

EC 5th Framework Programme  
MERSEA Strand 1 Project

Marine Environment and Security  
for the European Area





# MARINE ENVIRONMENT AND SECURITY IN THE EUROPEAN AREA - MERSEA STRAND-1



<http://www.nerisc.no/~mersea> &  
<http://www.mersea.eu.org/>

## Objectives -

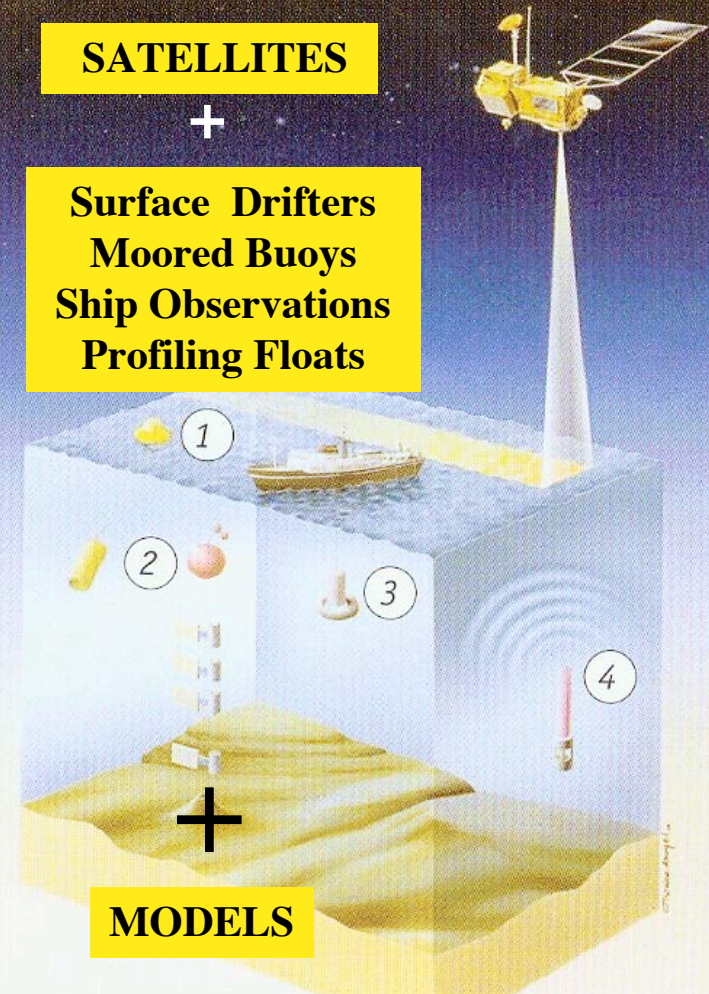
- a) deliver information products (physical, chemical and biological) needed by users concerned with European marine environment and security policies;
- b) report on the problems met and lessons learnt in supplying this information, and
- c) contribute to improved knowledge, methods and tools required for monitoring, information production and delivery to users.

## MERSEA Strand-1 Approach

**SATELLITES**

+

**Surface Drifters  
Moored Buoys  
Ship Observations  
Profiling Floats**



**MODELS**



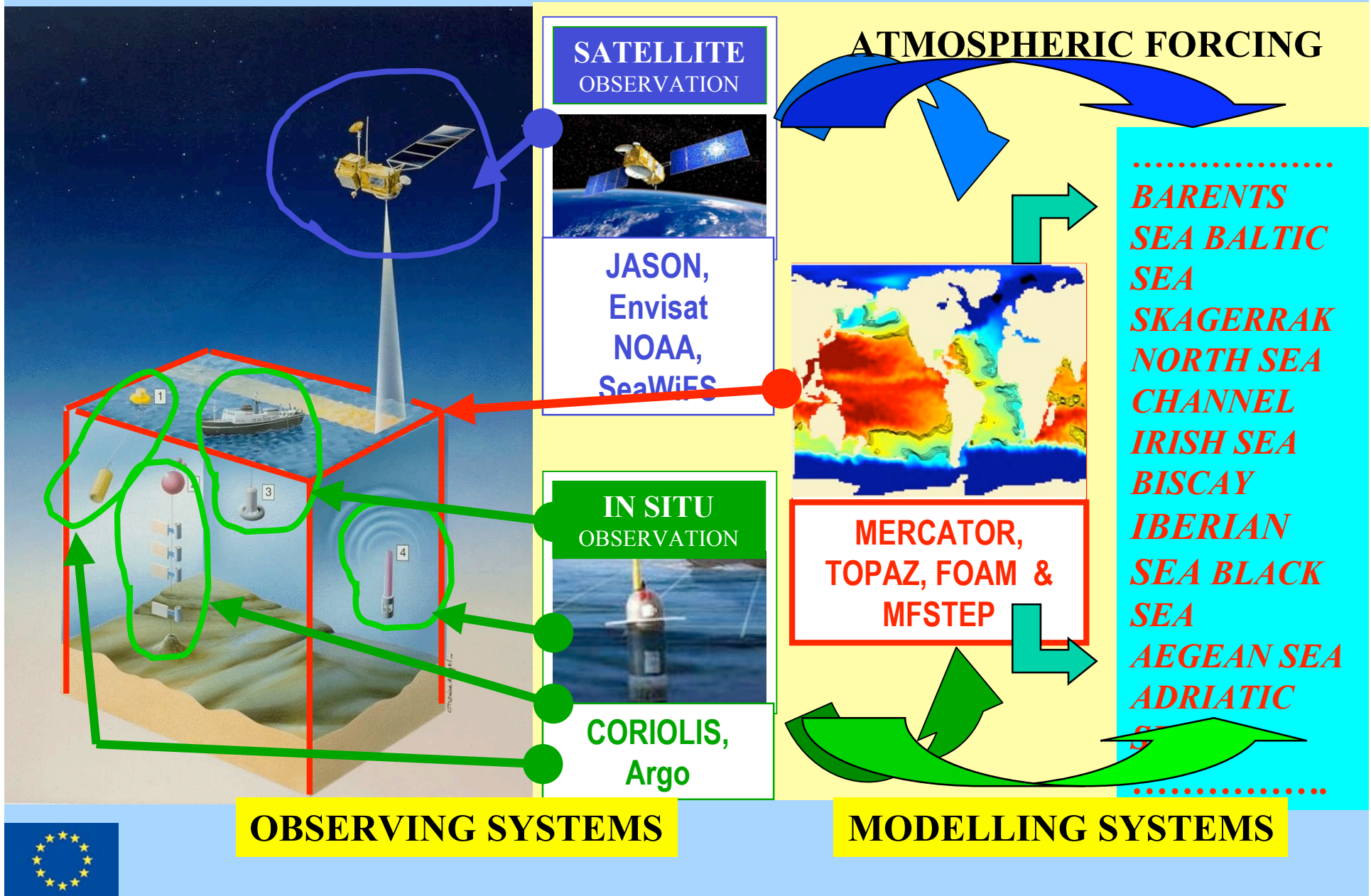
**MERSEA STRAND-1 takes on the way to  
OPERATIONAL OCEANOGRAPHY:**

**the backbone for provision of routine data and information in HINDCAST-NOWCAST-  
FORECAST mode for**

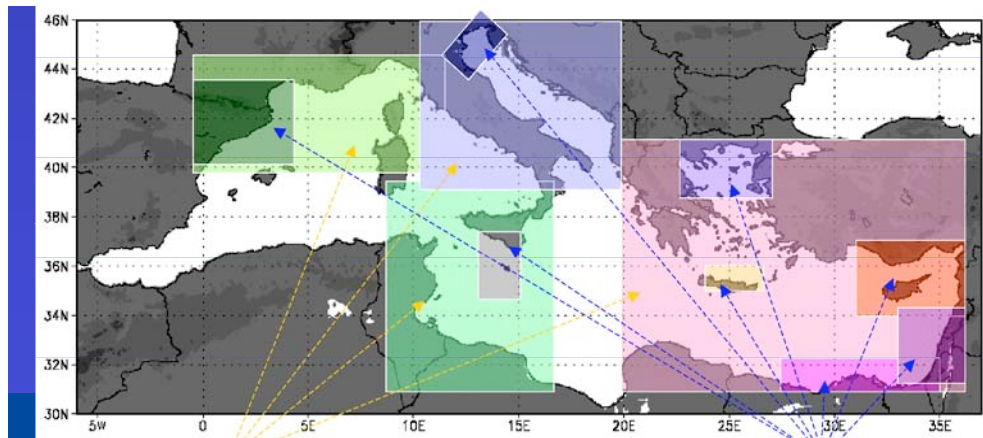
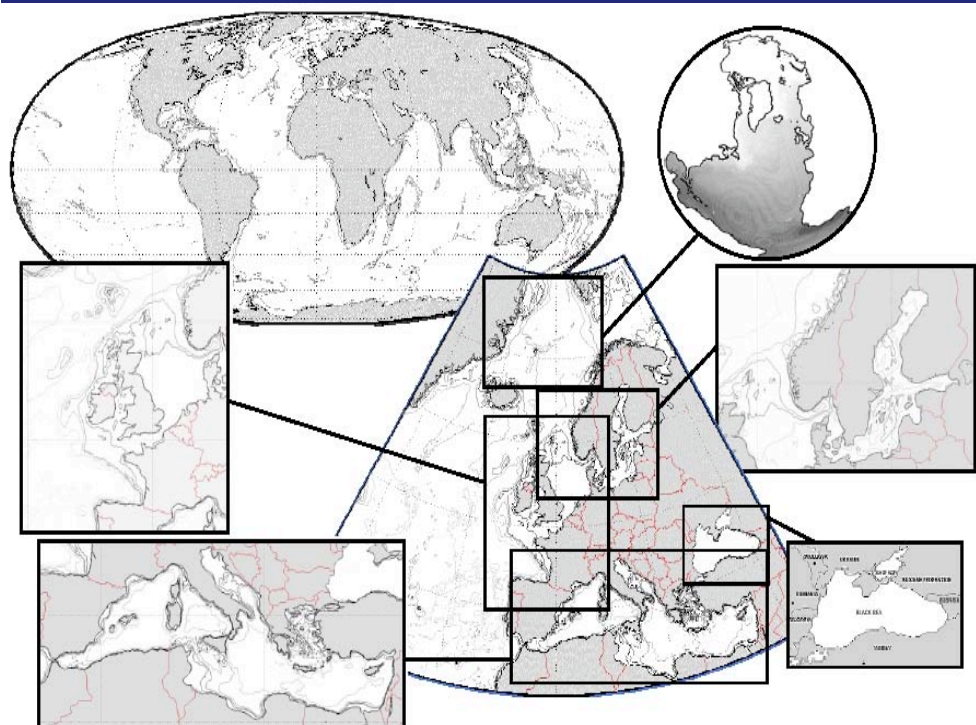
- **Climate research and prediction**
- **Marine security (crisis management)**
- **Regular and rapid marine environment assessment**
- **Fisheries**
- **Management of shelf/coastal areas**
- **Offshore industry**
- **Coast Guard and Navy applications**
- **Policy and Decision Making**

**MERSEA S-1 AN IMPORTANT KEY TO MARINE GMES**

# MERSEA Strand-1 Approach



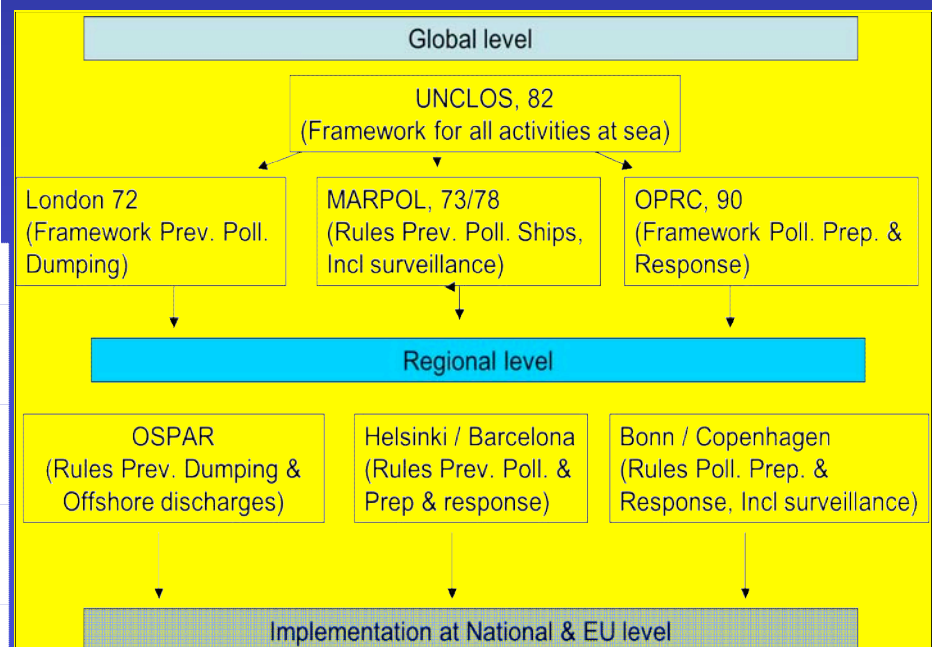
# FROM BASIN SCALE VIA REGIONAL TO LOCAL SCALE MODEL CAPACITY



★ regional models at 5 km

shelf models at 1.5-2 km

the way to approach the specific GMES application areas such as related to oil spill and water quality monitoring & their policies



EC 6th Framework Programme  
MERSEA Integrated Project

Marine Environment and Security  
for the European Area



# MERSEA Integrated Project

- Funded under 6th FP of the CEC
  - Thematic priority : SPACE - GMES (Global Monitoring for Environment and Security)
  - Ocean and Marine Applications
- Four-year project (2004 –2008)
- 40 contractors, 16 countries (or Int. Org.)
- Coordination : IFREMER (Institut Français de Recherche pour l'Exploitation de la Mer), France
- Budget : 24.4 M€ ; EC grant : 14 M€



# MERSEA : Summary

- GMES context
- Overall objectives
- Project description
- Expected achievements
- Project timetable
- Objectives of this meeting



# GMES : ocean applications

- Oceans
  - Climate change, CO<sub>2</sub>, seasonal forecasting
  - Ecosystems, fisheries,
  - Marine safety, traffic, pollution (crisis management)
  - Offshore activities
  - Coast guards and Navy applications
  - From global to coastal ocean (coastal management)
  - Scientific research
- International conventions
  - OSPAR (North Atlantic); HELCOM (Baltic); MARPOL; BARCELONE; UNCLOS; Kyoto; UNFCCC; AMAP (Arctic)



# ESA and EC support for GMES build-up

- Several previous R&D programmes on Earth Observations and operational monitoring
- ESA Earthwatch GMES Services Element (5 yr plan, 83 M€ )
  - Consolidation phase (2003-2004) : CoastWatch; ROSES; ICEMON; Medspiration (High resolution SST)
  - Full operationalisation (2004-2006)
- EC GMES Action Plan
  - GMES Forum; cross-cutting assessments
  - Initial phase FP5 : MERSEA - Strand 1 (2003-2004)
  - FP6 GMES calls : MERSEA Integrated Project (2004-08)



# Context

- National programmes (some with Global reach) and regional alliances;
- Previous, current and future EC and ESA - projects
- International programmes
  - GODAE, GOOS, CLIVAR
  - Satellite programmes : JASON, ...
  - In situ : ARGO, VOS...
- GOOS, IOC, JCOMM



# MERSEA Integrated Project

Will provide an integrated service of global and regional ocean monitoring and forecasting to intermediate users and policy makers, in support of :

- safe and efficient offshore activities,
- environmental management,
- security,
- sustainable use of marine resources,
- research

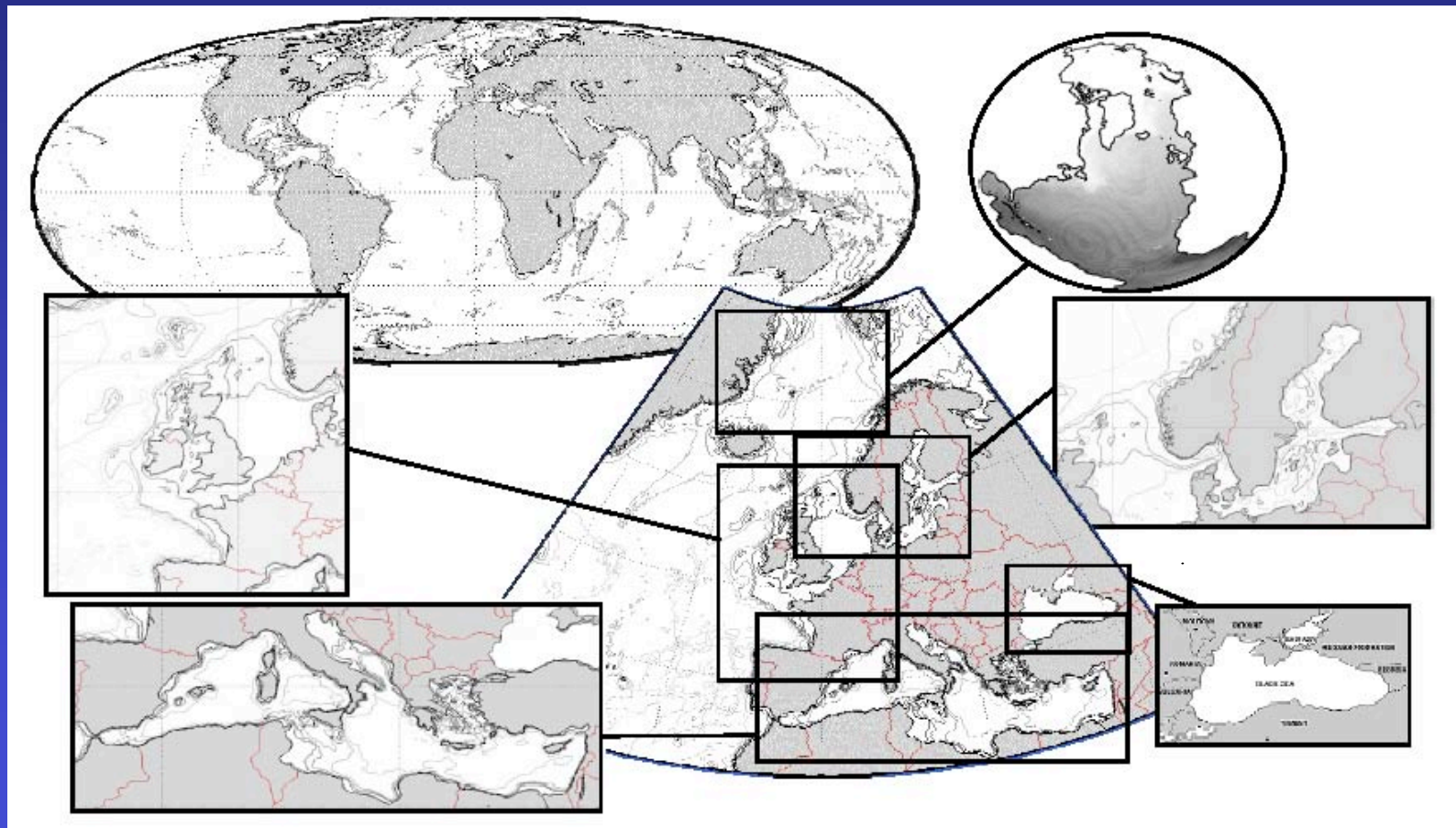


# MERSEA objectives

- Development of a European system for operational monitoring and forecasting of the ocean physics, biogeochemistry and ecosystems
    - A global system
    - Support for shelf sea systems
    - Connection to coastal systems
- } Nowcasts, forecasts, hindcasts
- It will build the Ocean component of GMES (2008)
  - Mersea federates European contribution to GODAE



# MERSEA Global to Regional coverage



# MERSEA Integrated Project

- Integrate and organise present systems
  - information management, communication
- Research and development :
  - Validate, improve, extend present capacities (resolution, geography, processes, assimilation, geochemistry and ecosystems, data,... )
- Provision of data (satellite, in situ, forcing fields)
- Deliver information products to intermediate and end-users :
  - Operate the systems
  - Biogeochemical variability, seasonal forecasting,
  - wave forecasts, ship routing, offshore activities, oil spills
- Design and validation of final system



Training, outreach

# The four Global systems

- **MERCATOR :**
  - OPA Z coord./Rigid Lid
  - Global  $1/4^\circ$ ; N. Atl. horiz.  $1/15^\circ$  verti. 43 levels
  - Daily ECMWF forcing + relaxation Reynolds SST and Reynaud SSS
  - Assimilate SLA, in situ profiles, SST
- **TOPAZ (NERSC):**
  - N. Atl., Arctic, Nordic seas
  - HYCOM, res. 18 to 35 km
  - Assimilate SLA, in situ profiles, SST, ice
- **FOAM (Met Office):**
  - Global + N Atl ( $1/9^\circ$ , 20 levels)
  - Assimilate SLA, in situ profiles, SST, ice
- **MFS (INGV):**
  - Mediterranean,  $1/16^\circ$ , 71 levels
  - Assimilate SLA, in situ profiles, SST



# MERSEA CORE DATA ASSIMILATION SYSTEM

<p><b>MERCATOR</b> <b>FR</b></p> <p><b>ATL</b> <b>MED</b></p>	<p><b>OPA</b> -Z coord./Rigid Lid</p>	<p>-horiz. 1/15° (5-7km) -verti. 43 levels</p>	<p>-Daily ECMWF forcing</p> <p>-Daily relaxation to weekly Reynolds SST and seasonal Reynaud SSS</p> <p>-Monthly river runoff from Unesco GRDB</p>	<p><b>-OI Cooper&amp;Haines</b></p> <p>-SLA (Jason1,ERS2/Envisat,GFO along track) once a week</p> <p>-MSSH from Rio et al.</p>
<p><b>TOPAZ</b> <b>NO</b></p> <p><b>ATL</b></p>	<p><b>HYCOM</b> -Hybrid coord./free surface -dynamic/thermodynamic Sea ice</p> <p>-KPP mixing</p>	<p>-horiz. 20 to 30km -Verti. 22 hybrid layers</p>	<p>-6 hourly ECMWF forcings.</p> <p><b>-Bulk formulae, for momentum &amp; heat (large&amp;pond,1981, with cd(u10))</b></p> <p>-Relaxation to Levitus SSS</p> <p>-NO river runoff</p>	<p><b>- EnKF</b></p> <p>-SLA (Maps) (SALTO-DUACS) once a week</p> <p>-SST from CLS AVHRR data once a week</p> <p>-Maps of ice concentration from NSIDC, Colorado, once a week</p> <p>-MSSH from OCCAM run</p>
<p><b>FOAM</b> <b>UK</b></p> <p><b>ATL</b> <b>MED</b></p>	<p><b>Hadley Center</b> -Z coord./Rigid Lid</p> <p>-sea ice model</p> <p>-Kraus-Turner Mixed layer</p>	<p>-horiz. 1/9° (12km) -verti. 20 levels</p>	<p>-6 Hourly NWP-MetOffice forcing</p> <p>-Weak relaxation to Levitus SST and SSS.</p> <p>-NO river runoff</p>	<p><b>-OI Cooper&amp;Haines</b></p> <p>-SLA (Jason1,GFO) along track</p> <p>- 2.5° gridded (not an analysis) SST (ARGO) .Once a day.</p> <p>- thermal profiles above 1000m</p> <p>-gridded sea ice concentration from CMC once a day</p> <p>-MSSH from a previous run with Singh&amp;Kelly climato in Gulfstream region</p>
<p><b>MFS</b> <b>IT</b></p> <p><b>MED</b></p>	<p><b>MOM</b> -Z coord./Rigid Lid</p> <p>-est vertical mixing+vertical adjustment</p>	<p>-horiz. 1/8° -verti. 31 levels</p>	<p>-6 Hourly ECMWF forcing.</p> <p>-relaxation to SST and SSS</p> <p><b>-Bulk formulae for momentum &amp; heat (Hellerman&amp;Rosenstein,1983, with cd(u10,T10-T0))</b></p> <p><b>-NO river runoff</b></p>	<p><b>-OI</b></p> <p>-SLA (SALTO-DUACS along track) once a week</p> <p>-XBT thermal profiles along track. Once a week</p> <p>-MSSH from where previous run with 1993-99 forcing.</p>
<p><b>HYCOM</b> <b>US</b></p> <p><b>ATL</b> <b>MED (not yet)</b></p>	<p><b>HYCOM 2.1</b> -Hybrid coord./free surface</p> <p>-KPP mixing</p>	<p>-Horiz 1/12° (6.5km) -Verti. 26 hybrid layers</p>	<p>-3 hourly USNAVY NOGAPS wind stress forcing</p> <p><b>-Bulk formulae for heat from Kara et al. 2002.</b></p> <p>-SSS= 50%(E-P) +50% relaxation to Levitus SSS</p> <p>-relaxation to MODAS SST analysis</p> <p>-monthly river runoff</p>	<p><b>-OI Cooper&amp;Haines</b></p> <p>-MODAS (Jason1 GFO ERS2) SLA (from map of objective analysis)</p> <p>-MSSH from 1/12° MICOM (ECMWF)</p> <p>-nex iteration daily AVHRR SST</p>



# Downscaling and nesting

- From Global to :
  - Arctic
  - Eastern N Atlantic (shelf)
  - Mediterranean
- From Eastern N Atlantic to
  - North Sea / Baltic
- From Arctic to
  - Greenland and Newfoundland shelves



# Input data

- Remote sensed
  - merged altimetry
  - high resolution SST
  - Ocean colour
  - Sea ice
  - + new products
- In situ
  - profiles (ARGO, XBT), moorings, SST from ships
  - global + focus on Med ; regional data sets
  - new technology (sensors, gliders)
- Forcing fields : fluxes, wind stress
- Data management



# Modelling and assimilation

- Physical modelling
  - global high resolution
  - parameterisation (mixing, sills, topography, boundary layers, ...)
  - nesting of models, shelf transition to shallow water, ..
- Biogeochemical
  - Nitrogen and Carbon in global upper ocean
    - N, P, Fe, Si, C (DOM, DOC, ..),
  - Ecosystem in OPA : phys / biogeochem coupling, assimilation, process studies, bloom experiment
- Assimilation
  - advanced methods, assimilation in global models
- Scientific validation of systems



# Metrics have been defined

- **Fields provided** : Daily mean best estimate + day(T0+6) forecasts.
- **Time period** : from JUNE 2003 on.
- **2 BASINS** : Atlantic + Mediterranean Sea
- **CLASS1** T,S,U,V,SSH,MLD,BSF,TX,TY,Qtot,E-P-R.  
**Interpolation** (non conservative) on 1/8° horiz. grid  
with 12 vert. levels in ATL (5;30;50;100;200;400;700;1000;1500;2000;2500;3000m)  
and 8 vert. levels in MED (5;30;50;100;200;500;1000;2000m).
- **CLASS2** High resolution(T,S,U,V) sections/moorings.
- **CLASS3** Integrated quantities: daily transports  
through sections/MHT/Overturning.
- **CLASS4** Test performance of analysis and forecasts.



# Experiments - applications - products

- Biogeochemical variability in regional and shelf seas (Atlantic margin and Med Sea)
- Seasonal forecasting
- User products :
  - offshore oil exploration and production
    - (relocatable high resolution models)
  - wave forecasts and ship routing
    - wave-current interaction, sea ice
  - oil drift fate prediction



# Some of Mersea Challenges

- Modelling, assimilation, in particular ecosystems
  - Data availability and quality,
  - Full validation of the system and of its components,
  - Develop links with coastal modules,
  - Develop applications and products, reach out to users
  - Agree on « best practices », standards, inter-operability
  - Integrated system
- 
- Deliver final system for GMES (2008)

