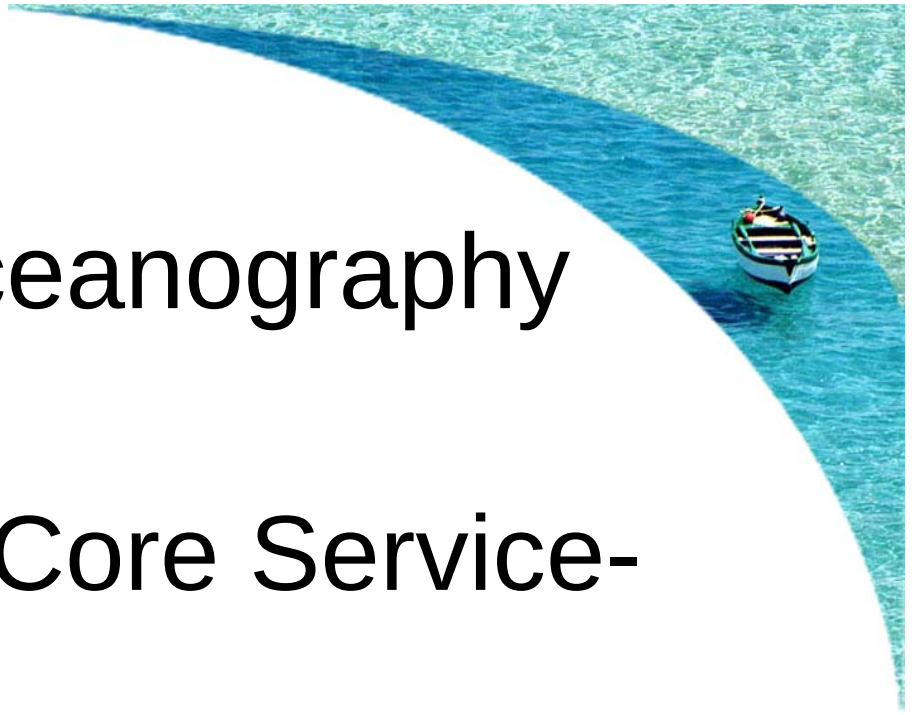
The Mediterranean Operational Oceanography Network (MOON): ocean observatories in support of science and management

Giovanni Coppini and Nadia Pinardi

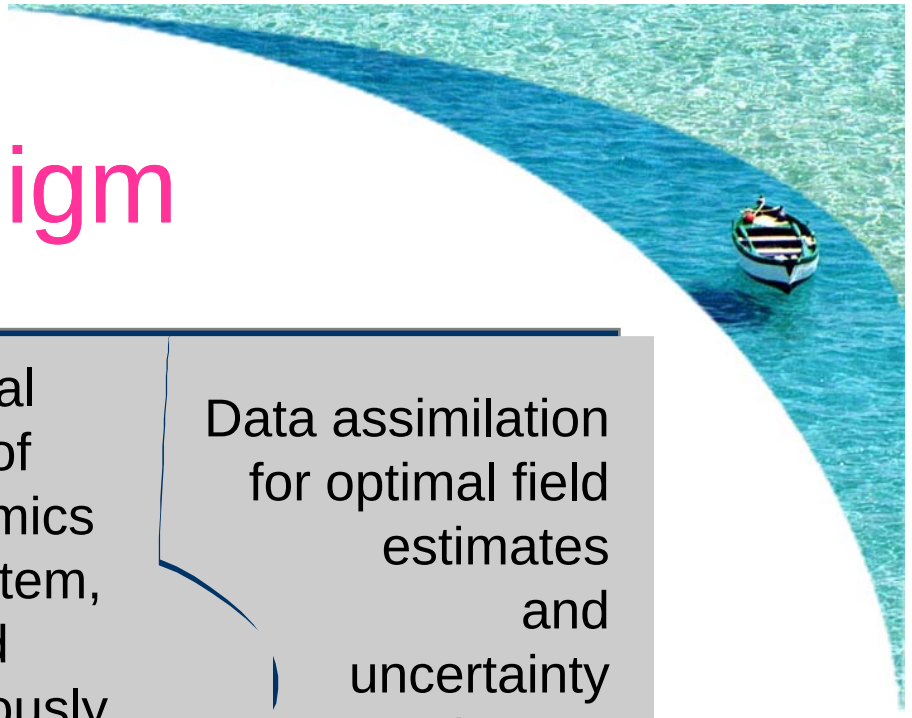
Istituto Nazionale di Geofisica e Vulcanologia,
Gruppo Nazionale di Oceanografia Operativa

Outline



- The Operational Oceanography paradigm
- The GMES Marine Core Service- *MyOcean* products
- Mediterranean Operational Oceanography Network components
- Final considerations

The Operational Oceanography paradigm



Multidisciplinary Multi-platform Observing system (permanent and relocatable)

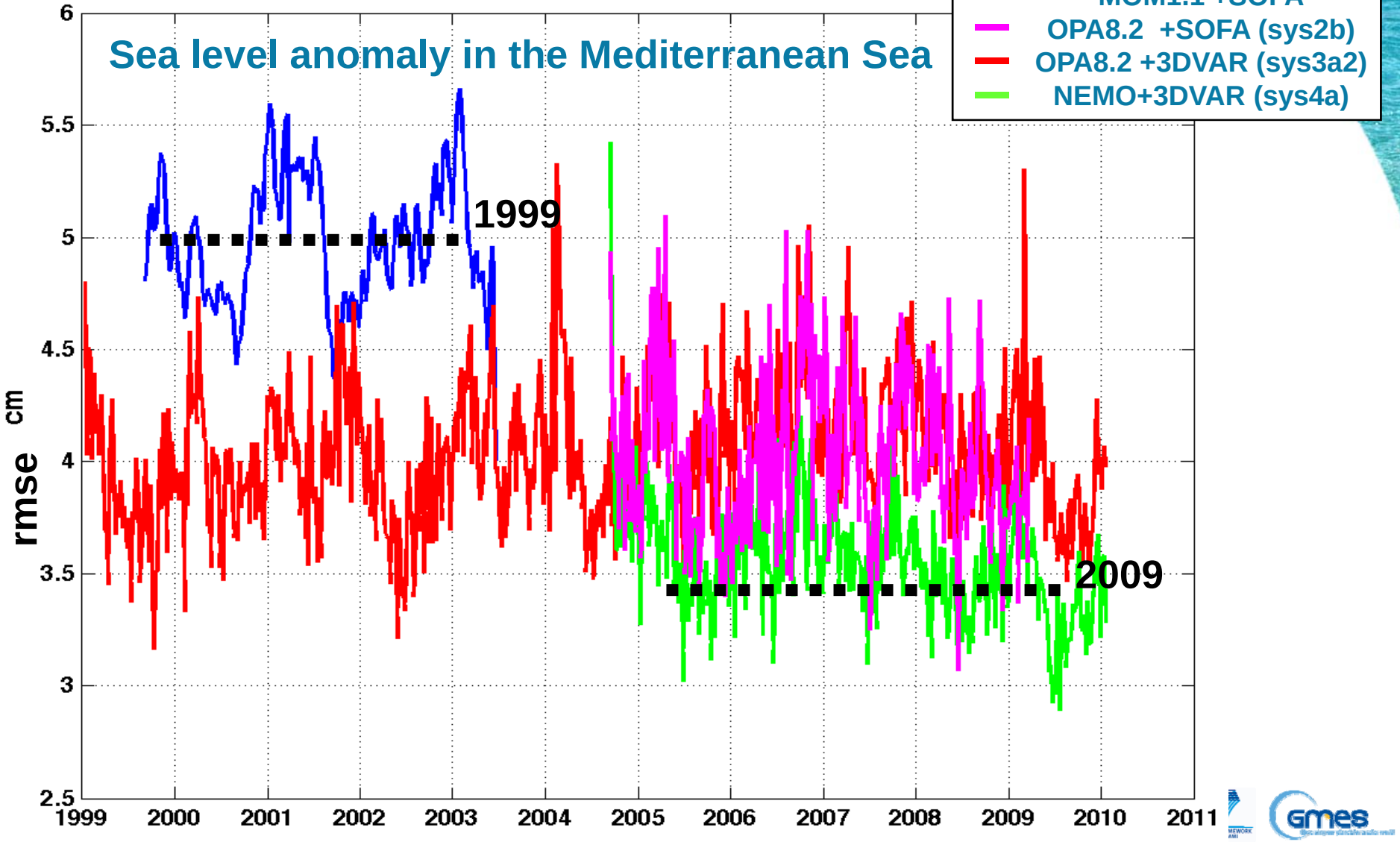
Numerical models of hydrodynamics and ecosystem, coupled a/synchronously to atmospheric forecast

Data assimilation for optimal field estimates and uncertainty estimates

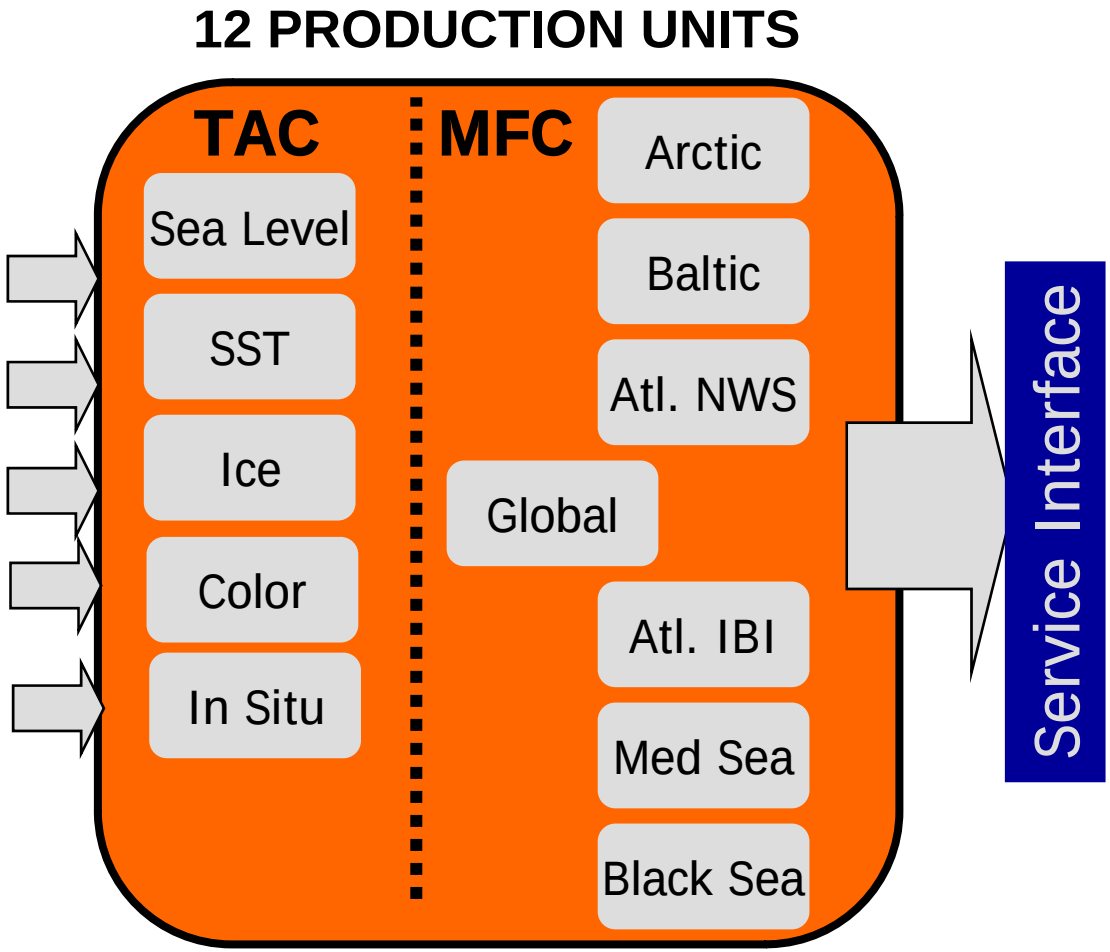
Continuos production of nowcasts/forecasts of relevant environmental state variables

Real time products with internationally agreed standards

Operational oceanography: 10 years of quality increase

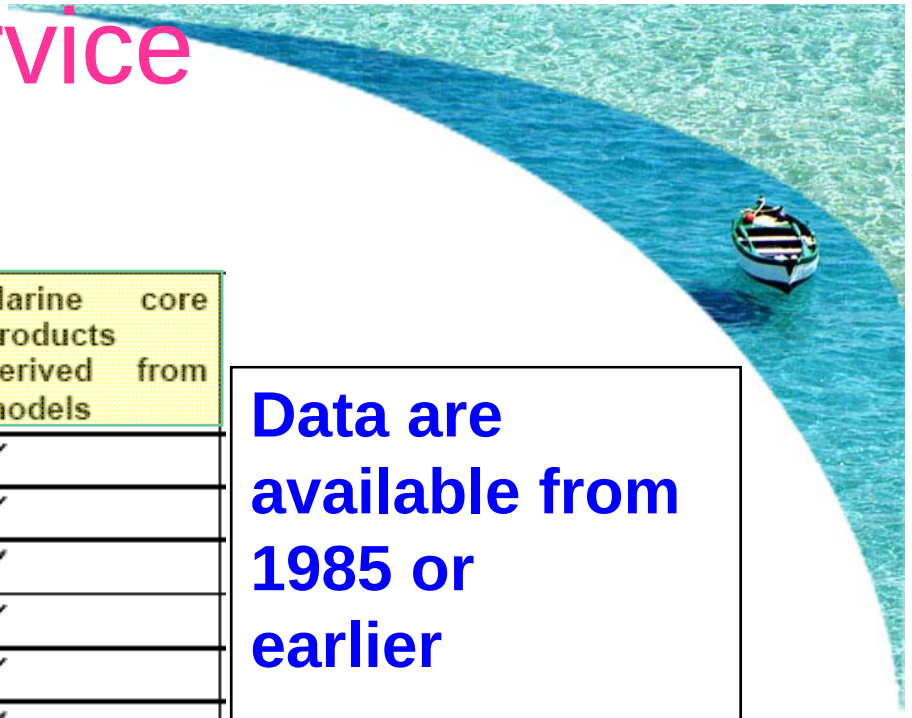


The GMES Marine Core Service implementation: the MyOcean project (2009-2012)



myOcean

The Marine Core Service products

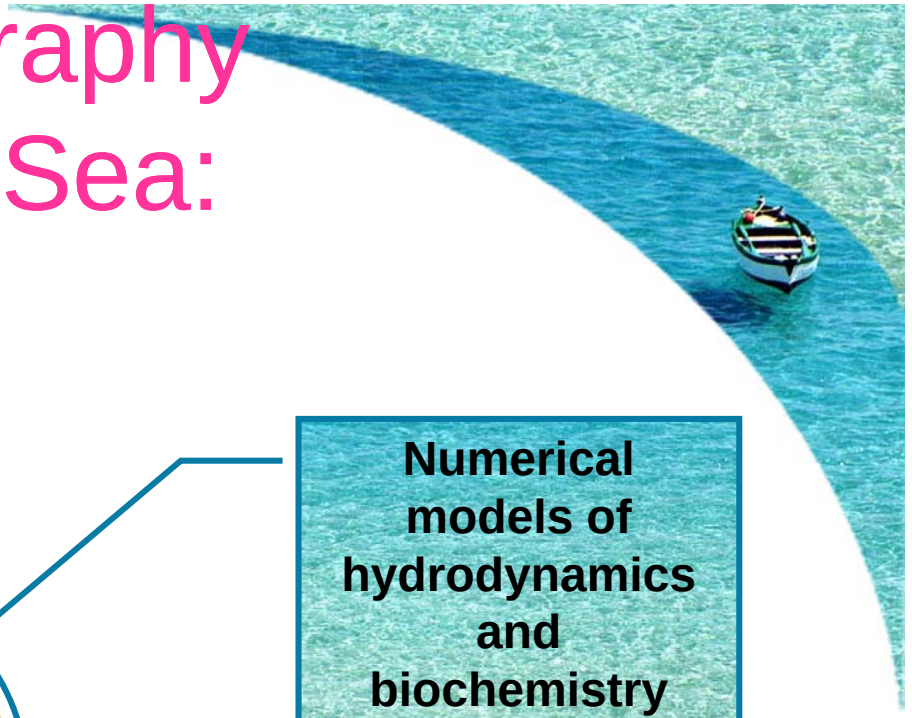


Geophysical State Variable	Marine core products derived from observations	Marine core products derived from models
Sea level, sea surface height	✓	✓
Temperature	✓	✓
Salinity	✓	✓
Currents	✓	✓
Surface winds	✓	✓
Surface waves	✓	✓
Sea ice (extent, concentration, thickness, motion)	✓	✓
Biophysical State Variable		
Attenuation of solar radiation – Note 4	✓	
Bio-geochemical State Variable		
Chlorophyll-a	✓	✓
Dissolved inorganic nutrients	✓	✓
Dissolved O^2	✓	✓
pCO^2	✓	
Benthic biomass – Note 3	✓	
Sediment grain size & organic content	✓	
Faecal indicators - Note 1		
Oil slicks - Note 2		

Data are available from 1985 or earlier

Every day an analysis and a forecast of the sea

Operational oceanography in the Mediterranean Sea: 1995-today



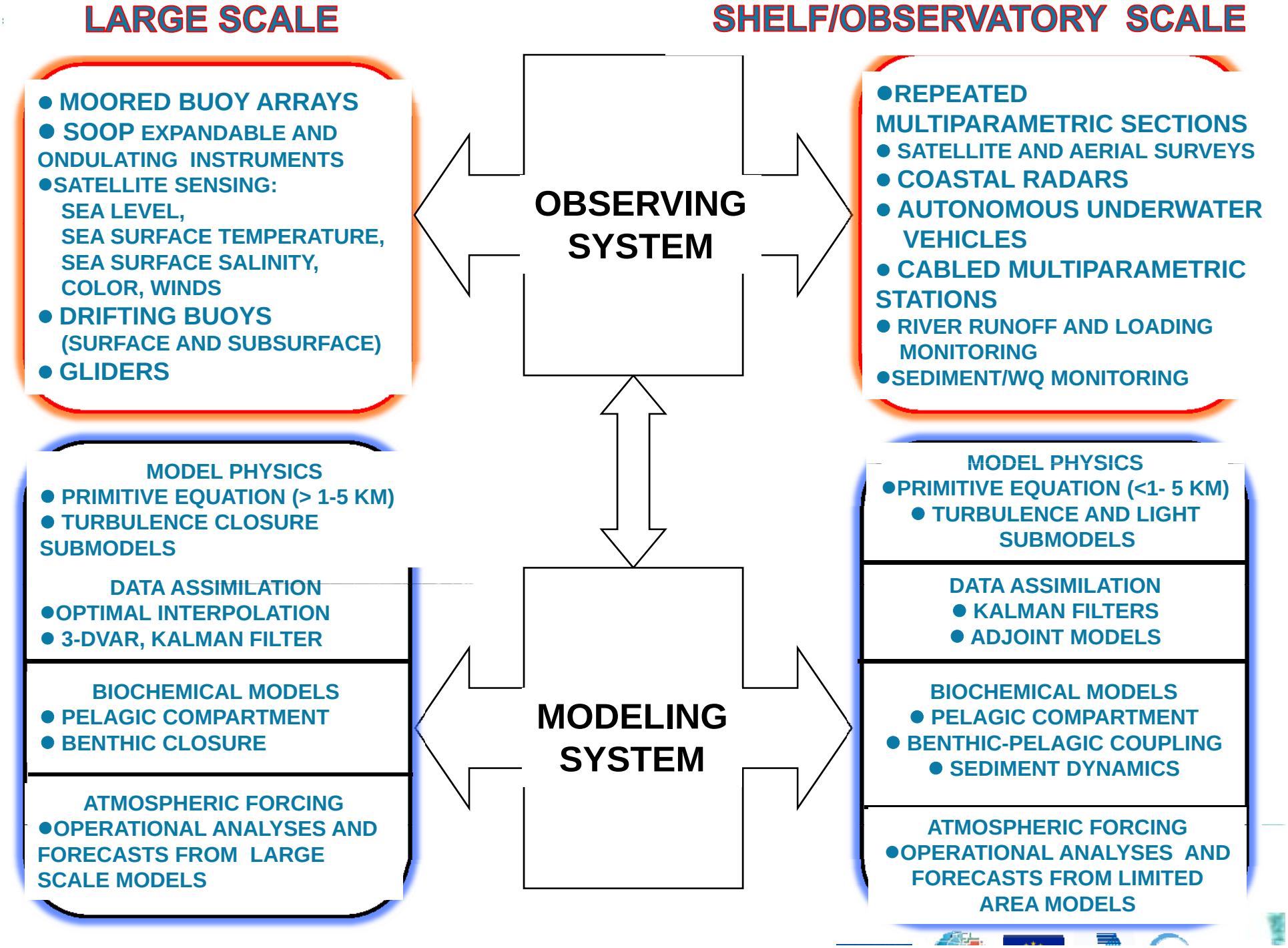
Real Time Observing System from satellites and in situ platforms

Numerical models of hydrodynamics and biochemistry at basin scale

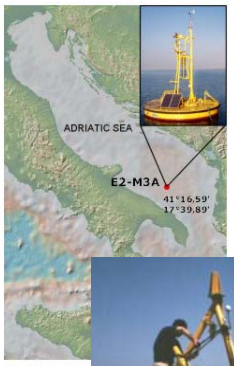
Numerical models for shelf and coastal areas

End-User applications - Downstream services

MOON: Mediterranean Operational Oceanography Network
16 nations involved, 36 institutions
http://www.moon-oceanforecasting.eu


LARGE SCALE
SHELF/OBSERVATORY SCALE
● MOORED BUOY ARRAYS
● SOOP EXPANDABLE AND ONDULATING INSTRUMENTS
●SATELLITE SENSING:
SEA LEVEL,
SEA SURFACE TEMPERATURE,
SEA SURFACE SALINITY,
COLOR, WINDS
● DRIFTING BUOYS
(SURFACE AND SUBSURFACE)
● GLIDERS
OBSERVING SYSTEM
●REPEATED MULTIPARAMETRIC SECTIONS
● SATELLITE AND AERIAL SURVEYS
● COASTAL RADARS
● AUTONOMOUS UNDERWATER VEHICLES
● CABLED MULTIPARAMETRIC STATIONS
● RIVER RUNOFF AND LOADING MONITORING
●SEDIMENT/WQ MONITORING
MODEL PHYSICS
● PRIMITIVE EQUATION (> 1-5 KM)
● TURBULENCE CLOSURE SUBMODELS
DATA ASSIMILATION
●OPTIMAL INTERPOLATION
● 3-DVAR, KALMAN FILTER
BIOCHEMICAL MODELS
● PELAGIC COMPARTMENT
● BENTHIC CLOSURE
ATMOSPHERIC FORCING
●OPERATIONAL ANALYSES AND FORECASTS FROM LARGE SCALE MODELS
MODELING SYSTEM
MODEL PHYSICS
●PRIMITIVE EQUATION (<1- 5 KM)
● TURBULENCE AND LIGHT SUBMODELS
DATA ASSIMILATION
● KALMAN FILTERS
● ADJOINT MODELS
BIOCHEMICAL MODELS
● PELAGIC COMPARTMENT
● BENTHIC-PELAGIC COUPLING
● SEDIMENT DYNAMICS
ATMOSPHERIC FORCING
●OPERATIONAL ANALYSES AND FORECASTS FROM LIMITED AREA MODELS

MOON large scale data collection



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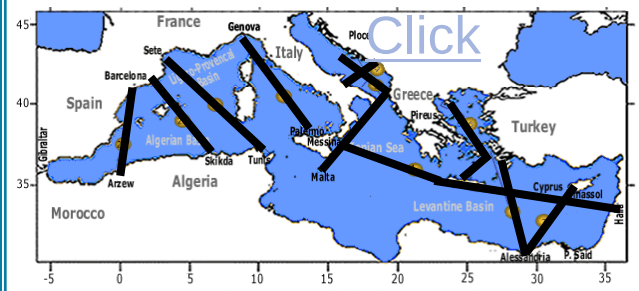
Multiparametric buoys in: Ligurian Sea, Adriatic Sea and Cretan Sea (few hours delay)



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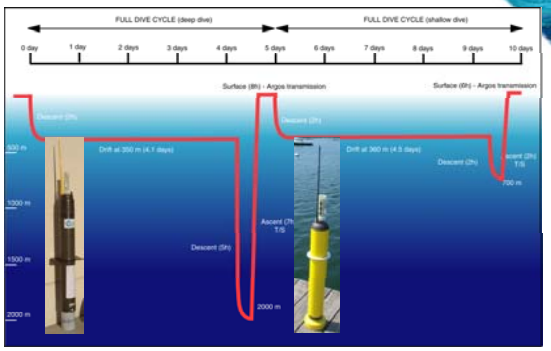
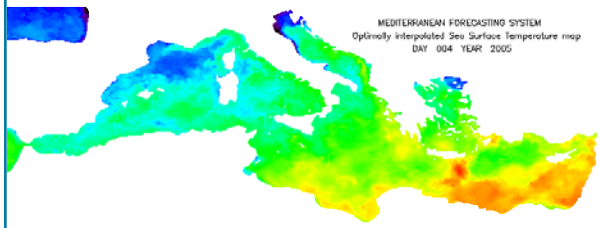
XBT VOS/SOOP high resolution (12 nm along track and full profile transmission, few hours delay)

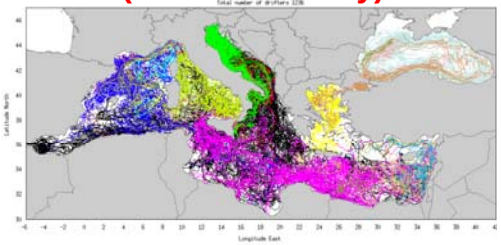


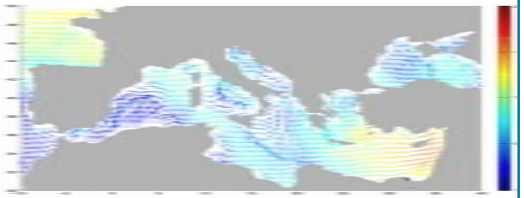
20 ARGO floats deployed from VOS (few hours delay)



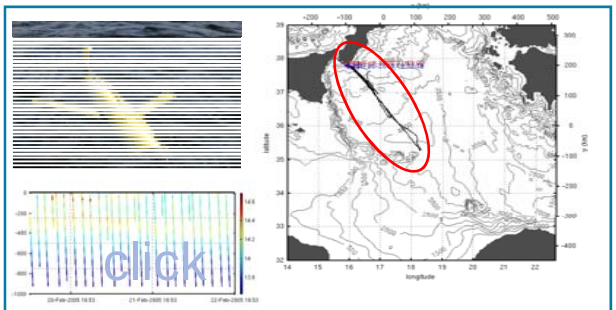
Daily satellite SST interpolated in RT on model grid (one day delay)

Surface drifters (few hours delay)





Scatterometer DAILY winds analysis, 1/2x1/2 (one week delay)



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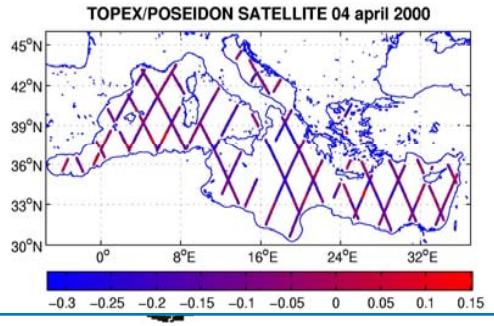
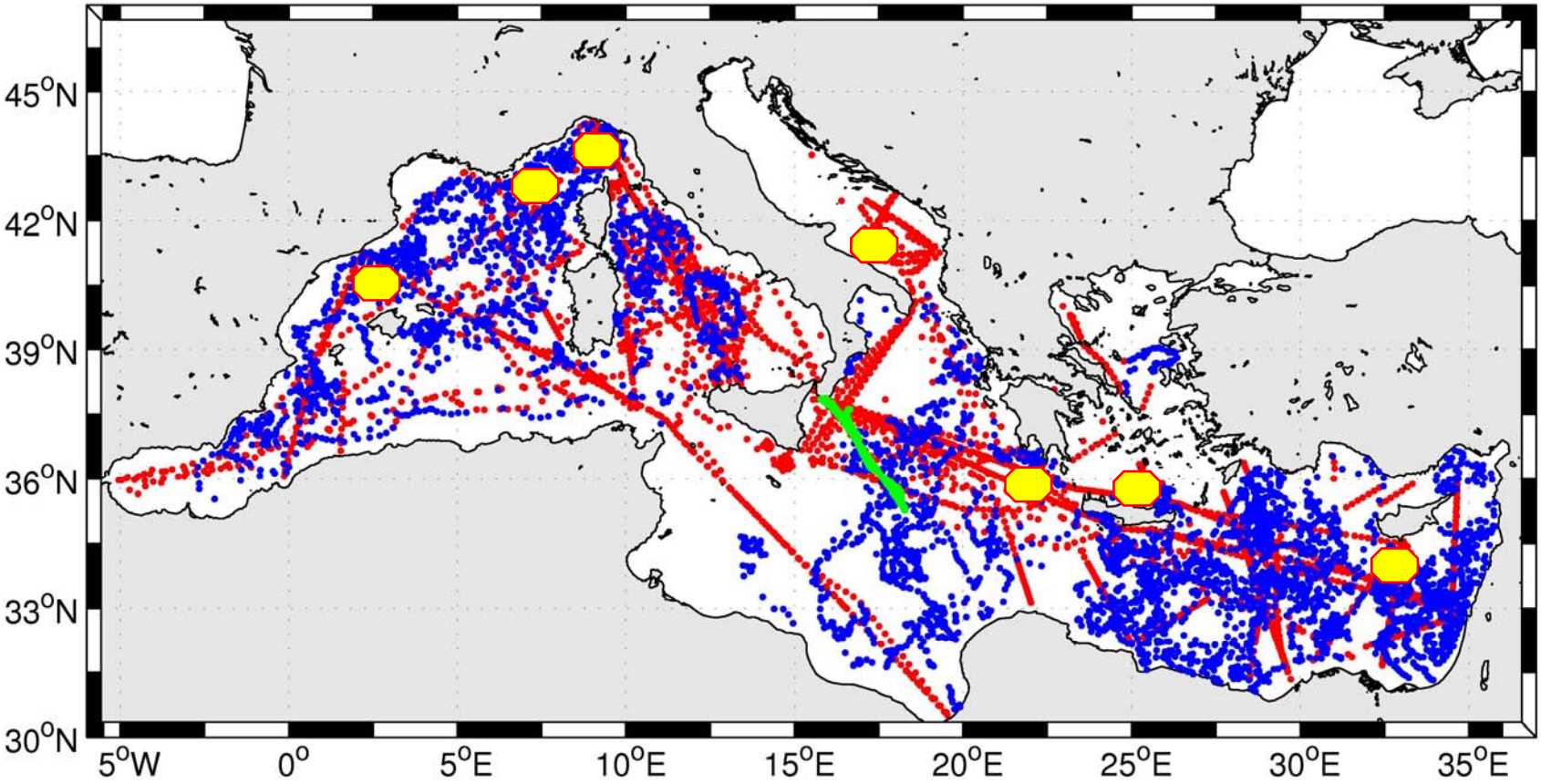
Open ocean monitoring by gliders (few hours delay)

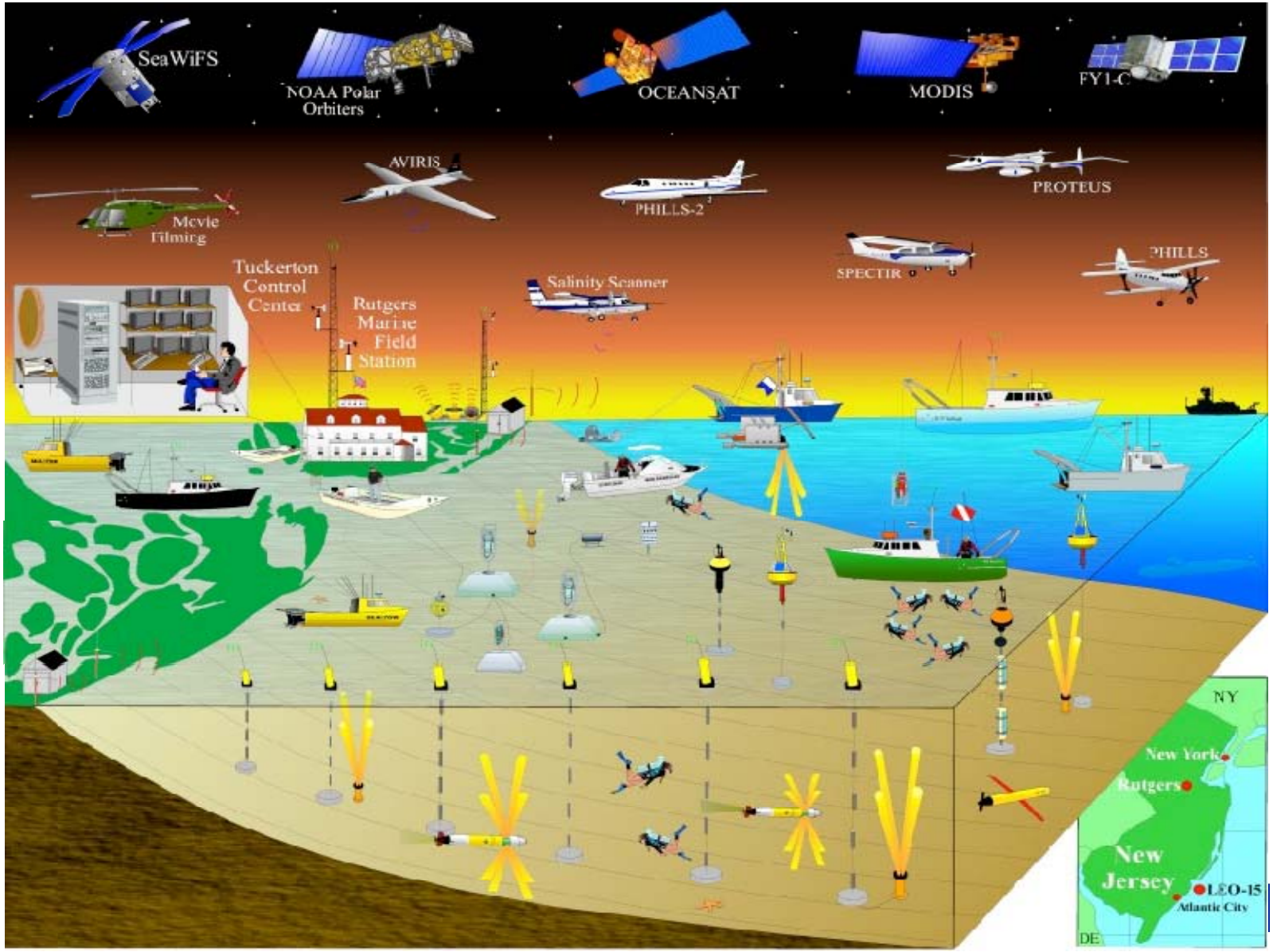


MOON LARGE SCALE data collection: real time data coverage (2004-2008 period)



gliders SOOP ARGO M3A Buoy

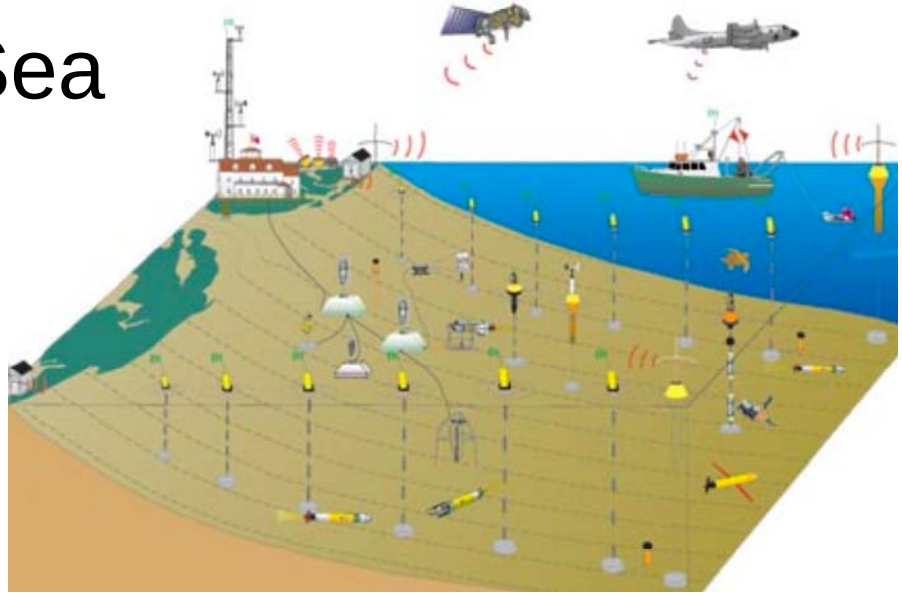
The ocean/coastal observatories: general concept



MOON recent developments: Ocean/Coastal observatories

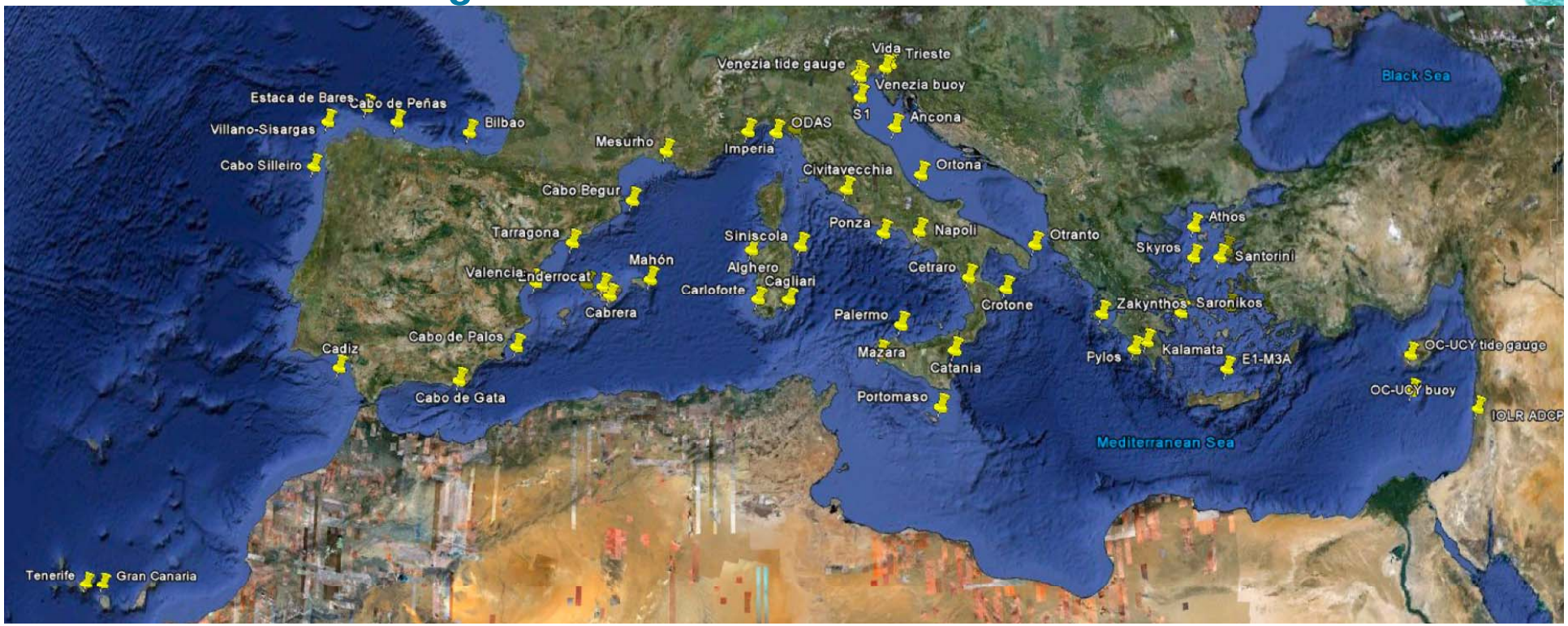
Concentrated efforts in sub-regional areas of the Mediterranean Sea have started to develop ocean/coastal observatories in four sub-basin scale areas:

- 1. The Iberian-Balearic Sea
- 2. The Adriatic Sea
- 3. The Aegean Sea
- 4. The South-eastern Levantine



MOON recent developments: data exchange from national networks observatories

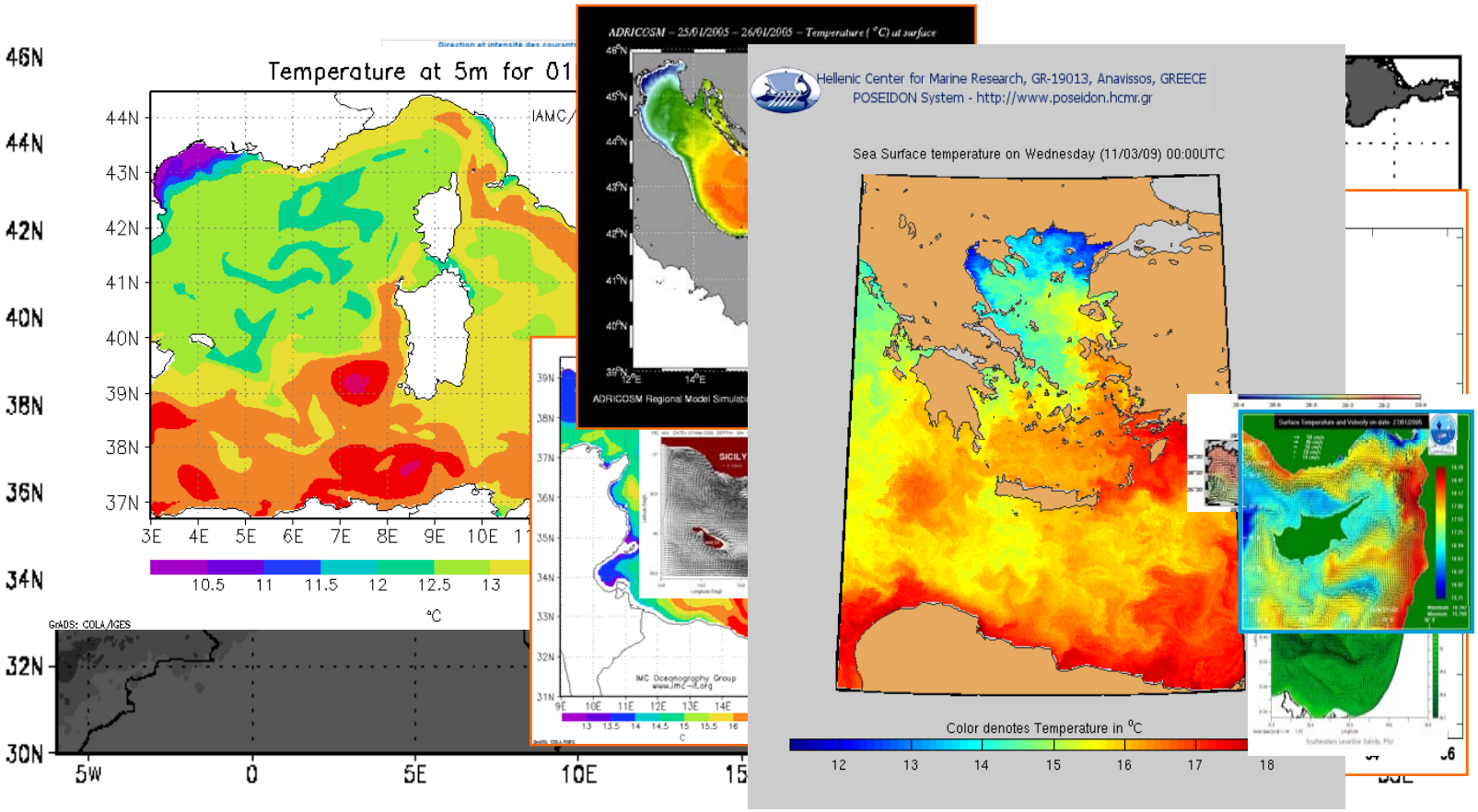
The MyOcean Validation network composed of national real-time transmitting stations



wave, surface meteorological parameters and sea level

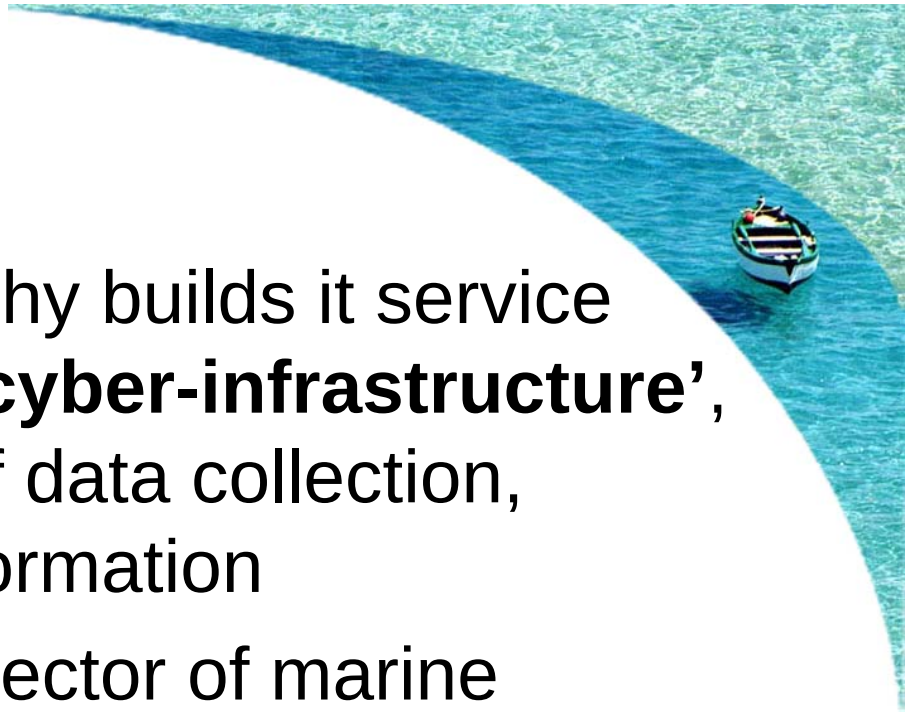
Marine and coastal environment: limited area modelling for the shelf and coasts

MyOcean disseminates daily forecasts to 13 nested national models every day



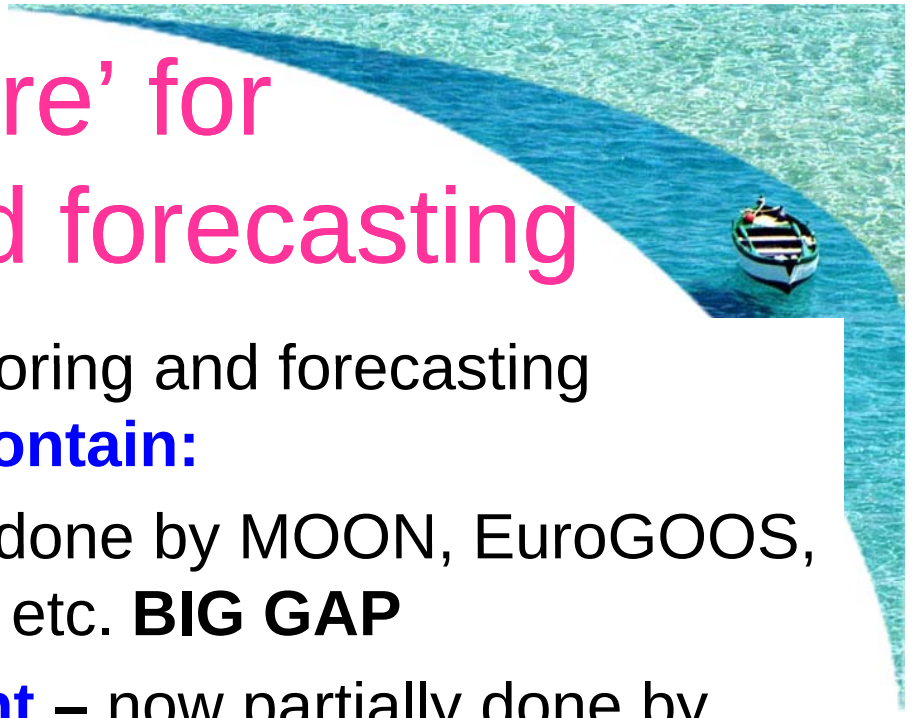
Shelf and sub-regional models now reach 1 - 3 km resolution

In synthesis



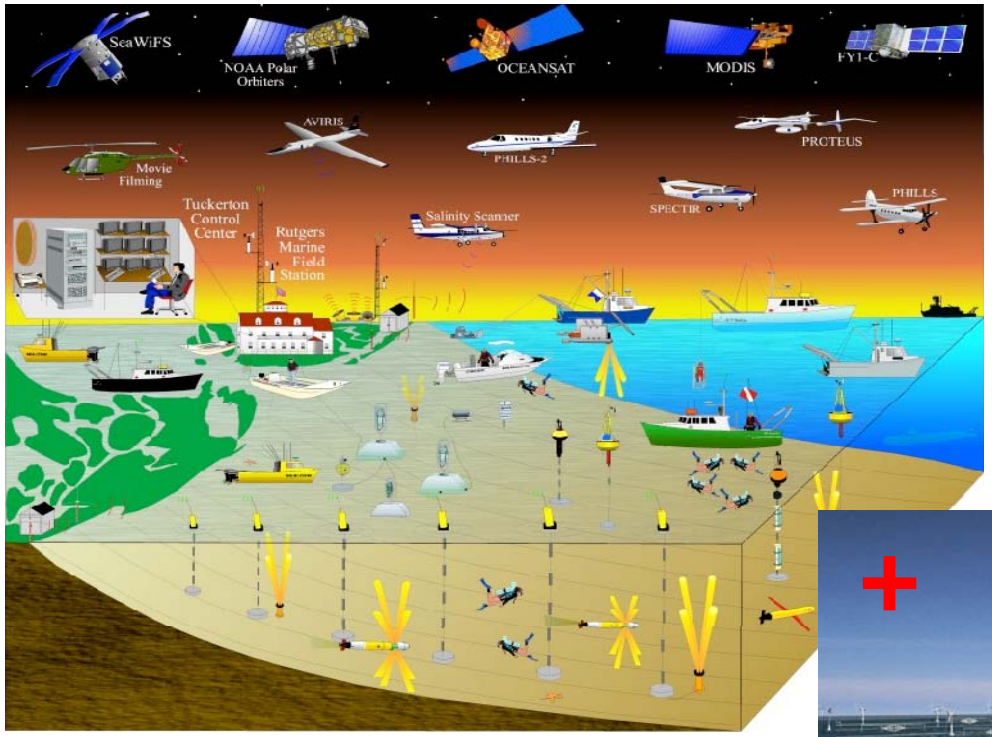
- Operational Oceanography builds it service over the existence of a **‘cyber-infrastructure’**, i.e., a complex system of data collection, management and transformation
- It is a highly developed sector of marine sciences, structured around a science based engineering approach for the monitoring and forecasting of the ocean hydrodynamics and marine biochemical components up to fish resources
- MOON has developed an initial prototype for such an infrastructure

The ‘cyberinfrastrucure’ for ocean monitoring and forecasting



- A **comprehensive** marine monitoring and forecasting "**cyberinfrastructure**” **should contain:**
- **data acquisition -** now partially done by MOON, EuroGOOS, ESFRI initiatives plus EuroSites, etc. **BIG GAP**
- **data storage, data management –** now partially done by SeaDataNet, GMES-ESA space data initiative, GMES-EEA in situ data initiative, EUMETSAT SAFs, MOON, EuroGOOS, EMODNET, Digital Repositories initiatives
- **data integration, data mining** – done by MyOcean (real time), MOON (real time), SeaDataNet (historical)
- **data visualization and transformation** – done by MyOcean (real time), MOON, SeaDataNet (historical)

The next challenge: multi-purpose offshore platforms



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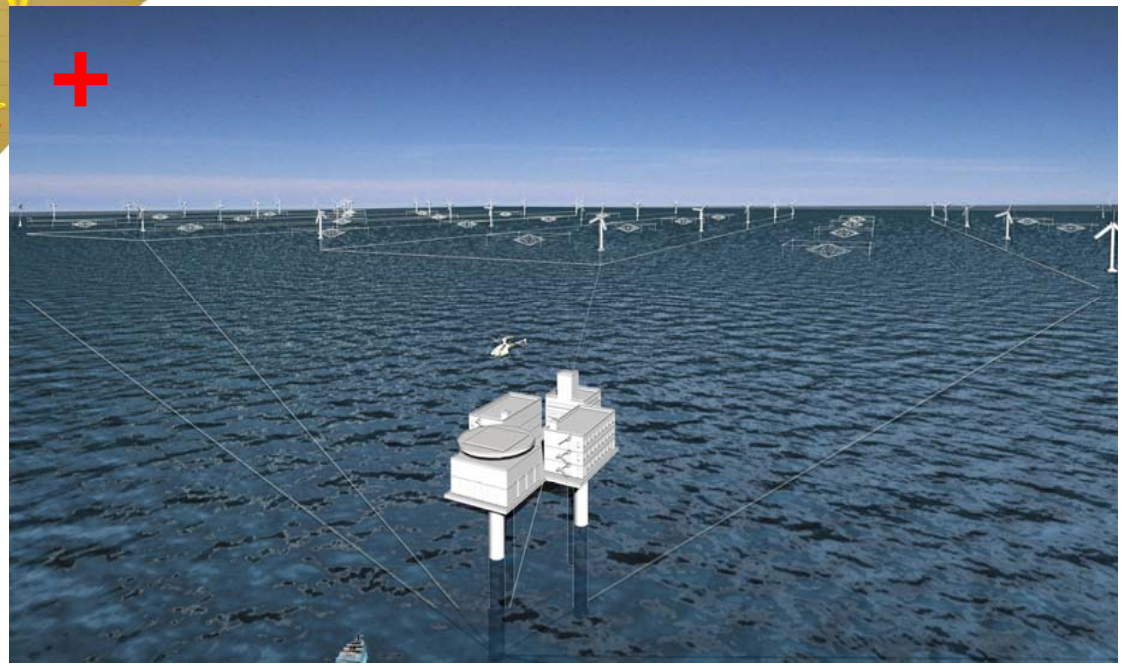

For planning of the ocean territory in accordance with Natura 2000, MFSD, WFD