

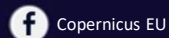


# Search and Rescue

Copernicus Environment Monitoring Service



Space



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[www.copernicus.eu](http://www.copernicus.eu)



Marine Monitoring

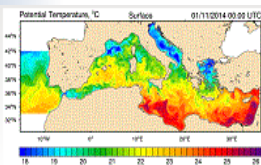
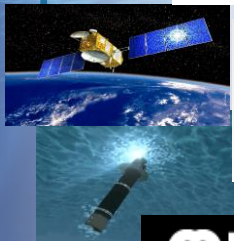
# Sea Situational Awareness : Why? For whom?



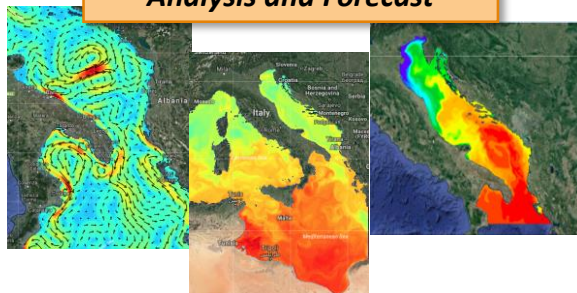


Marine Monitoring

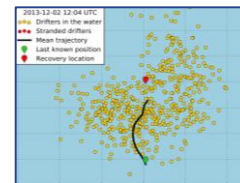
# Sea Situational Awareness Services: how we produce them



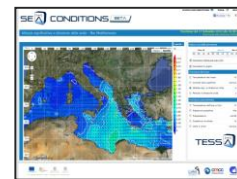
**Downscaling  
High Resolution  
Analysis and Forecast**



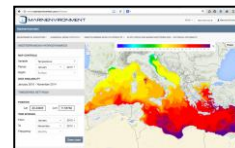
**Informations and applications  
for end-users**



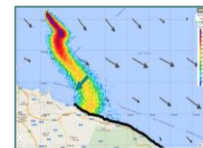
**Search and Rescue**



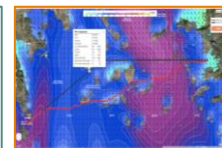
**SeaConditions**



**Marine Environment**



**Oil Spill**



**Ship Routing**





**OCEAN-SAR** DISCOVER OCEAN-SAR NEWS <sup>3+</sup> TESSA CONTACT US HELP More Services Welcome paola

Home

**SIMULATION INPUT**

**GENERAL**

Simulation name  
Enter simulation name

Object class  
1. Person-in-water (PIW), unknown state (mean val...)

**LAST KNOWN POSITION**

Lat  °  '  " Radius  5.0 km  
Lon  °  '  "

Coordinate format  DMS  DMM  DD

Start of drifter release  2016-08-11  15:57

**SIMULATION DURATION**

1 93 24 hours

**FORECASTING SYSTEM**

Oceanographic forecasting system  
 MFS MvOcean

**SUBMIT**

**Map**

Map data ©2016 GeoBasis-DE/BKG (©2009), Google, Inst. Geogr. Nacional, Mapa GISrapl, ORION-ME 200 km Terms of Use | Report a map error

last known position  
drifter in water  
stranded drifter  
mean trajectory  
search area envelope

**SUBMIT**

m/s  
1.1 >  
1.0  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2  
0.1  
0.0

Map Satellite

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# The OCEAN-SAR user interface

The User Interface (UI) allows setting the parameters of the simulation, submitting requests and displaying the results of simulations on a map. The parameters can be grouped as follows:

- general parameters (simulation name, object category);
- last known position (start position, end position, start date, end date);
- simulation duration;
- forecasting system (wind and currents models);
- display settings (environmental fields on/off);

<http://www.ocean-sar.com/en/join>

**General**

- Simulation name
- Object class (63 entries)

**Last Known Position**

- Start position
- End Position
- Start date
- End date

**Simulation duration**

**Forecasting system**

- Wind and currents forecast systems

**Visualization settings**

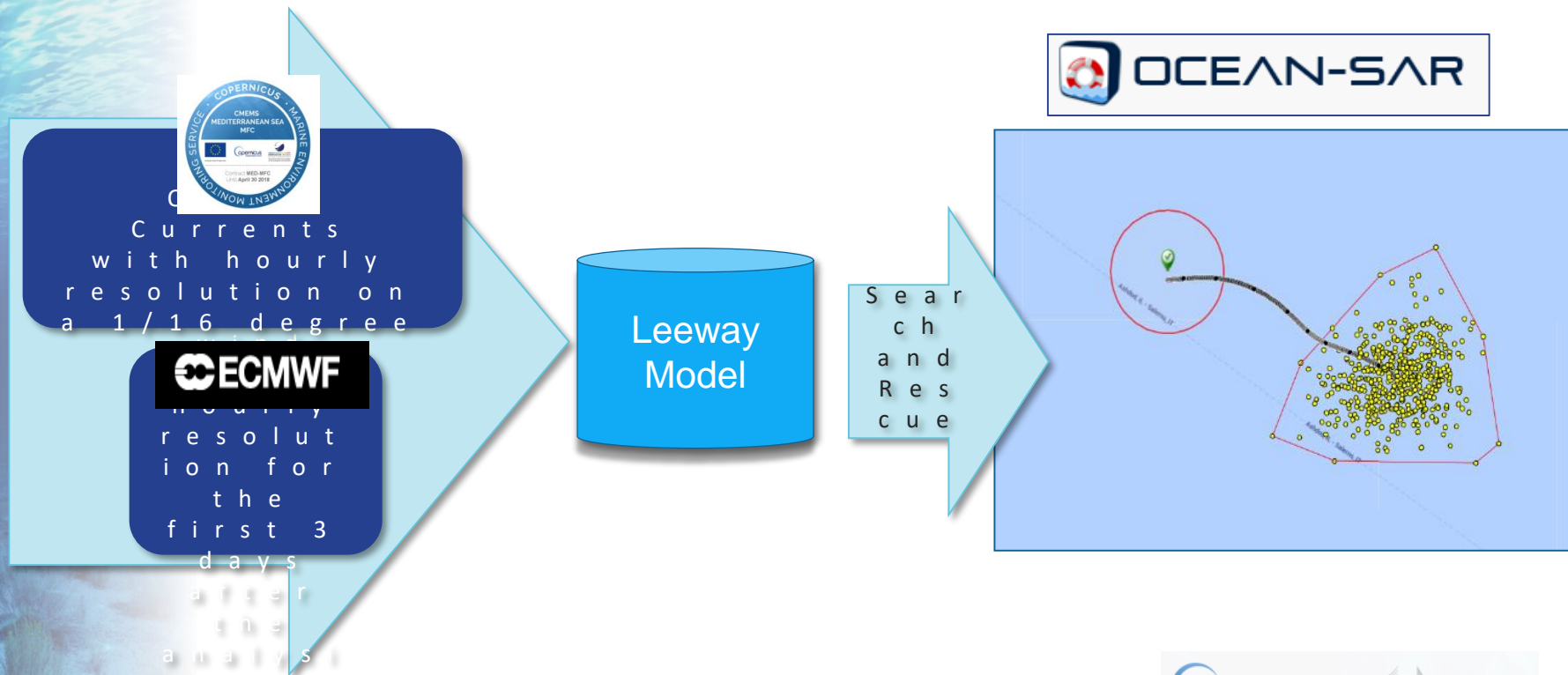
- Display or not environmental fields

The screenshot displays the OCEAN-SAR web application. On the left, a configuration panel is organized into sections: 'General' (Simulation name, Object class), 'Last Known Position' (Start position, End Position, Start date, End date), 'Simulation duration' (Simulation duration), 'Forecasting system' (Wind and currents forecast systems), and 'Visualization settings' (Display or not environmental fields). Orange arrows point from these sections to the corresponding input fields in the 'SIMULATION INPUT' form. On the right, an 'Interactive Map' shows a simulation path over the Mediterranean Sea. A red dot on the map is labeled 'Cursor location'.



Marine  
Monitoring

# Data and Model





Marine  
Monitoring

# Data: CMEMS MED-MFC products

Online catalogue on <http://marine.copernicus.eu/services-portfolio/access-to-products/>

### ONLINE CATALOGUE

**YOUR SEARCH** ?

**AREA**

- All areas
- Global Ocean (0)
- Arctic Ocean (0)
- Baltic Sea (0)
- European North-West Shelf Seas (0)
- Iberia-Biscay-Ireland Regional Seas (0)
- Mediterranean Sea (4)
- Black Sea (0)

**PARAMETER**

- All parameters
- Ocean Temperature (4)
- Ocean Salinity (4)
- Ocean Currents (4)
- Sea Ice (0)
- Sea Level (4)
- Winds (0)
- Ocean Optics (0)



**COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE**  
Providing PRODUCTS and SERVICES for all marine applications

Search terms  OK

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### ONLINE CATALOGUE

CATALOGUE PDF  MY CART

Found 1 product matching your criteria.

KEYWORD SEARCH

#### MEDITERRANEAN SEA PHYSICS ANALYSIS AND FORECAST

MEDSEA\_ANALYSIS\_FORECAST\_PHYS\_006\_01

Numerical-model, Currents, Temperature, Salinity, Sea level, Forecast, Near-real-time, Mediterranean-sea

The physical component of the Mediterranean Forecasting System (Med-currents) is a coupled hydrodynamic-wave model implemented over the whole Mediterranean Basin. The model horizontal grid resolution is 1/16° (ca. 6-7 km) and has 72 unevenly spaced vertical levels. The hydrodynamics are supplied by the Nucleus for European Modelling of the Ocean (NEMO) while the wave component is provided by WaveWatch-III. The model solutions are corrected by the variational assimilation (based on a 3DVAR scheme) of temperature and salinity vertical profiles and along track satellite Sea Level Anomaly observations.



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Monitoring

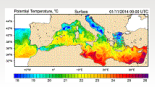
# Data: CMEMS MED-MFC products

ONLINE CATALOGUE

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## MEDITERRANEAN SEA PHYSICS ANALYSIS AND FORECAST

Metadata provided by CMEMS  
Credits: Copernicus Marine Service



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DOWNLOAD PRODUCT

INFORMATION DOCUMENTATION SERVICES

PRODUCT IDENTIFIER: MEDSEA\_ANALYSIS\_FORECAST\_PHYS\_006\_001

OVERVIEW

The physical component of the Mediterranean Forecasting System (Med-currents) is a coupled hydrodynamic-wave model implemented over the whole Mediterranean Basin. The model horizontal grid resolution is 1/16° (ca. 6.7 km) and has 72 unevenly spaced vertical levels. The hydrodynamics are supplied by the Nucleus for European Modelling of the Ocean (NEMO) while the wave component is provided by WaveWatch-III. The model solutions are corrected by the variational assimilation (based on a 3DVAR scheme) of temperature and salinity vertical profiles and along track satellite Sea Level Anomaly observations.


FULL OVERVIEW

VARIABLES

- northward\_sea\_water\_velocity
- eastward\_sea\_water\_velocity
- surface\_eastward\_sea\_water\_velocity\_produced\_by\_sea\_surface\_waves
- surface\_northward\_sea\_water\_velocity\_produced\_by\_sea\_surface\_waves
- oceanmixed\_layer\_thickness
- sea\_water\_salinity
- sea\_surface\_height\_above\_sea\_level
- sea\_water\_potential\_temperature
- sea\_water\_temperature

GEOGRAPHICAL COVERAGE

45.9375 Area: mediterranean-sea



-15 36.25

30.1875

SPATIAL RESOLUTION: 0.06 degree

VERTICAL COVERAGE: from -5500.0m to 0.0m (CRS=EPSG:5714)

TEMPORAL RESOLUTION: Daily mean, Hourly mean

TEMPORAL COVERAGE: from 2013-01-01T00:00:00Z, still going

UPDATE FREQUENCY: daily

PRODUCTION UNIT: MED-INGV-BOLOGNA-IT

DATA ACCESS

BACK TO SEARCH

MY CART

MEDSEA\_ANALYSIS\_FORECAST\_PHYS\_006\_001

Mediterranean Sea Physics Analysis and Forecast

CHOOSE A DATASET

- CMEMS\_V02-MED-INGV-MED-SEA-CAT-F
- CMEMS\_V02-MED-INGV-MLD-AN-FC-D
- CMEMS\_V02-MED-INGV-MLD-AN-FC-H
- CMEMS\_V02-MED-INGV-SAL-AN-FC-D
- CMEMS\_V02-MED-INGV-SAL-AN-FC-H
- CMEMS\_V02-MED-INGV-SSH-AN-FC-D
- CMEMS\_V02-MED-INGV-SSH-AN-FC-H
- CMEMS\_V02-MED-INGV-TEM-AN-FC-D
- CMEMS\_V02-MED-INGV-TEM-AN-FC-H


DATASET SELECTED: CMEMS\_V02-MED-INGV-MED-SEA-CAT-F

CMEMS\_V02-MED-IF

DATASET FILTERS

GEOGRAPHICAL AREA (Default = Product region)

Mediterranean Sea



46

6

36.5

30

TIME RANGE (Default = Last date available)

START DATE: 2016-09-24 11:30:00

END DATE: 2016-09-24 11:30:00

DEPTH (Default = Surface depth)

START DEPTH: 1.4721

END DEPTH: 1.4722

VARIABLES (Default = All variables) Uncheck All

DOWNLOAD	NAME	DESCRIPTION	STANDARD NAME	UNITS
<input checked="" type="checkbox"/>	sowavenu	Wave Number	sea_water_wavenumber	m-1
<input checked="" type="checkbox"/>	somestdy	V-Stokes drift velocity at surface	surface_northward_sea_water_velocity_produced_by_sea_surface_waves	m/s
<input checked="" type="checkbox"/>	vomecxy	meridional current	northward_sea_water_velocity	m/s
<input checked="" type="checkbox"/>	sozostdx	U-Stokes drift velocity at surface	surface_eastward_sea_water_velocity_produced_by_sea_surface_waves	m/s
<input checked="" type="checkbox"/>	voozctx	zonal current	eastward_sea_water_velocity	m/s

DOWNLOAD

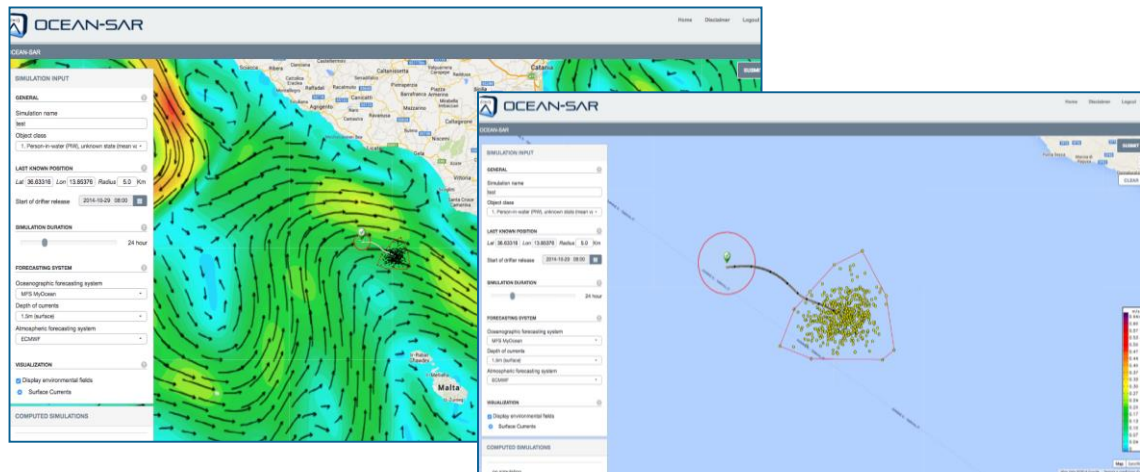




OCEAN-SAR provides the user with an intuitive interface to run simulations and to visualize their results using Google Maps.

The UI visualizes the following output/results of the model:

- Drifters final positions (yellow or red markers);
- Mean trajectory drift (black curve);
- Drifters stranded along the coast line (red markers).



- The Italian Coast Guard has been using our service to help guide search and rescue missions in the Med Sea
- Data from exercises and real missions is collected by us and used to test and further improve modeling

REAL CASE  
SCENARIOS



Marine  
Monitoring

# Mediterranean real case scenarios: Norman Atlantic Accident – 28 December 2014



Date: 29/12/2014

SaR Bulletin n° 3 29/12/2014 for: "Norman Atlantic accident"  
Contents: SAR scenarios

The bulletin has been produced by CMCC team based on the system developed in the TESSA project (PON2007-2013 <http://tessa.linksmt.it>)

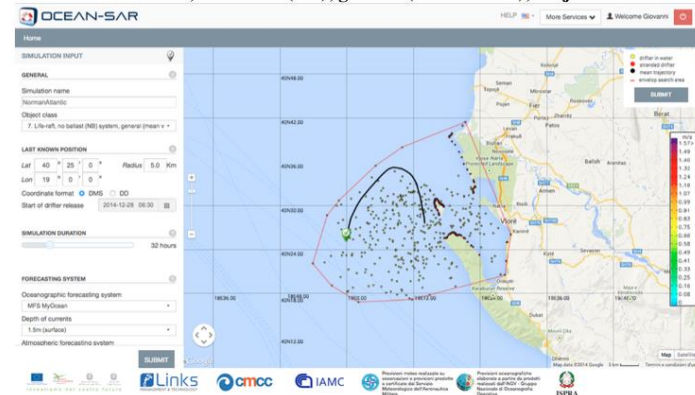
This bulletin is transmitted to the Italian Coast Guard (Comando Generale and Direzione Marittima Bari).

**Ship Position:** 40° 25' N 019° 00' E  
All simulations starts at 6.30 Local time (IT) 28-12-2014  
Simulation duration: **32 hours (until 12:30 29/12/2014)**

**SAR Scenarios:**

- Scenario 1: PIW; Object class 1
- Scenario 2: PIW horizontal, deceased; Object class 6
- Scenario 3: Life-raft, no ballast (NB), general (mean values); Object class 7
- Scenario 4: Life-raft, 4-6 persons capacity, deep ballast system with drogue; Object class 21
- Scenario 5: Life-raft, 15-20 person capacity, deep ballast system, no drogue, light loading

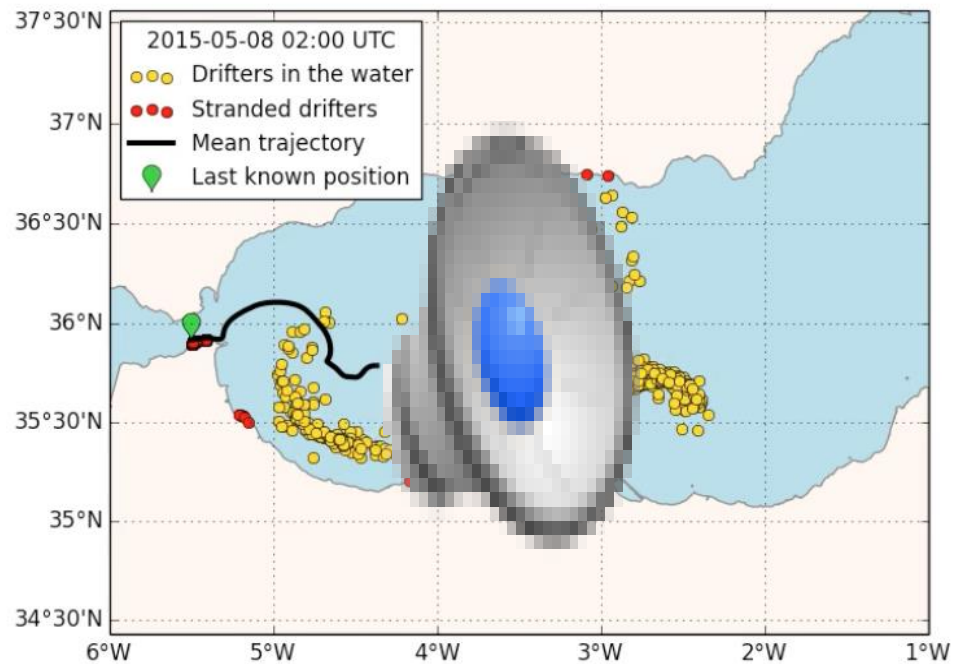
### Scenario 3: Life-raft, no ballast (NB), general (mean values); Object class 7





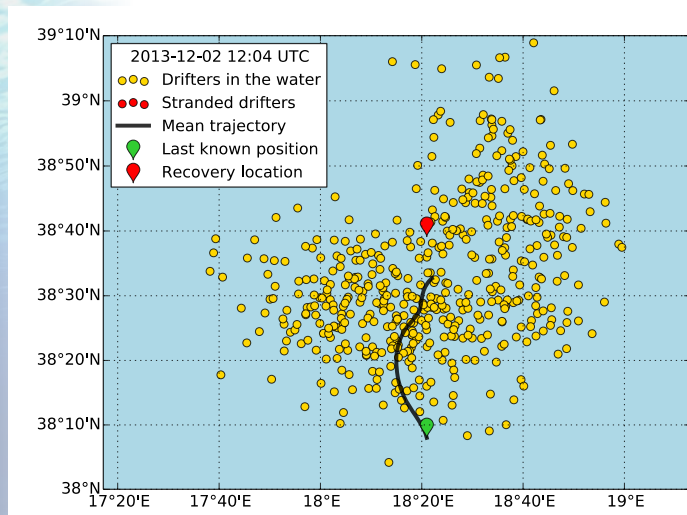
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# Example of a 10-day simulation over a distance of 400 km

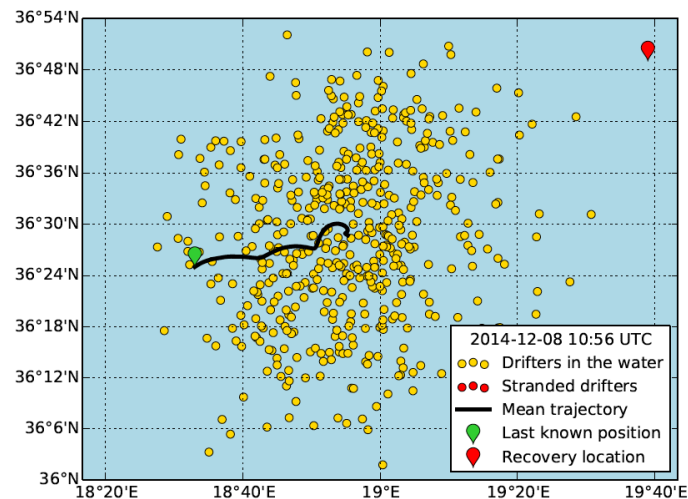




# OCEAN-SAR model applied to real cases – migrant ships (2013/2014)



- ✧ Fishing troller with migrants discovered by coast guard
- ✧ Ship drifted for 36 hours without engines in rough sea until evacuation was possible

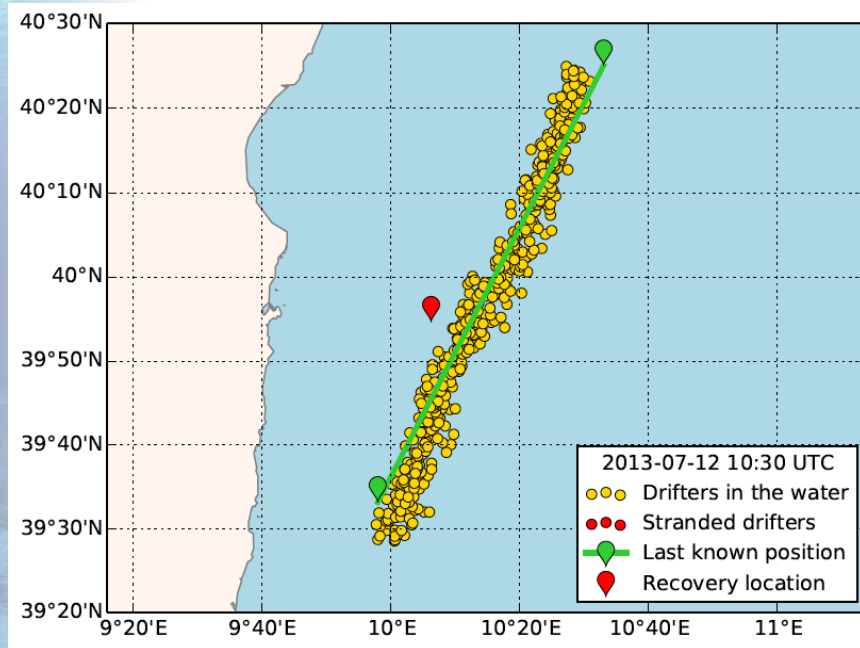


- ✧ 60 m Coastal freighter with migrants in Ionian Sea
- ✧ Evacuated, but left adrift until it could be towed 3 days later



# OCEAN-SAR model applied to real cases – ferry accident (July 2013)

- ✧ A passenger went missing from a ferry en-route near Sardinia in the evening of 11-07-2013
- ✧ Person was last seen by other passengers around 20:30 UTC
- ✧ Reported missing to the crew at 23:30 UTC

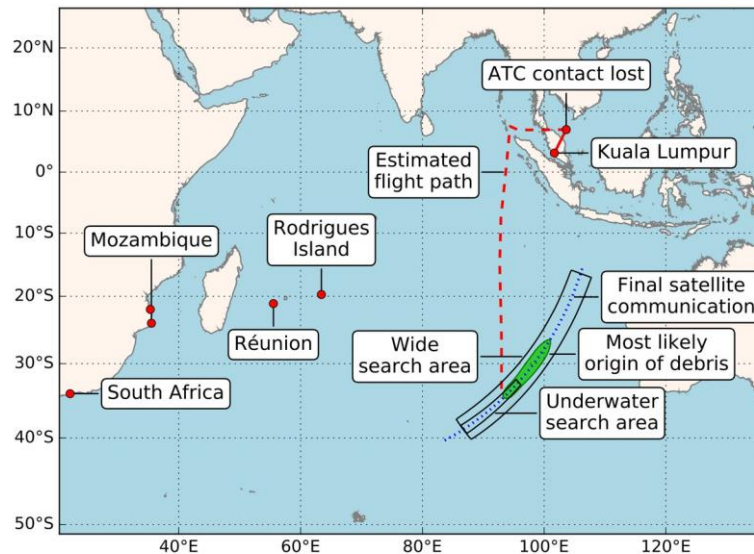


- ✧ Initial position is set along the route of the ferry with 3-hour time window
- ✧ Simulation of 14 hours
- ✧ Body was found the next morning



# Global real case scenarios: Malaysian Airlines Flight MH370

- On 7 March 2014 (UTC), Malaysia Airlines flight 370 vanished without a trace. The aircraft is believed to have crashed in the southern Indian Ocean, but despite extensive search operations the location of the wreckage is still unknown. The first tangible evidence of the accident was discovered almost 17 months after the disappearance.
- To find out how MH370 debris drifted since the crash, the researchers ran a computer model that used oceanographic data from the **EU Copernicus Marine Environment Monitoring Service**, including data of **global surface currents and winds over the past two years**. To improve their simulation, they used the locations of the five confirmed debris found to date: **two in Mozambique and one each in Réunion, South Africa and Rodrigues Island (Mauritius)**



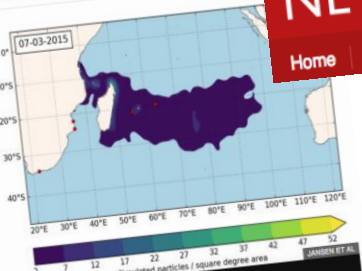


Marine Monitoring

# Global real case scenarios: New Simulation Extends Possible Crash site of Malaysian Airlines Flight MH370

MH370: Missing jet 'could be further north'

By Jonathan Amos  
BBC Science Correspondent  
© 28 July 2016 Science & Environment



Discovered debris (red dots) is used to weight the outcomes of multiple simulations

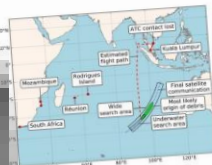


**FLOW OF DEBRIS** Researchers predict MH370 search teams have been looking in the **WRONG** place for years

New study says plane is 300 miles further north than search area



Finding MH370: How algorithms are helping to hone in on the missing plane



Dov'è scomparso l'aereo della Malaysia Airlines? Nuove ipotesi da una ricerca salentina  
mercoledì 27 luglio 2016



Flight MH370: modelling shows debris may be further north, say scientists

Missing MH370 wreckage may be further north, study suggests

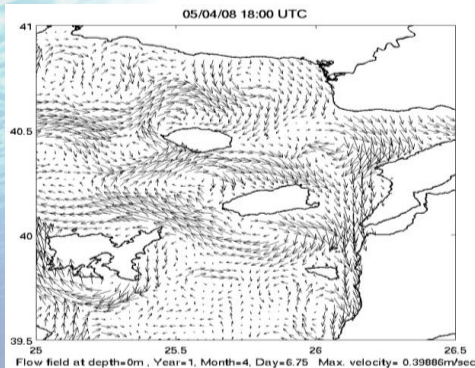
The graphic that proves search teams have been looking in the **WRONG** place for missing flight MH370: Scientists show how debris spread from new crash site





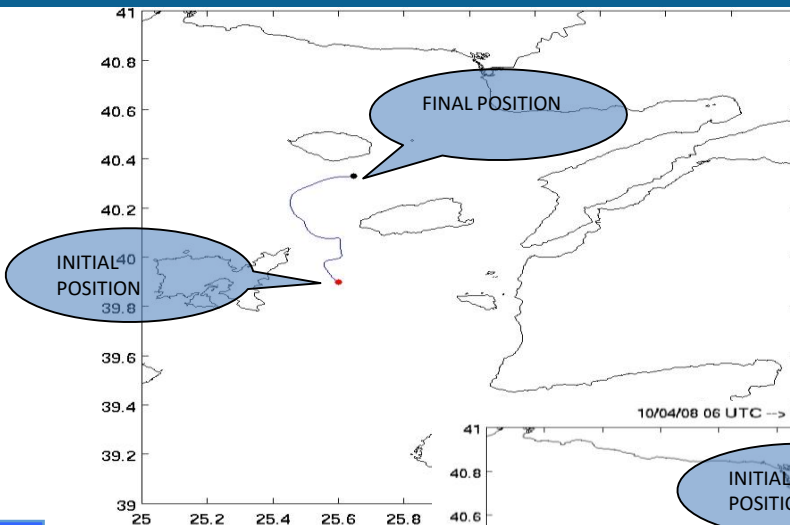
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# Search & Rescue service developed by the POSEIDON team - Greek



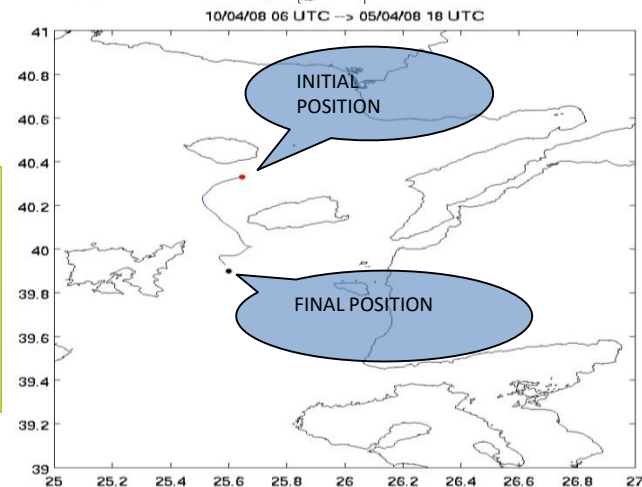
Surface currents forecast from the POSEIDON system (NE Aegean)

- The core of the service is the Leeway model a Monte Carlo-based stochastic ensemble trajectory model that calculates the motion of objects on the sea surface under the influence of wind (reference height 10m) and surface ocean currents
- On a daily basis, the service uses winds and surface currents 5-days forecasts from the POSEIDON system



Forward integration of  
SAR application for 12  
hours

Inverse integration of  
SAR for 12 hours  
starting from final  
position of previous  
experiment  
(backtracking)



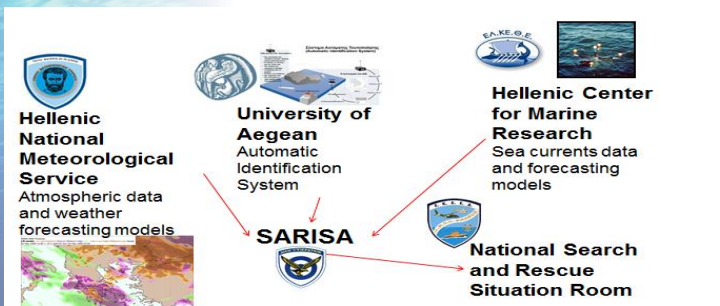




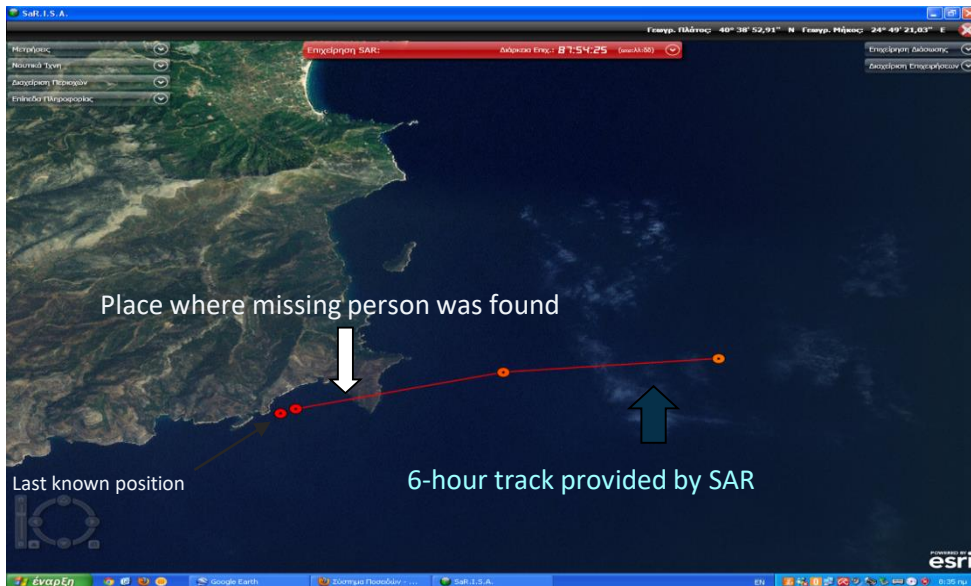
# SARISA: The Greek Search & Rescue service

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Surface currents forecasts for the Aegean and Ionian Seas are provided by the POSEIDON system which downscales the Copernicus CMEMS Med-currents solution. The service is operational since Dec 2011



SARISA can use LEEWAY or MOTHY models



**Real case - 29/10/2012: Fisherman reported missing SE of Thasos island**  
Missing fisherman found on land in the area indicated by the SAR system.