COASTAL OBSERVATIONS
& FORECASTS

# Assessing sediment dynamics on the continental shelf : a glance at French modelling and observation initiatives

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## What are the issues?

### Morphodynamic context

- Natural fine sediment infill in estuaries and bays
- Coastal erosion / accretion related to artificial structures
- Coastline dynamics (e.g. beach erosion, estuarine morphological adaptation to climate change-related forcing)
- Aggregate extractions

### Environmental context

- Turbidity : light attenuation, link with primary production and vegetation
- Benthic habitat changes (and anthropic impact such as trawling, climate change)
- Fine sediment contamination, link with the whole trophic chain

# SHELFLUX : a national network to federate research institutions, universities, consulting companies

**Scientific motivations and operational objectives (1/2)**

• Can we quantify the sand transfers between the shelf and the coastal zone?

• What is the natural infill rate of bays and estuaries, what is the sediment source for this infill?

• Can we quantify sediment fluxes on the shelf and assess their natural variability (seasonal, interannual, impact of extreme events) in order to sort out current variability from other effects

# SHELFLUX : a national network to federate research institutions, universities, consulting companies

**Scientific motivations and operational objectives (2/2)**

- Can we quantify the impact of human activities on

  - ✓ resuspension (e.g. trawling, dredging, aggregate extraction)
  - ✓ sediment trapping (e.g. harbors, aquaculture)

- Can we predict how climate change will affect coastal and estuarine morphological changes?

- Can we provide consulting companies with reliable boundary conditions?

# SHELFLUX

## Strategy

- Using the network in order to answer national (european?) calls for proposal

- Developping a numerical modelling strategy within the national coastal oceanography operational program (Previmer)

- Introducing sediment oriented measurements within existing or planned monitoring networks (e.g. FONCE), and in collaboration with recurrent oceanographic / fish stock cruises on the shelf

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PREVIMER

# PREVIMER
# A coastal operational forecasting system

# PREVIMER - Objectives

PREVIMER provides coastal synoptic observations and 96 hour to 6 day forecast in regional areas (the English Channel, the Bay of Biscay and NW Mediterranean Sea) down to very local areas on the following parameters:

- direction and intensity of currents,
- sea-surface and bottom temperature and salinity,
- sea level,
- waves: frequency, direction and height,
- nutrients and phytoplankton concentration,
- turbidity

2006-2007 : phase 1 based on demonstrators

2008-2012 : phase 2 toward an operational system


**Website**

- presentation:

www.previmer.org/presentation

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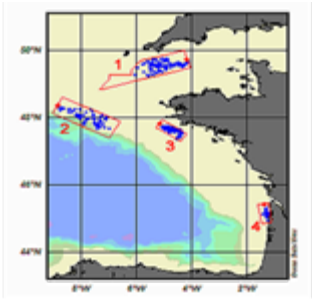
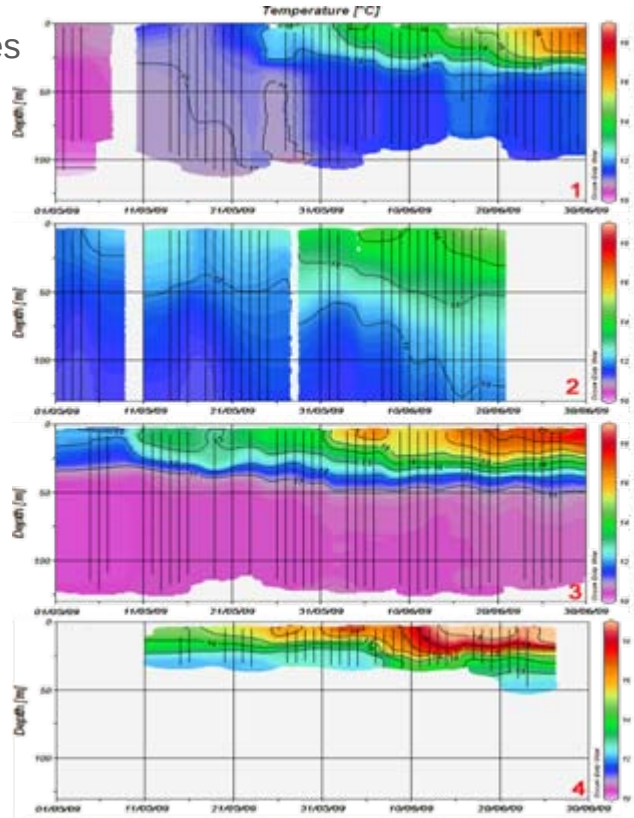
# Monitoring networks and instrument developments

# RECOPESCA
# (a network of Voluntary Observing Ships)

- initially, ICES assessment of the pressure of fisheries over the various fishing areas,
- routine acquisition of complementary data: temperature, salinity, turbidity,
- data are transferred to the Data Centre by GPRS,
- Probes provided by NKE.
- 1st stage: 30 ships (done).
- 2nd stage: deployment up to 300 ships (2014).

Cartes des profils de température récoltés par le réseau RECOPESCA :
- en Manche (1),
- près du talus continental (2),
- au sud de Penmarch (3) et
- au nord du bassin d'Arcachon (4).




Profils de température en fonction du temps, en Manche (1), près du talus continental (2), au sud de Penmarch (3) et au nord du bassin d'Arcachon (4).

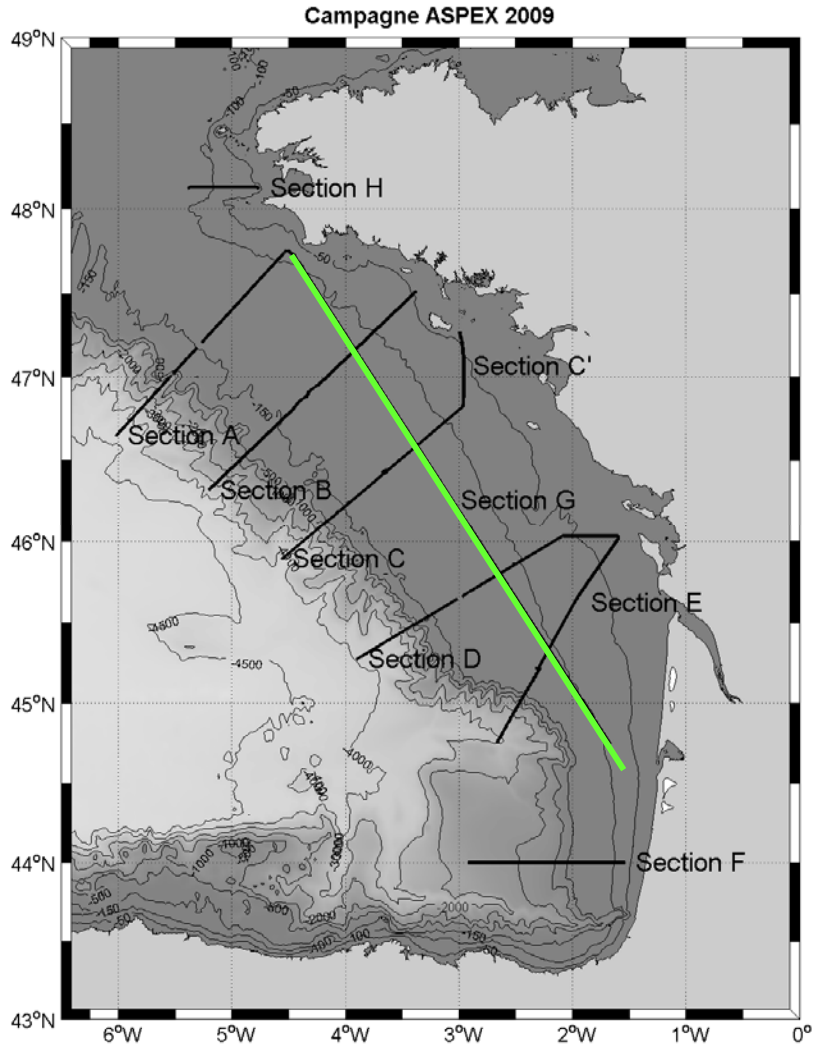


Ifremer

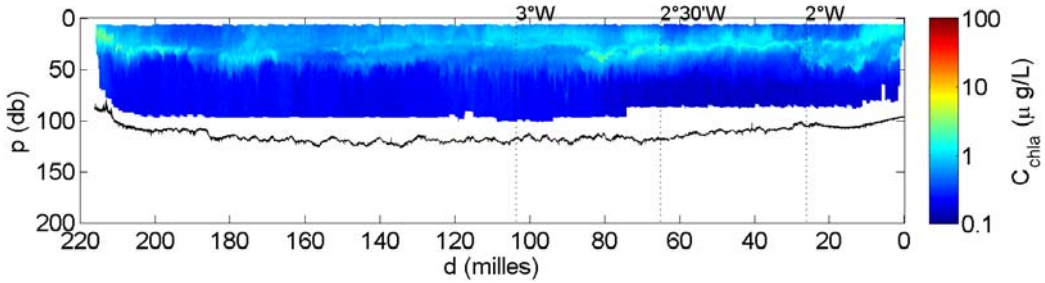
# SCANFISH – towed fish

- 1.8m large towed fish oscillating from the surface down to 100 m water depth along the route of the vessel.
- Provides 2D slices for temperature, salinity, chlorophyll and turbidity

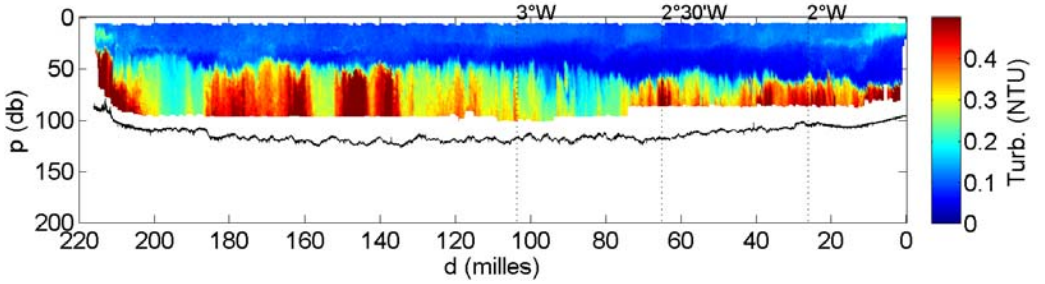
# SCANFISH – towed fish




## Chlorophyll




## Turbidity

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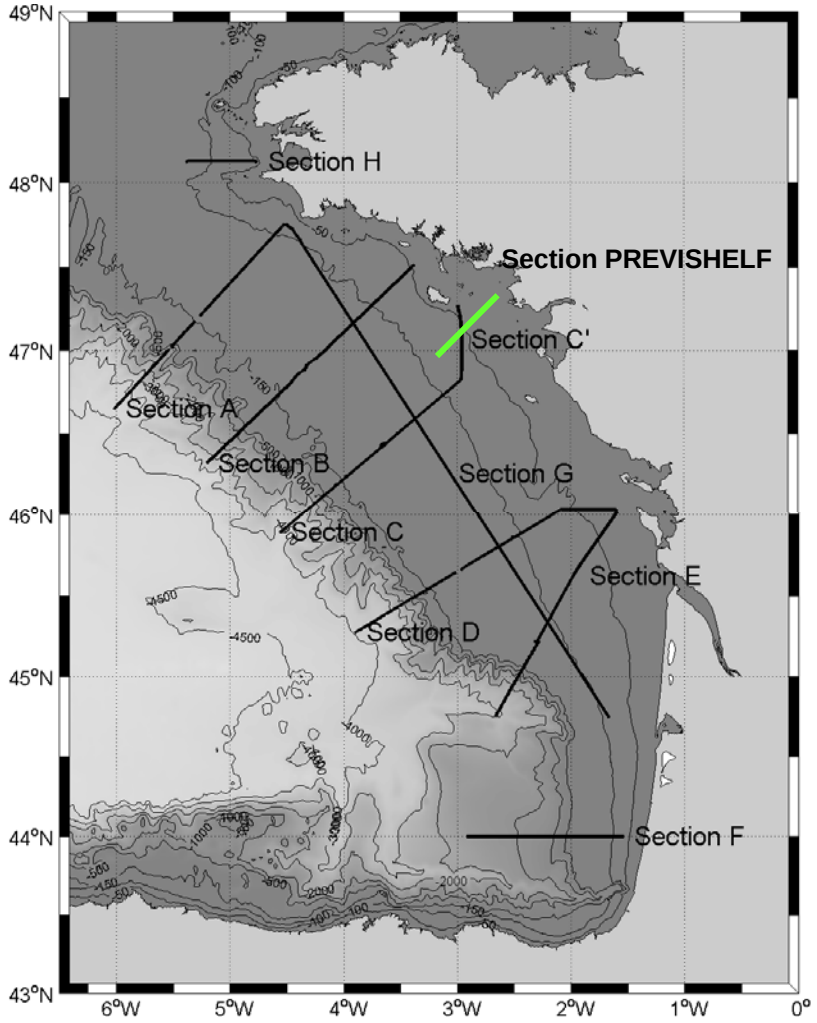
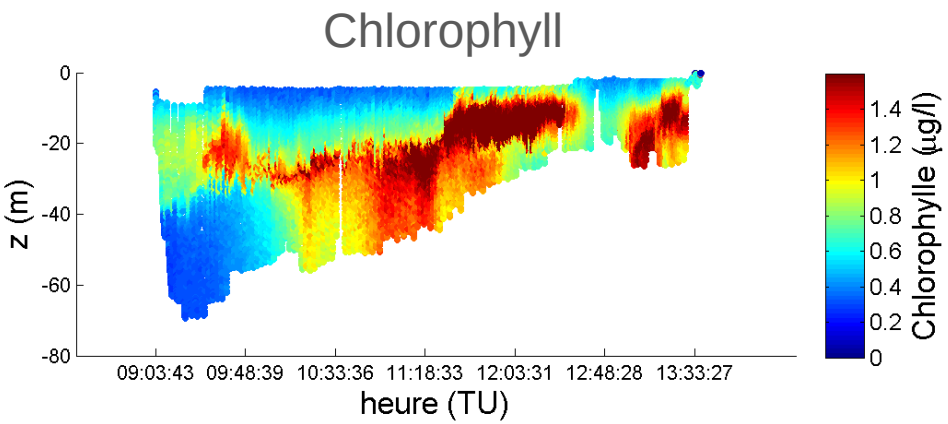
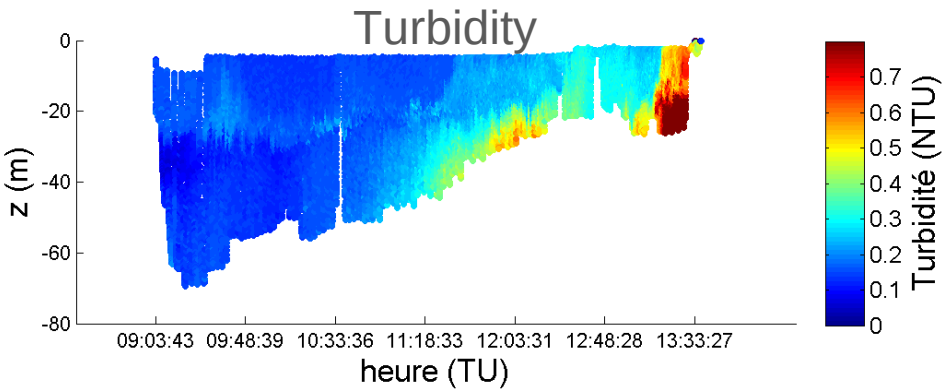
# SCANFISH – towed fish

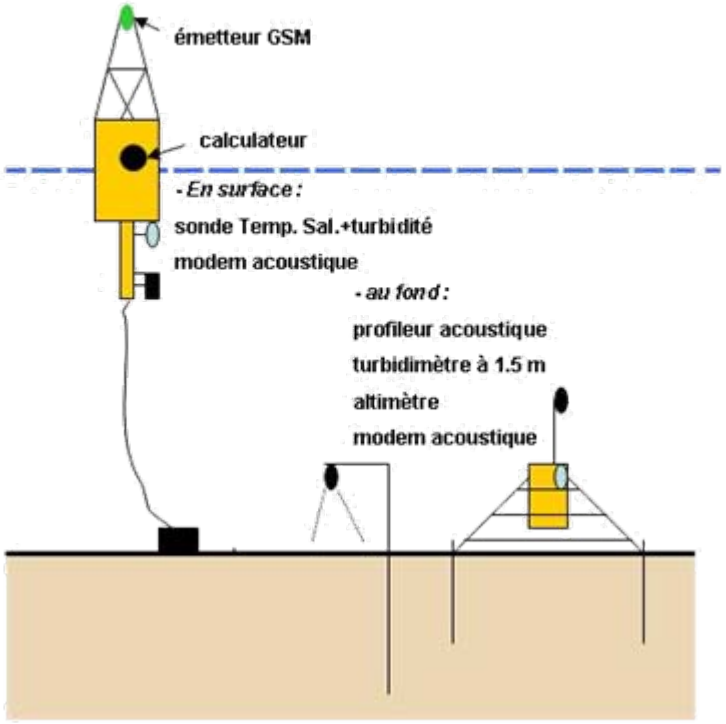


# Turbidity measurement buoy

- Southern Brittany prototype


Wave, current, surface and bottom turbidity, altimeter, real time data transmission

# Satellite observation

- Sea surface temperature:
  high resolution without clouds (infra-red),
  lower resolution when cloudy (radar).
- Water colour: exploitation of visible and near infra-red wave lengths.
- Image processing using specific algorithms to discriminate chlorophyll-A from inorganic suspended matter.
- Data collected and archived at CERSAT, distributed using Nausicaa browser.

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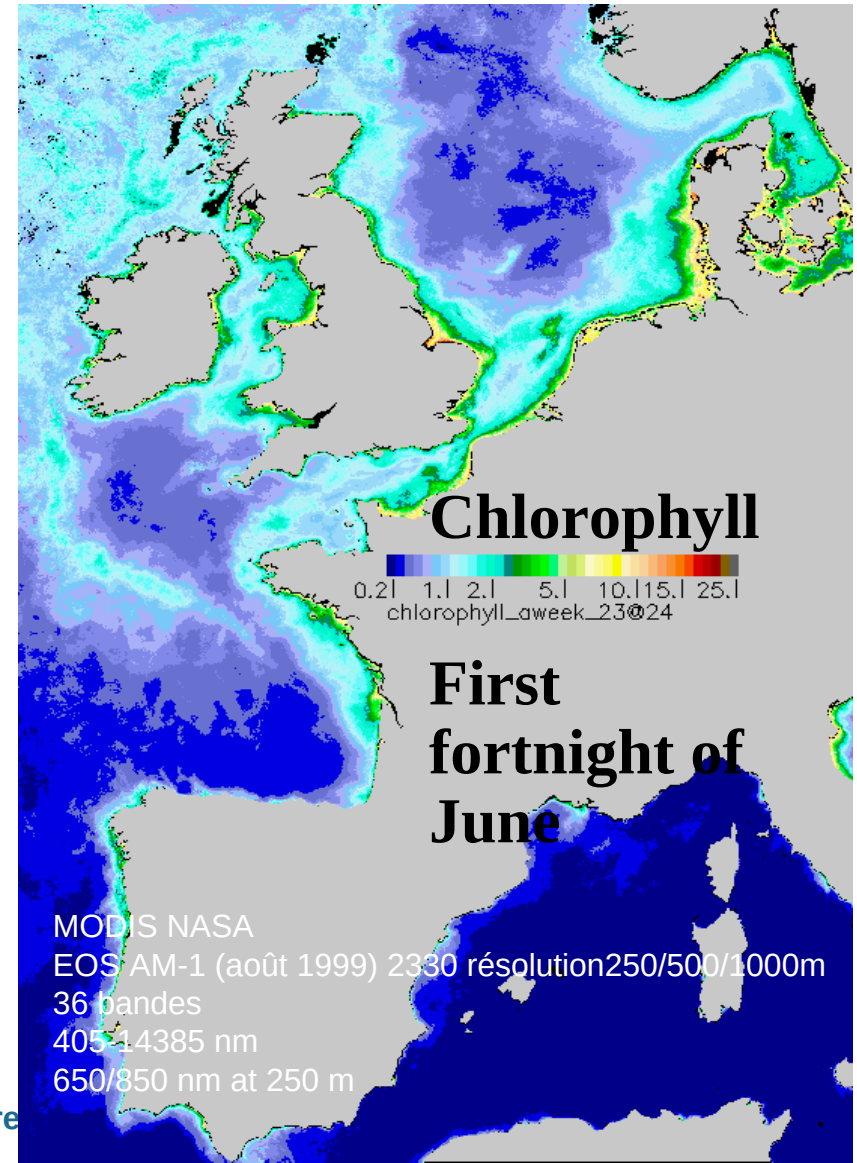


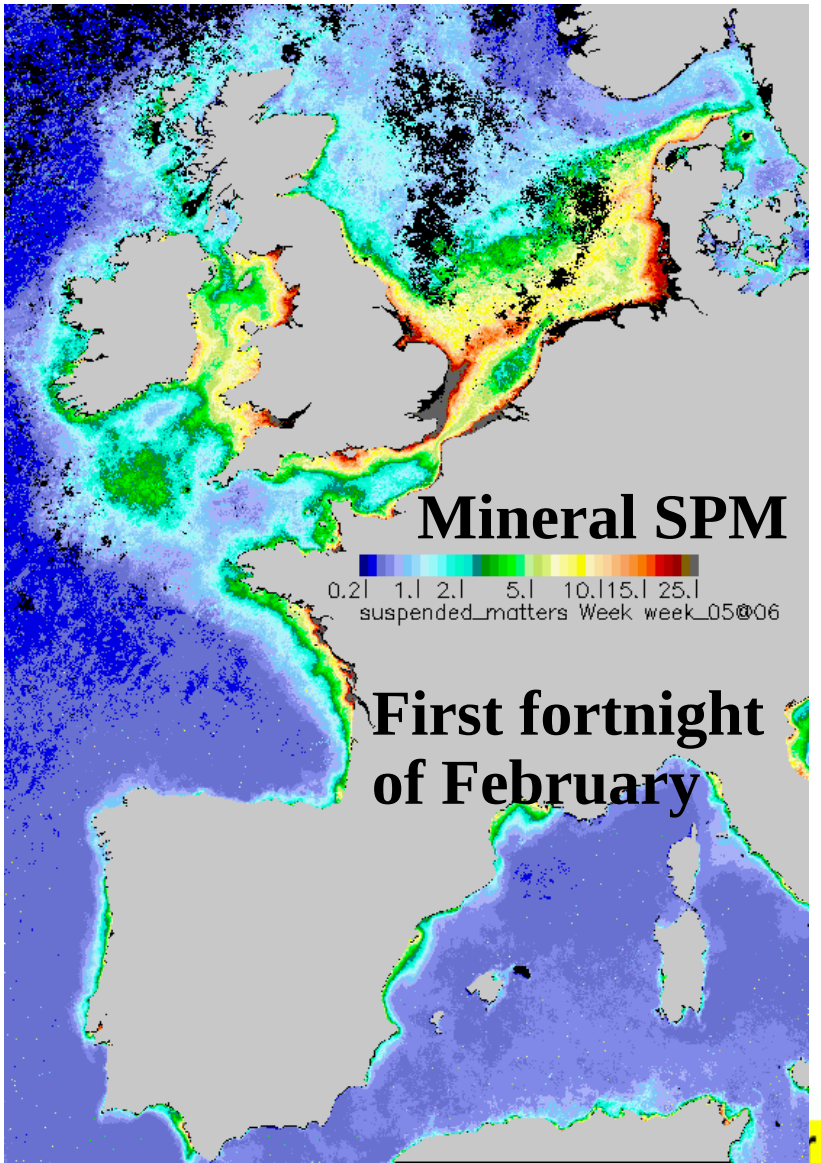

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# PREVIMER forecasting models

# Currents, T, S, storm surges

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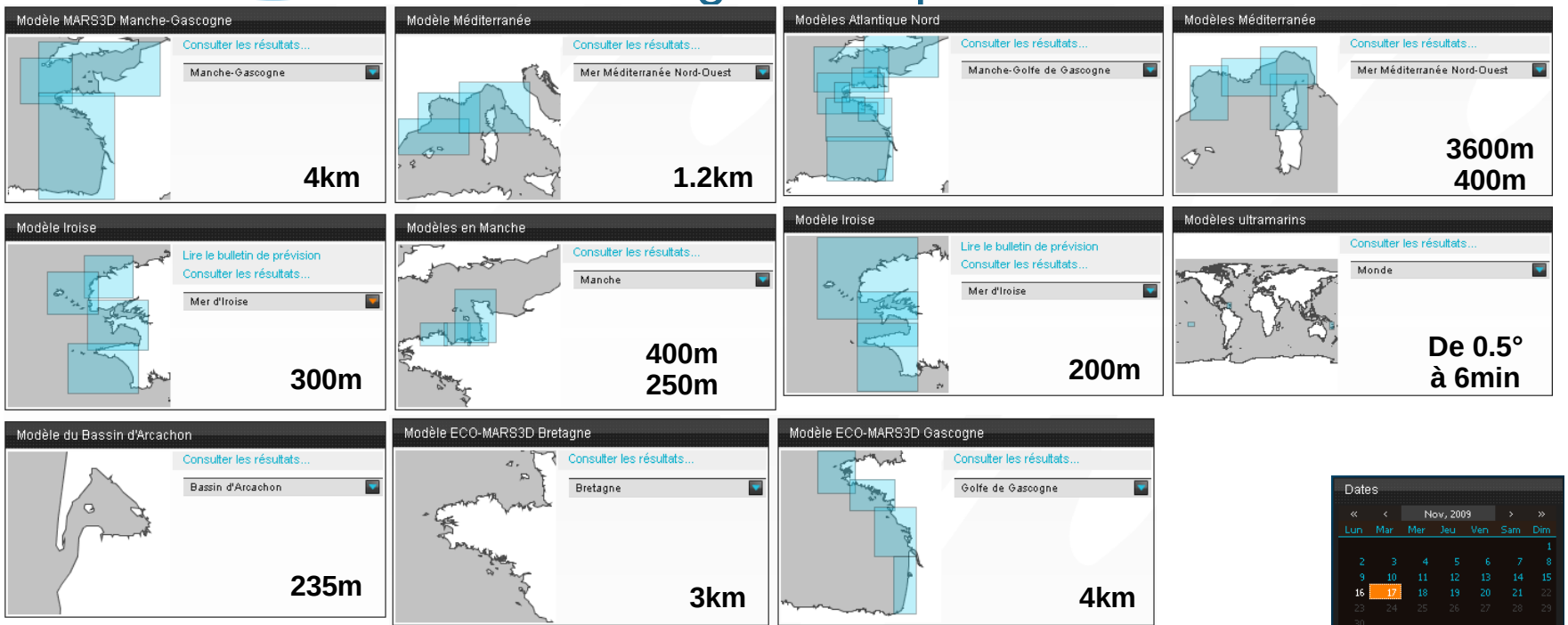
In coastal zones on a range of scales from continental shelf to bay with a capacity for zooming-in on specific areas.

Where ?




What ?

Courants | Vagues | Niveaux | Température et salinité | Production primaire

When ?


www.previmer.org

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# Waves

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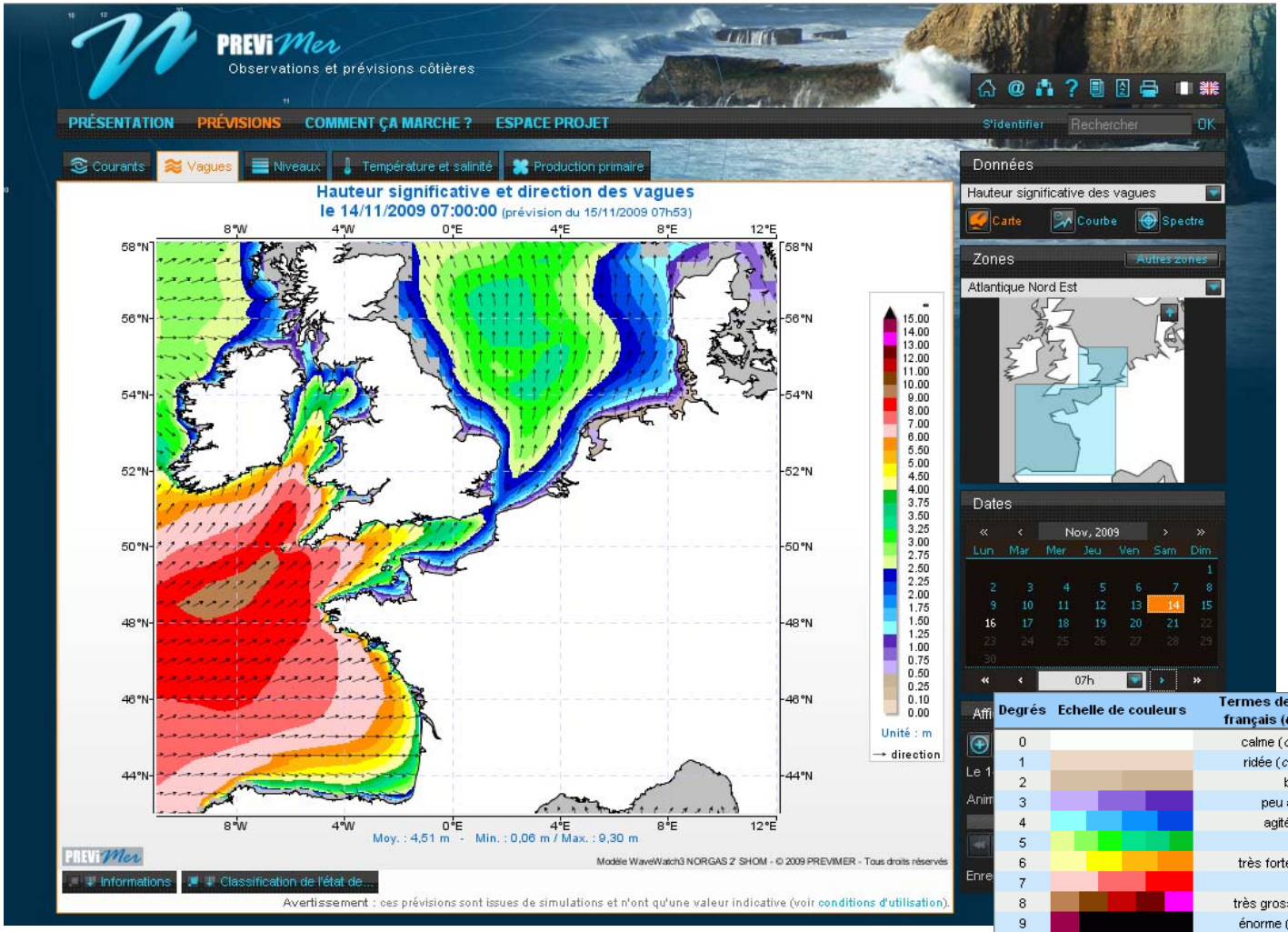
## Wave forecasts (WWIII regional scale)
## French Hydrographic Services

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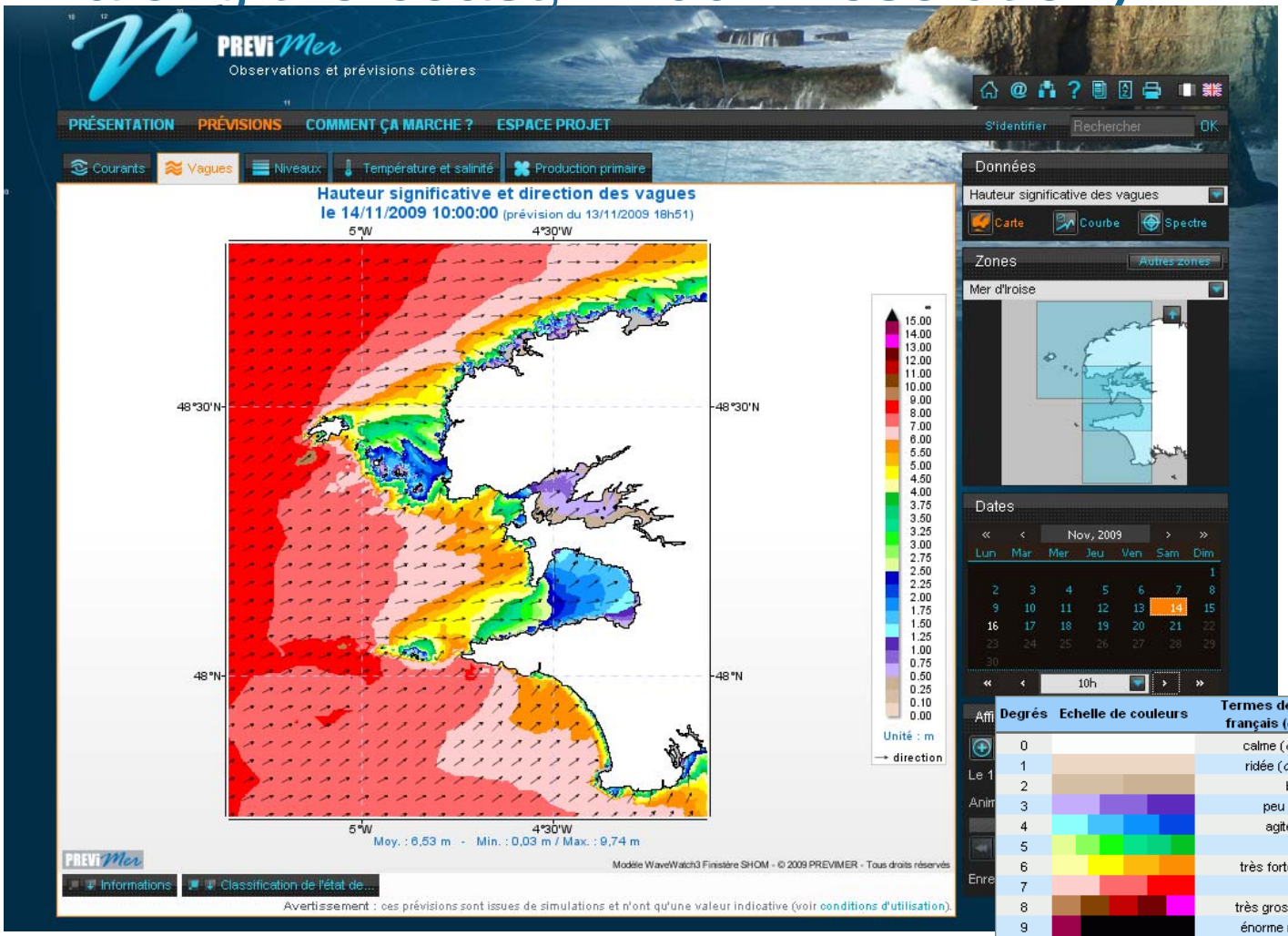
# Wave forecasts (unstructured mesh all along the coast, ~200m resolution)



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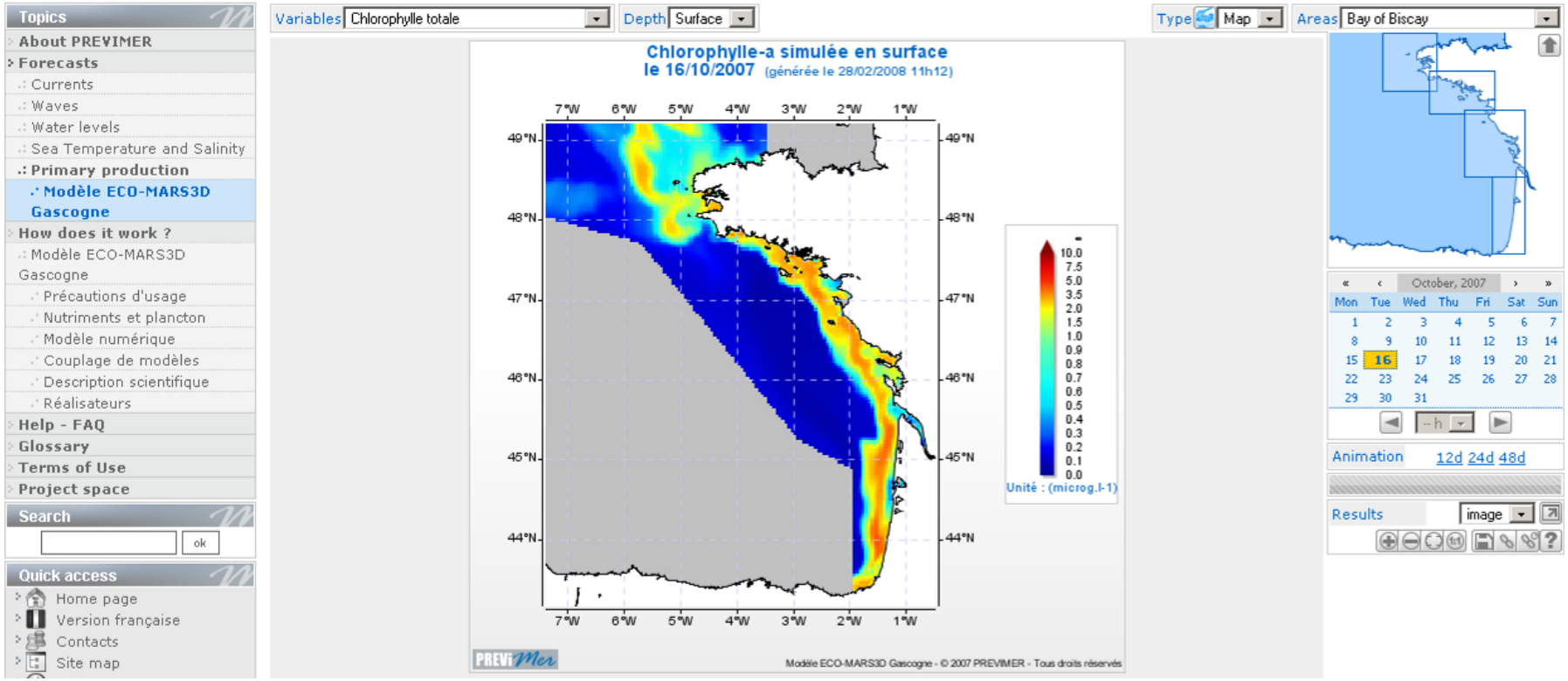
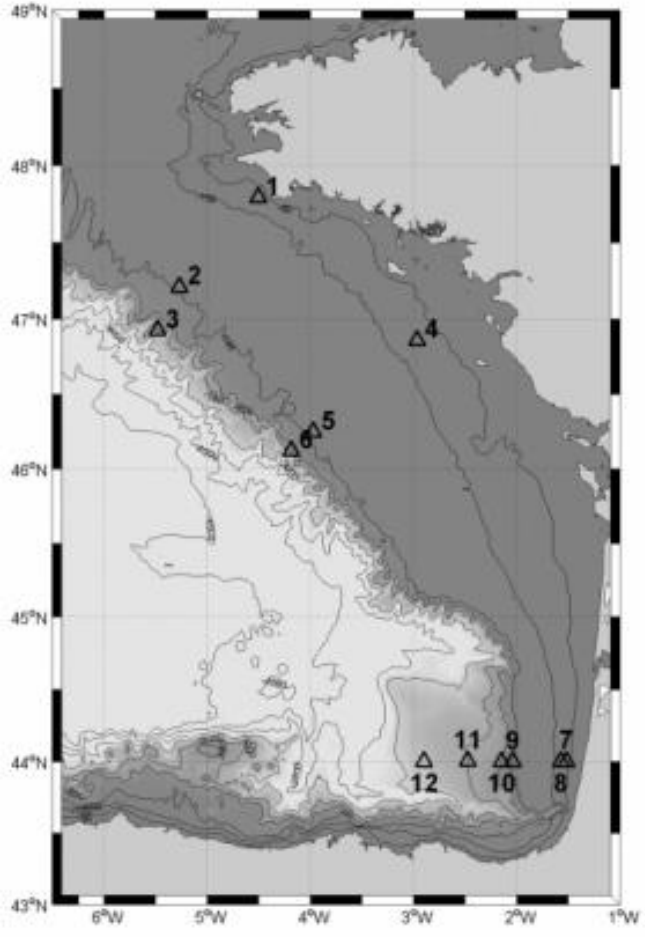
# Ecological modelling of nutrients and phytoplankton



# Turbidity, sediment fluxes SHELFLUX / COO




- Modelling : regional scale, river plumes (Seine, Loire, Rhone, not operational)
- Data acquistion
  - ✓ Cruises of opportunity : long-term moorings on the shelf (ADCP, turbidity sensors)
  - ✓ SCANFISH profiles
  - ✓ CTD-Turb profiles during fish stock cruises

ANR EPIGRAM
Louis Marié, Ifremer

# FONCE
# French Observatory Network of Coastal Environment

Proposal to develop an monitoring network of the French coastal seas within the context of Coastal Operational Oceanography Programs

**Scientific objectives :**

- Coastal hydrodynamics characterization
- Sediment Dynamics
- Marine Ecosystems

**Applications**

- Research
- Marine strategy
- Operational Oceanography

# FONCE
# French Observatory Network of Coastal Environment

WP0: Project management and coordination

WP1: Technology development for sensors, buoys and sub bottom platforms

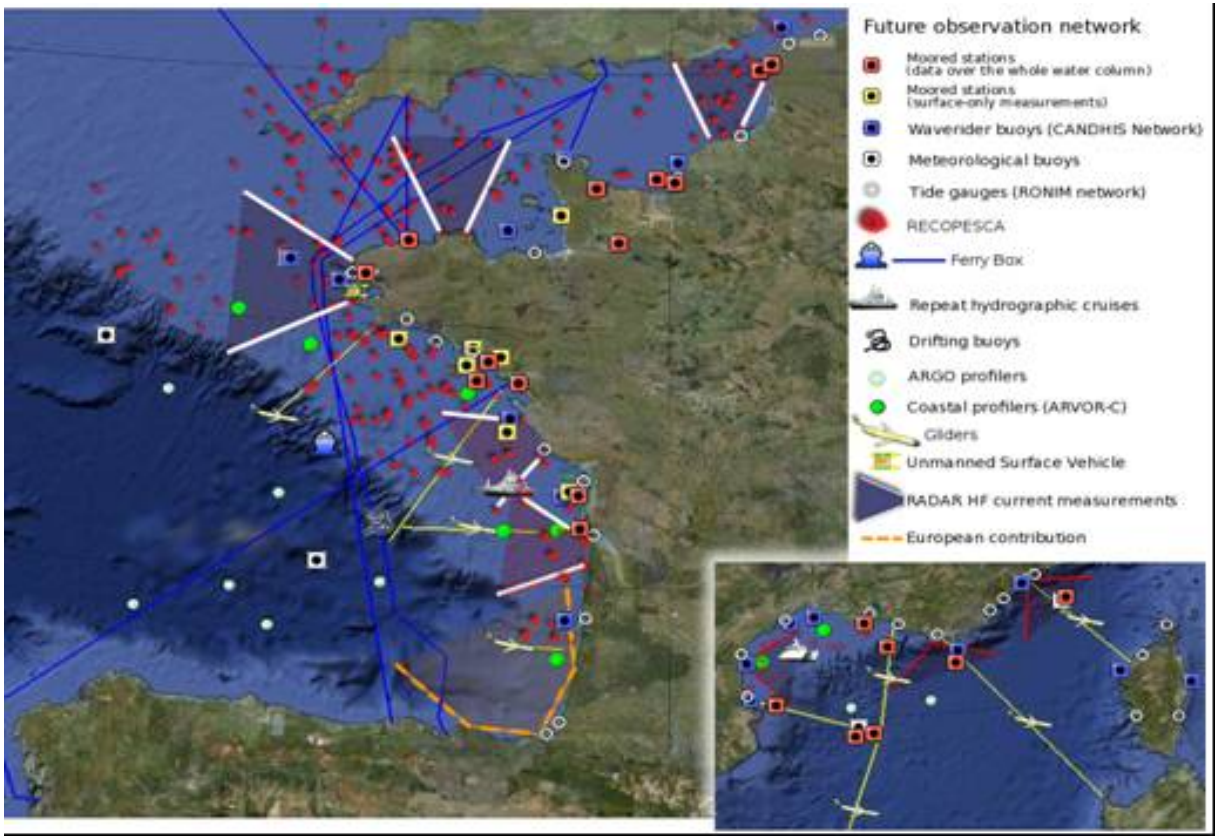
WP2: Development of the fixed observatory network (focus on French main fluvial plumes : Seine, Loire, Gironde, Rhone)

WP3: Observatories of opportunity : Recopesca (CTDs and turbidity sensors on fishing boat trawls) & ferrybox

WP4: HF Radar network

WP5: Glider fleet

# FONCE
## French Observatory Network of Coastal Environment



# FONCE
# French Observatory Network of Coastal Environment

WP1: Technology development for sensors, buoys and sub bottom platforms

Proposed development for sediment related parameters

- Association of multi-spectral sensors (performant for organic/inorganic material assessment) and multi-frequency acoustic sensors (performant for grain size analysis)

- Improving SPM quantification : development of antifouling systems

- Development of automatic in situ water samplers for SPM calibration

# Conclusions

Need for a better undersanding of **sediment pathways on the shelf**, based on :

- Observation (national / international networks, satellite image analysis)
- Numerical modelling (link with operational oceanography)

Research needed :

- improved measurement techniques (SPM, sand fluxes)
- feedbacks between turbidity and primary production (for in situ data analysis and satellite image processing)
- quantification of the impact of human activities
- development of indicators (e.g. links between environmental parameters and habitats, Marine Strategy oriented)