MERSEA Strand-1

MARINE ENVIRONMENT AND SECURITY IN THE EUROPEAN AREA

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

Partners

Nansen Environmental and Remote Sensing Center, Norway, Collecte Localisation Satellites, France, Southampton Oceanography Centre, UK, Institut Francais de Recherche et d´Exploitation de la Mer, France, National Centre for Marine Research, Greece, The Danish Meteorological Institute, Denmark, The UK Met Office, UK, Instituto Nazionale di Geofisica e Vulcanologia, Italy, Department of Fisheries and Marine Research, Cyprus, Norwegian Meteorological Institute, Norway, Institute of Marine Research, Norway, Proudman Oceanographic Laboratory, UK, Plymouth Marine Laboratory, UK, Météo-France , France, MERCATOR, France, Deutsches Zentrum für Luft- und Raumfahrt e.V.,Germany, The Finnish Institute of Marine Research, Finland, The Centre for Environment, Fisheries & Aquaculture Science, UK, Laboratoire d'Etudes en Géophysique et Océanographie Spatiale, France

http://www.nersc.no/~mersea & http://www.mersea.eu.org/

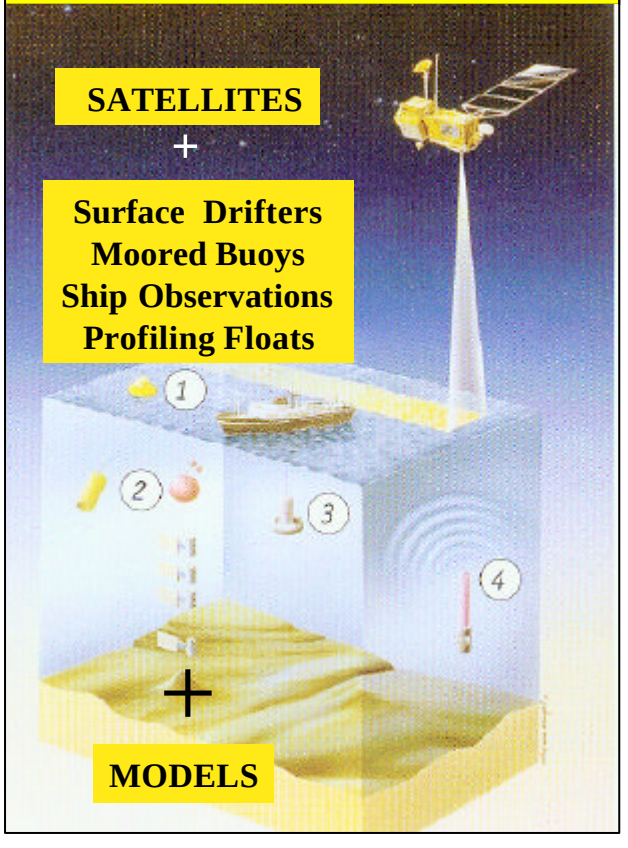
Objectives -

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

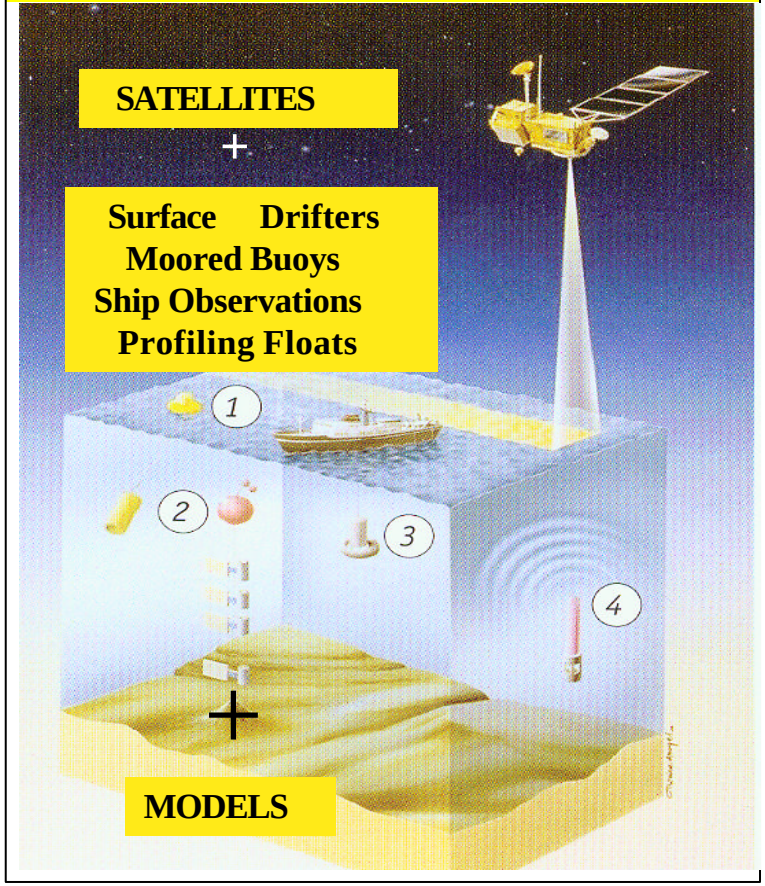
c) contribute to improved knowledge, methods and tools required for monitoring, information production and delivery to users.

MERSEA Strand-1 Approach



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

Integrated System



Relevance for Society

Monitoring and protection of the marine environment in Europe concerns a wide range of international bodies, treaties, conventions and organisations at regional and national levels.

Convention of the Law of the Sea in 1982,
MARPOL 73/78
London Dumping Convention 72
OSPARCOM, HELCOM, BARCELONE
Framework for oil pollution response-OPRC90
European Maritime Safety Agency (EMSA)

The overarching goal is to establish a sound balance between economic and social benefit on one hand and acceptable environmental impact on the other hand.

MERSEA Strand-1 contributes to the provision of marine environmental information that is needed to establish this balance. It moreover undertakes the necessary preliminary measures towards implementation and operation of a European global operational oceanography system in the context of GMES by 2008.

MERSEA STRAND-1 takes on the way to

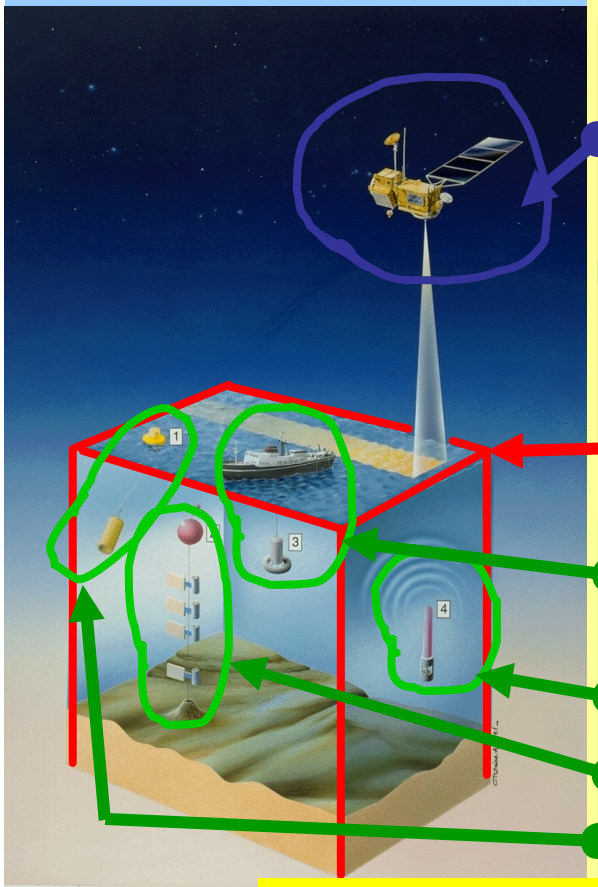
OPERATIONAL OCEANOGRAPHY:

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



SATELLITE
OBSERVATION

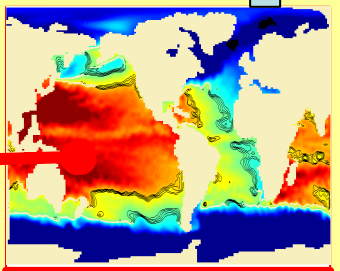
JASON, Envisat NOAA, SeaWiFS

IN SITU
OBSERVATION

CORIOLIS, Argo

OBSERVING SYSTEMS

ATMOSPHERIC FORCING



MERCATOR, TOPAZ, FOAM & MFSTEP

MODELLING SYSTEMS

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BARENTS SEA
BALTIC SEA
SKAGERRAK
NORTH SEA
CHANNEL
IRISH SEA
BISCAY
IBERIAN SEA
BLACK SEA
AEGEAN SEA
ADRIATIC

……

MODEL TYPES		RES.+COORD.	ATM. FORCING	ASS. SCHEME	AREA
MERCATOR FR	**OPA** -Simple thermo. ice model	**-horiz. 1/15° (5-7km)** **43 levels** **Z-coordinate/Rigid Lid**	**-Daily ECMWF forcing** -TKE -Relaxation to Reynolds SST and Reynaud SSS -Monthly river runoff	**-OI Cooper&Haines** **-SLA along track** -MSSH from Rio et al.(data)	**ATL** **MED**
TOPAZ NO	**HYCOM** -dyn./thermodynanic sea ice	**-horiz. 20 to 30km** **22 hybrid layers** **Free surface**	**-6 hourly ECMWF forcing** -KPP mixing -Relaxation to Levitus SSS -No river runoff	**-OI EnKF** **-SLA Maps** once a week -**SST** maps once a week -**Maps of ice** concentration -MSSH from OCCAM run	**ATL**
FOAM UK	**HADLEY CENTRE** -dyn./thermodynamic sea ice	**-horiz. 1/9° (12km)** **20 levels** -Z coord./Rigid Lid	**-6 Hourly NWP-MetOffice forcing** -Kraus-Turner -Weak relaxation to Levitus SST and SSS. -No river runoff	**-OI Cooper&Haines** **-SLA along track** **-SST** 2.5° gridded ARGO once a day. **-gridded ice conc.** -MSSH from previous run	**ATL** **MED**
MFS IT	**MOM** - no ice model	**-horiz. 1/8°** **31 levels** -Z coord./Rigid Lid	**-6 Hourly ECMWF forcing** cst vertical mixing+vertical adjustment -relaxation to satellite night time SST and SSS climatology -N0 river runoff	**-OI SOFA** **-SLA along track** once a week SST maps once a weak **-T profiles** once a week -MSSH from previous run	**MED**
HYCOM US	**HYCOM *2.1*** - no ice model	**-Horiz 1/12° (6.5km)** **26 hybrid layers** **Free surface**	**-3 hourly NOGAPS forcing** **-KPP** -relaxation to Levitus SSS -relaxation to MODAS SST ana. -monthly river runoff	**-OI Cooper&Haines** **-SLA MODAS Maps** -MSSH from 1/12° MICOM (ECMWF)	**ATL**

Metrics have been defined

- **Fields provided** : Daily mean Best Estimate + (T0+6) forecast.
- **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° horizontal grid**

  with 12 vert. levels in ATL
  (5;30;50;100;200;400;700;1000;1500;2000;2500;3000m)
  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** Diagnostics to test assimilation method performance

•DATA STORED ON OPENDAP SERVERS

http://opendap.mercator-ocean.fr/dodsC/
http://www.sincem.unibo.it:8080/dodsC/
http://www.nerc-essc.ac.uk:9090/
http://mersea.nersc.no/dodsC/
http://hycom.rsmas.miami.edu/dodC/

•LAS (Live Access Server)

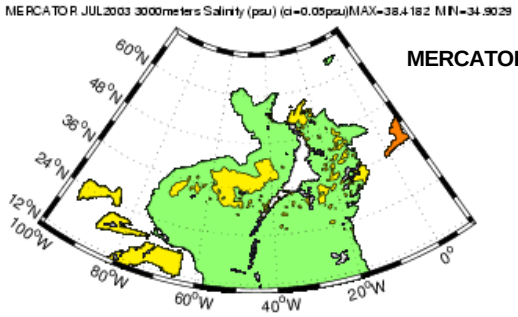
•DODS/MATLAB or DODS/IDL

>> loaddods('http://www.nerc-essc.ac.uk:9090/FOAM_NAT?temperature[0][0]')
Reading: http://www.nerc-essc.ac.uk:9090/FOAM_NATL_120_8th_ARC
Constraint: temperature[0][0]
Server version: catalogaggserver/0.8
Creating matrix temperature (1 x 1 x 441 x 869) with 383229 elements.
Creating vector time with 1 elements.
Creating vector depth with 1 elements.
Creating vector latitude with 441 elements.
Creating vector longitude with 869 elements.

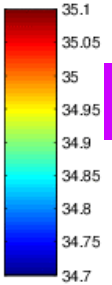
•Available : CLASS1 + CLASS2 + CLASS3

•working on CLASS4

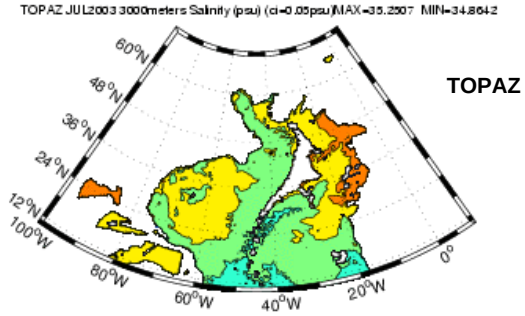
CLASS1 July mean salinity at 3000m depth (ci=0.05psu)



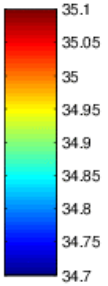
MERCATOR

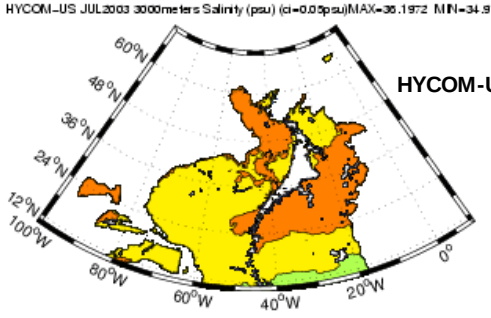


DRIFT from SPIN UP length

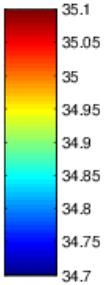


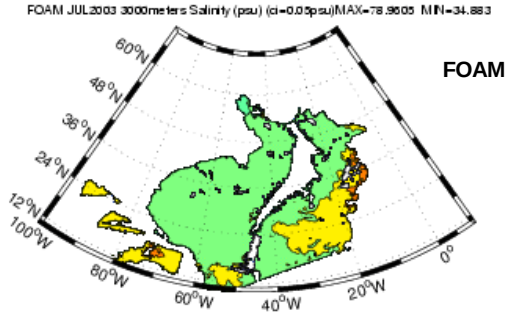
TOPAZ



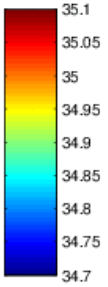


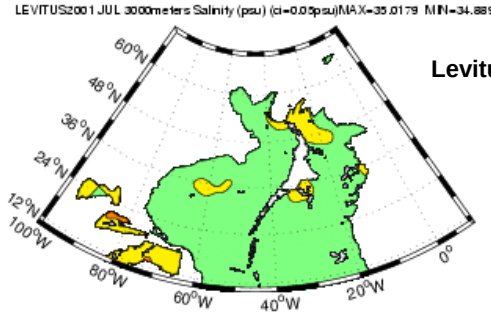
HYCOM-US



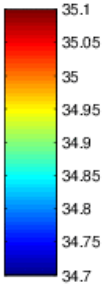


FOAM



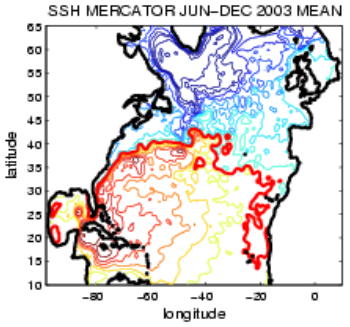


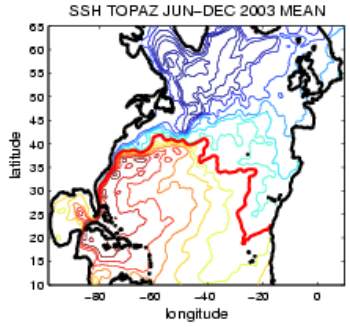
Levitus01



mean SSH (ci=0.1m) (BASIN MEAN SSH SUBTRACTED)

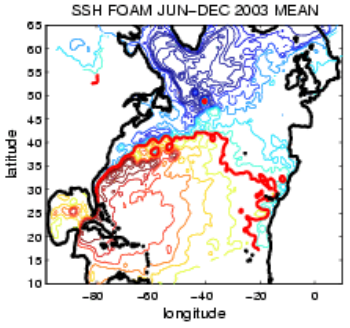
MERCATOR

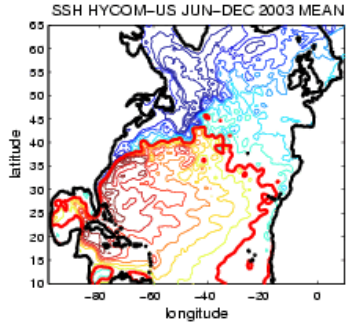




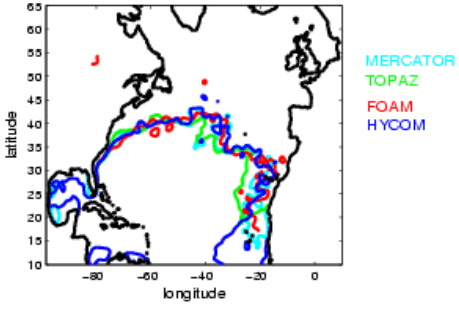
TOPAZ

FOAM

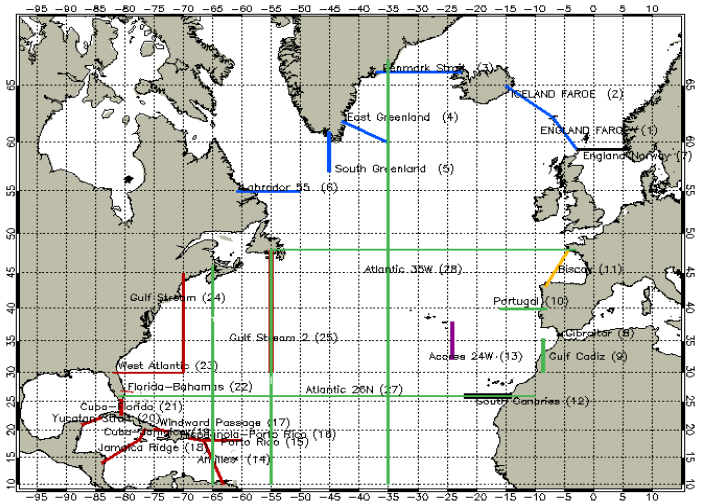




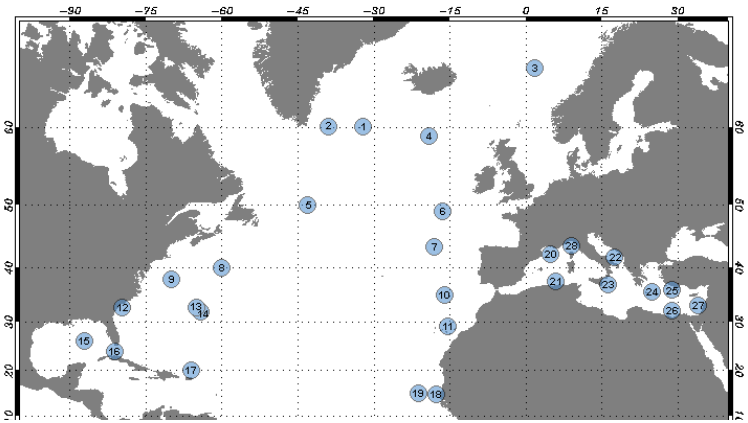
HYCOM new

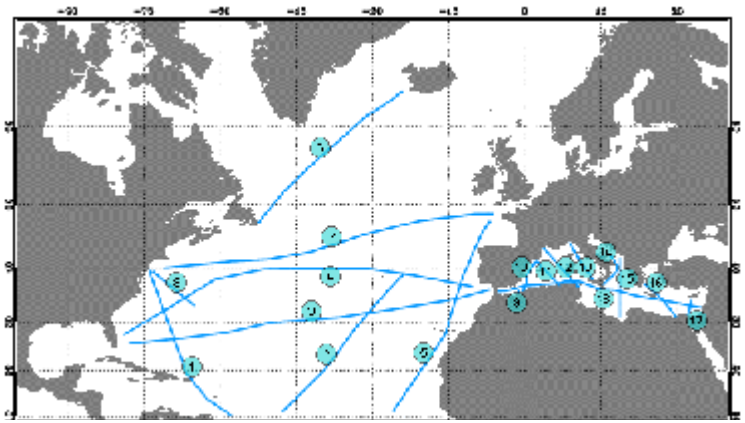


CLASS 2 in the Atlantic



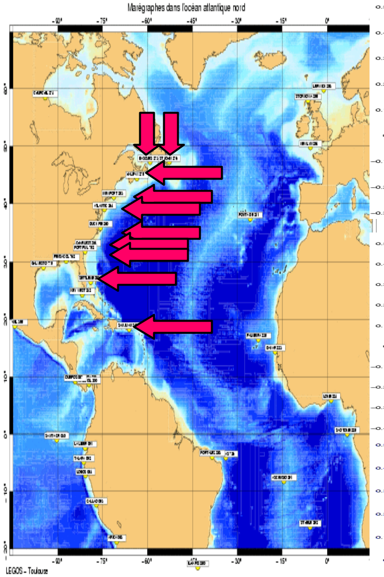
Mouillages MERSEA

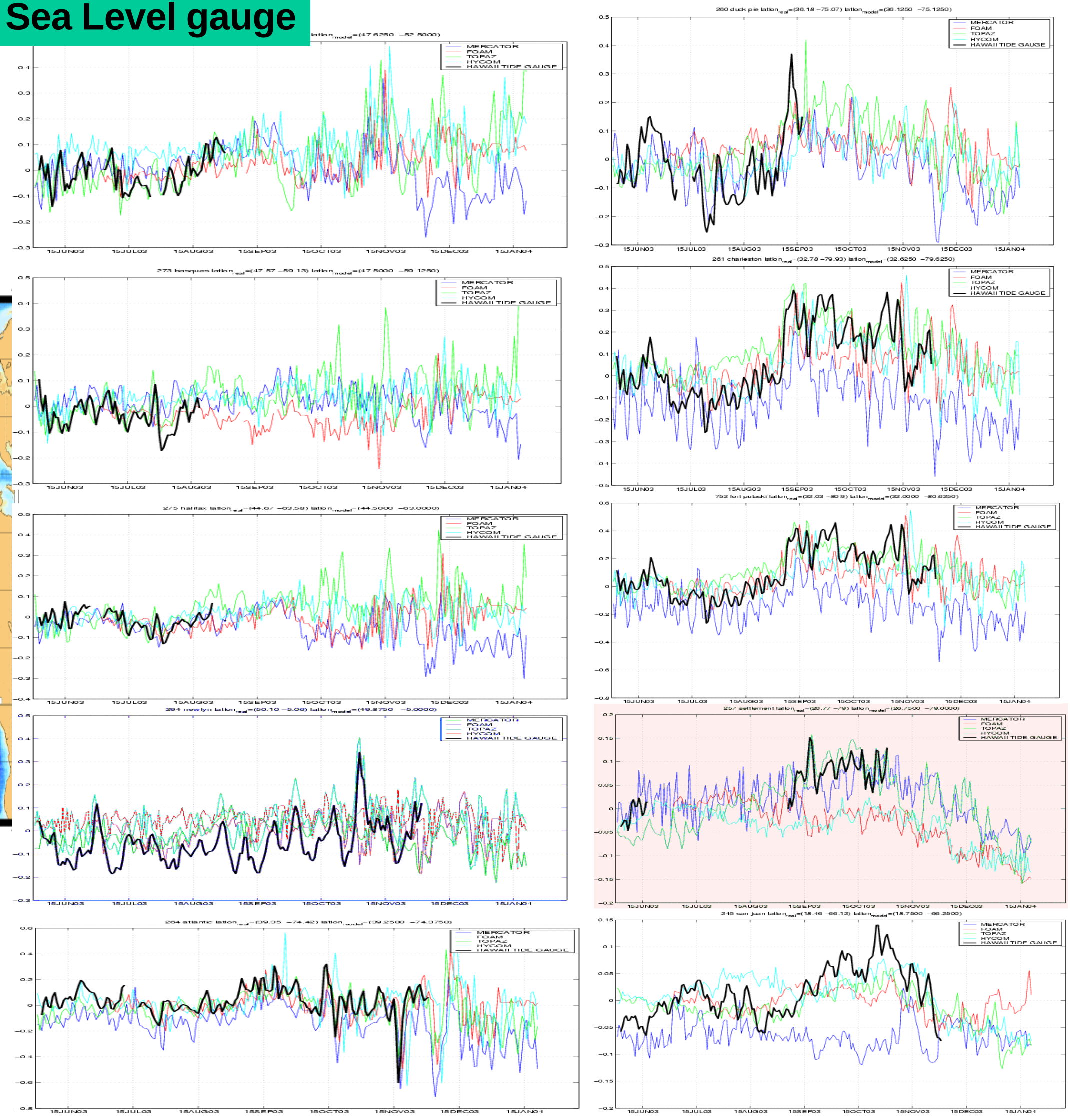




SLA Comparison with Sea Level gauge

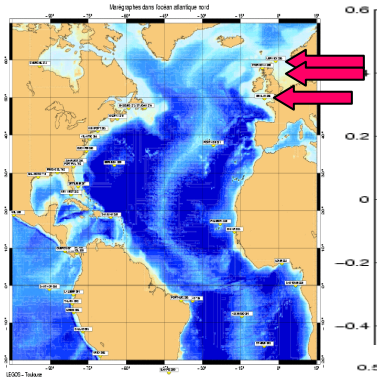
MERCATOR
FOAM
TOPAZ
HYCOM
TIDE GAUGE

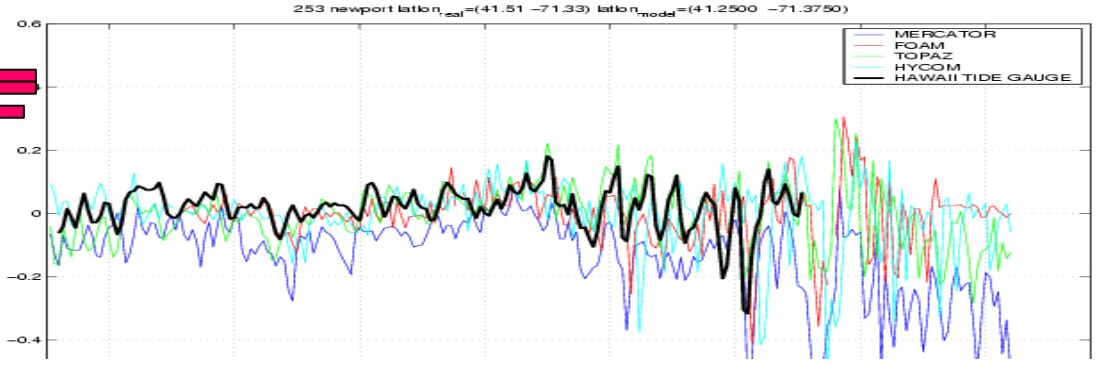




StJohn	Duckpie
Basques	Charleston
Halifax	FortPulaski
Newport	Settlement
Atlantic	SanJuan

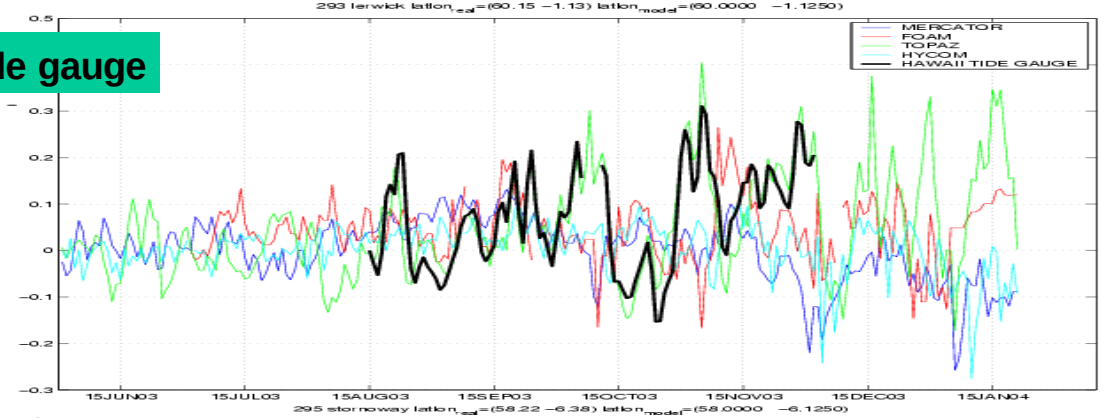
NO SLA ASSIMILATION IN COASTAL ZONES

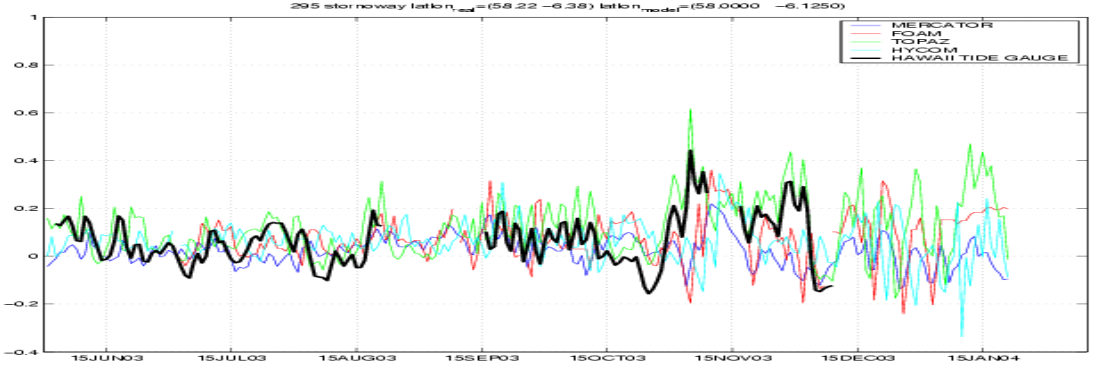




Comparison with tide gauge

Newlyn
Lerwick
Stornoway

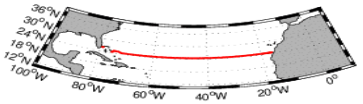




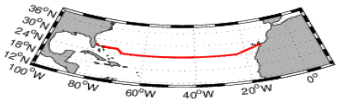
MERCATOR
FOAM
TOPAZ
HYCOM
TIDE GAUGE

Zonal Section 26°N Salinity

WOCE A05 JUL AUG 1992

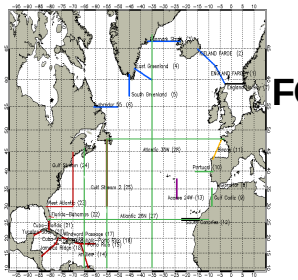


WOCE A01 JAN FEB 1998



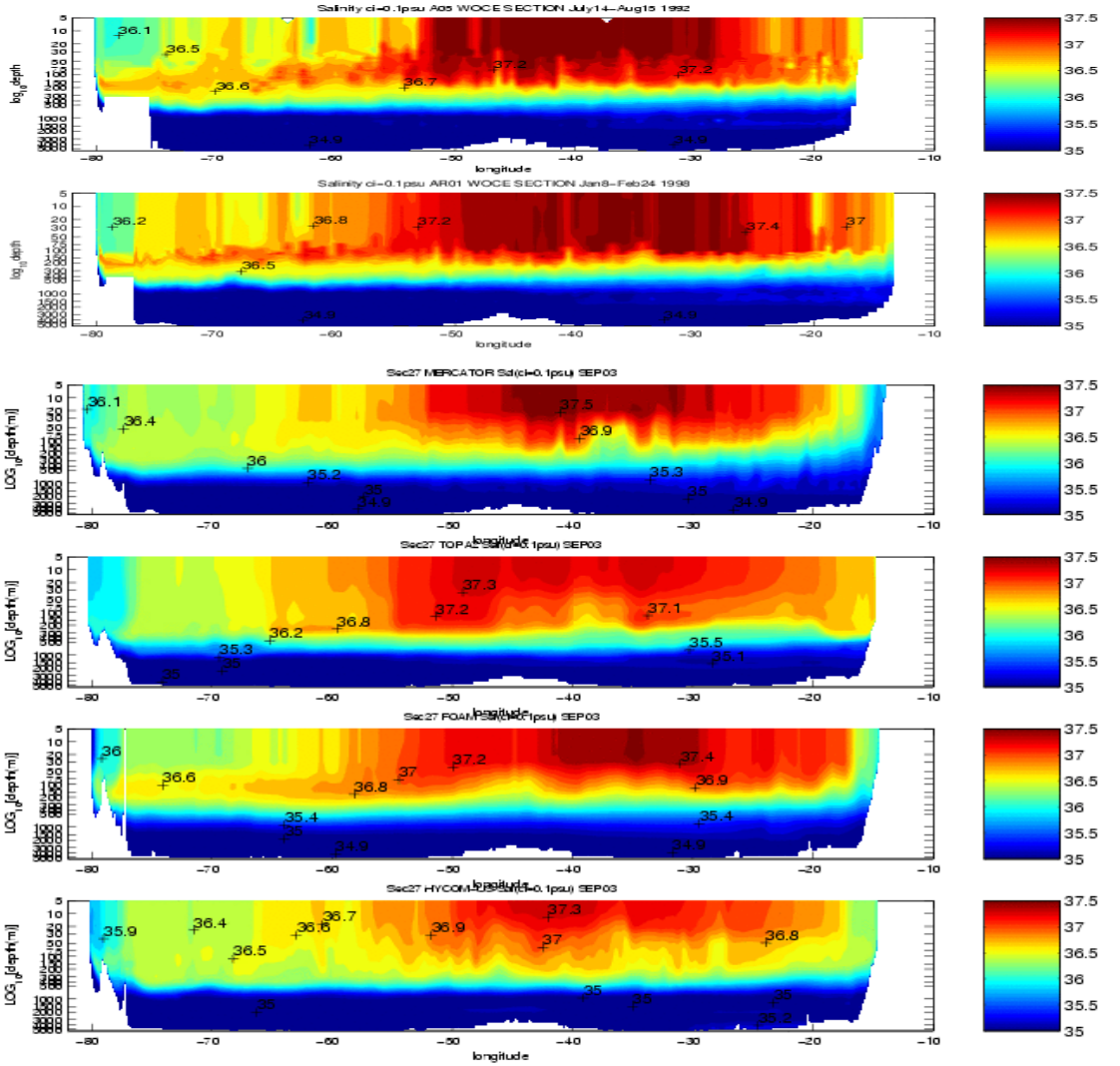
MERCATOR

TOPAZ



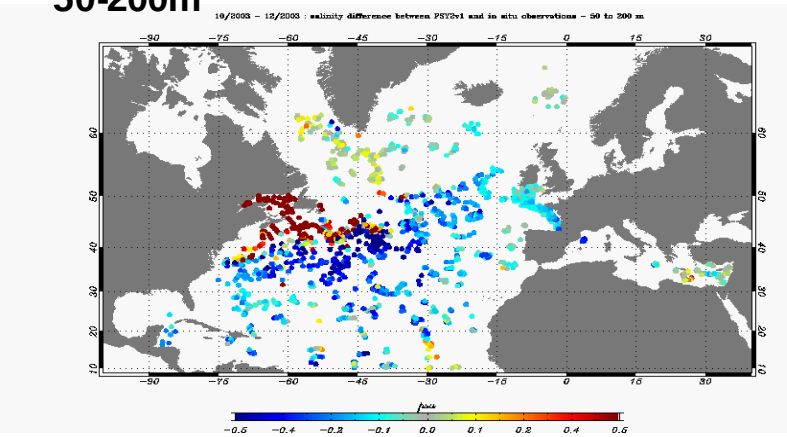
FOAM

HYCOM

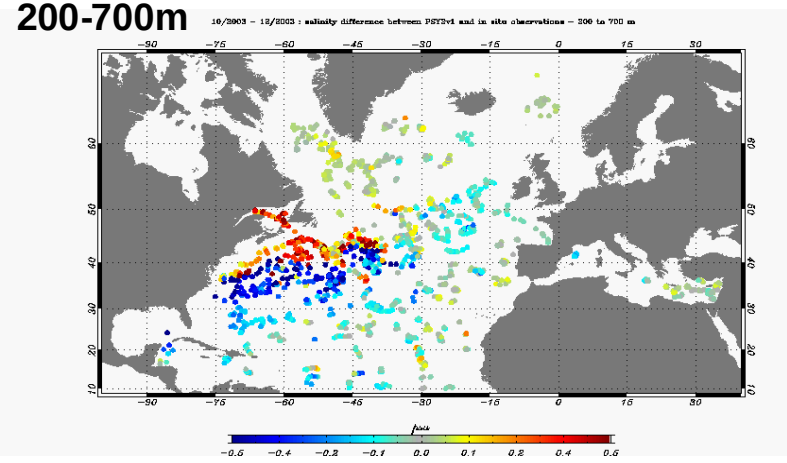


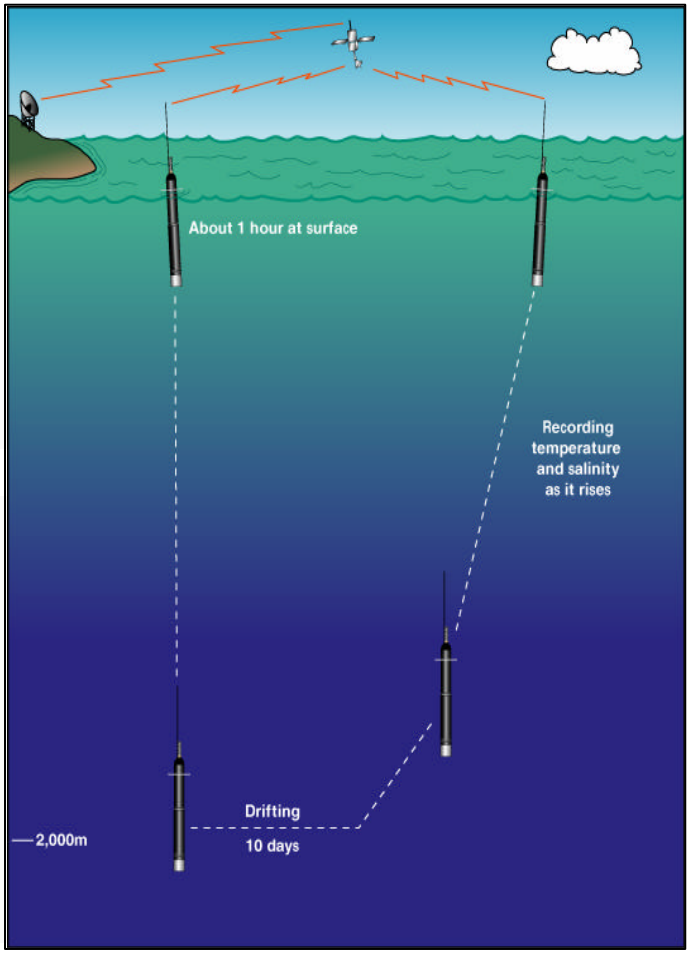
In situ Argo salinity profile available from 10-2003 to 12-2003

50-200m



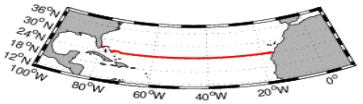
200-700m



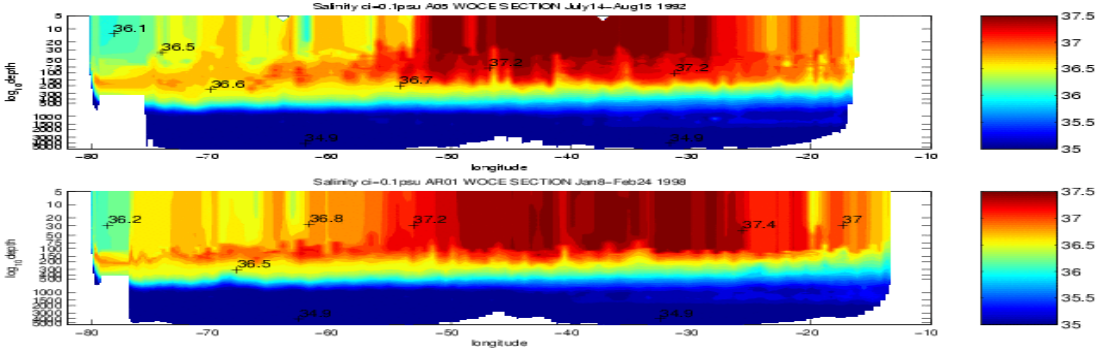


IMPACT OF ASSIMILATION OF ARGO SALINITY PROFILE

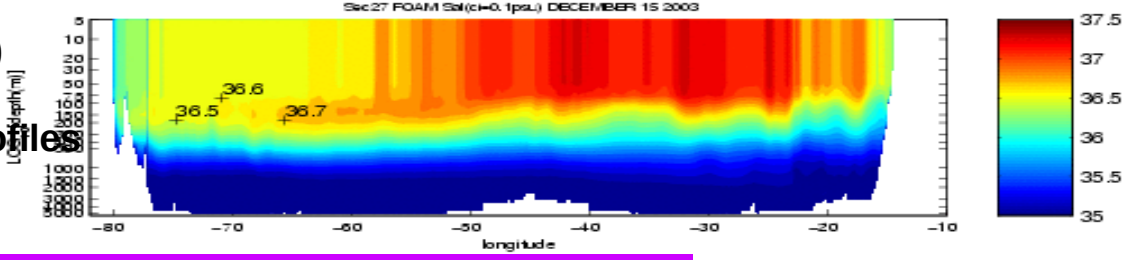
WOCE



Class2 Zonal Section 26°N Salinity

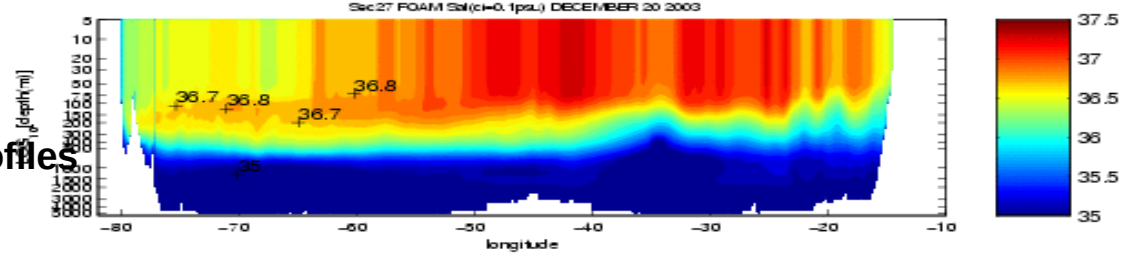


FOAM (DEC15 2003)
Before assimilation
of ARGO salinity profiles

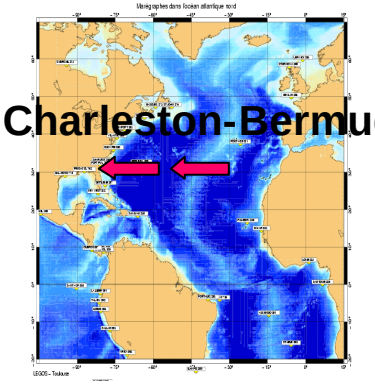


assimilation of ARGO salinity profiles from DEC17 2003 on

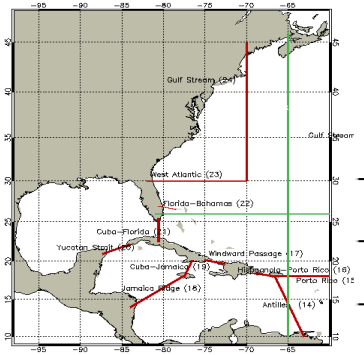
FOAM (DEC20 2003)
After assimilation
of ARGO salinity profiles

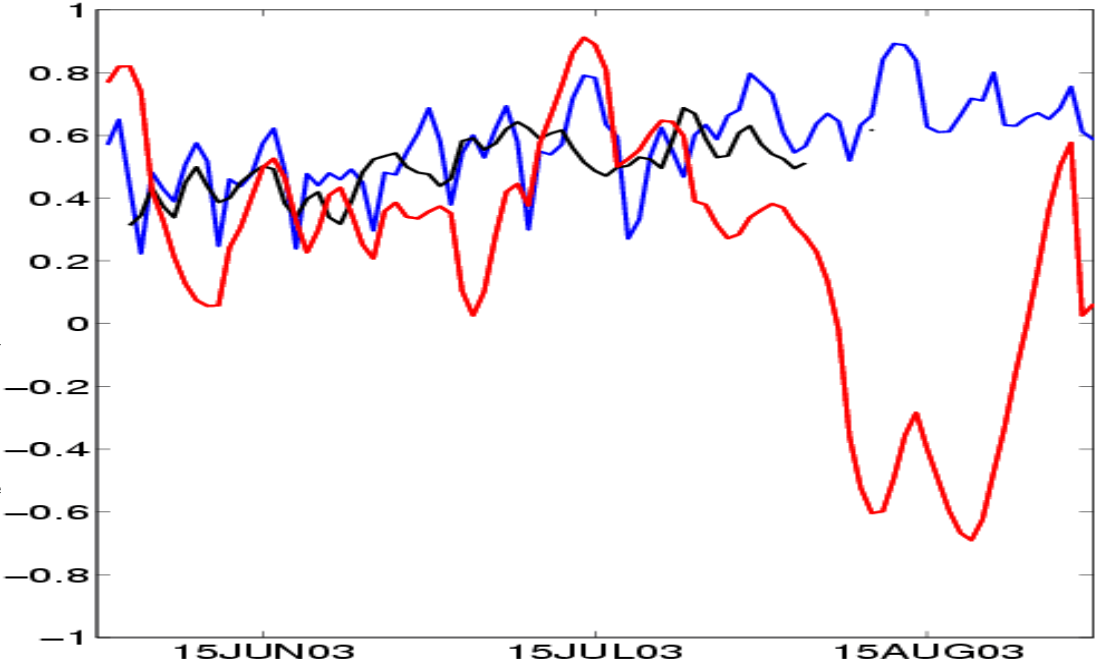


Charleston-Bermud



CLASS 1 AND CLASS 3
Monitoring of Gulf stream transport?





MERCATOR SLA (Bermuda-Charleston) (in meters)

SEA LEVEL GAUGE (Bermuda-Charleston) (in meters)

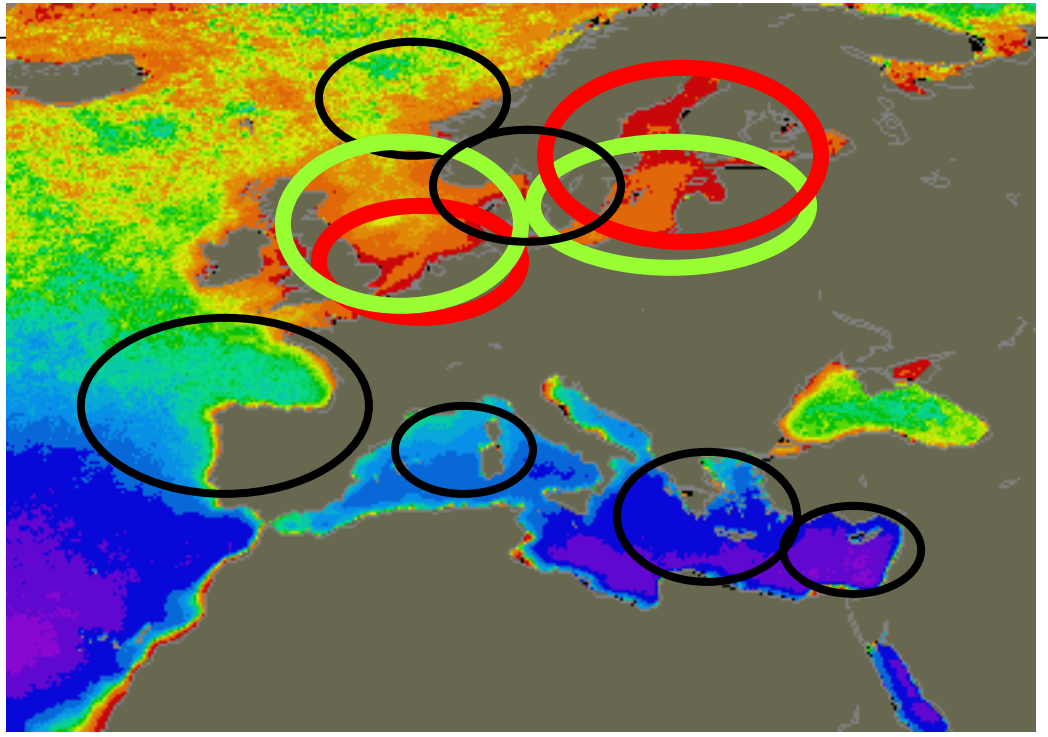
CLASS3 MERCATOR TRANSPORT through West Atlantic Section (Sverdrups/100)

Conclusion

MERSEA web site: www.mersea.eu.org

- 1st time such an inter-comparison exercise is conducted on 5 Ocean forecast systems.
- Metrics definition+OPENDAP+LAS technology = efficient inter-comparison strategy.
- Class1-2-3 ready. Working on Class4.
- Strength and weakness shown. Upgrades of each system to improve results.
- So far: Atlantic + Mediterranean basins. Soon Global ocean.
- Mersea IP - GODAE metrics for Pacific/Indian/Austral Oceans : same definiton used.

3 applications – 11 demonstration cases

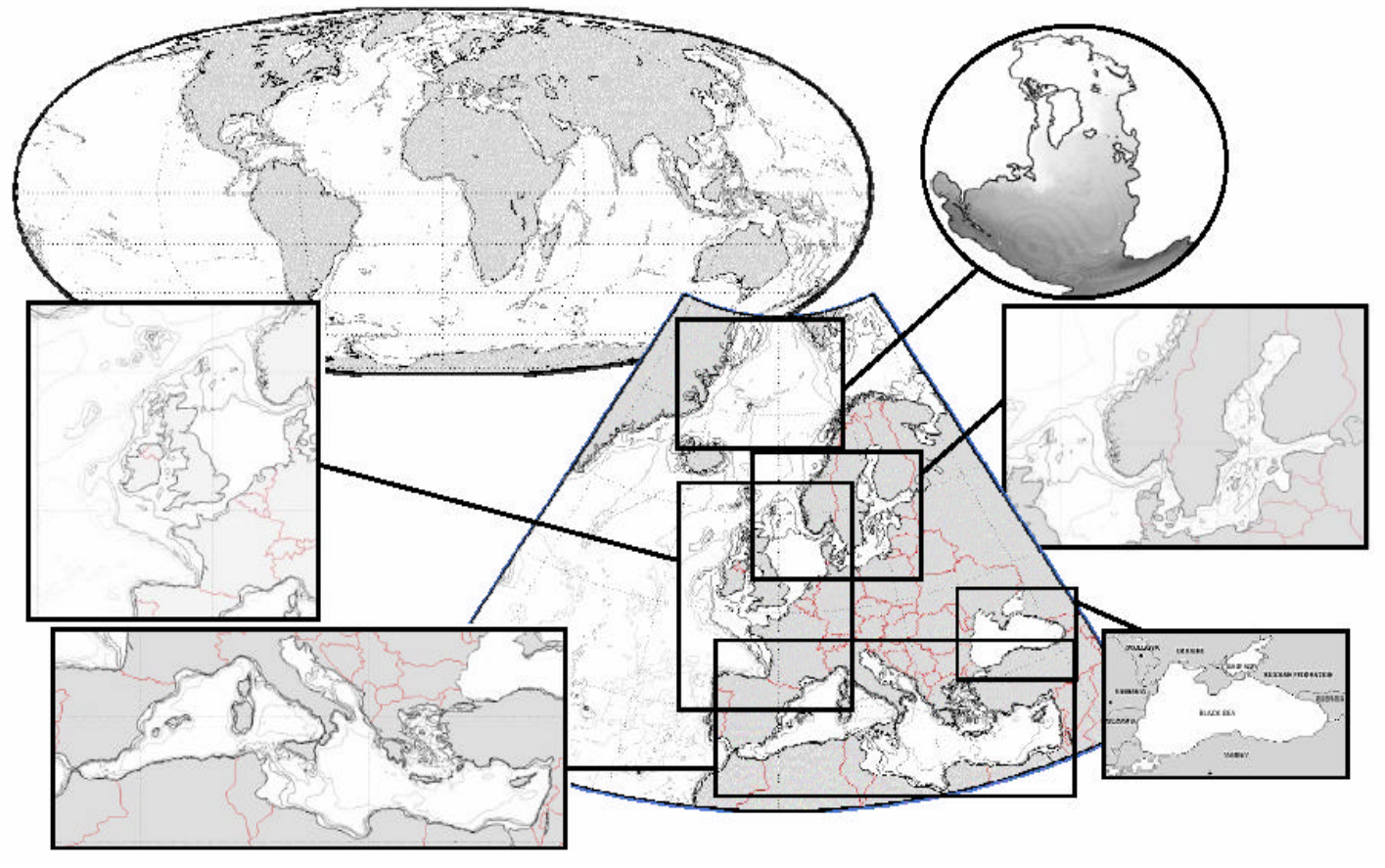


HAB

Eutrophi cation

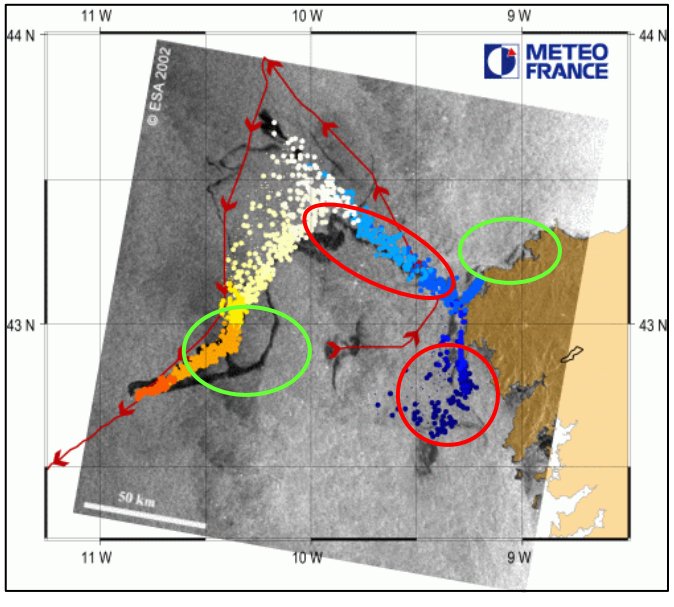
Oil Spills

FROM BASIN SCALE VIA REGIONAL TO LOCAL SCALE MODEL CAPACITY

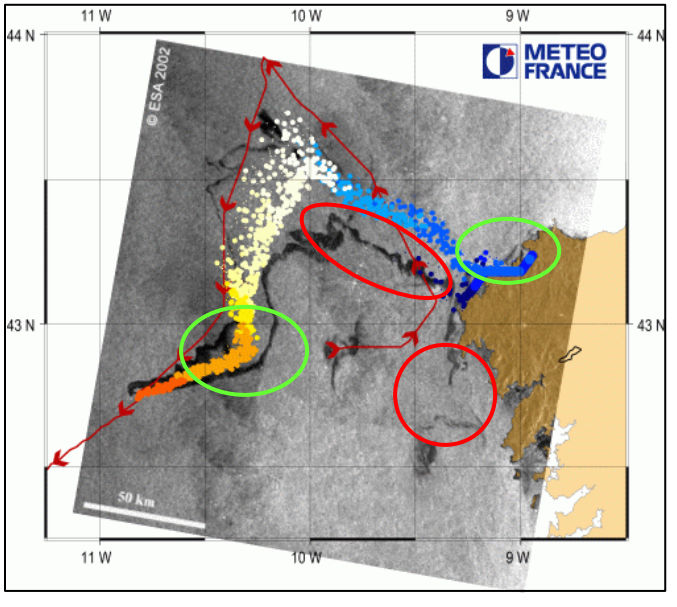


Short simulations : Validation on 17 november 17th, 11h utc

MOTHY operational version



MOTHY + Mercator 103m

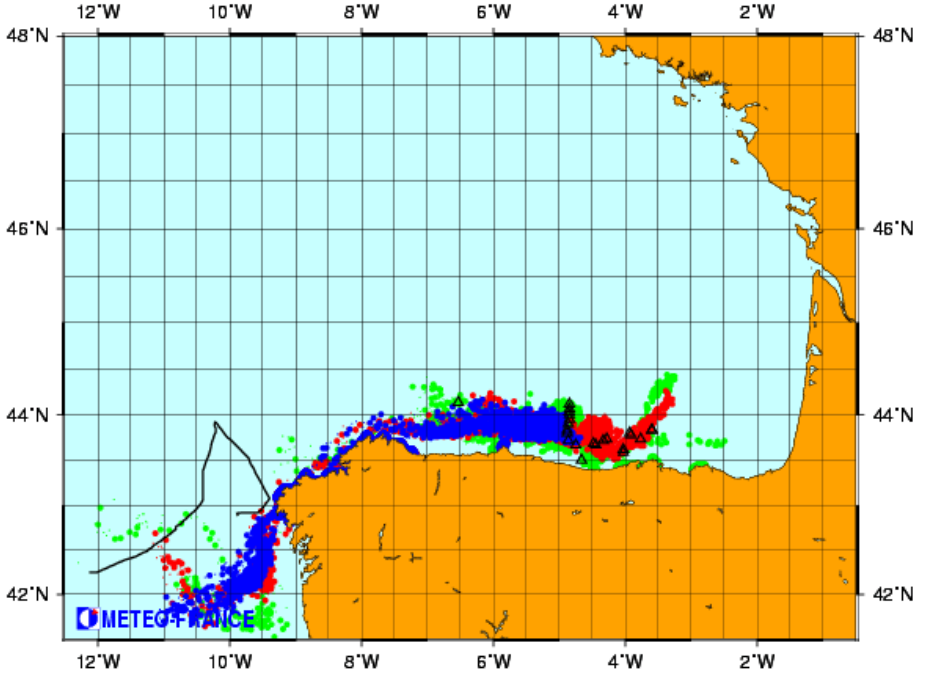


In green, areas where the use of Mercator currents in MOTHY seems to improve the forecast

In red, the operational version of MOTHY seems to be better.

Long simulations : Validation on December 13th

MOTHY/ARPEGE : Analyse pour le 13/12/2002 à 00 utc



MOTHY seul en bleu

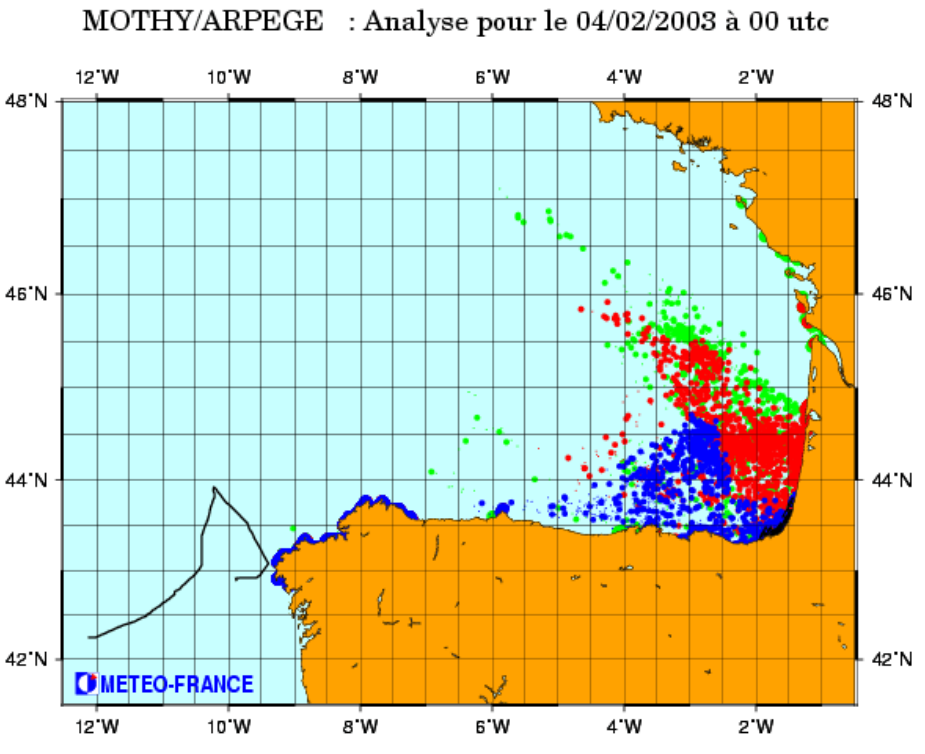
MOTHY+FOAM en rouge

MOTHY+MERCATOR en vert

Observations: triangles noirs

MOTHY is a little bit late. The addition of the Mercator current at 103m seems to improve the Forecast as well as the FOAM current at 96m.

Long simulations : Validation on February 4th



MOTHY seul en bleu

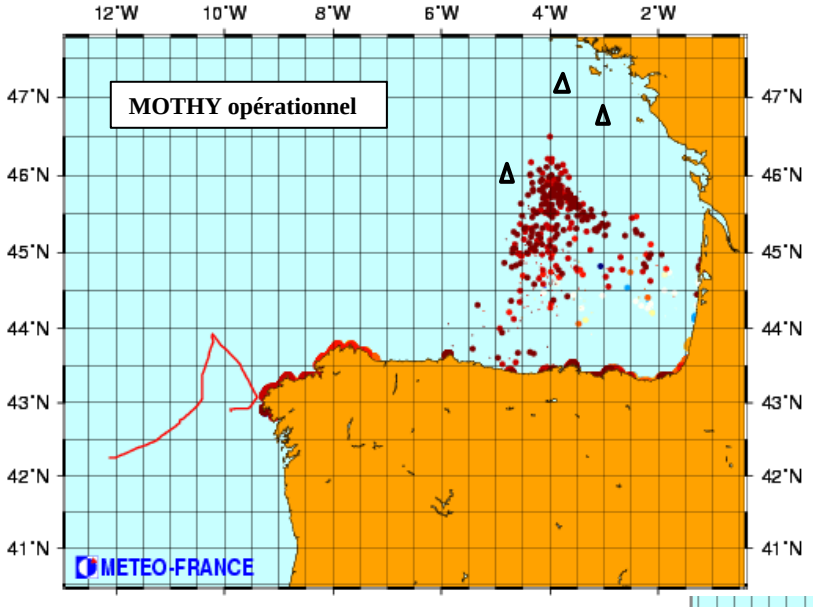
MOTHY+FOAM en rouge

MOTHY+MERCATOR en vert

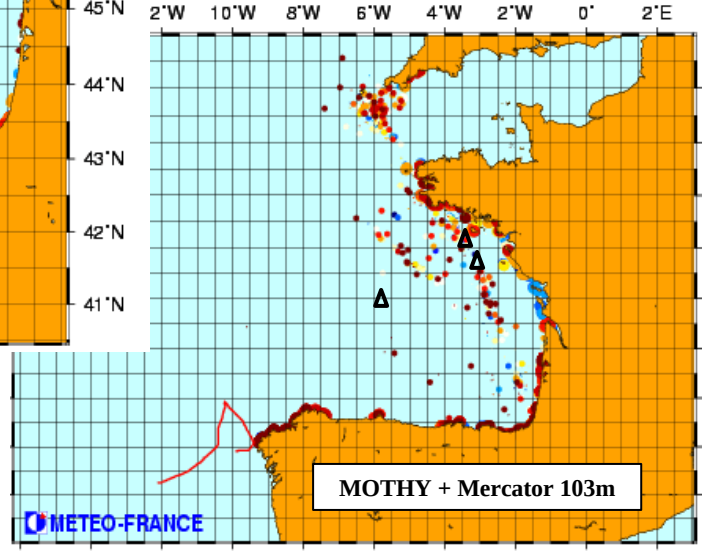
Observations: triangles noirs

MOTHY correctly simulates the beaching of the oil released on November 19th as well as MOTHY+Mercator and MOTHY+FOAM. Beaching were observed from 43°20'N to 44°30'N.

Long simulations : Validation on March 18th



Δ = observations

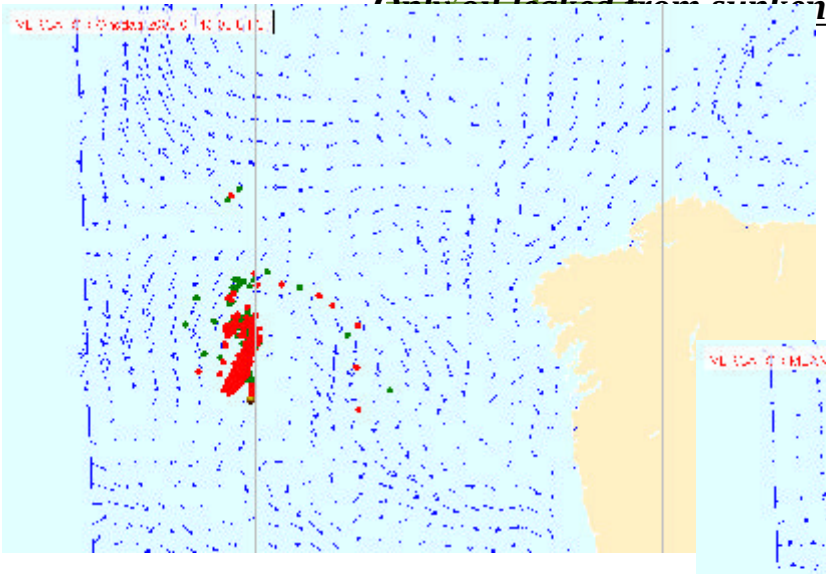


MOTHY is still a little late. The two observations close to the coast are correctly simulated by MOTHY+Mercator. However, the Prestige pollution did not reach the Ushant before the first days of May. MOTHY+Mercator is therefore in advance after 4 months of simulation.

NPrestigeÓ oil spill model state 15.01.03 00 utc

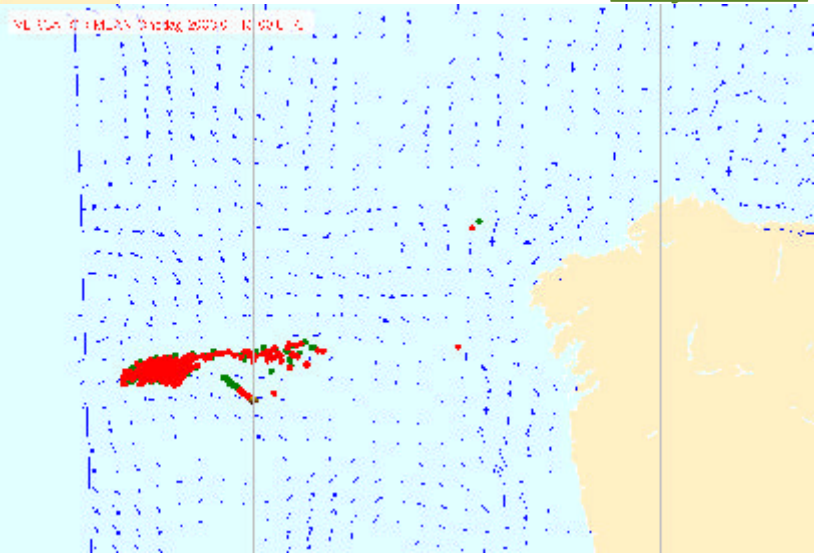
Ocean data: **Mercator daily snapshots**

Oil spill model from sunken wreck



- surface
- subsurface
_ stranded

Ocean data: **Mercator daily means**

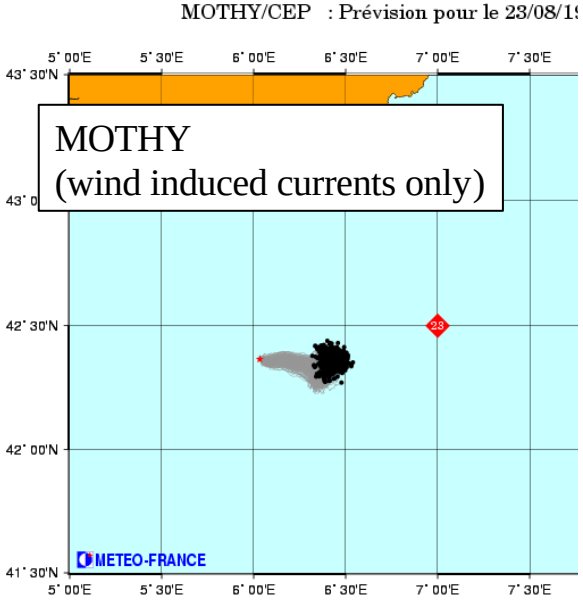


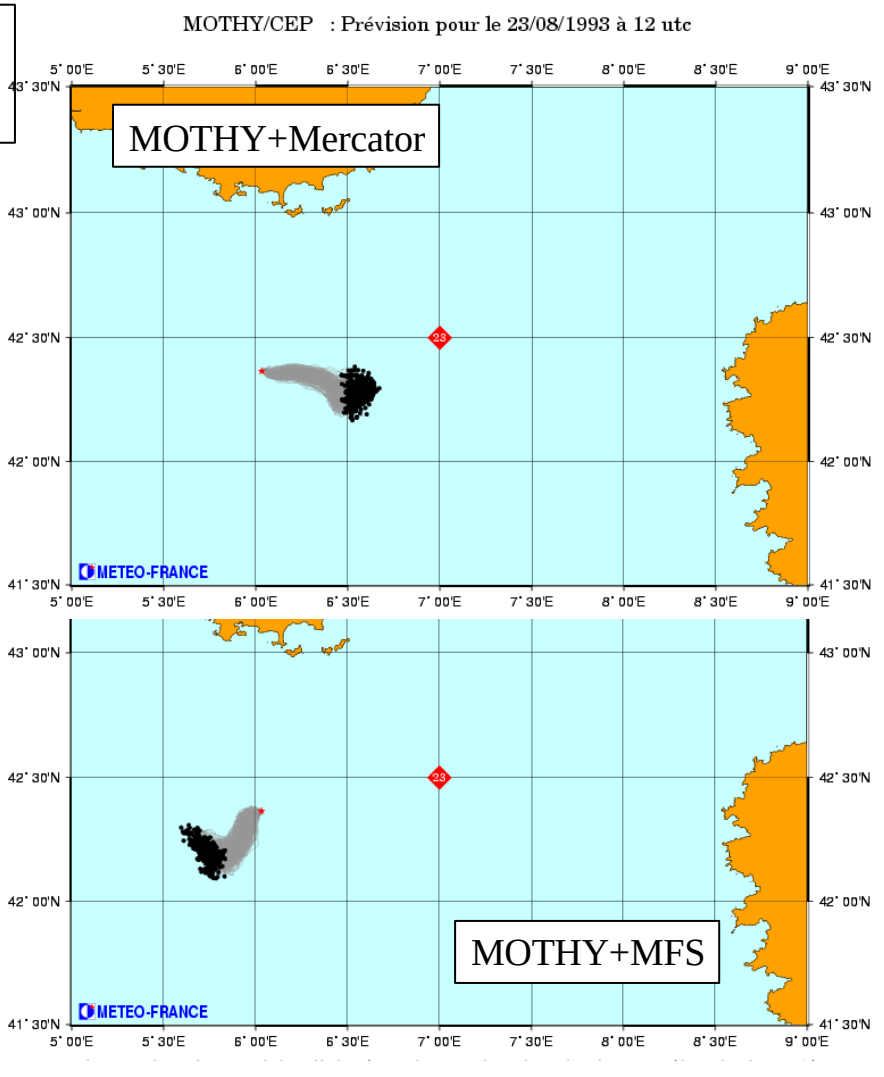
Oil spill model: met.no OD3D

Atmos. data: ECMWF

Wave data: met.no WAM

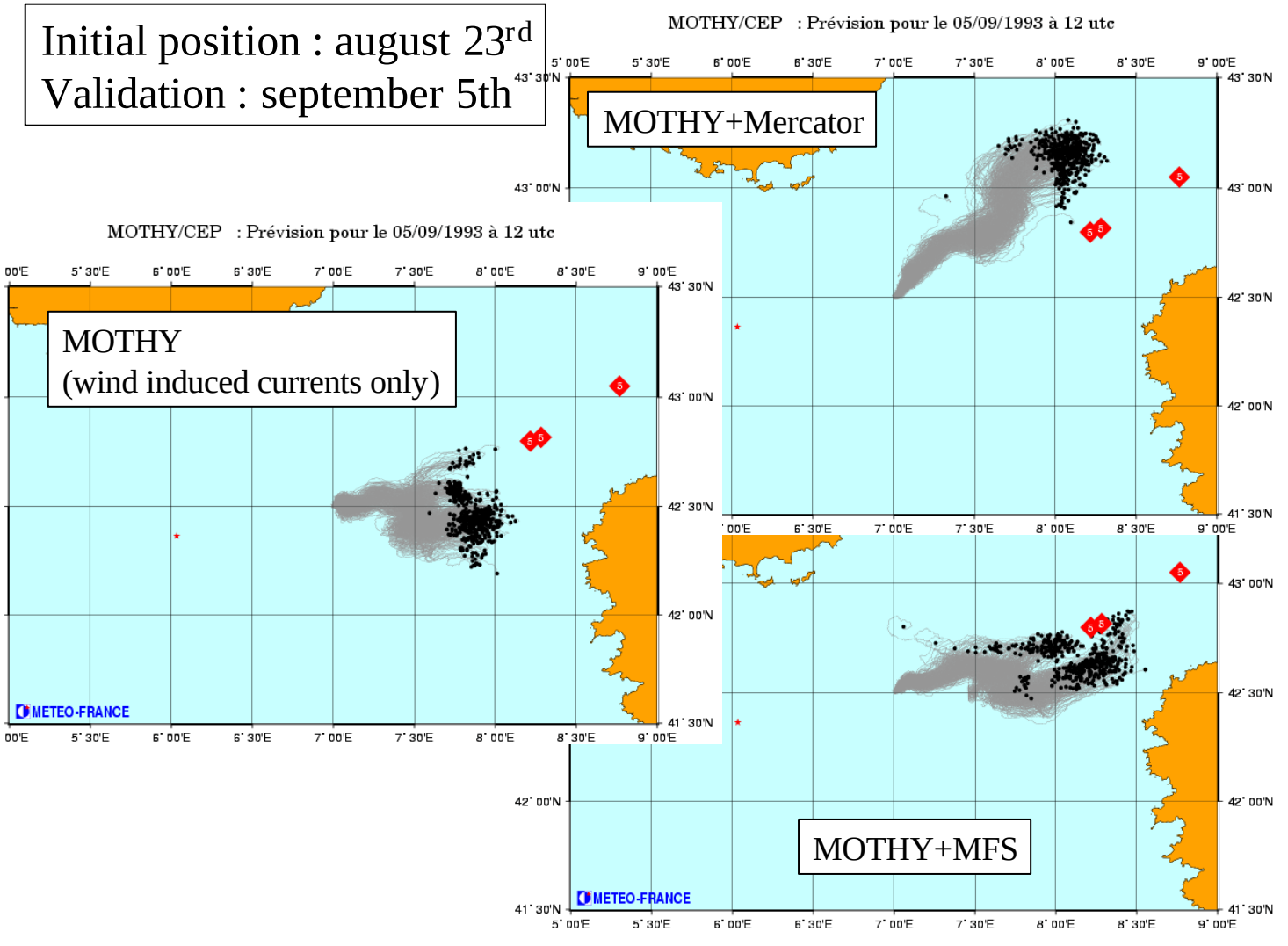
Initial position : august 17th
Validation : august 23rd



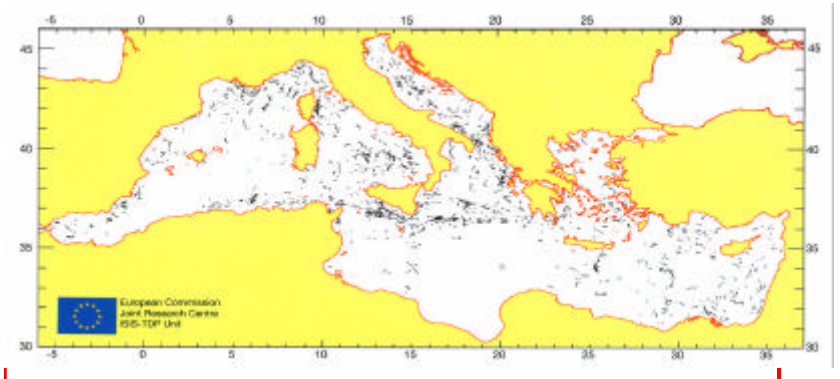


MOTHY+Mercator : slight improvement
MOTHY+MFS : degradation

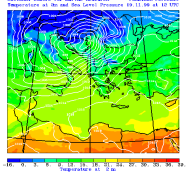
Initial position : august 23rd
Validation : september 5th

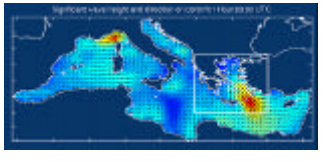


Integrated Monitoring and Forecasting Systems

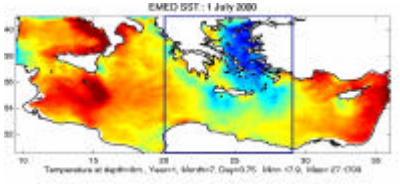


Weather and Waves forecasts



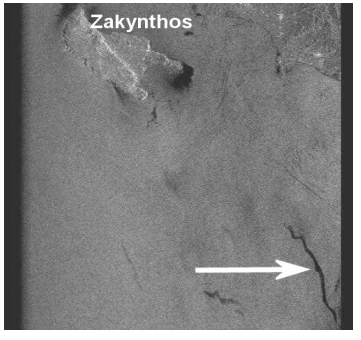


Circulation Forecasts

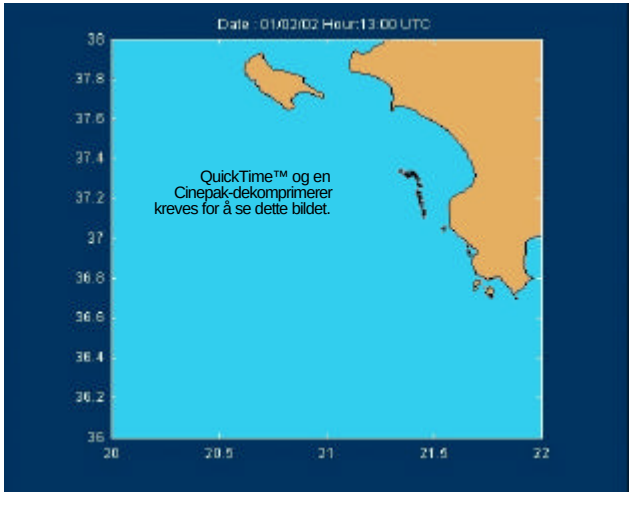


Oil drift Forecasts

Oil slick detected in the Ionian Sea

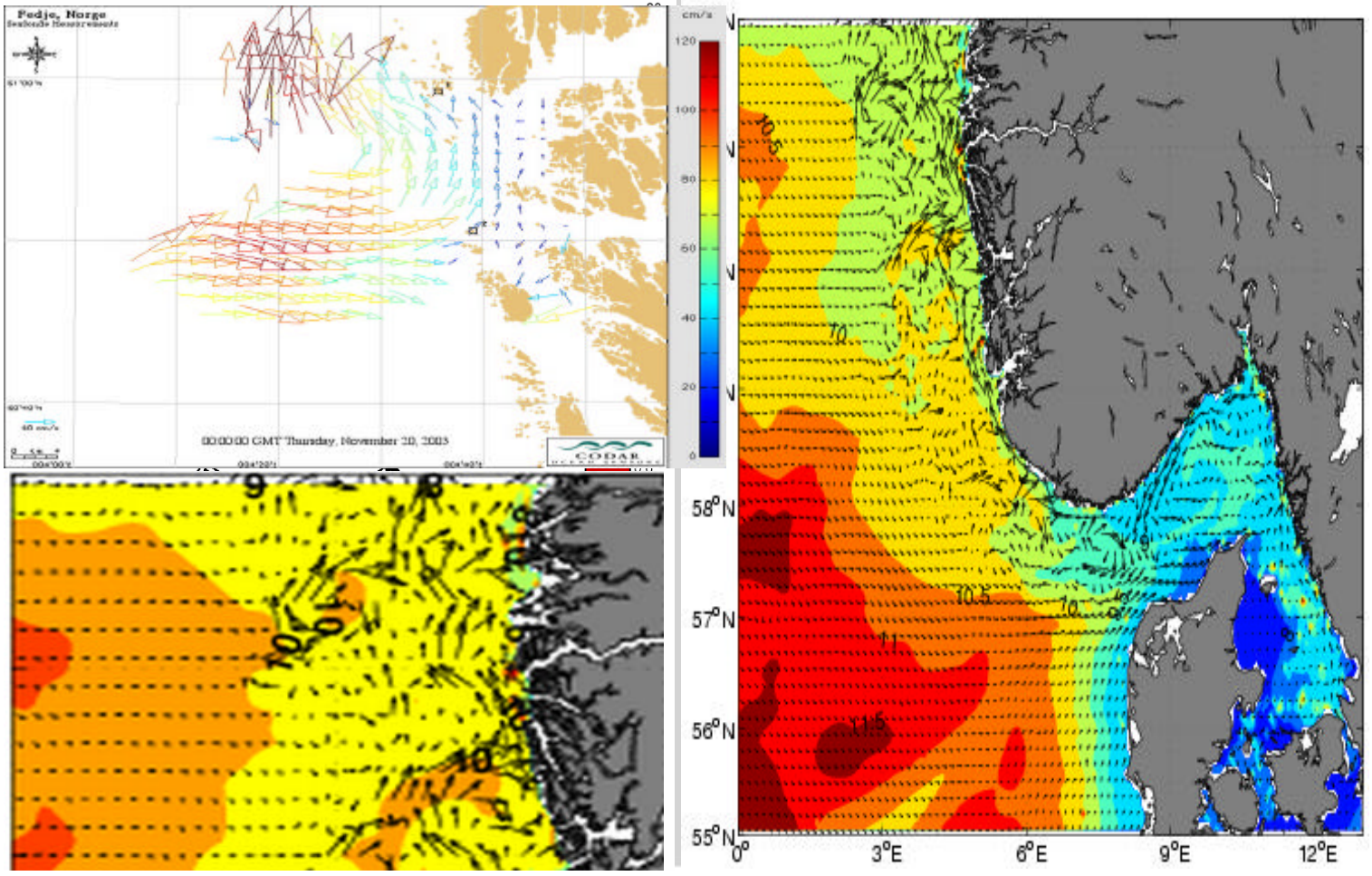


10 days forecast of oil drift

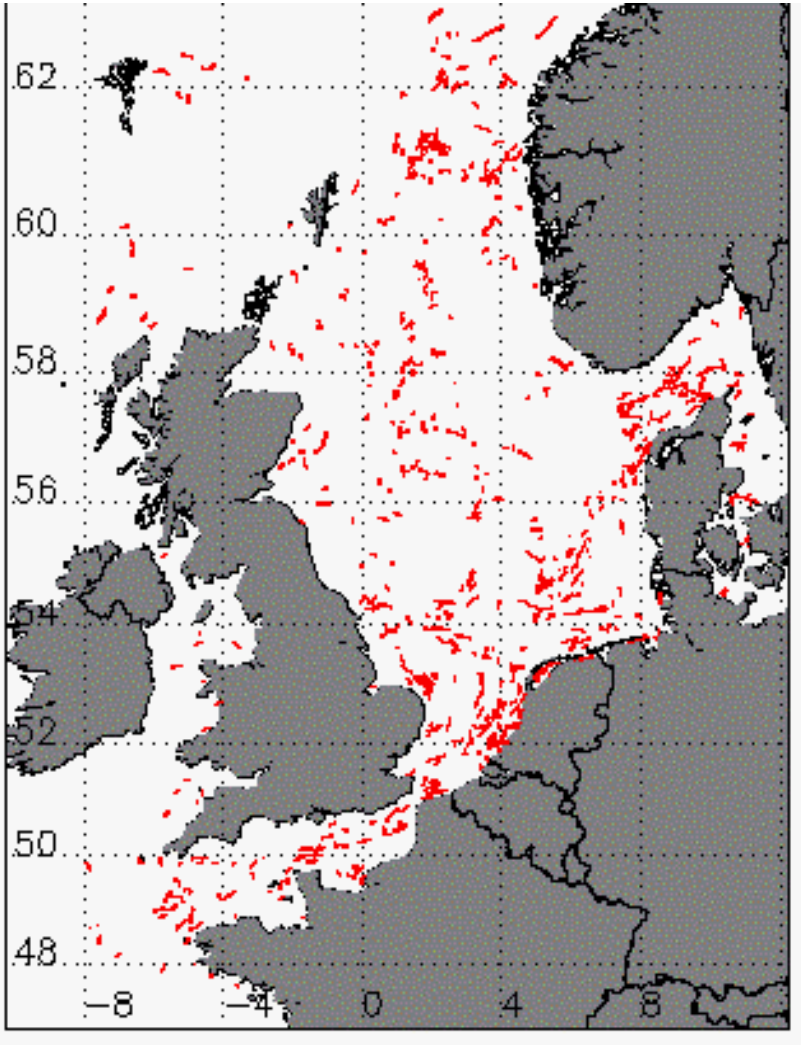


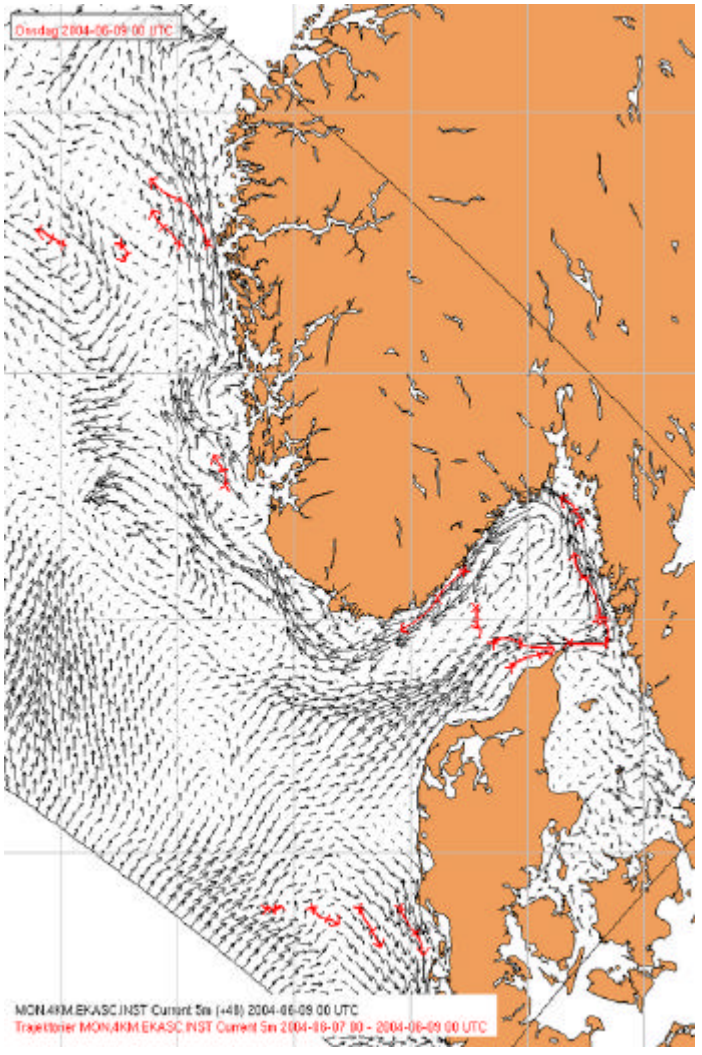
RESULTS: SST-CURRENT MONITORING WITH DOWNSCALING: North Sea Case

http://moncoze.met.no/

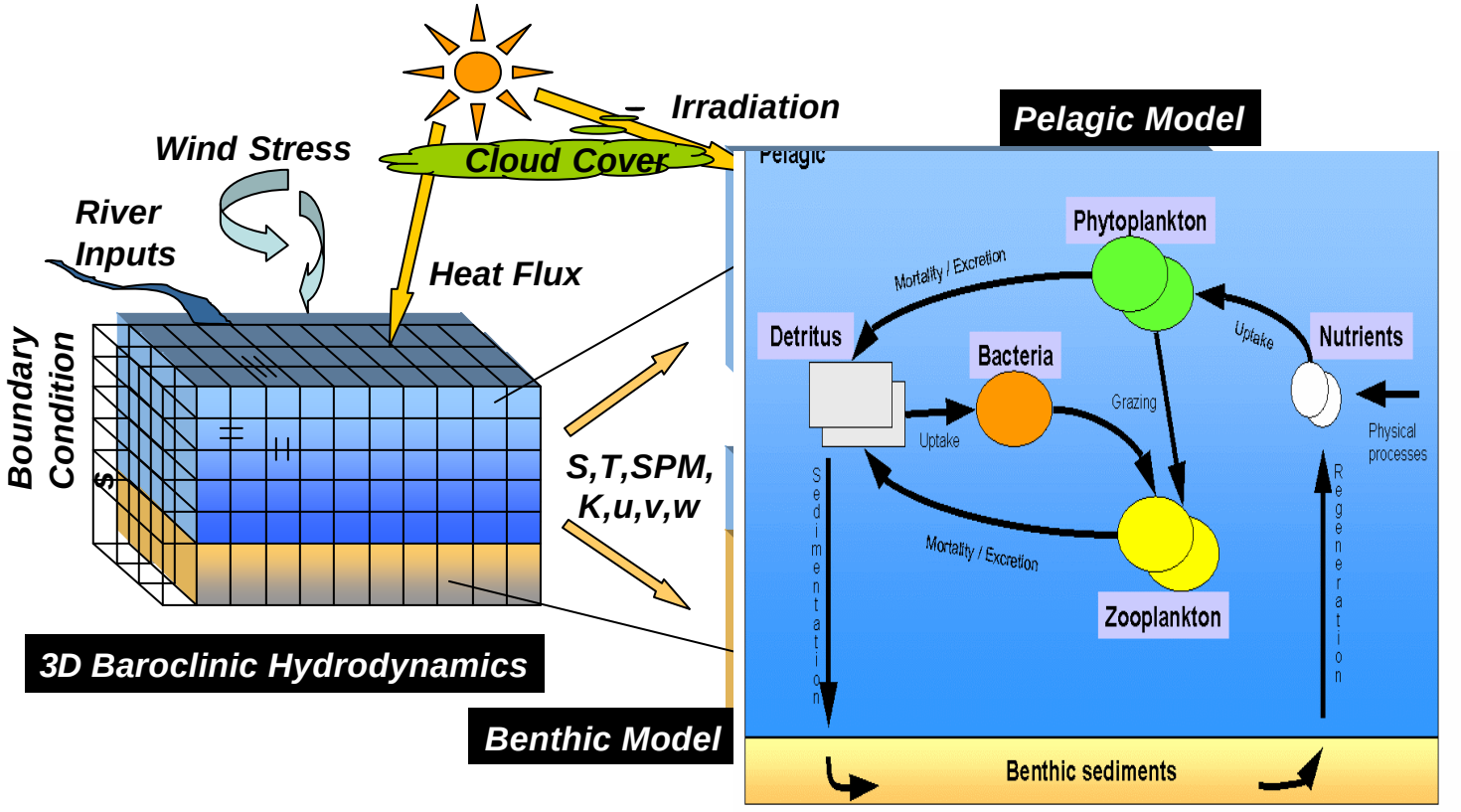


OIL SPILL MONITORING BY SATELLITE SAR FOR THE NORTH SEA + SKAGERRAK

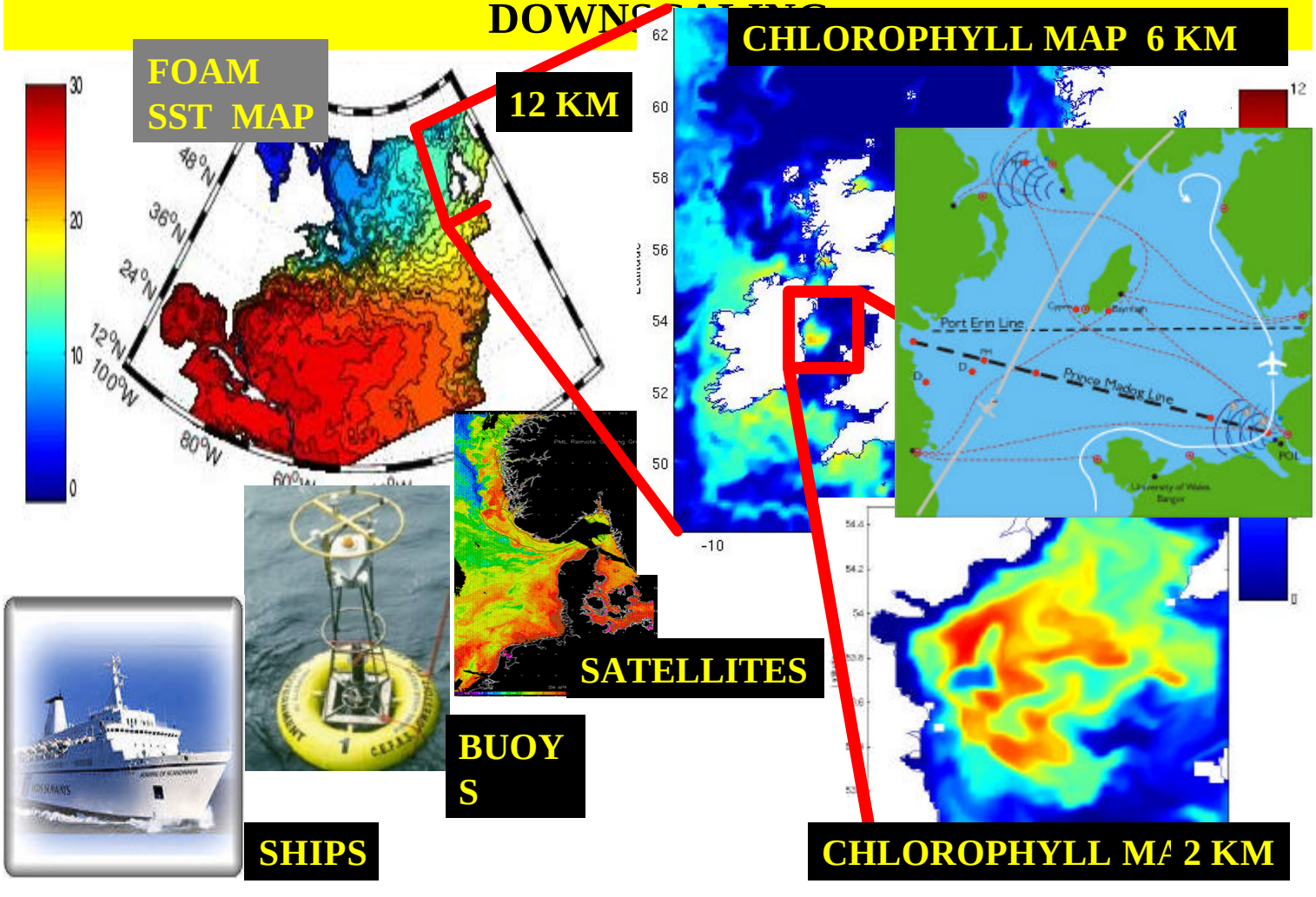




Coupled Physics-Ecosystem Model



RESULTS: ALGAE BLOOM MONITORING WITH DOWNSCALING



LESSONS LEARNED

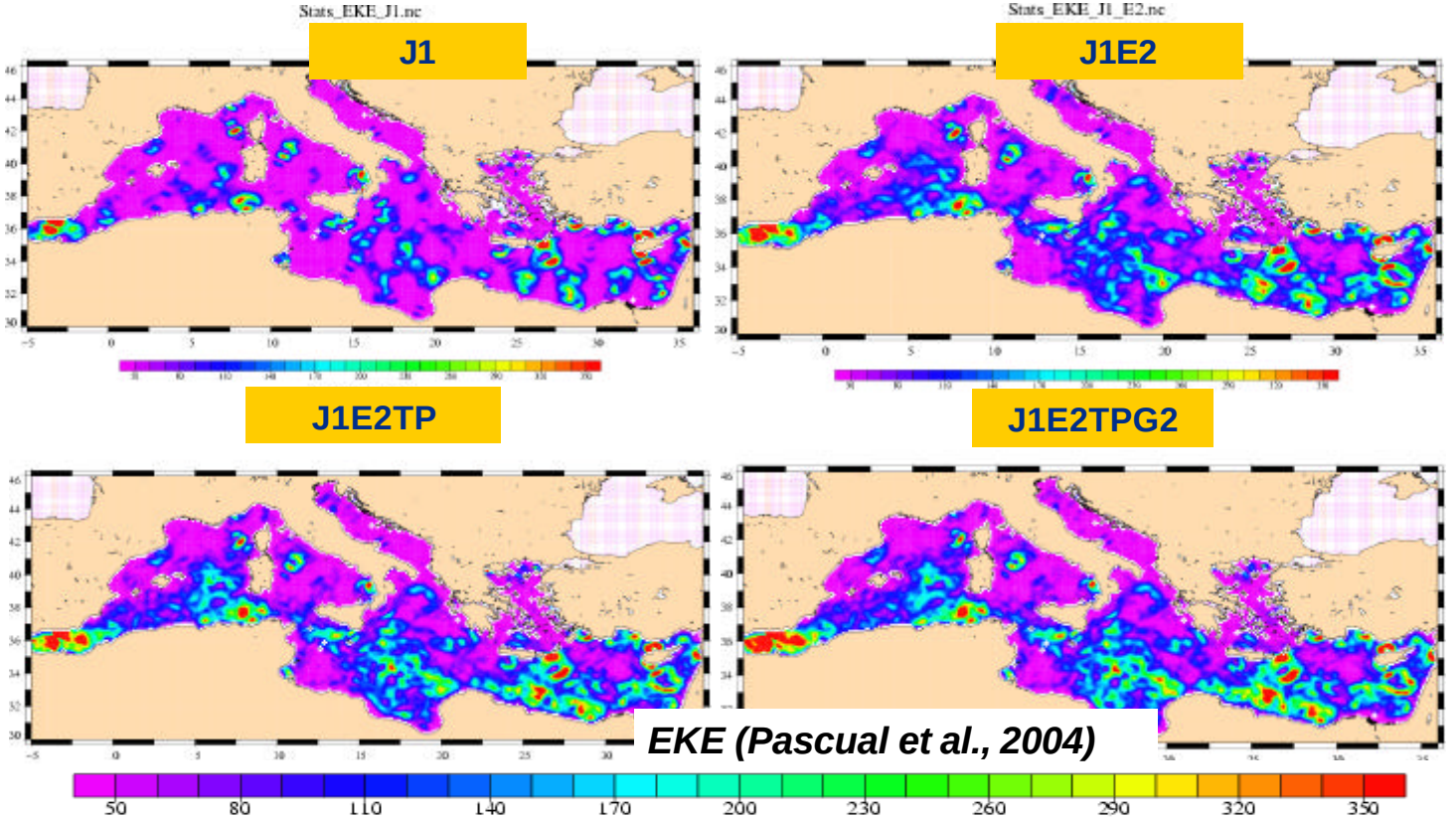
Altimeers. Ok to 2007. Then a mesoscale altimeter mission is at least needed to complement Jason-2 and to constrain the mesoscale variability and open ocean currents.

Infrared radiometers. Ok to 2007. Then high quality and high resolution SST measurements from combined use of passive microwave and infrared radiometers are needed.

Spectrometers. Ok to 2007. Then high-resolution measurements of chlorophyll served in near-real time are needed for validation or assimilation into marine biogeochemical models.

SAR. Ok to 2007. Then new SAR missions are highly needed as a source of information for detection of oil spills both from illicit vessel discharges and major accidents.

SATELLITE DATA


Stats_EKE_J1.nc
J1
Stats_EKE_J1_E2.nc
J1E2
J1E2TP
J1E2TPG2
EKE (Pascual et al., 2004)
50
80
110
140
170
200
230
260
290
320
350

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IN SITU DATA

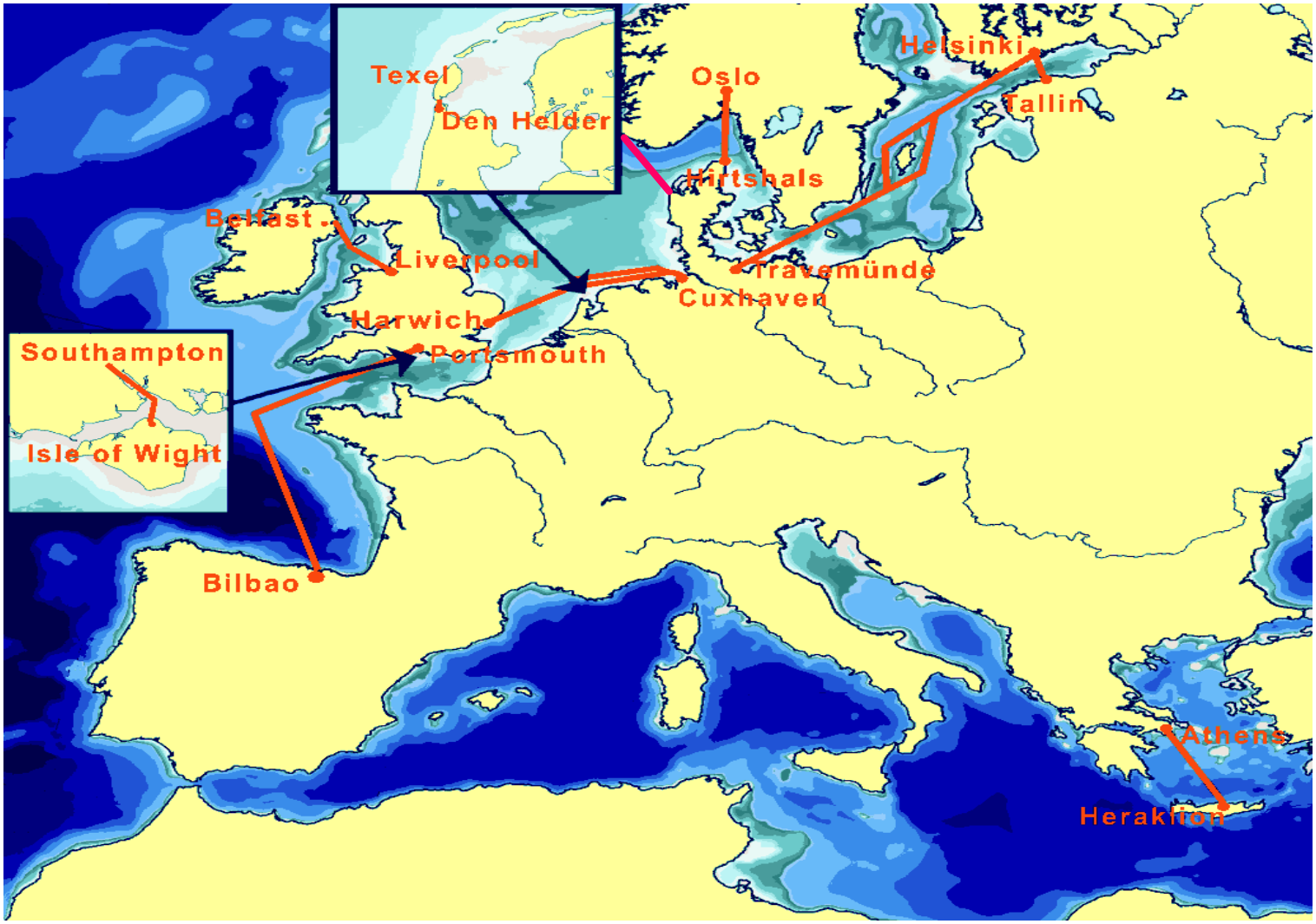
VOS, Ferry-boxes and data transmission: Data from VOS and ferry boxes along European coastal and shelf seas should significantly increase, and adapt to rapid data transfer.

Observatories: Integrated observatories including HF radars at selected "tie-points" along European coastal and regional seas are needed for routine and sustained in-situ monitoring.

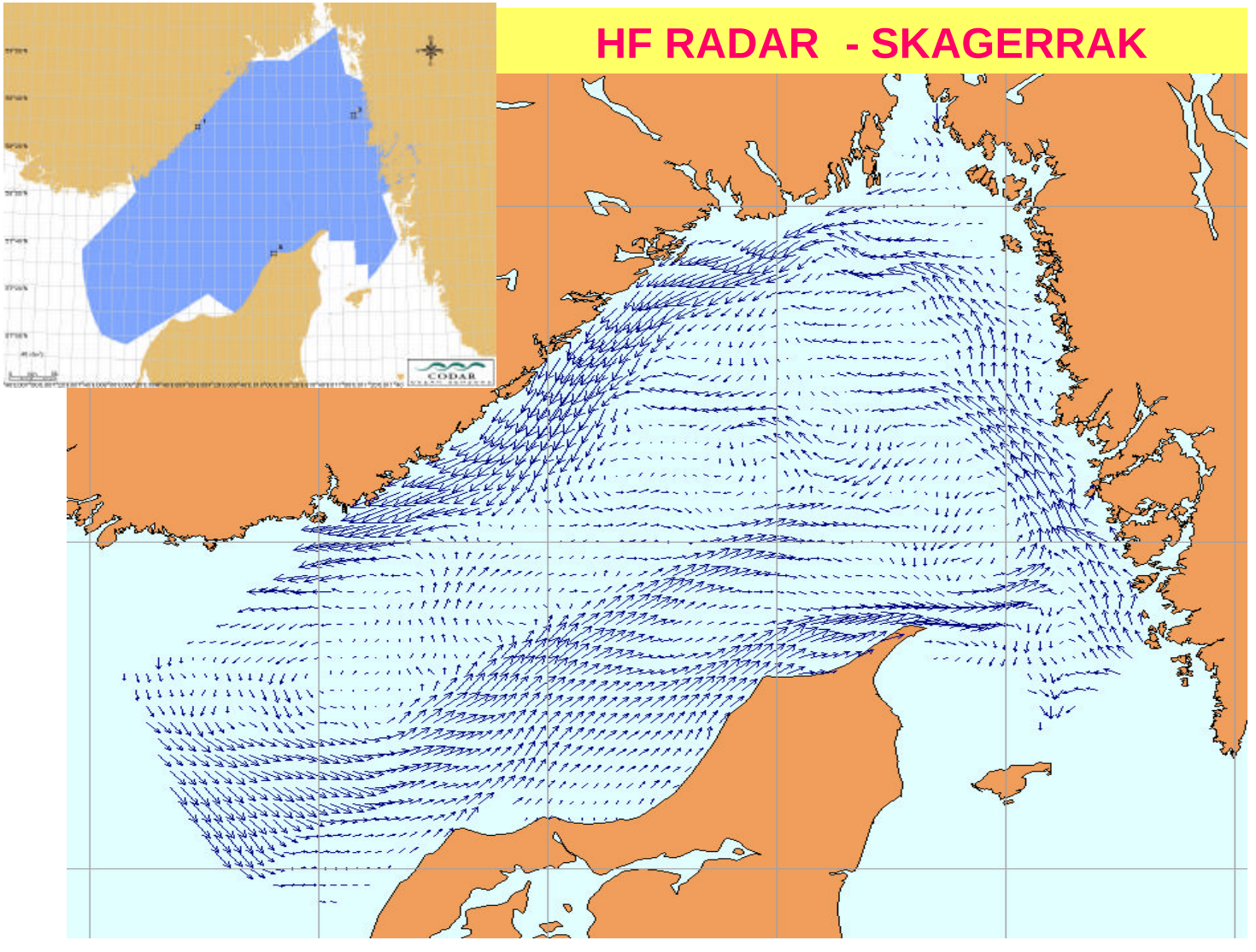
Biogeochemical sensor development: There is a developing need to be able to measure pigments, nutrients, dissolved gases and other biogeochemical properties in the sea.

River discharges: There is an urgent requirement for a routine monitoring system of river discharges (volume and nutrients) into coastal seas.

Overview on the Ferry Lines and FerryBoxes in the European FerryBox Project



HF RADAR - SKAGERRAK



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MODELS

Marine GMES: The ocean monitoring and modelling system will not be adequate for several major applications without a high-inclination altimeter to complement Jason-2 beyond 2007.

Downscaling: The regional high resolution forecasting systems improves with systematic and reliable information on the open boundaries from global and basin scale systems.

Coastal Models: Coastal models are far from being developed and operated at the adequate resolution for applications to pollution monitoring from land sources.

Ecosystem modelling: There is a strong need to develop and advance the maturity of ecosystem modelling.

Need for improvement (cont.)

Model resolution; enhanced resolution in the vertical and horizontal to obtain reliable simulations - global model at 10 km combined with nesting;