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

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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

Continuous production of nowcasts/forecasts of relevant environmental state variables

Real time products with internationally agreed standards
Operational oceanography: 10 years of quality increase

Sea level anomaly in the Mediterranean Sea

- MOM1.1 + SOFA
- OPA8.2 + SOFA (sys2b)
- OPA8.2 + 3DVAR (sys3a2)
- NEMO + 3DVAR (sys4a)
The GMES Marine Core Service implementation: the MyOcean project (2009-2012)

12 PRODUCTION UNITS

TAC
- Sea Level
- SST
- Ice
- Color
- In Situ

MFC
- Arctic
- Baltic
- Atl. NWS
- Global
- Atl. IBI
- Med Sea
- Black Sea

Service Interface
The Marine Core Service products

<table>
<thead>
<tr>
<th>Geophysical State Variable</th>
<th>Marine core products derived from observations</th>
<th>Marine products derived from models</th>
<th>Marine core products derived from earlier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level, sea surface height</td>
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<td>✓</td>
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<tr>
<td>Temperature</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Salinity</td>
<td>✓</td>
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<tr>
<td>Currents</td>
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<tr>
<td>Surface winds</td>
<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Surface waves</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sea ice (extent, concentration, thickness, motion)</td>
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<td>✓</td>
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<table>
<thead>
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<th>Biophysical State Variable</th>
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<td>Attenuation of solar radiation – Note 4</td>
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<table>
<thead>
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<th>Bio-geochemical State Variable</th>
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<tr>
<td>Chlorophyll-a</td>
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<tr>
<td>Dissolved inorganic nutrients</td>
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<tr>
<td>Dissolved O²</td>
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<tr>
<td>pCO²</td>
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<td>Benthic biomass – Note 3</td>
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<tr>
<td>Sediment grain size &amp; organic content</td>
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<td>Faecal indicators - Note 1</td>
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<td>Oil slicks - Note 2</td>
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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

End-User applications - Downstream services

Numerical models for shelf and coastal areas

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

- **XB T VOS/ SOOP high resolution** (12 nm along track and full profile transmission, few hours delay)
- **20 ARGO floats deployed from VOS** (few hours delay)
- **Surface drifters** (few hours delay)
- **Multiparametric buoys in:** Ligurian Sea, Adriatic Sea and Cretan Sea (few hours delay)
- **Daily satellite SST interpolated in RT on model grid** (one day delay)
- **Scatterometer DAILY winds analysis, 1/2x1/2** (one week delay)
- **Open ocean monitoring by gliders** (few hours delay)
MOON LARGE SCALE
data collection: real time data coverage (2004-2008 period)
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 ‘cyberinfrastructure’ 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

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