# Oil spill drift forecast and operational oceanography systems: how to progress in one of the dimensions of the problem

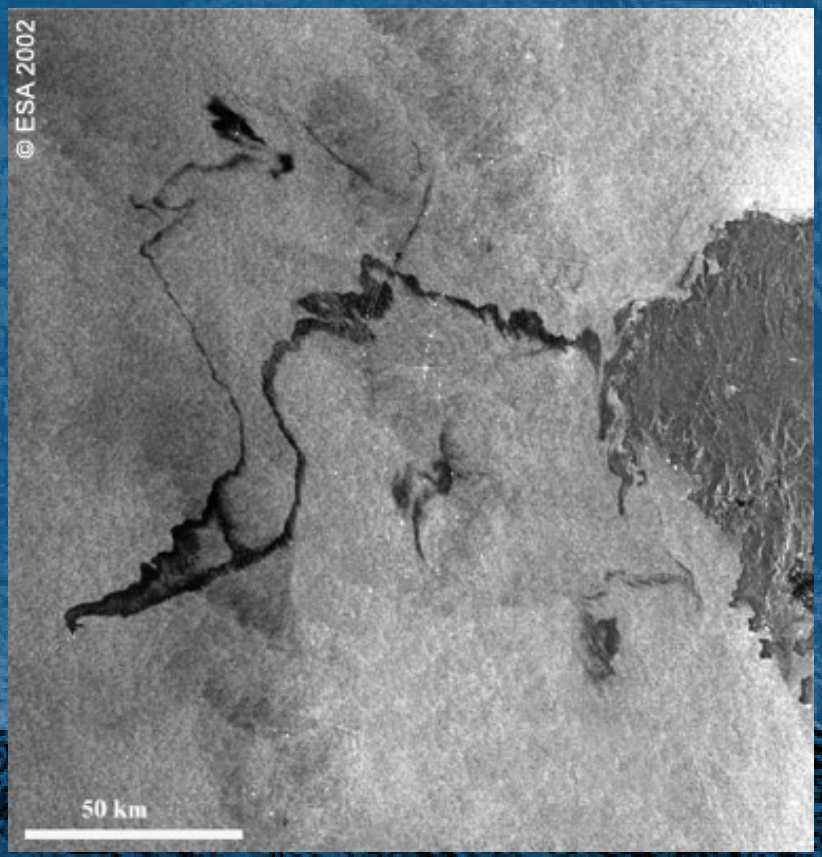
Pierre Daniel
*Météo-France*

Mersea Second Annual Meeting
Toulouse, March 28-31, 2005

METEO FRANCE

# What is (are) the pb?

- You don’t know the source(s)
- You don’t know what is (are) the product(s)
- The products are evolving (weathering) and therefore their behaviour




METEO FRANCE

# What is (are) the pb?

- You don’t know the source(s)
- You don’t know what is (are) the product(s)
- The products are evolving (weathering) and therefore their behaviour
- Observations are sparse and difficult (spurious effects… diurnal effect…) but are the truth by definition
- The weather is often bad (winter, accidents, strong sea state, poor visibility…)

METEO FRANCE

# What is (are) the pb?

- You don’t know the source(s)
- You don’t know what is (are) the product(s)
- The products are evolving (weathering) and therefore their behaviour
- Observations are sparse and difficult (spurious effects… diurnal effect…) but are the truth by definition
- The weather is often bad (winter, accidents, strong sea state, poor visibility…)
- You forecast BEFORE the reality. This is one of the major difficulty with forecasting. It’s easier AFTER.

METEO FRANCE

# Oil spill drift forecast , Météo-France & MERSEA

- Our duties
- Our tools
- Our needs

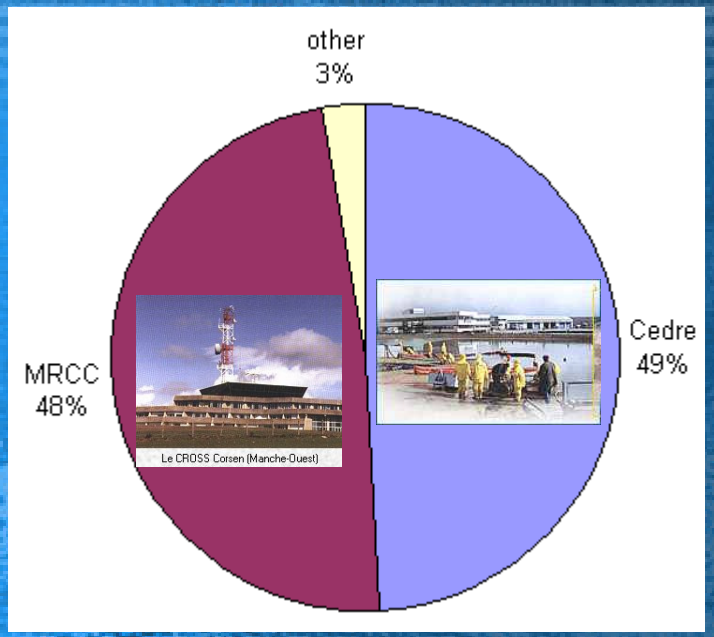
MERSEA objectives (task 12.3) :

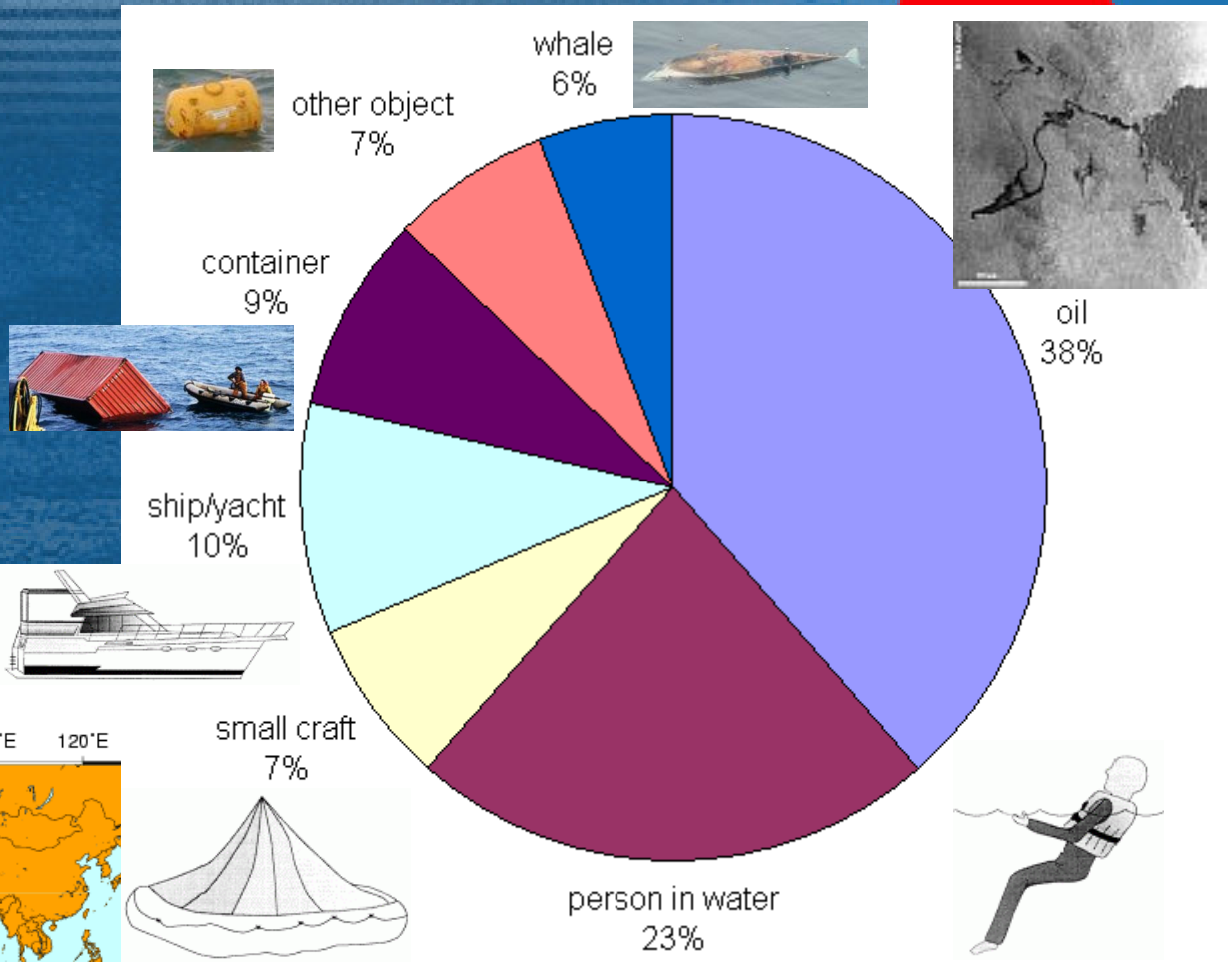
Interface MERSEA current forecasts with existing oil spill modeling systems, and evaluate improved forecast skill and accuracy

METEO FRANCE

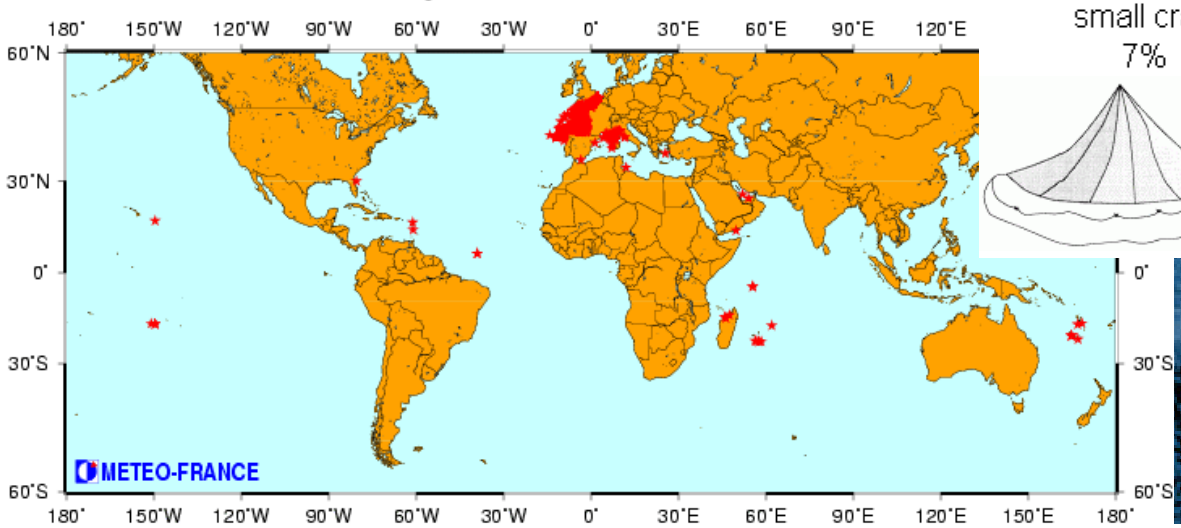
# Our duties

## About 120 interventions in 2004



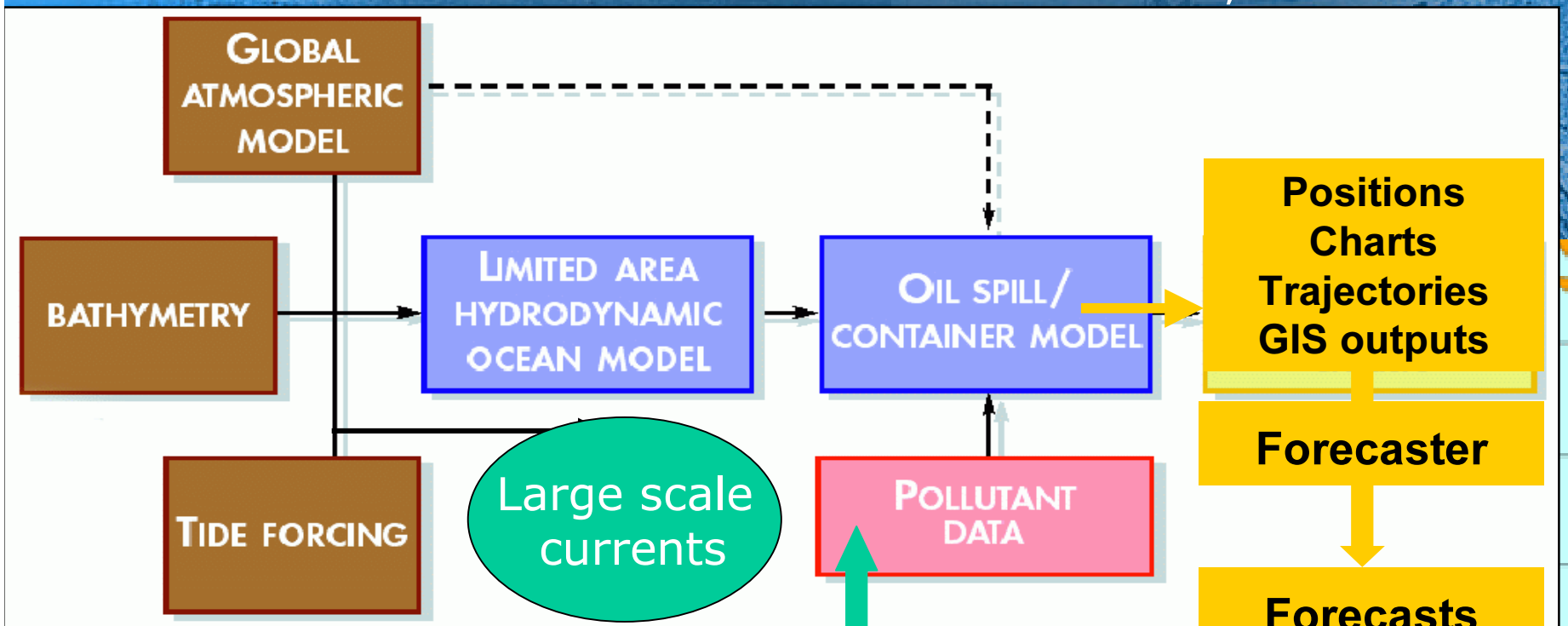

Lancements MOTHY du 6 juin 2001 au 12 mars 2003: 531

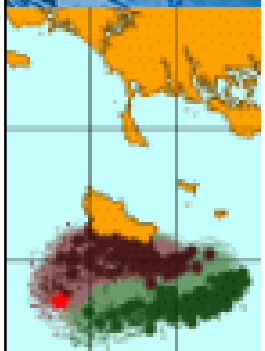



METEO FRANCE

# Our tools

**MOTHY drift system:** Hydrodynamic ocean model + pollutant model
Direct access to weather forecasts ; forecaster's validation



Observations

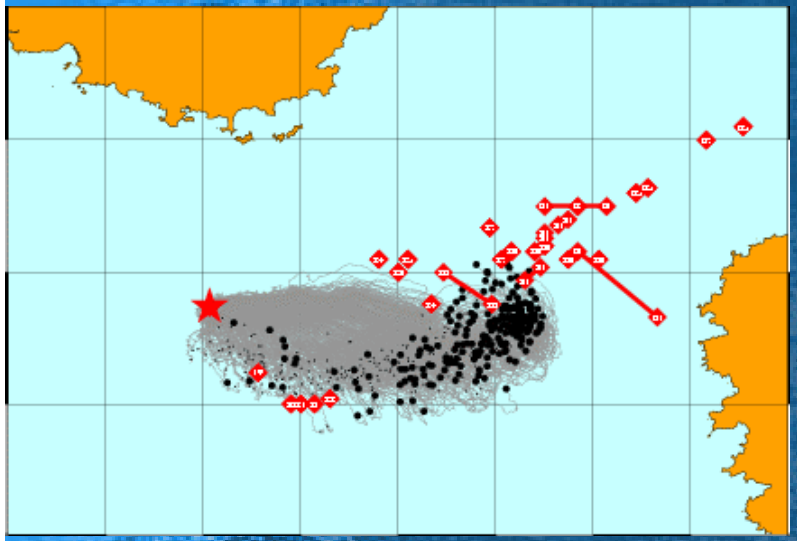
In a fighting loop

Planning tool & action

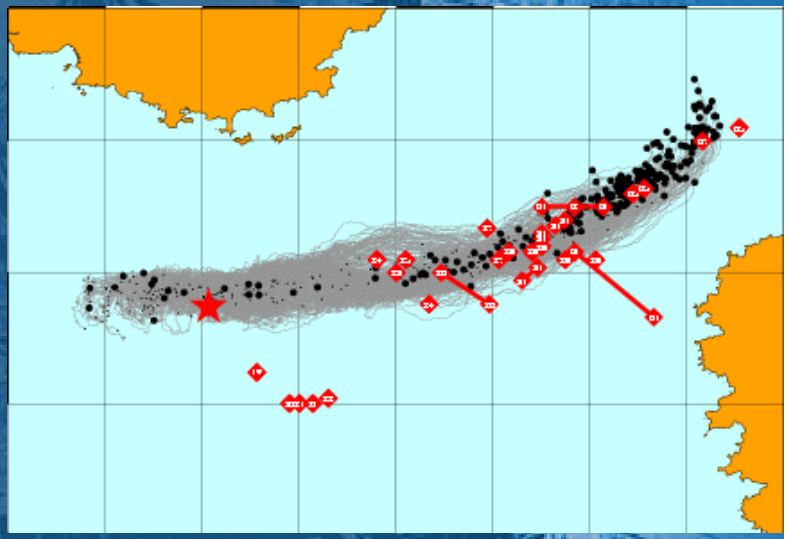
METEO FRANCE

# Our needs

Mediterranean Sea, Lyria incident (1993): 3 weeks drift



MOTHY without large scale current



MOTHY + climatology from in situ measurements (MODB)

➢ MOTHY + OOS ?

METEO FRANCE

# How to improve this system with operational oceanography systems?

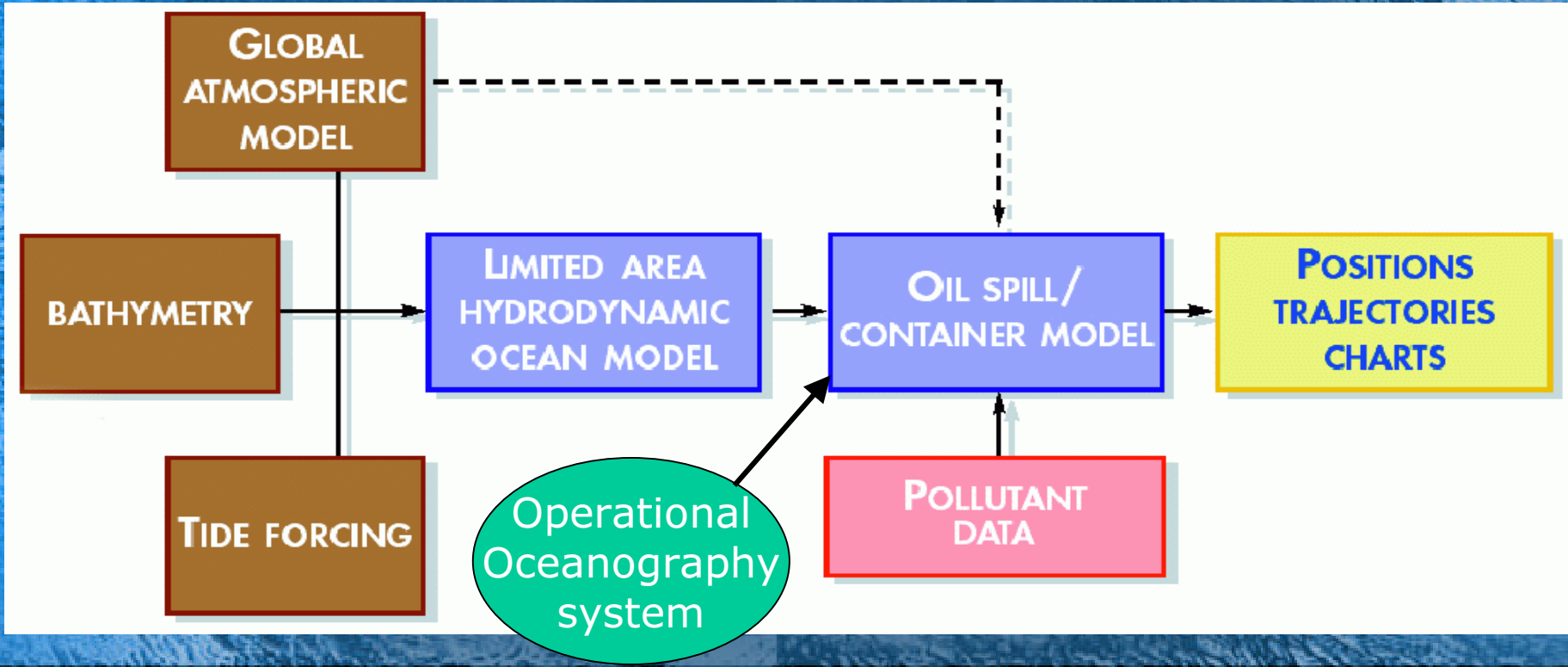
- 2 solutions:
- 1- direct use of currents from an operational oceanography system
- 2- combination of current from an operational oceanography system and from MOTHY



METEO FRANCE

# How to improve this system with operational oceanography systems?

2 solutions:



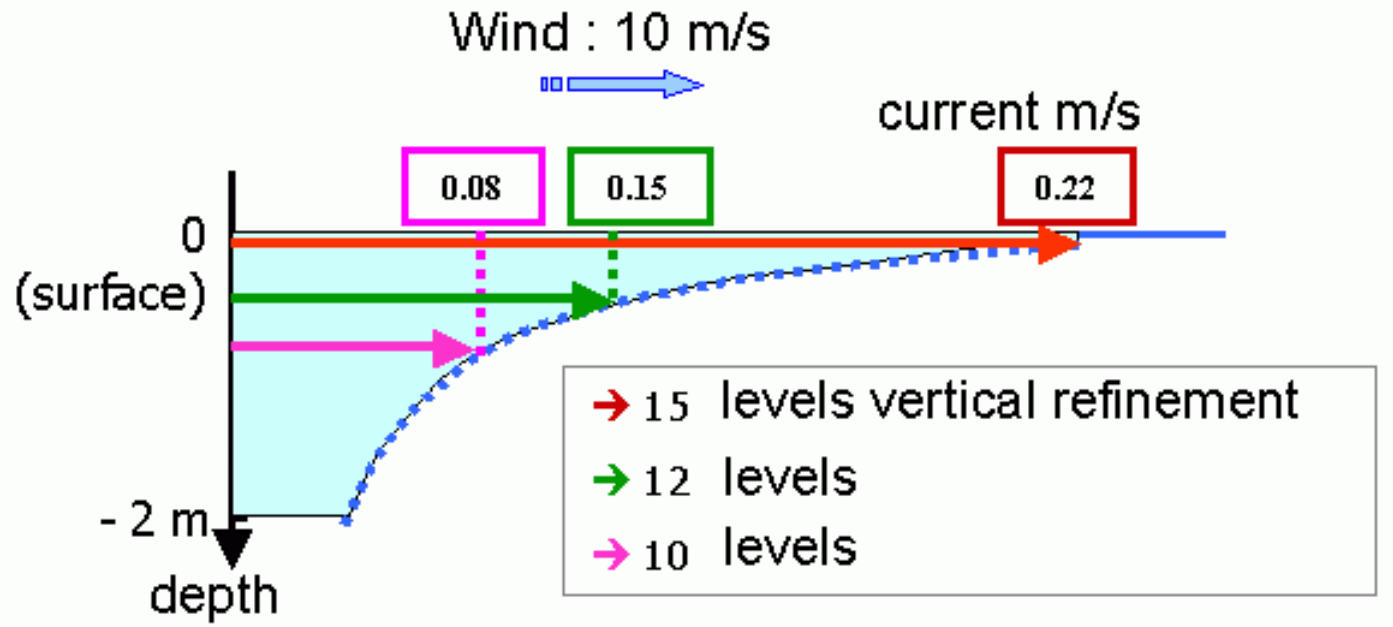

**MOTHY and operational oceanography systems**

METEO FRANCE

# MOTHY and MARS3D (IFREMER)

- How to modify a 3D hydrodynamic model ?

Hyper vertical refinement near the surface + some modifications to the turbulence model




From M. Jouhan and P. Lazure



METEO FRANCE

# Direct use of currents from an operational oceanography system

Test with MARS3D:

- it works (Erika)
- but only with adequate temporal forcing resolution
- it has a cost

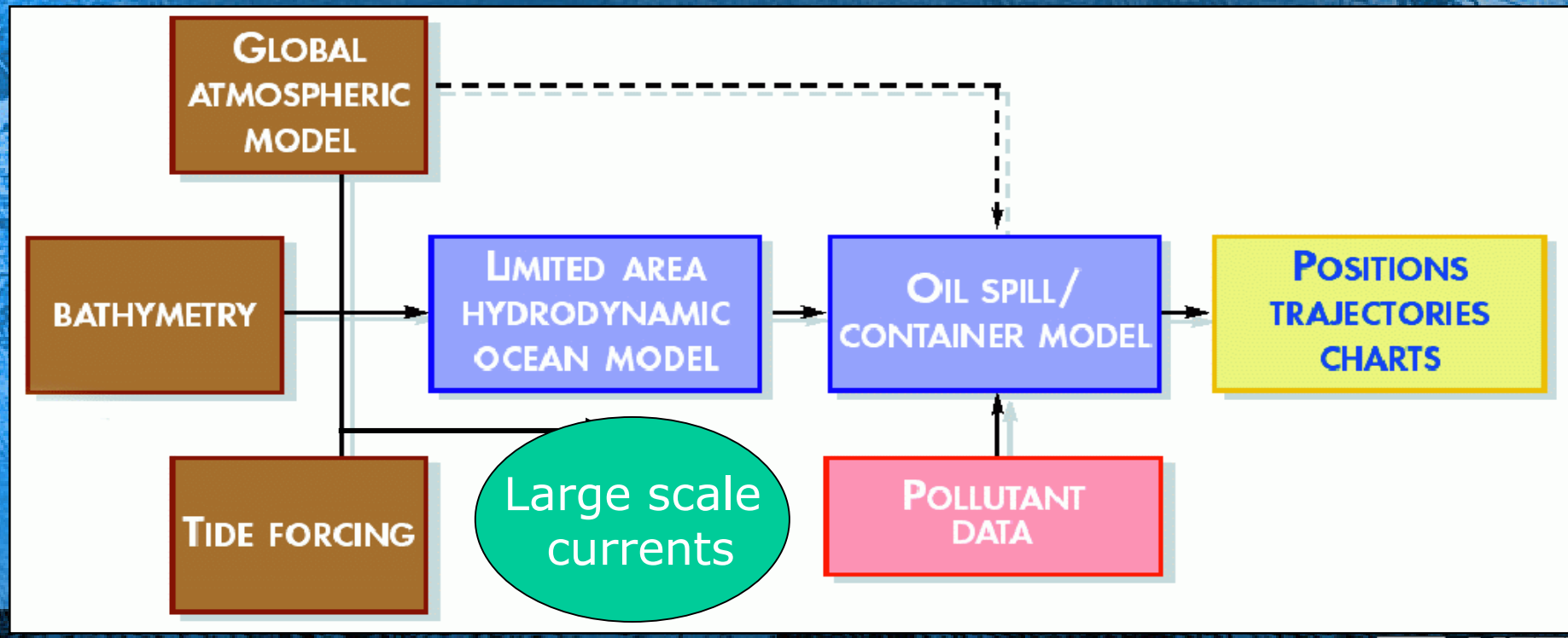
- Such currents are not available from operational oceanography systems.



METEO FRANCE

# Second solution

- combination of current from an operational oceanography system and from MOTHY




**MOTHY and operational oceanography systems**

METEO FRANCE

# How to include large scale currents into MOTHY ?

- MOTHY: wind and tide currents, high frequency.
- OOS: wind current (low frequency) and large scale current.
- How to use such a current in MOTHY, without counting 2 times the effect of the wind?

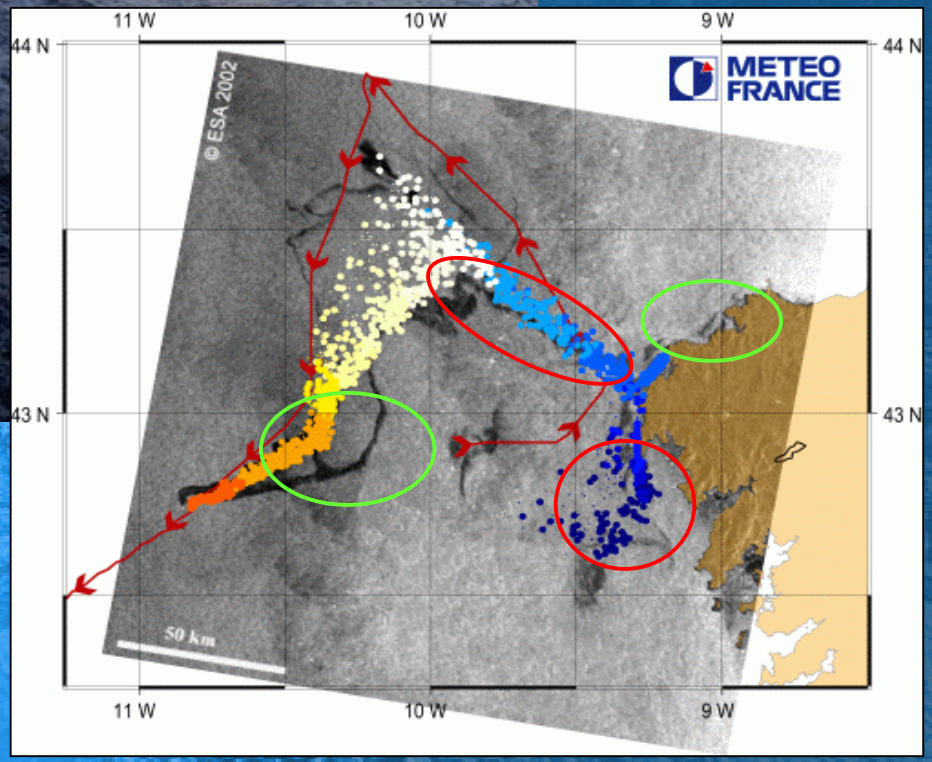
→ Current at the base of the mixed layer.
→ For example: 100 m depth on the Prestige area



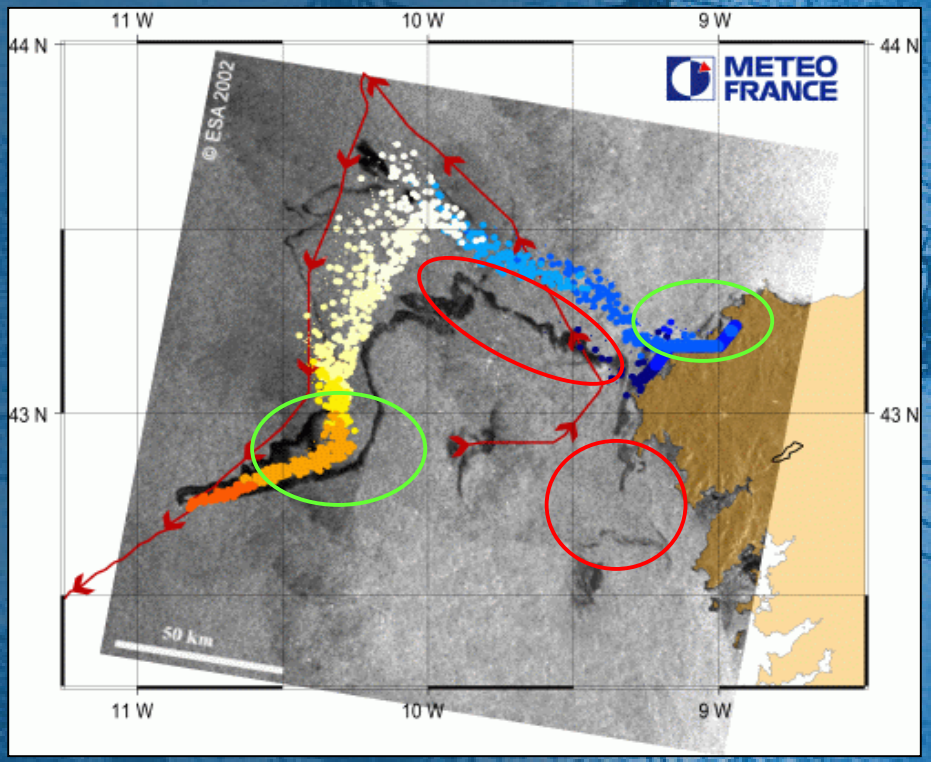
METEO FRANCE

# Prestige : oil spilled on the track

MOTHY operational




MOTHY + Mercator 103m




In green, areas with positive impact of Mercator currents

In red, areas where MOTHY alone is better

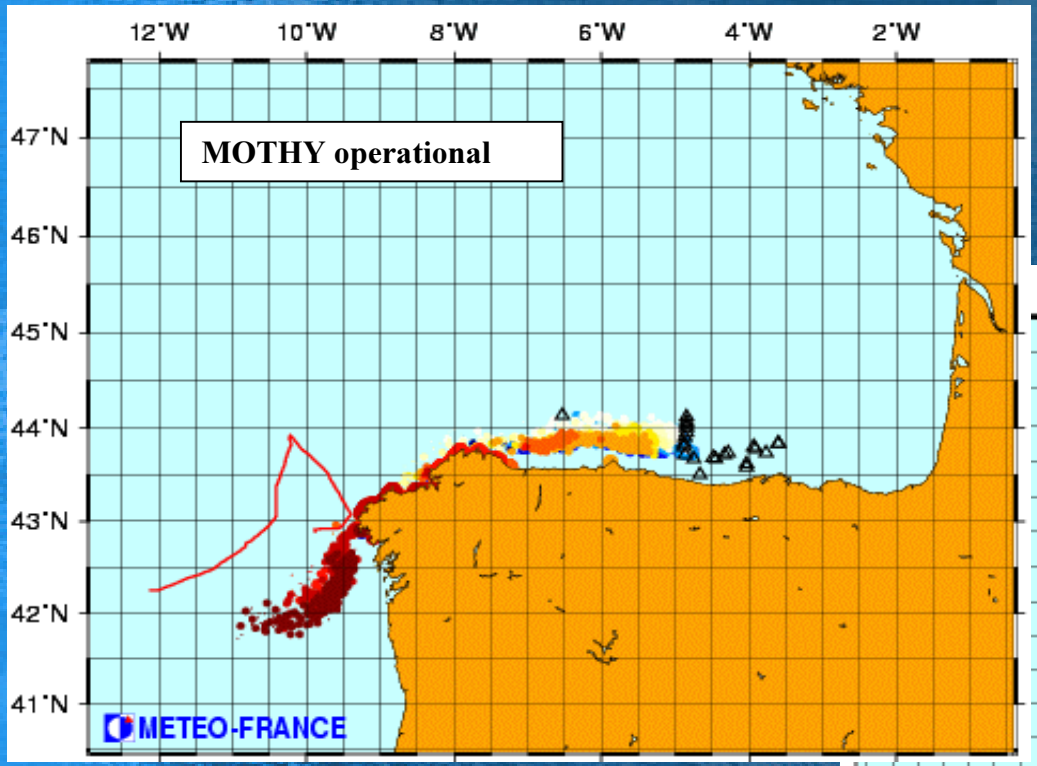
**MOTHY and operational oceanography systems**

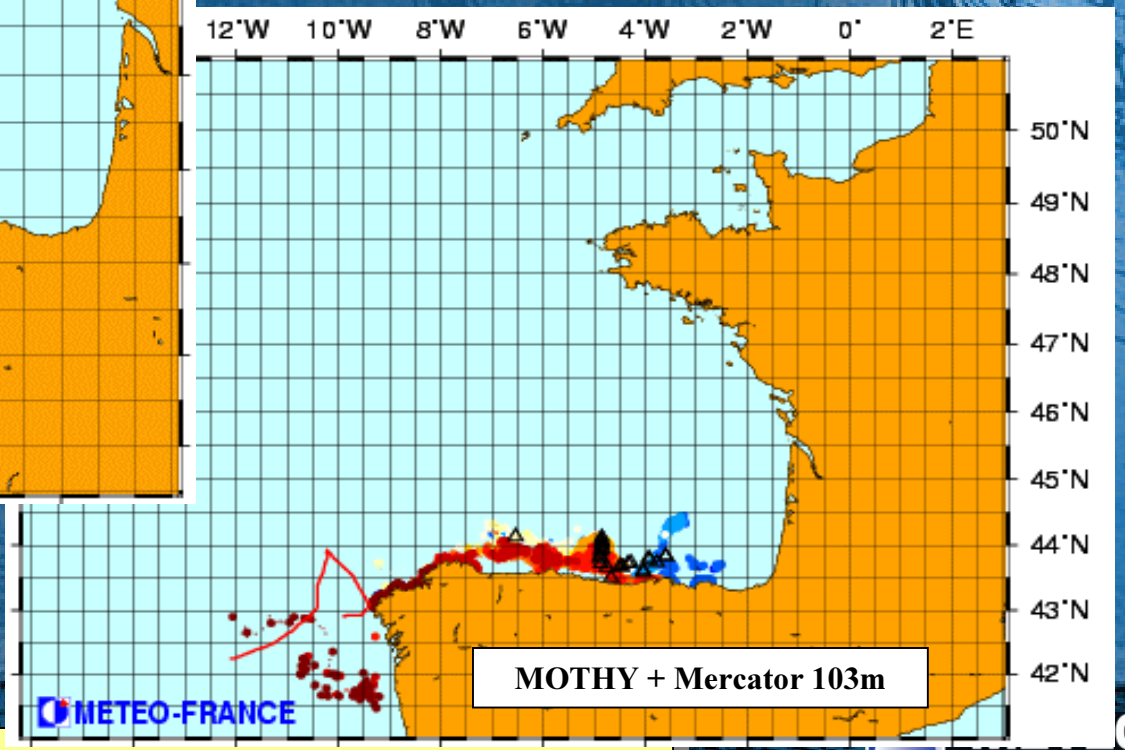
METEO FRANCE

# Prestige : oil spilled on the track

December 13, 2002

Δ = observations



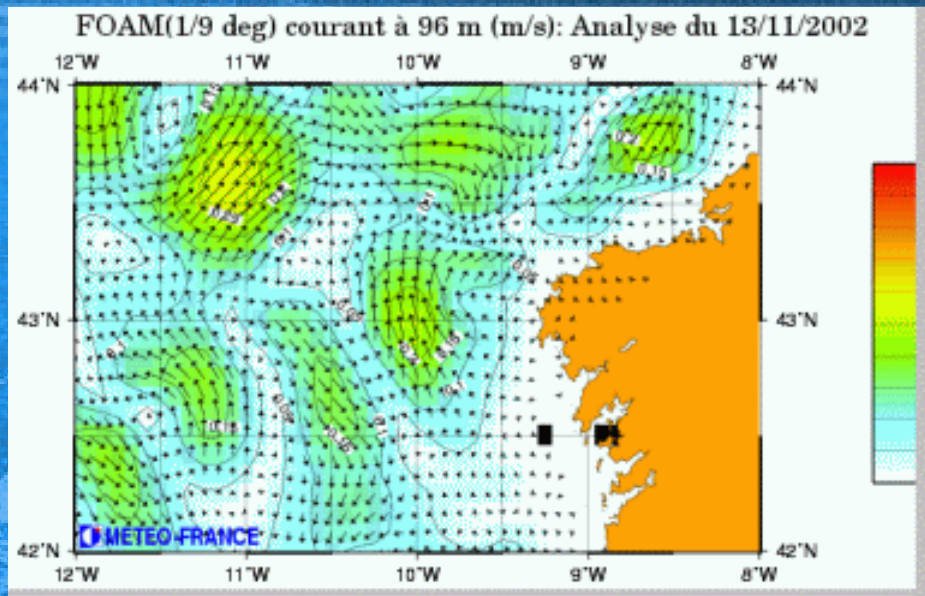



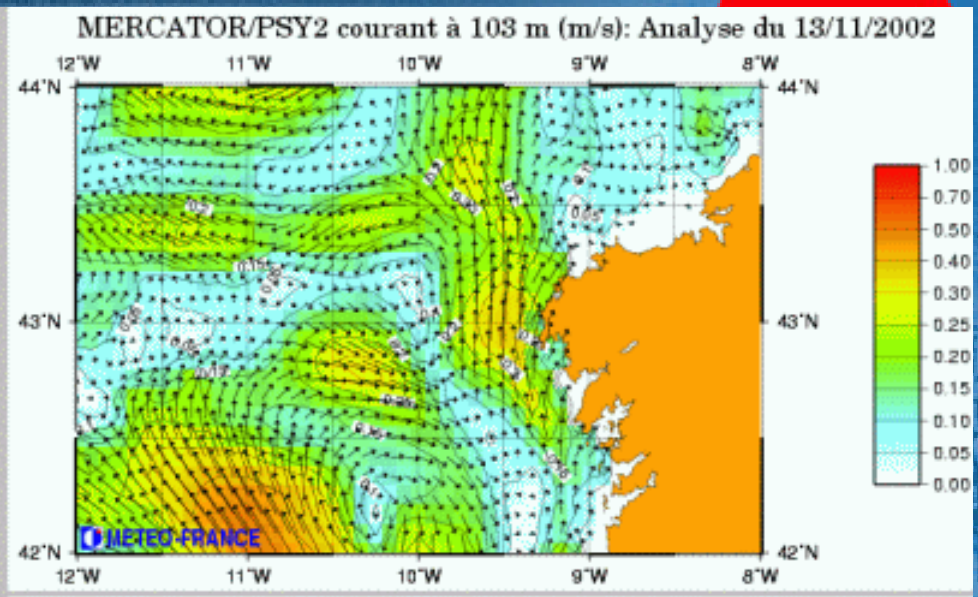

MOTHY is late. Addition of Mercator current at 103 m improves the simulation.

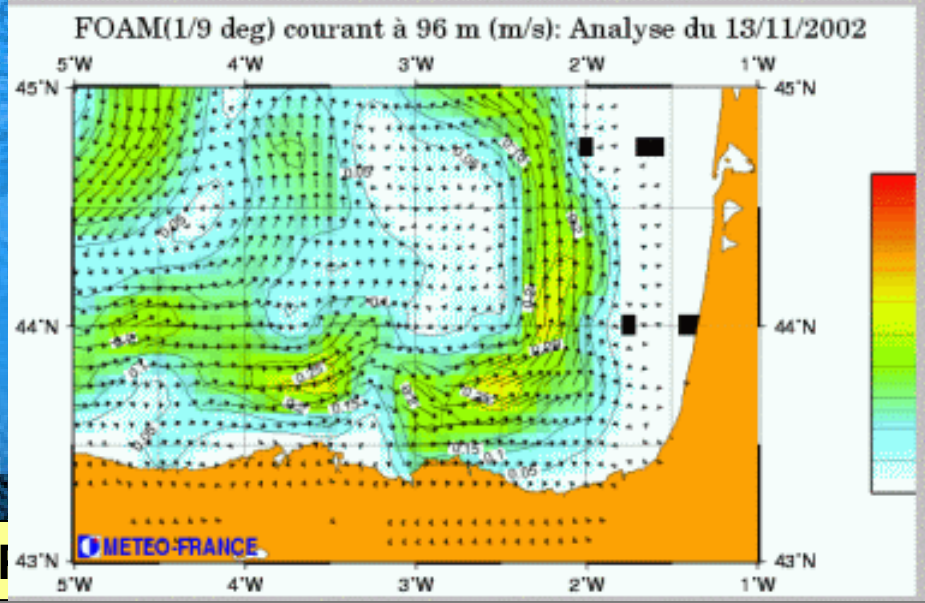
**MOTHY and operational oceanography systems**

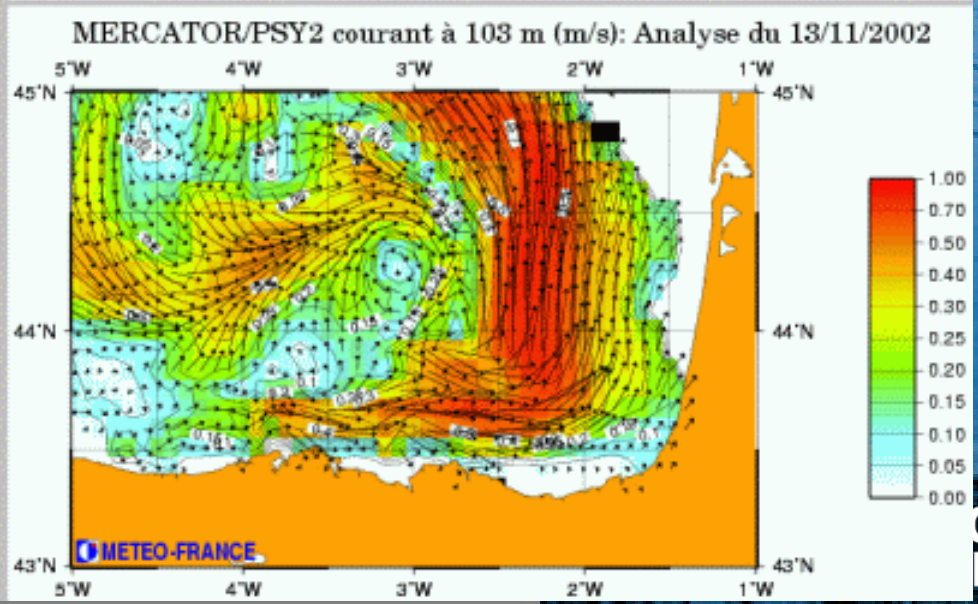
FRANCE

# MERCATOR and FOAM currents



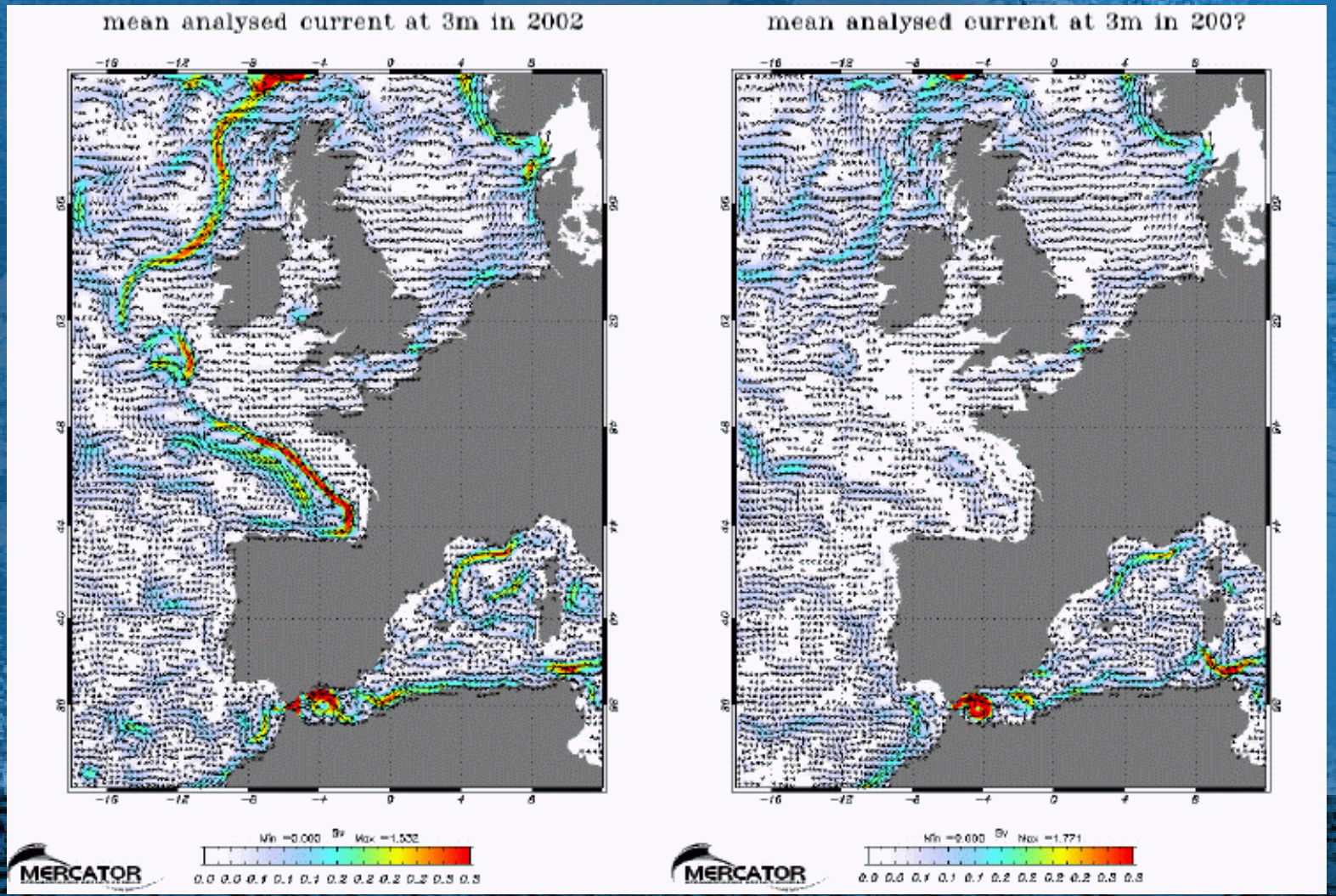



# But models evolve and improve

- From MERCATOR Newsletter N°12 (PSY2v1r0 → PSY2v1r1)



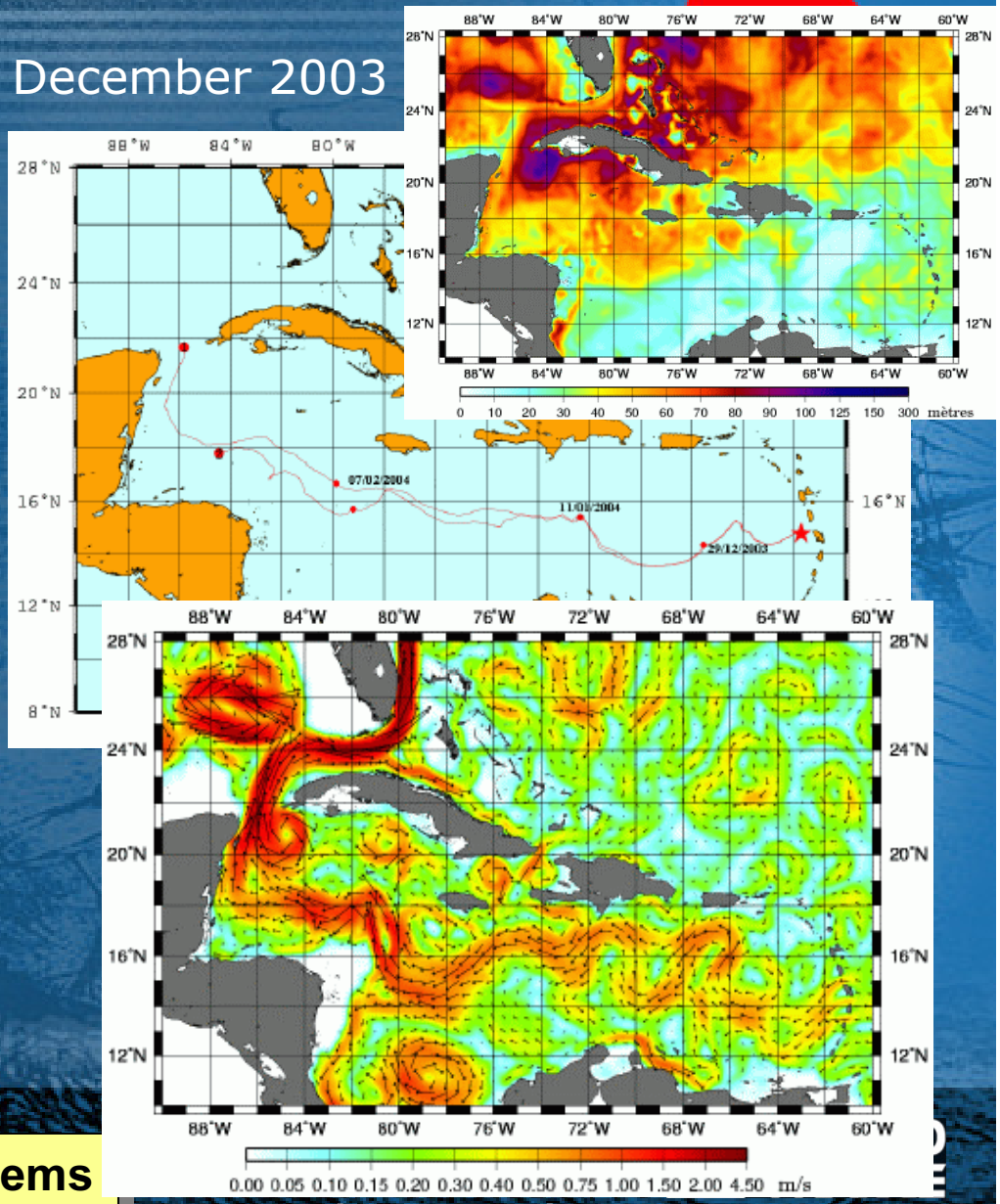
# Experiment in the Caribbean Sea

December 2003

MOTHY+MERCATOR/FOAM better than MOTHY alone

MOTHY+Mercator better than MOTHY+FOAM

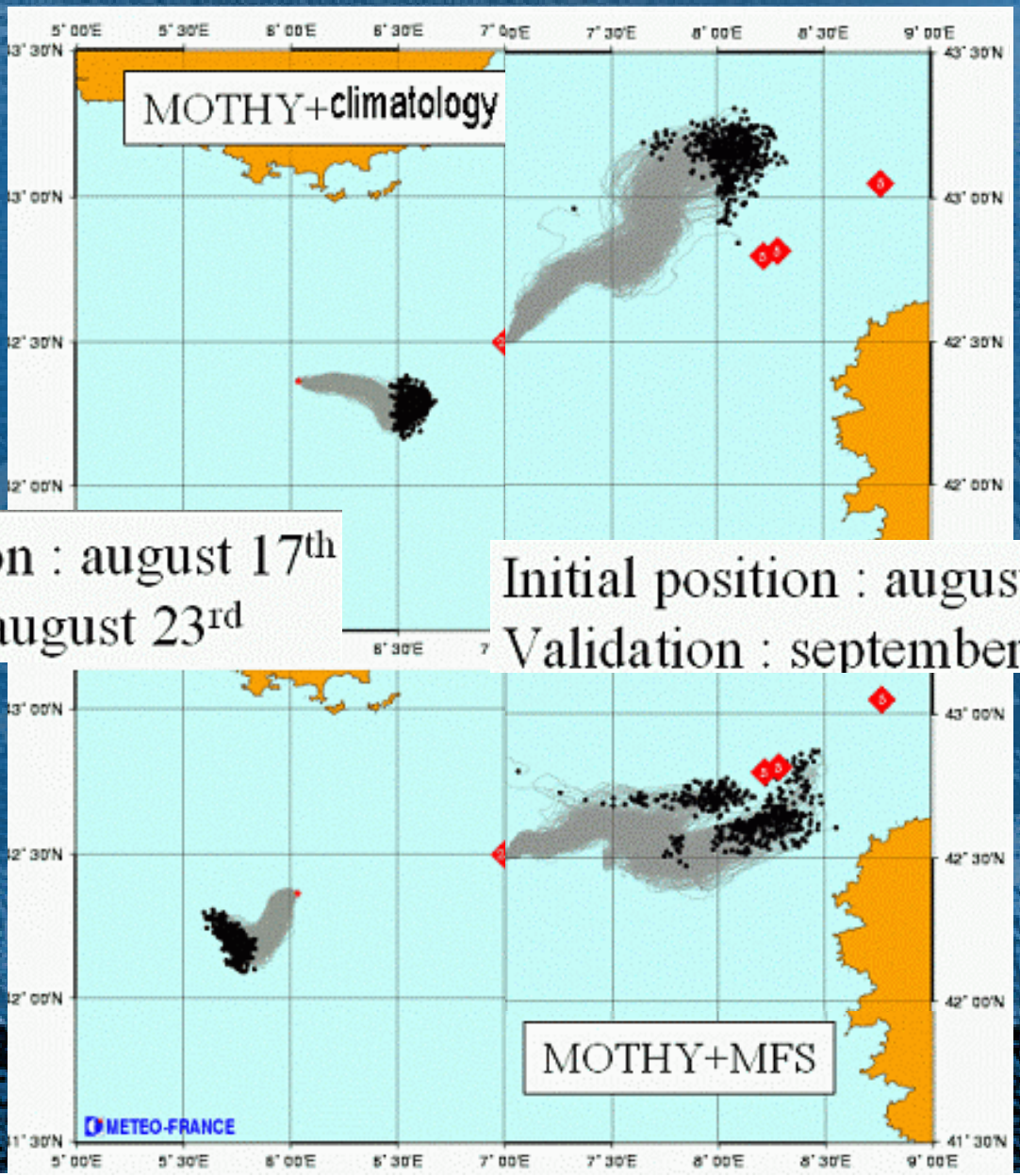
Relation between the depth of the current to add and the mixed layer depth remains unclear




From Chatenet & Giroux

**MOTHY and operational oceanography systems**

# Mediterranean Sea, Lyria, August 17, 1993




Initial position : august 17th
Validation : august 23rd

Initial position : august 23rd
Validation : september 5th

METEO FRANCE

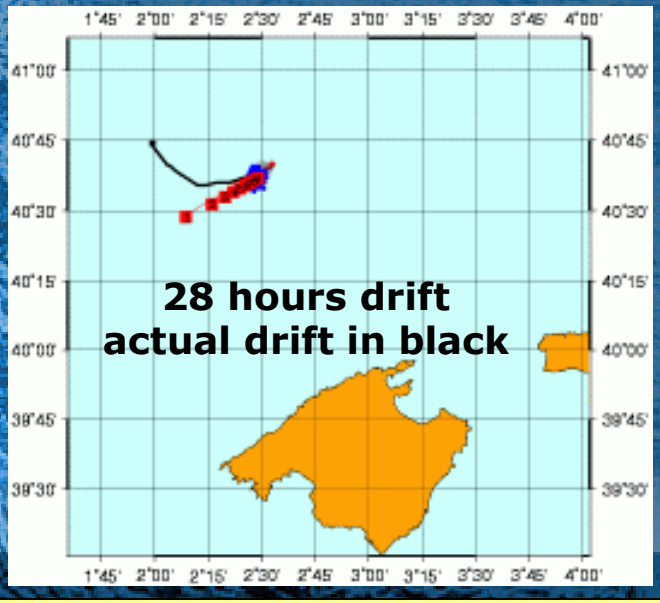
# Experiment in the Mediterranean Sea

December 2004

Mediterranean Sea: a challenge for accurate drift forecasts

Strong currents, highly variable

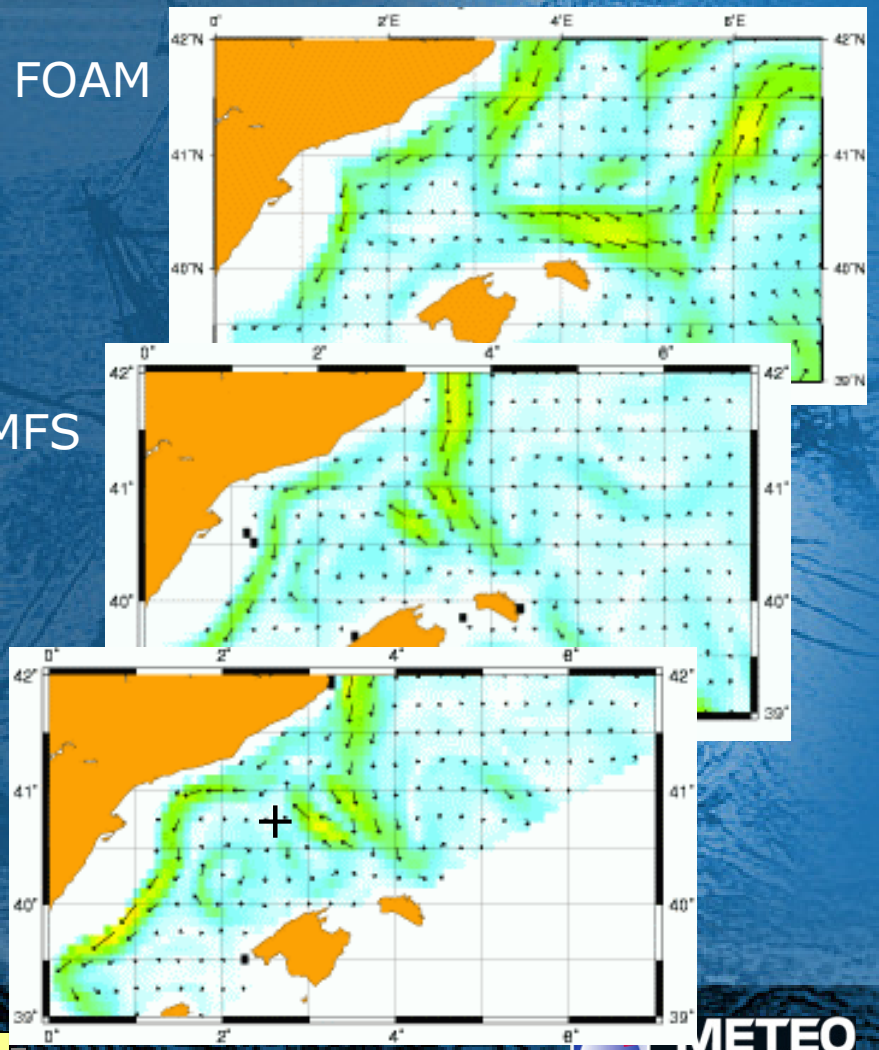
Inertial loops




FOAM

MFS

NWMED



**MOTHY and operational oceanography systems**

From K. Belleguic

METEO FRANCE

# Summary

Direct use of operational oceanography system needs:

- Hyper refinement in the first meters below the surface.
- Use of high resolution wind forecasts
- High resolution grid near the coast

Combine currents from an operational ocean system and MOTHY

- MOTHY + OOS current taken at the base of the mixed layer improve the drift on some cases and on some areas.
- How to go further ?

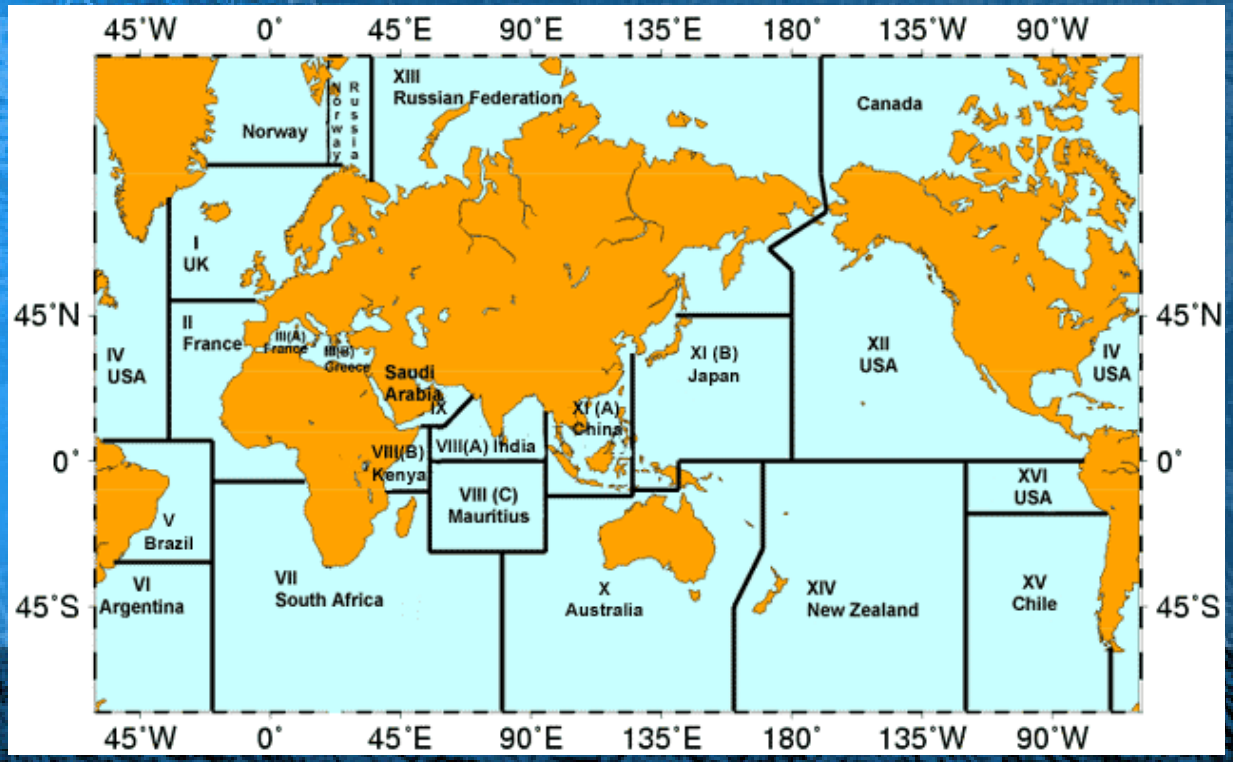
# Next step

To improve the coupling between Mercator and MOTHY:

- use of barotropic current as a boundary condition of MOTHY (instead of zero)
- use of the current stratification in the surface layer rather than a current at a fixed depth.
- redo the Prestige case (and other relevant cases) with PSY1V1r1 and PSY2V2
- use of Mercator with 6h atmospheric forcing (2006)

Comparison with other OOS (FOAM, MFS…) and existing nested regional models.

**All what is done under MERSEA should be applicable to ultraperipherical regions and overseas**




jcomm
OCEANOGRAPHY & MARINE METEOROLOGY

MPERSS: Marine Pollution Emergency Response Support System

METEO FRANCE