SVP	GLOBALSTAR	2022-05-24T10:19:14	38,06516667	21,01531667	2022-06-29T06:58:28	21.55524	37.18103	Picked up
medosmosis2	0-4426357	SVP	GLOBALSTAR	2022-05-24T10:26:28	38,06505	21,01983333				
medosmosis3	0-4422619	SVP	GLOBALSTAR	2022-05-24T10:00:32	38,06825	21,01505	2022-07-22T03:31:16	21.631010	34.880660	Ceased
medosmosis4	0-4425617	SVP	GLOBALSTAR	2022-05-24T09:41:05	38,06801667	21,0174	2022-06-29T06:58:28	21.56981	32.88887	Beached
medosmosis5	0-4423374	SVP	GLOBALSTAR	2022-05-24T10:14:46	38,06795	21,01855				
medosmosis6	0-4423366	Dummy_v	GLOBALSTAR	2022-05-24T09:41:05	38,06801667	21,0174	2022-05-26T02:21:02	21.27453	38.02744	Recovered
PLB		Bacon								

Table A4: List of all the devices for Greek deployment and their status updated on 2022-09-08 at 12:25 pm.

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Appendix B: Agendas

HOUR UTC	ACTION	LOCATION
Thursday February 3		
8h00	Equip. preparation and loading aboard the SNS 092	Port Vendres
8h30	Boarding 2 people from ICM 1 Univ. Perpignan	Port Vendres
XXh00	Drifter Deployment 1 CODE, 1 SVP	Point A
XXh00	Drifter Deployment 1 CODE, 1 SVP	Point B
XXh00	Deployment 1 CODE, 1 SVP, 2 DUMMIES, 1 LIFEBOAT 4 wreck glass bottles (outreach activity)	Point C
XXh00	Drifter Deployment 1 CODE, 1 SVP	Point D
XXh00	Return	Port Vendres
XXh00 + 1 h	Alert notification "AVURNAV Toulon" through PING system “EXERCISE-SAR-MEDOSMOSIS”	(via CROSSMED and INFONAUT)
February 4 – 5		
0 - 24h	SAR and tracking operations **End of the formal exercise**	Barcelona SASEMAR CROSS
February 6 - 9		
0 - 24h	Additional SAR and tracking operations using remaining drifters on a voluntary basis	Barcelona SASEMAR CROSS
Wednesday February 9 (to be confirmed)		
09h00 – 12h00	Briefing	CCS Barcelona Maritime Captaincy building

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According to the agenda:

- **SNSM is charged of deploying the equipment and issuing and alert**
- **SASEMAR will be in charge of field operations to recover dummies and life raft. Drifters will remain at sea far beyond the end of the exercise.**
- **CROSSMED will coordinate with INFONAUT office to issue a fictional navigation warning using the PING S-124 system developed by SHOM**
- **CROSS and SASEMAR will perform the tracking and the forecasting of searching areas during three days (72 h) after the emergency issue.**

Interreg Mediterranean
MED OSMoSIS

Appendix C: List of participants, observers, contacts and roles

C.1 Participants

Institution	Name	Function	Role
ICM	E. García	Research staff	MEDOSMOSIS coordinator of Pilot Study
ICM	J. Salvador	Technical staff	Preparation equipment
ICM	J. Ballabrera	Research staff	COSMO-VIEW tool test
SASEMAR	G. Gantés	Head of MRCC	Spanish SAR coordinator Barcelona
CROSS	L. Cougoureux	A1AM	French SAR coordinator Mediterranée
SNSMS	M. Armisend	SNS 092 Skipper	SNS 092 Skipper
SHOM	Y. Le Franc	Division Produits et Services Maritimes	Navigational Warning S124 API
Perpignan University	F. Bourrin	Professor staff	Observer

C.2 Observers and Stakeholders

Ms Lieutenant A. Ginella (PREMAR)

Ms A. Sommier (SHOM)

Mr. M. Boada (SNSMS delegate at Port-Vendres)

Mr. J.-R. Trancon (Maritime Captain of Girona)

Mr. M. Barroso (CNCSS SASEMAR Madrid)

Mr. J.M. Allegue (Head of MRCC, Almería)

Mr. Lieutenant C. Zacharakopolus (Hellenic Coast Guard)

Mr. Dimitrios Panagopoulos (GMMA, MEDOSMOSIS Coordinator)

Mr. Stratos Tserkos (REMACO S.A., MEDOSMOSIS Partner)

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