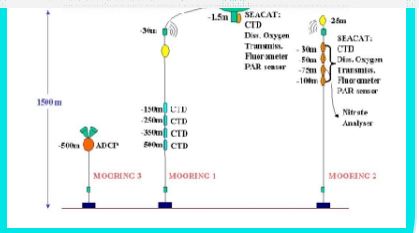
HCMR Operational Oceanography activities
Present status and future perspectives

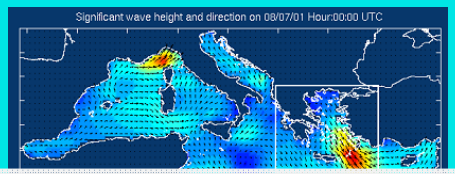
Leonidas Perivoliotis, Institute of Oceanography, HCMR

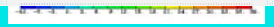
POSEIDON: An operational monitoring, forecasting and information system for marine environmental conditions in the Eastern Mediterranean

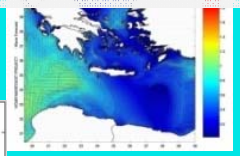
Observations

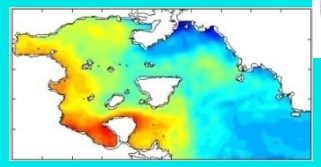


Processing & Modeling









Information and Decision Support Systems

End Users

- ✓ Developed through infrastructure funding (EEA & national funds): 14.1 M€ in 1997-2000, 9.8 M€ in 2005-2010, 1.2 M€ in 2010-2012
- ✓ Operated by I.O. of HCMR since 2000 – Supported by Greek NMS & Navy
- ✓ Continuously upgraded through collaborative research projects
- ✓ Integrated with / contributing to major European projects and initiatives

The Vision / Motivation

“An integrated system able to support science, safety, environment and maritime economy in Greece” e.g.

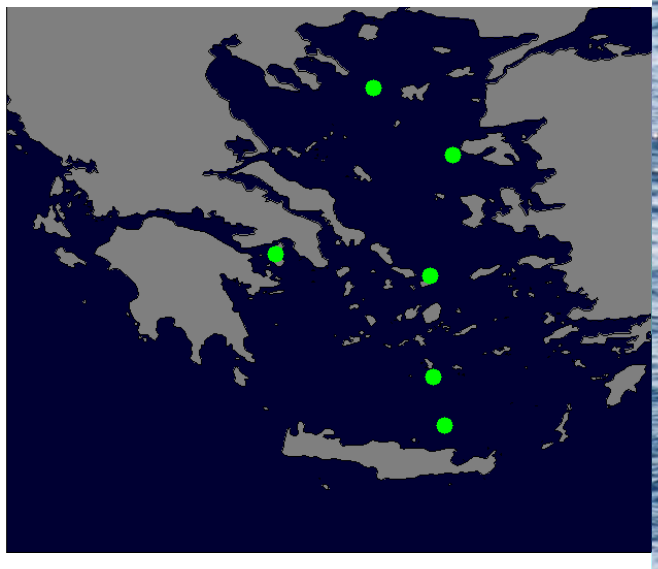
- **Research** oriented applications (climatic variability, ecosystem functioning)
- Support of **maritime transport** (forecasts, SAR)
- Environment **protection** (ecosystem health, oil pollution)
- Support of **tourism** industry (water quality, yachting, ..)
- **Fisheries** and aquaculture management
- **Coastal** zone management (erosion, etc) & Water framework directive

Development Strategy

- Embed into appropriate policy frameworks: IOC/GOOS, EuroGOOS, MedGOOS, GEO
- Balance between the operational and research character of the infrastructure
- Integrate national investments with European initiatives: GMES, EMODnet, ESFRI
- Complementarity between national and EU projects: MFSTEP, MERSEA, ECOOP, MARCOAST, MYOCEAN I &II, JERICO, EuroARGO, FixO3…(20 EU projects since 2000)
- Integrate coastal - shelf - deep systems & scales: necessary due to specificities of Greek Seas

Poseidon Monitoring Component: 2000-2006
Main system development

11 buoys – 6 locations



- *Measurements at the sea surface*
- *Temperature and Salinity recordings down to 50m in selected locations*

Moorings

Sensors:

Atmospheric
- Air temperature
- Atmospheric pressure
- Wind Speed/Direction

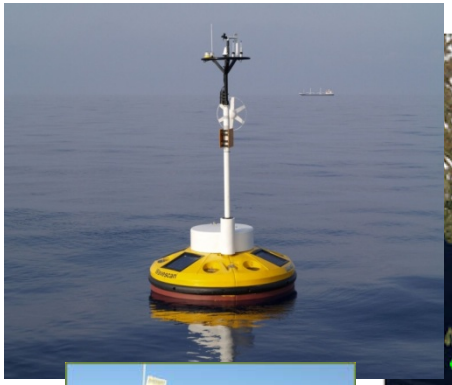
Oceanographic
- Temperature
- Salinity
- Currents
- Waves

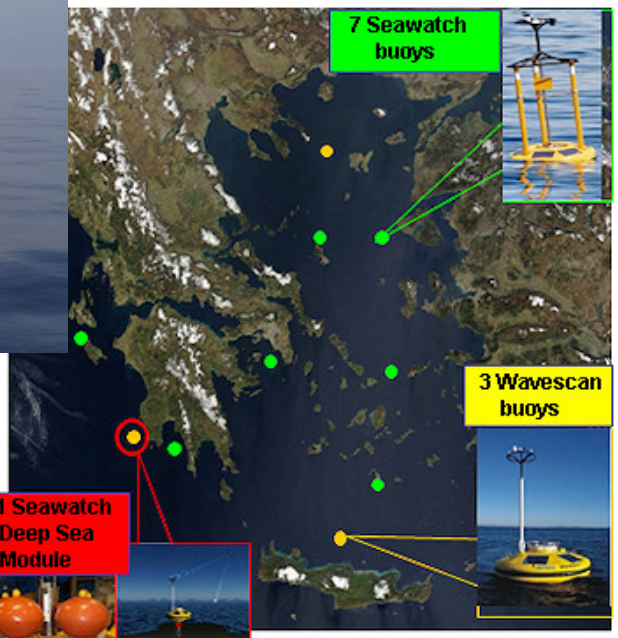
Water quality
- Chlorophyll-A
- Oxygen
- Turbidity
- Radioactivity

Poseidon Monitoring Component
Mooring network

10 locations – 16 buoys

5 moorings (WaveScan) to support deep sea monitoring including ecosystem variables

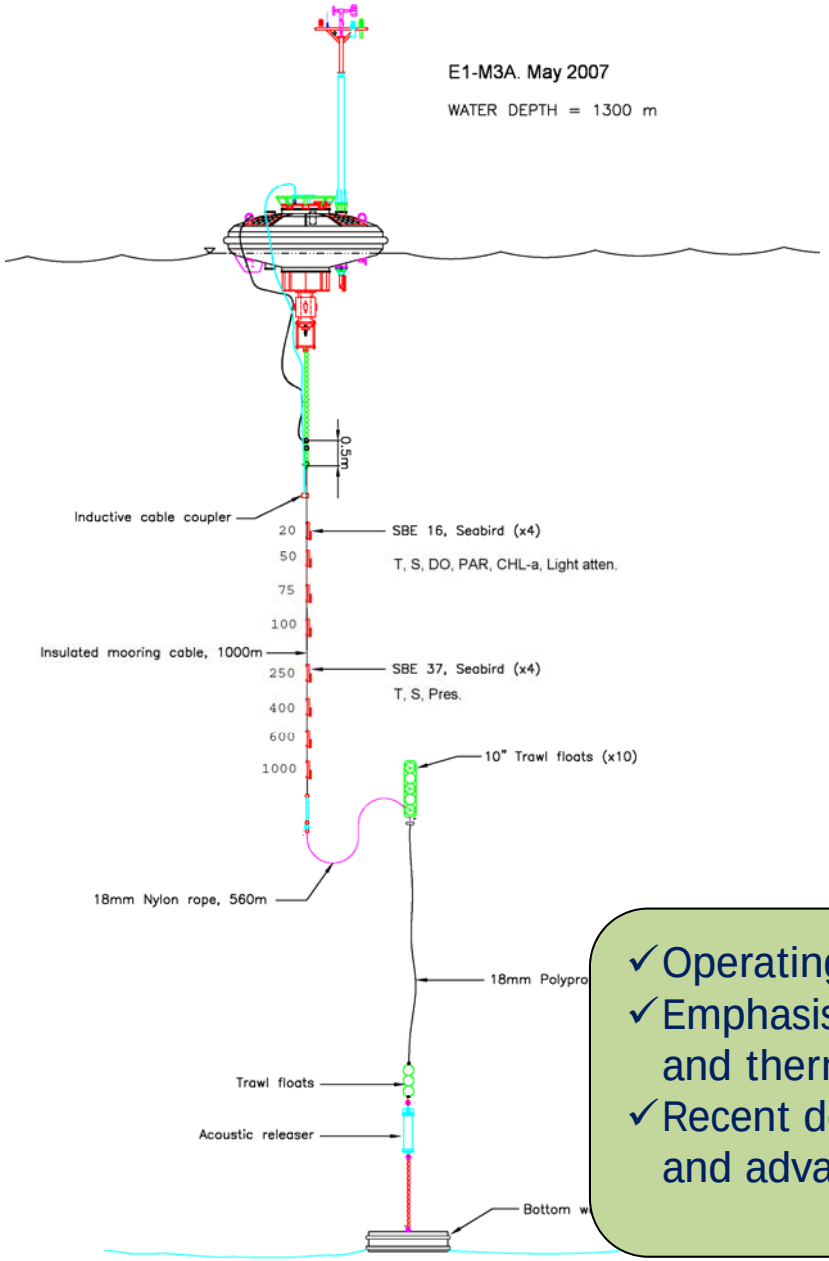




Monitoring network extended to Ionian Sea

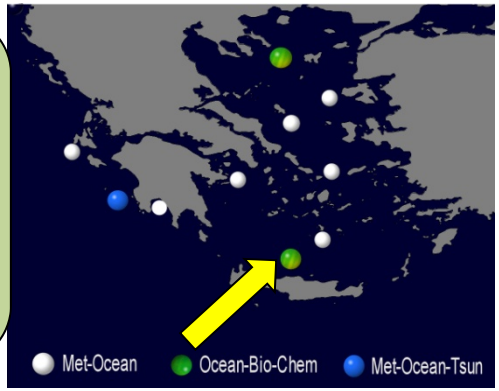
- ✓Eight met-ocean buoys
  - ✓Atmospheric data (wind speed & direction, atmospheric pressure, air temperature)
  - ✓Marine data (waves, surface currents, temperature & salinity down to 100m in selected locations)
- ✓Two reference stations
  - Cretan Sea
  - Pylos-Ionian Sea
- ✓One seafloor observatory (bottom platform module)

Reference station E1-M3A (Cretan Sea)



Parameter	Depths measured (m)	Sensor(s) used
Wind speed/dir.,	Surface	Young 04106
Air Pressure,	Surface	Vaisala PTB 220A
Air temperature,	Surface	Omega
Wave Height	Surface	Fugro OCEANOR Wavesense
Pyranometer PSP,	Surface	Eppley
Radiometer PIR,	Surface	Epply
Relative humidity,	Surface	Vaisala HMP 45A
Precipitation sensor,	Surface	Young 50203
Radiance	Surface	Satlantic ocr-507-r10w
Irradiance	Surface	Satlantic ocr-507-ricsw
SST, SSS surface,	Surface (1m)	Aanderaa 3919A
Currents	5-50, 10 bins of 5m	Nortek Aquadopp 400 kHz
Temperature	20, 50, 75, 100m 250, 400, 600, 1000m	Seabird 16plus-IMP C-T Seabird 37-IM C-T
Salinity	20, 50, 75, 100 250, 400, 600, 1000m	Seabird 16plus-IMP C-T Seabird 37-IM C-T
Pressure	250m	Seabird 37-IM C-T-P
Turbidity	20, 50, 75, 100m	Wetlabs flntus-rt
Dissolved Oxygen	20, 50, 75, 100m	SBE43
Chl-a	20, 50, 75, 100m	Wetlabs flntus-rt
PAR	20, 50, 75, 100m	Licor LI-193

- ✓Operating since 2000
- ✓Emphasis on bio-chemical processes and thermohaline circulation
- ✓Recent developments: CO2 sensor and advanced optics



Reference station Pylos

A new Sea-bed observatory developed through POSEIDON –III

Deployed in the sea on October 2013

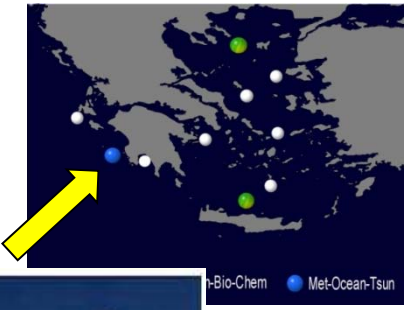
✓Sensors: Pressure (incl. tsunami mode), T, S, DO, Turbidity, CO2, CH4, pH

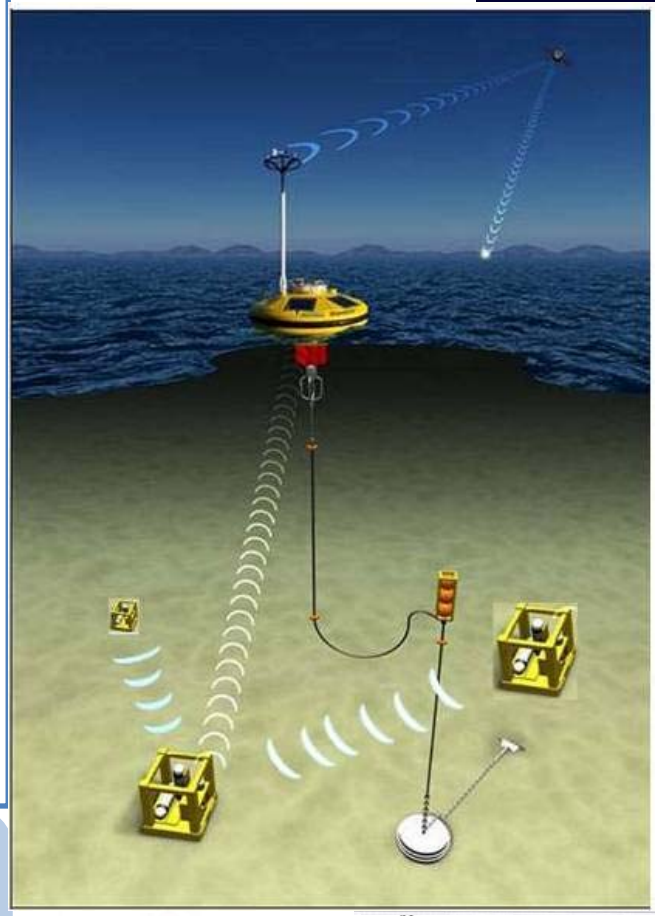
✓Multi-node autonomous platform (acoustic link between nodes)

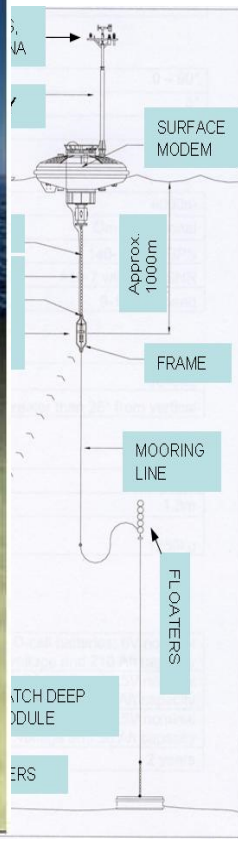
✓Upgrade of existing platform to form a node of the network

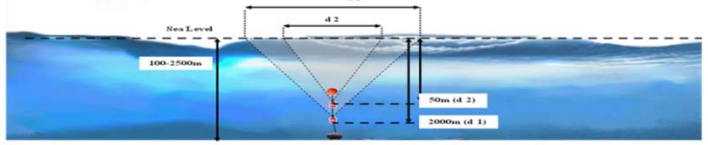
✓Compatibility of hardware (cpu) with rest of the systems

✓Modular – expandable system









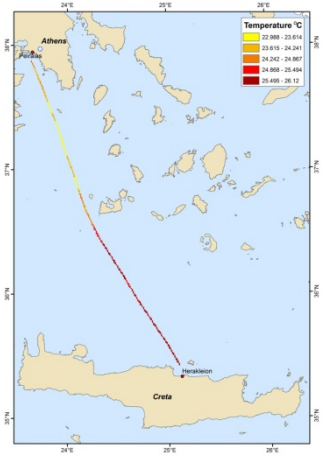
Mooring cable also hosts an experimental PAL (passive aquatic listener) sensor

Data from additional sources

Ferry Box System

Real time continuous recording of:

- Temperarure
- Salinity
- Chlorophyll-a
- Turbidity
- pH

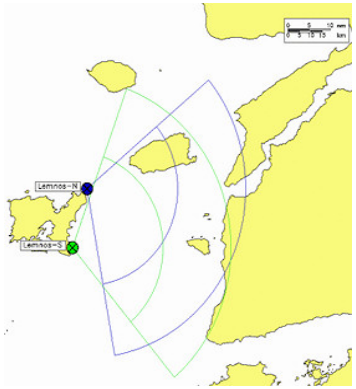


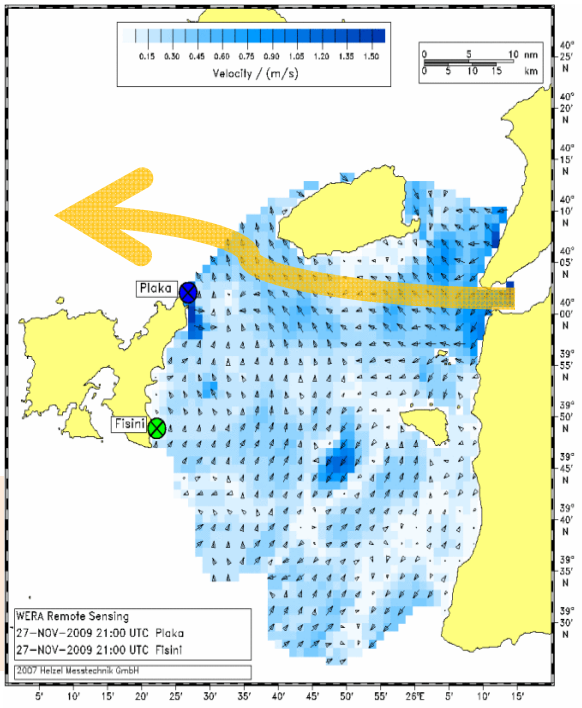
Piraeus-Heraklion

Olympic Champion High Speed

In operation since 2012

HF Radar





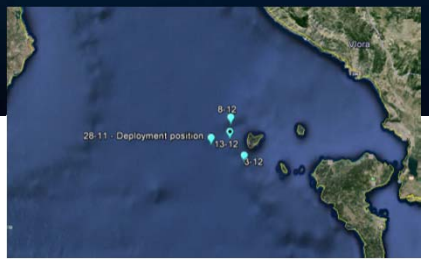
In operation since June 2009

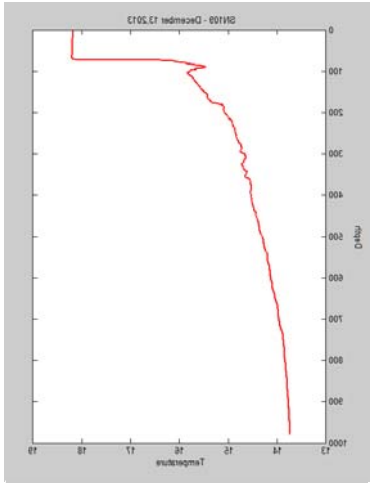
The Black Sea waters outflow through Dardanelles is an important driving mechanism for the Aegean sea hydrology and circulation.
The systematic monitoring of this outflow is a key issue for:

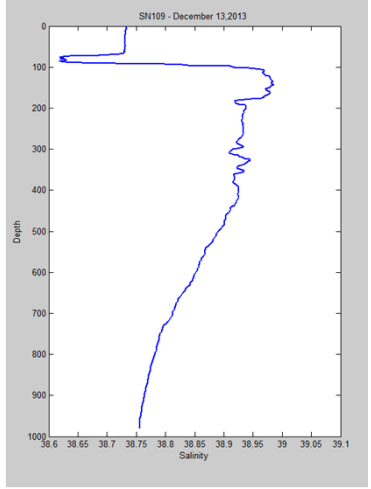
- The validation of the hydrodynamical forecasts
- The improvement on the numerical simulations in the Aegean
- The Search and rescue activities in the area

Data from additional sources

Greek Argo infrastructure

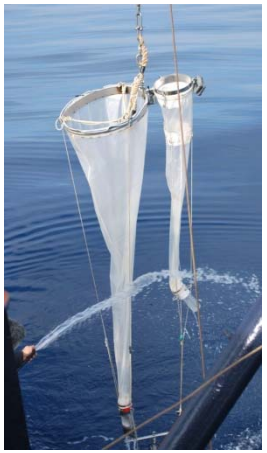






Greek contribution to EuroArgo
Started on 2010

Ecosystem monitoring at E1-M3A site (Cretan Sea)

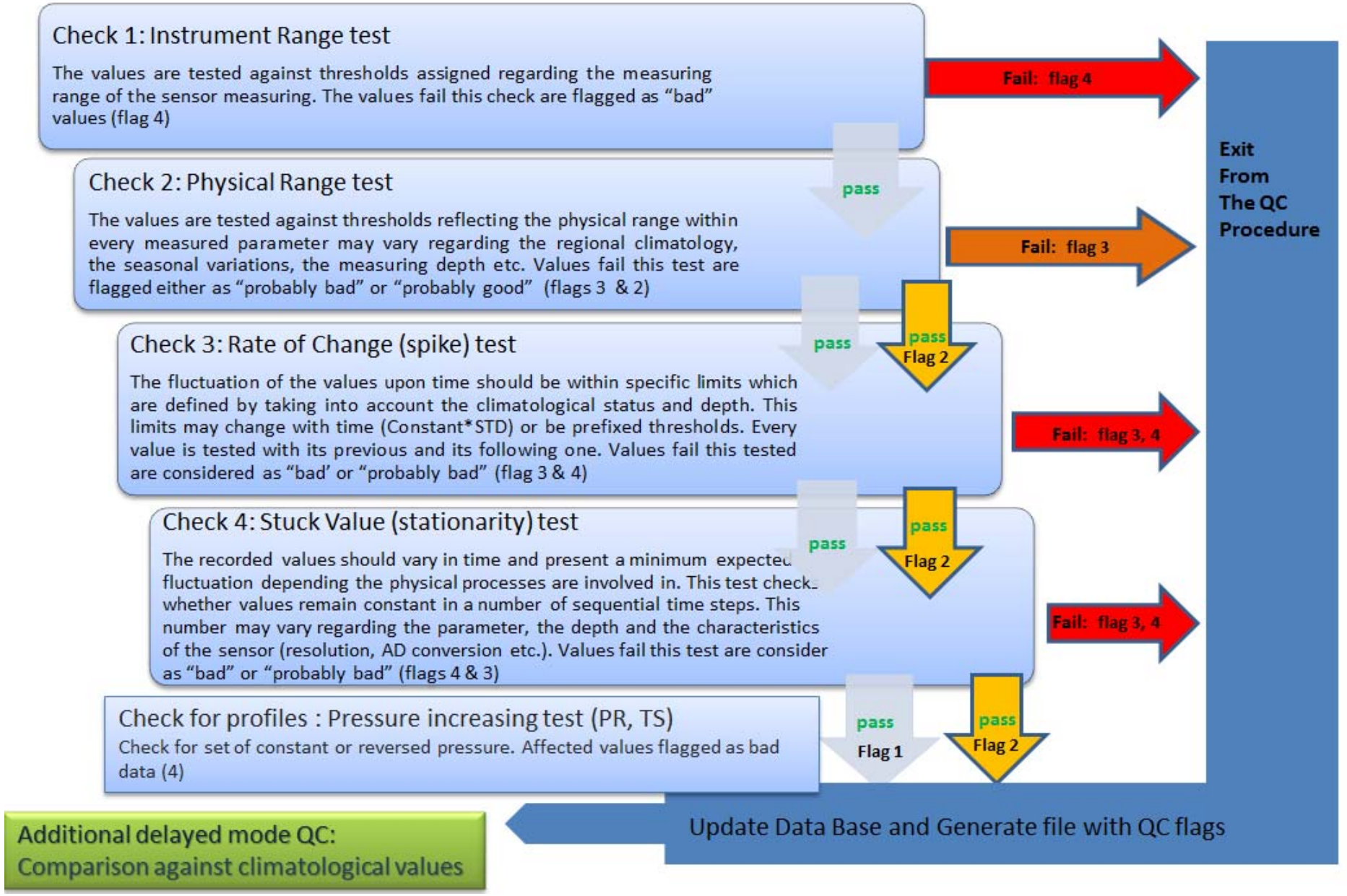


Site is visited in monthly basis
Data available since March 2010

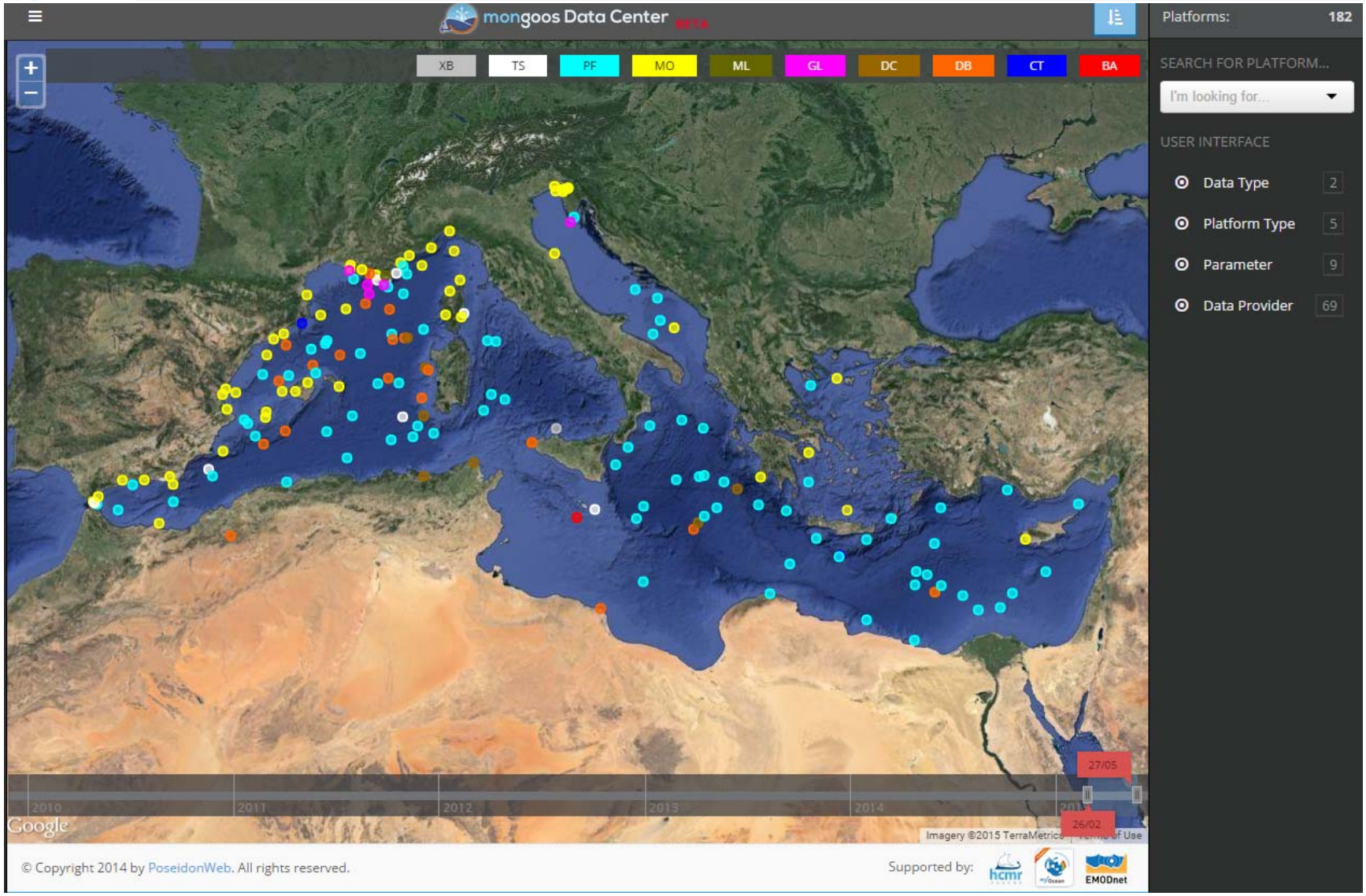
Parameters:

T, S, nutrients, C_T-A_T, CO_2, Chlorophyll-*a*, pigments (HPLC), planktonic community: phytoplankton, coccolithophores, bacteria, microzooplankton, mesozooplankton

POSEIDON Quality Control procedures

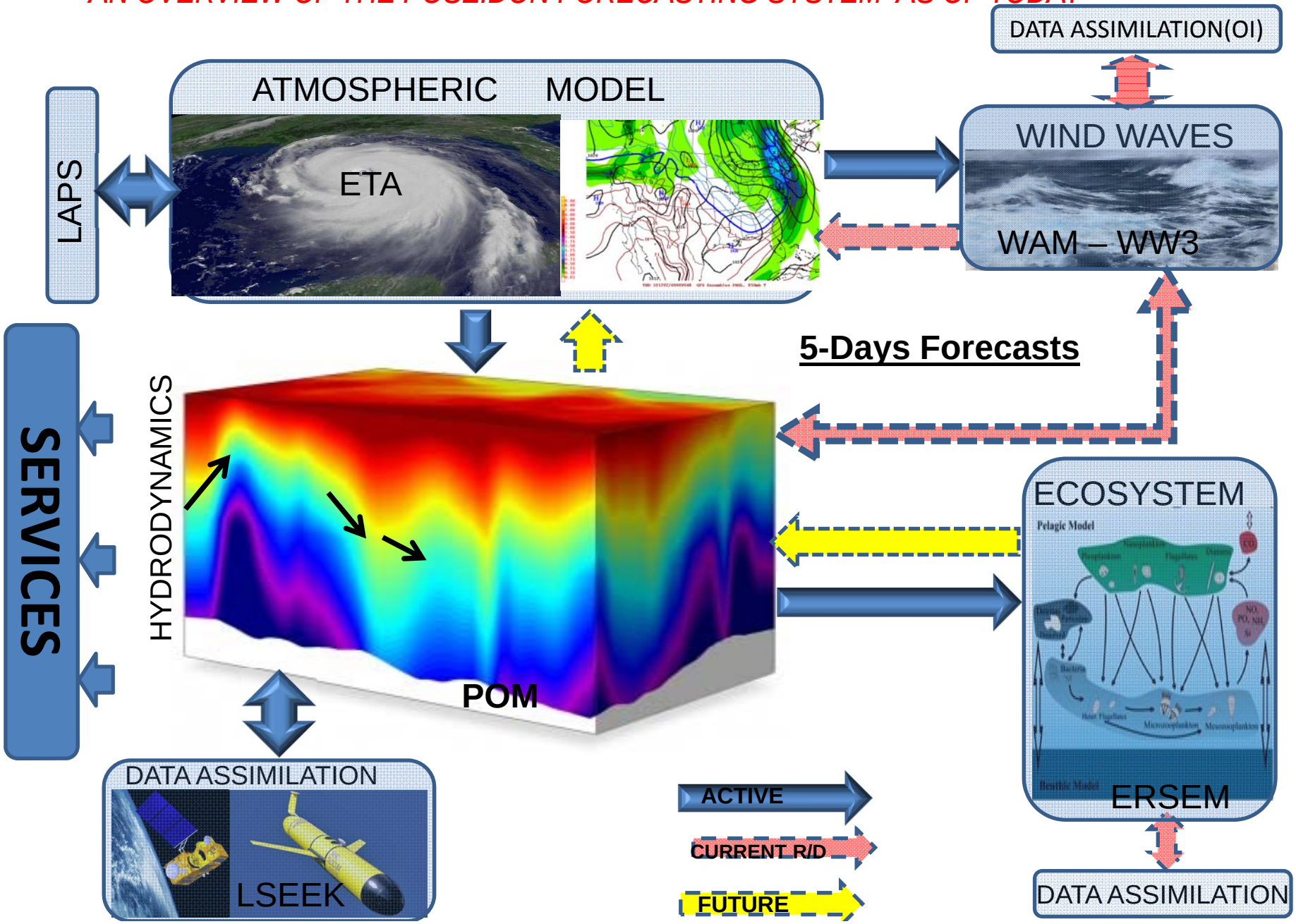


MonGOOS Data Center



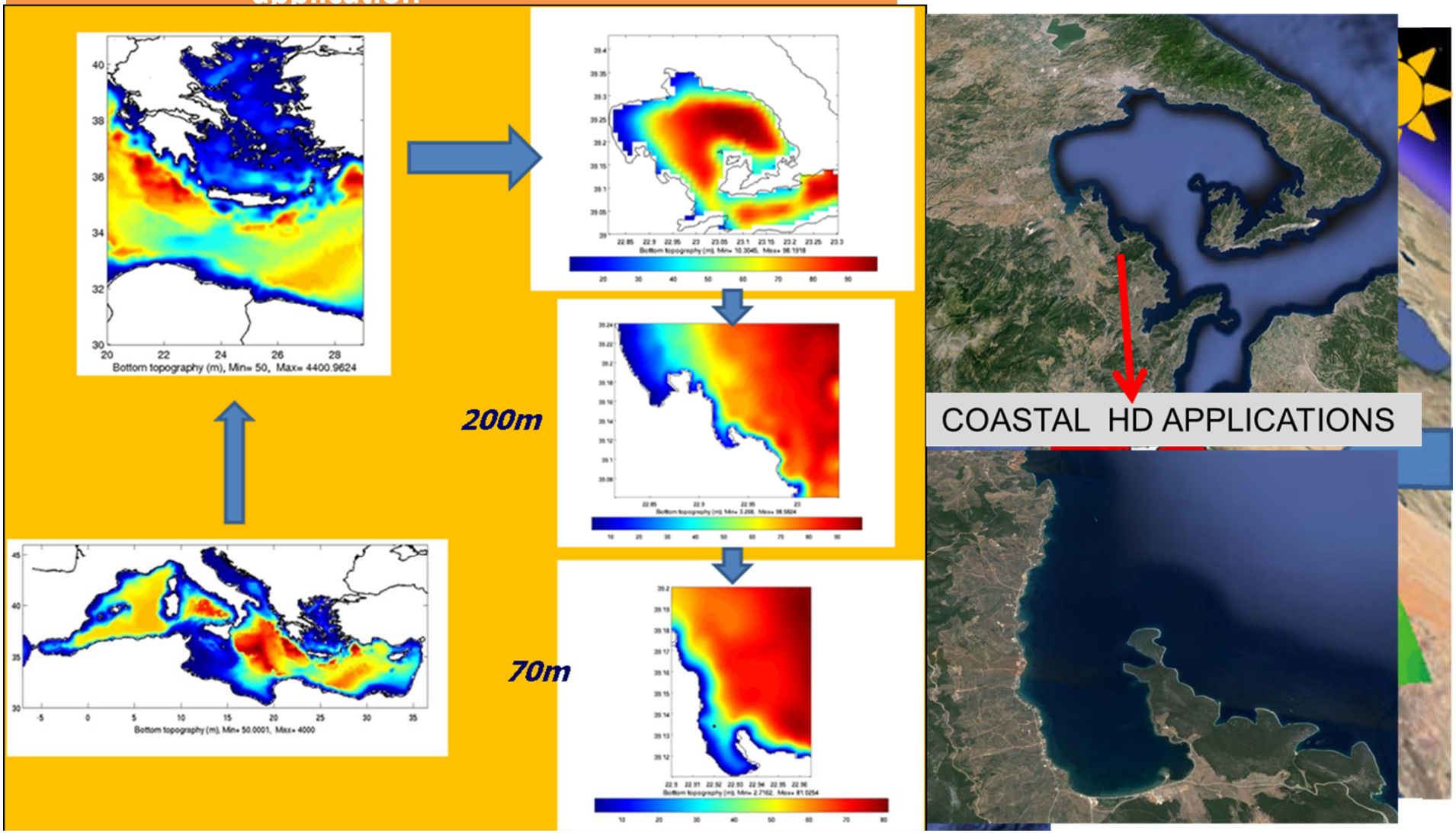
http://www.mongoos.eu/data-center

AN OVERVIEW OF THE POSEIDON FORECASTING SYSTEM AS OF TODAY



The atmospheric, hydrodynamic and wave models

Model type	Domain of application	Forecasted Variables

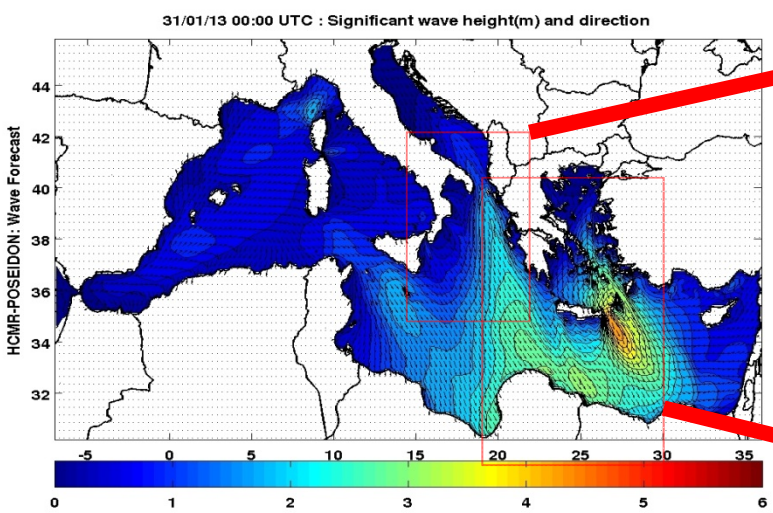


Wave forecasting system

5-days forecasts daily

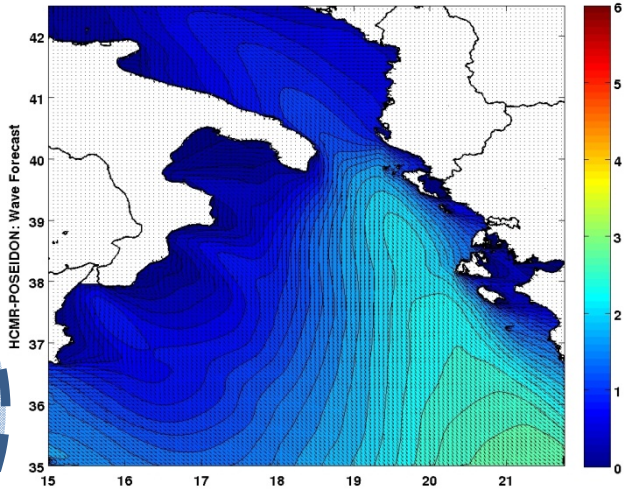
Based on WAM Cycle-4.5 code

1/10 x 1/10



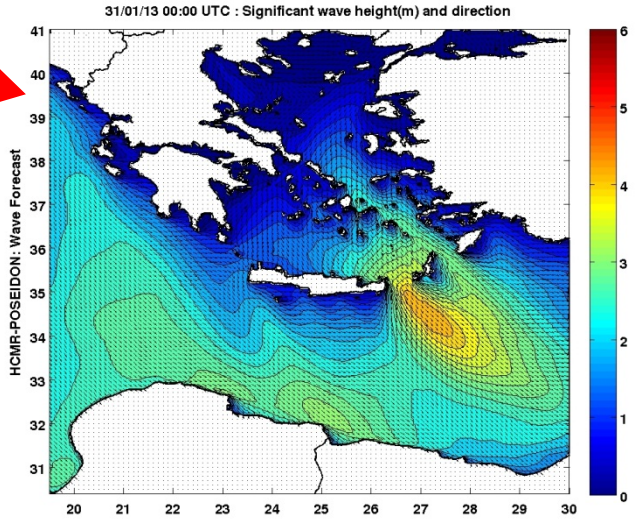
NESTING

1/50 x 1/50



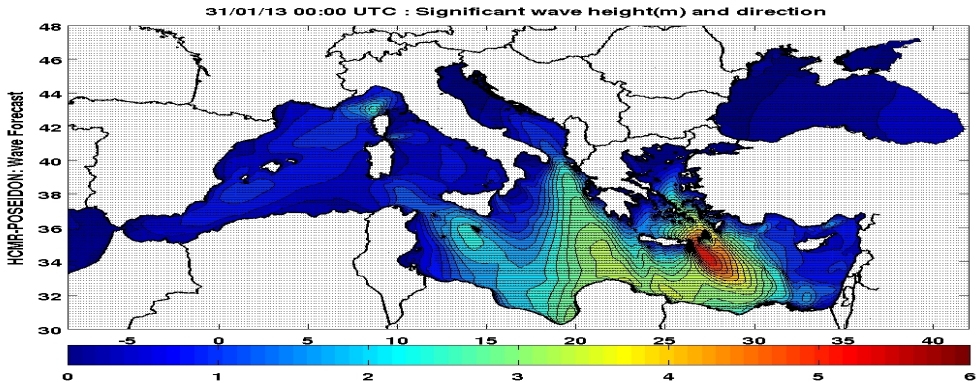
IONIAN

1/30 x 1/30



AEGEAN

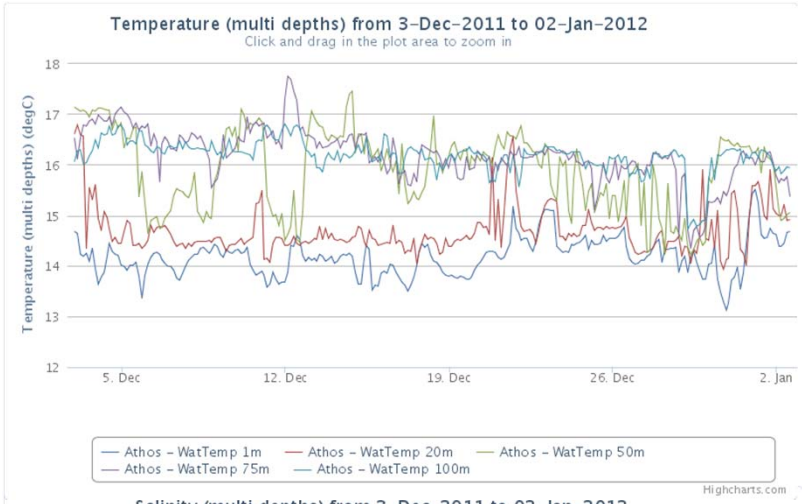
Based on WW-III MED + BLACK SEA 1/20 x 1/20

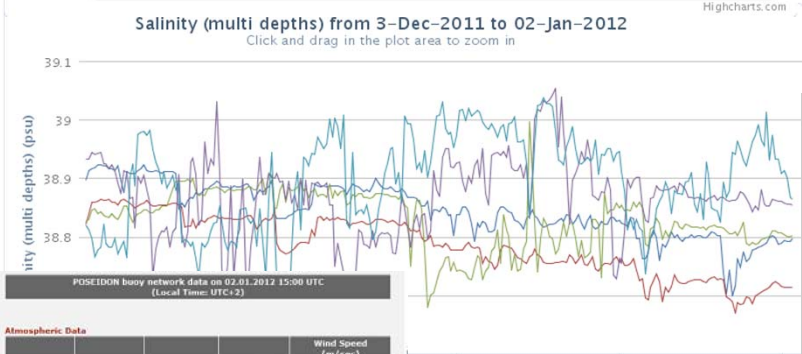


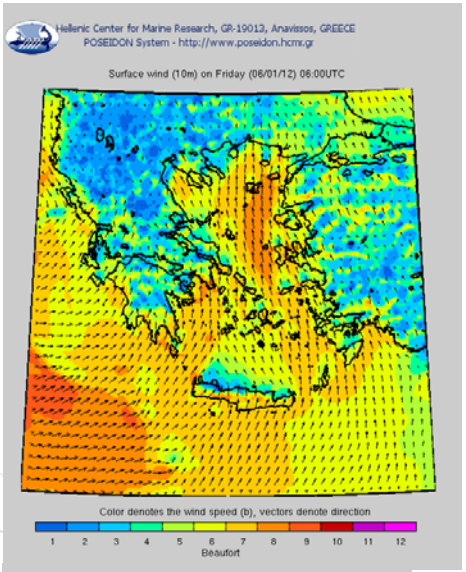
Information to the public

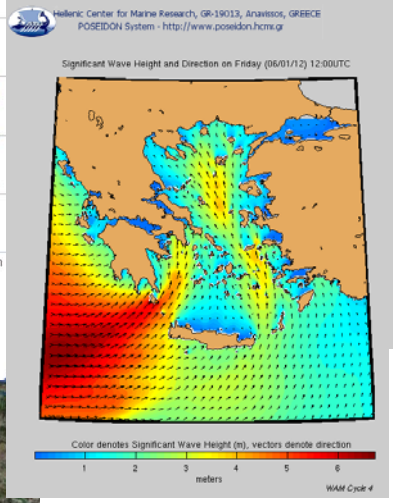
http://www.poseidon.hcmr.gr

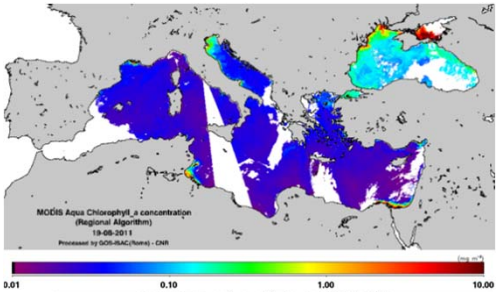
Institute of Oceanography

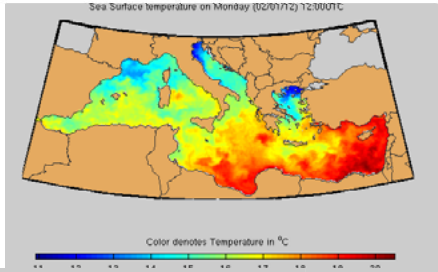


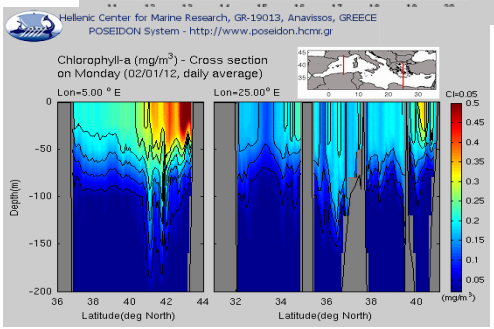












POSEIDON buoy network data on 02.01.2012 15:00 UTC
(Local Time: UTC+2)

Atmospheric Data

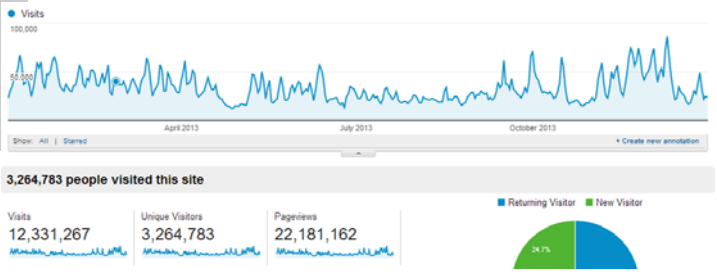
	Air Pressure (mbars)	Air Temperature (oC)	Wind direction (degrees)	Wind Speed (m/sec) Gust	Wind Speed (m/sec) Mean speed
Athos	1025.76	11.11	22.50	1.17	0.23
E1M3A	N/A	N/A	N/A	N/A	N/A
Lesvos	1025.13	9.83	1.41	9.04	6.30
Mykonos	1017.95	11.06	350.42	13.11	9.48
Saronikos	1018.99	11.22	12.04	3.69	2.26
Pylos	N/A	N/A	N/A	N/A	N/A
Santorini	1024.23	13.82	344.53	11.48	8.67
Skyros	N/A	N/A	N/A	N/A	N/A
Zakynthos	1019.94	12.65	99.92	1.60	0.82

N/A denotes a non-available value

Marine Data

	Current Data Direction (degrees)	Current Data Speed (cm/sec)	Waves data Significant height (meters)	Waves data Maximum height (meters)	Waves data Main direction (degrees)	Surface Temperature (oC)
Athos	156.45	3.22	0.39	0.39	313.59	14.67
E1M3A	N/A	N/A	N/A	N/A	N/A	N/A
Lesvos	78.66	8.64	0.59	0.64	343.92	16.11
Mykonos	97.47	9.16	1.58	2.10	350.24	15.27
Saronikos	145.02	13.40	0.36	0.37	55.99	14.67
Pylos	N/A	N/A	N/A	N/A	N/A	N/A
Santorini	228.52	23.14	1.09	1.56	352.97	14.81
Skyros	N/A	N/A	N/A	N/A	N/A	N/A
Zakynthos	226.14	N/A	0.46	0.68	254.44	17.49

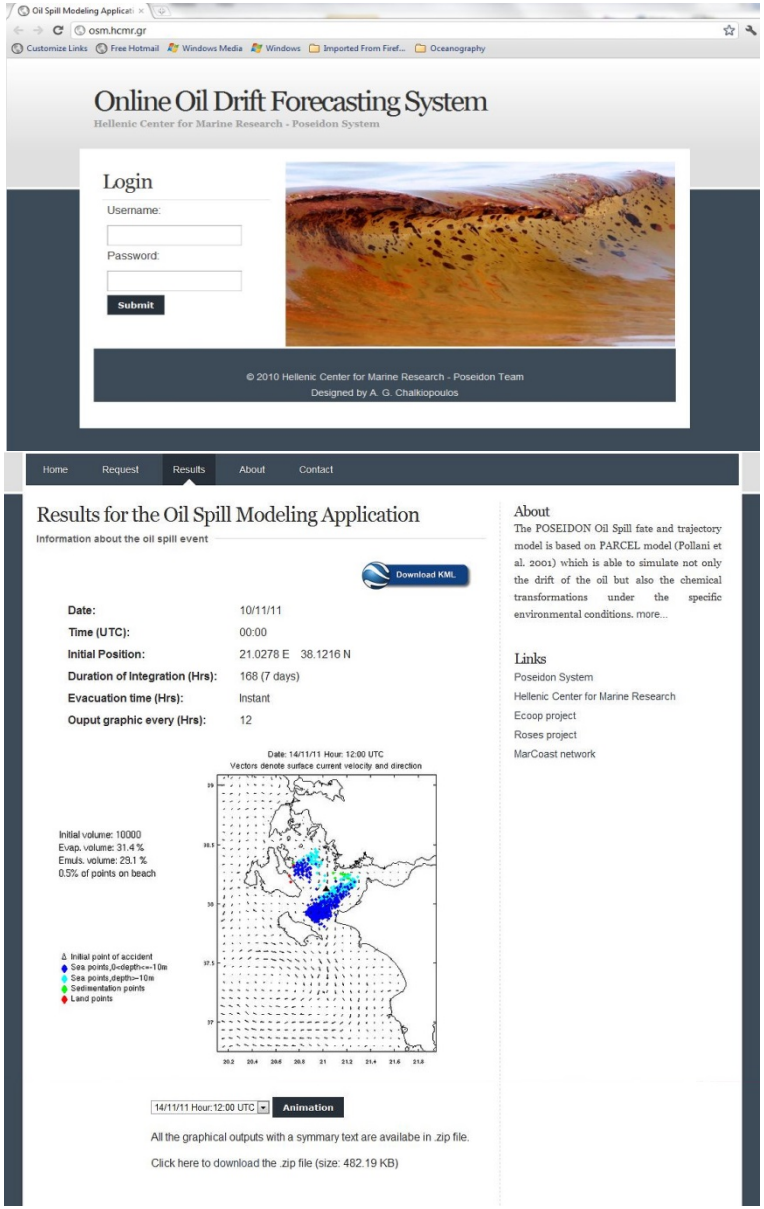
N/A denotes a non-available value



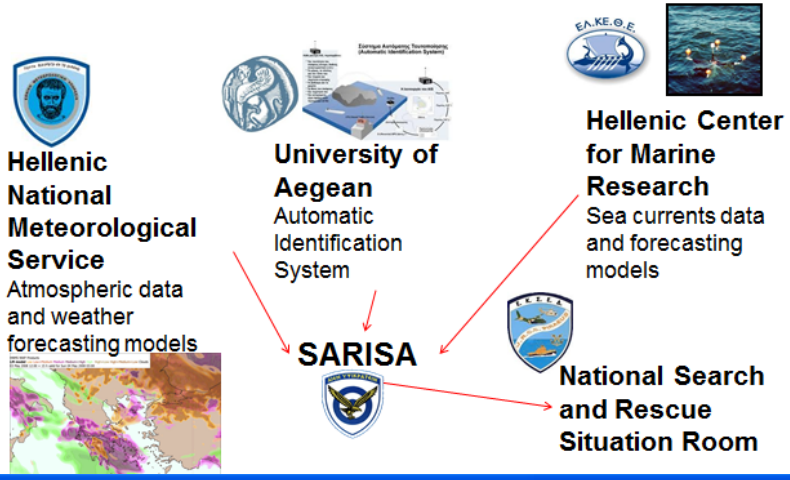
Web: ~1.000.000 user sessions/month

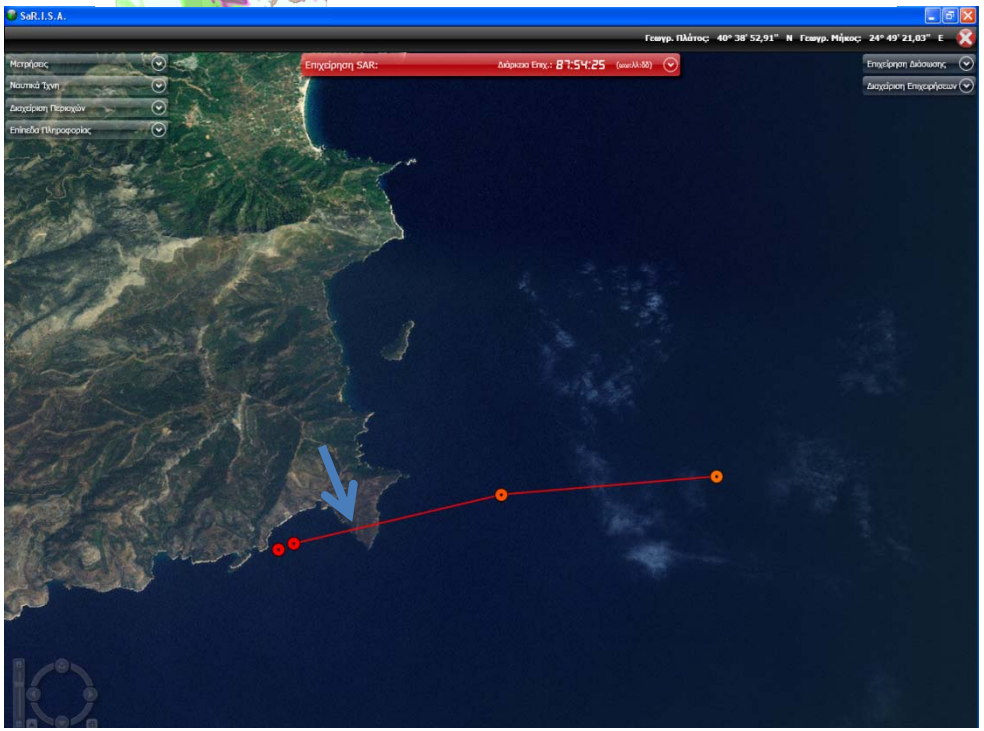
Products and Services

OIL DRIFT FORECASTING



SEARCH & RESCUE





Priorities and Targets for the period 2014-2020

Modeling system upgrades (Hydrodynamics)

- **Implement a new HD model (ROMS) to run in parallel with POM for the Med Sea**
- **Improve horizontal resolution (5 km for the Med Sea)**
- **Improve open boundary conditions (nest with the MyOcean Global and Marmara & Black Sea models) and rivers input.**
- **Introduce wave-current interaction terms (coupling HD and wave models)**

Extending operational oceanography to the coast

- **Ocean prediction for the open ocean has reached maturity. Take the necessary actions to boost for coastal predictions and extend the operational oceanography to the coast**
- **Develop integrated coastal forecasting systems in key areas (i.e. Saronikos Gulf) efficient to resolve coastal geometry and to assimilate high frequency and regular coastal data sets that are already available**

Wave forecasting

- **Improve wave forecasting (with data assimilation) at the Mediterranean basin scale in close collaboration with the European wave community (Copernicus Service)**

Coupled systems

- **Integrate the coupled atmosphere – wave system into the POSEIDON operational chain**
- **Develop a coupled atmosphere – wave – ocean prediction system**

The step forward : Towards an Integrated Observatory

Monitoring the ocean on multiple scales

Three multi-parametric moorings (Cretan Sea, Ionian Sea, North Aegean) – Biochemical parameters (nutrients, pH, CO2) at several depths

Coastal monitoring: Three stations (+on demand)

Argo component : Greek Argo infrastructure, 25 deployments up to 2017

Introduce a Glider component: Two will be purchased in 2014 through national funding. Up to five is foreseen in the national research roadmap

Ferry Box System: Introduce a new line in the Northern Aegean

Integrate the EMSO Hellas infrastructure: Cabled observatory, Pylos, Ionian Sea (in operation during 2015)

High resolution recording of surface currents: Integrate the surface drifter component (University of Aegean – National Roadmap) – Add another HF Radar system

Introducing a sea level monitoring component: Integrate the existing network of HHS (National Roadmap), addition of new stations