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IMEDEA

TRANSPORTE DE SEDIMENTOS EN LA PLATAFORMA CONTINENTAL DEL DELTA DEL EBRO: MODELIZACIÓN Y PREDICCIONES

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1. LIM-UPC, 2. IMEDEA, 3. SIMO

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Introduction

- Importance of inner shelf – aquaculture, fisheries
- High suspended sediment concentration impact on biota
- High energy events transport great quantities of sediment from shallow waters to deeper ones.
- Some pollutants absorb to cohesive materials
- Lack of numerical studies of the sediment dynamics at a shelf scale

- The main objective of this presentation is to describe results from the implementation of a sediment transport model in the **Ebro Delta continental Shelf**, and forecasting possibilities

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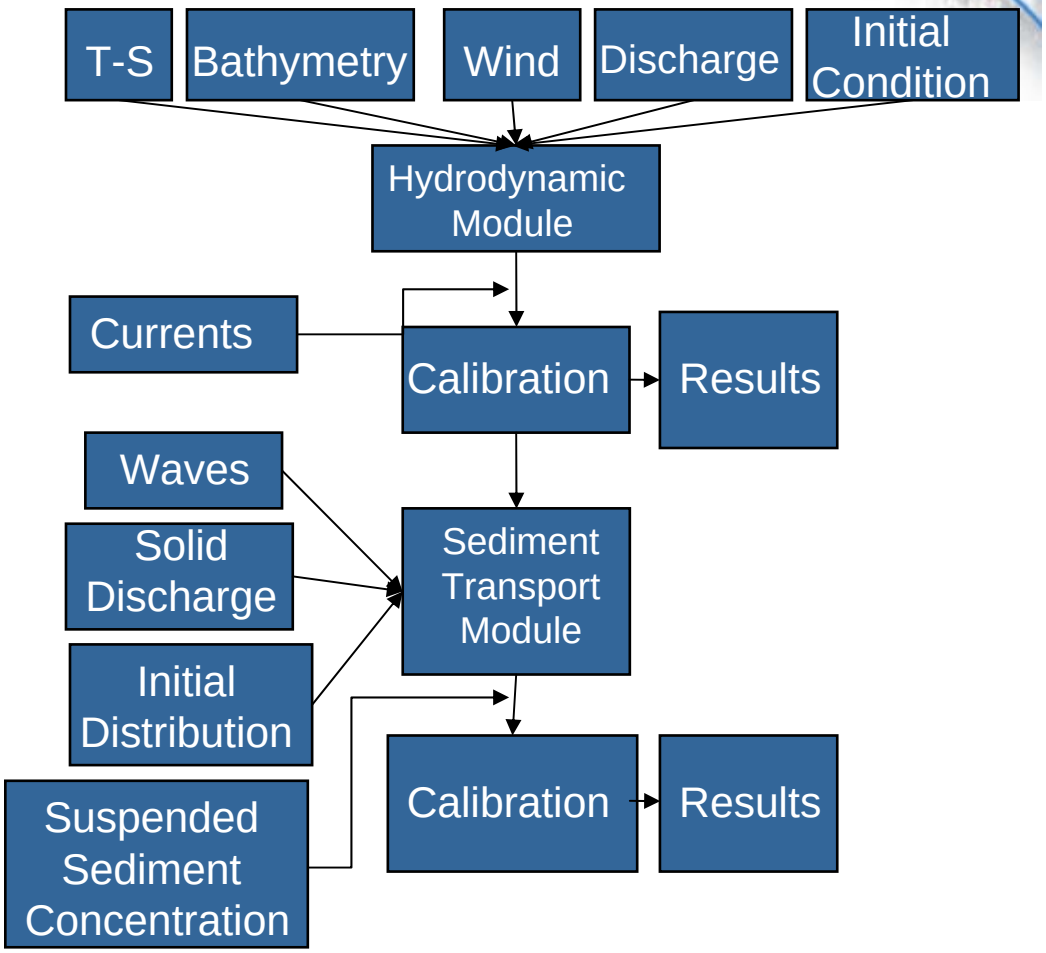
Numerical Model - Symphonie

- Pole d'Oceanographie Cotiere in Toulouse
- 3D primitive equation model of the coastal ocean.
- Implemented and validated in different coastal and ROFI areas
- Sediment transport module
- Possibility of bed armouring
- Cohesive and non-cohesive material



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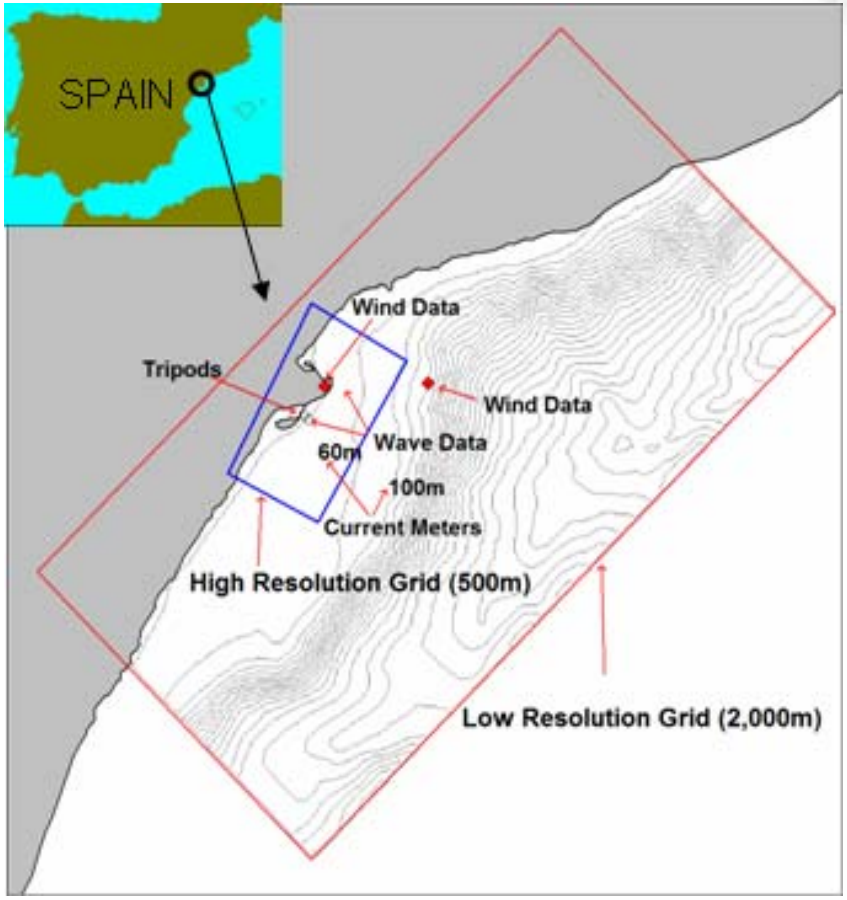
Model Implementation – First Steps

- Low resolution grid (2000m)
- Nested high resolution grid (500m)
- The model potential vorticity method (MPV) - initialization technique
- Current and sediment transport model calibrated



Implementation and calibration

- Freshwater, stratification, grid size, vertical level number, roughness length and friction coefficient roles evaluated.
- Sediment transport module implemented for 4 non-cohesive class and one aggregate.
- Spin-up role analysed.
- Sediment transport parameters calibrated

Parameter	Value
Partheniades Resuspension coefficient	0.00004
Smith & McLean Resuspension Coefficient	0.00300
Transition criteria from Cohesive to Non Cohesive (% of clay)	0.04
Porosity (%)	0.73
Sediment density (kg/m^3)	2650
Clay Diameter (m)	$2.0000E^{-06}$
Silt Diameter (m)	$5.5000E^{-05}$
Fine Sand Diameter (m)	$7.5000E^{-05}$
Coarse Sand Diameter (m)	$1.1500E^{-04}$

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Period 1 – Dec 96 – Jan 97

- High river discharge
- North winds, intensity higher offshore, but same pattern onshore.
- High current velocities associated to watercourse and wind interactions.

Wind Velocity

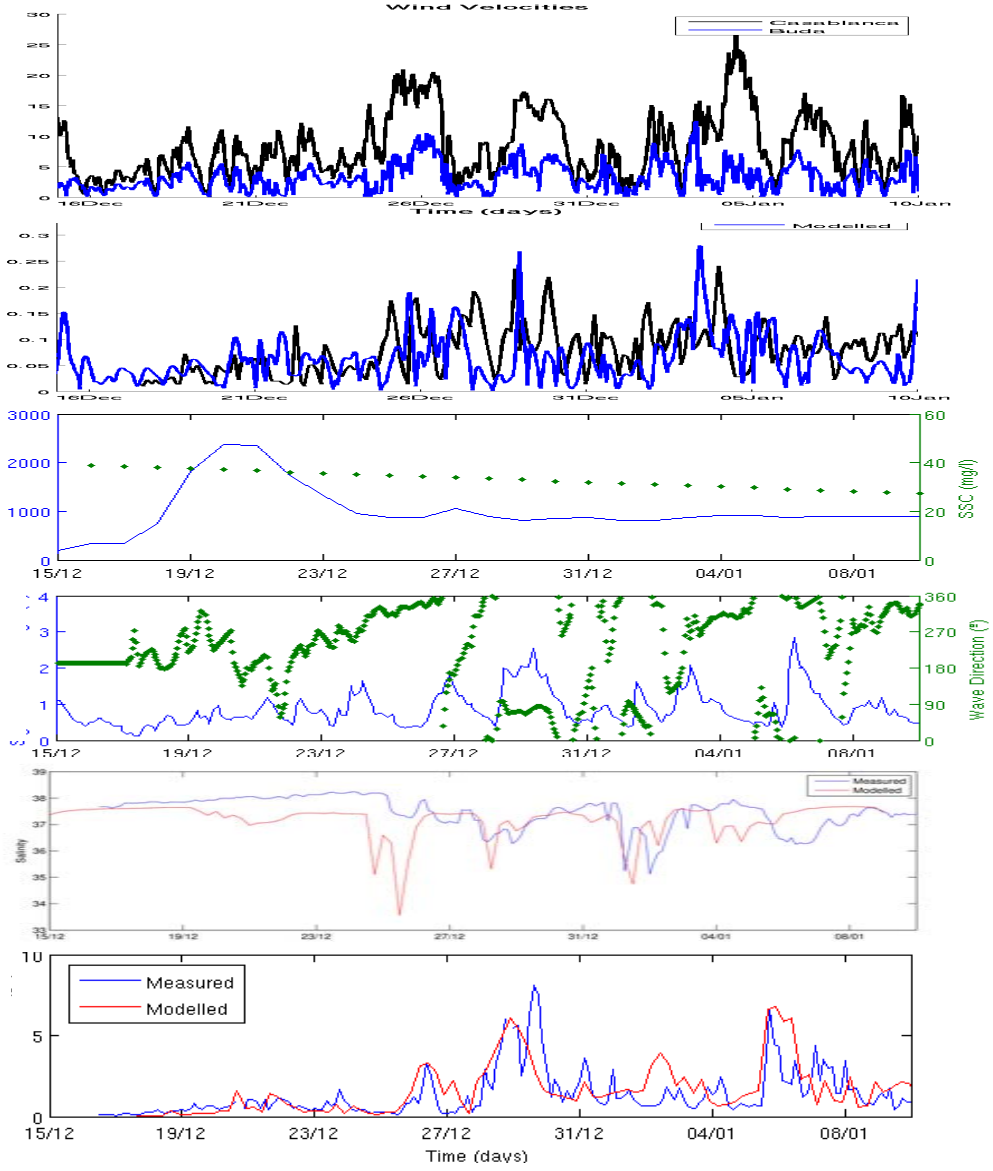
Current Velocity

River Flow

Wave Height - Direction

Salinity

SSC (g/l)



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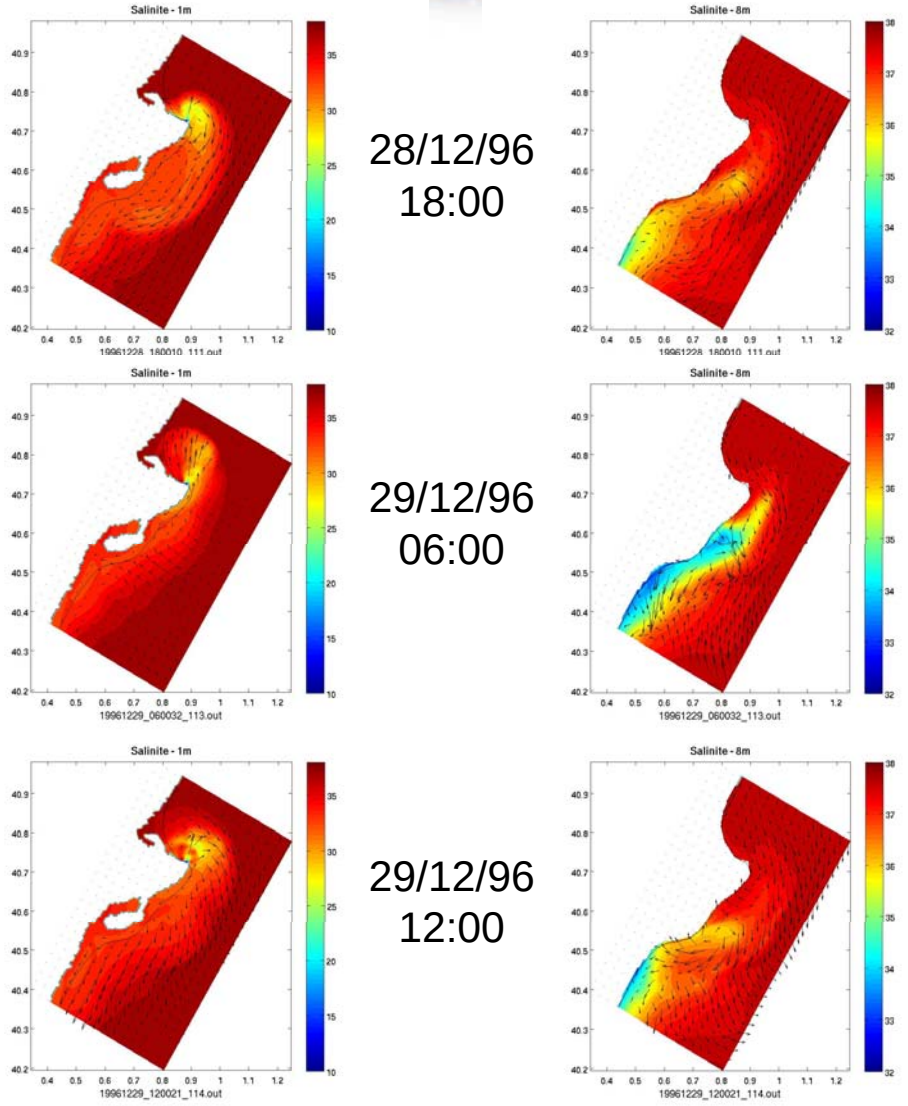
Period 1 – Salinity peak 2

- River plume developed on surface
- Offshore winds narrow and deepen plume influence
- Wind relaxation creates baroclinic instability

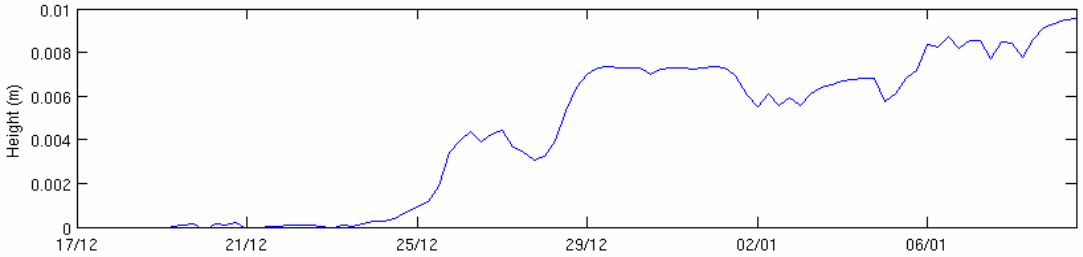


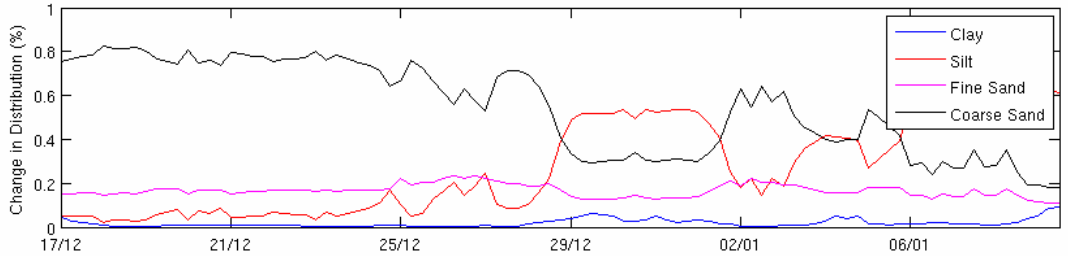
Salinity at 1m depth

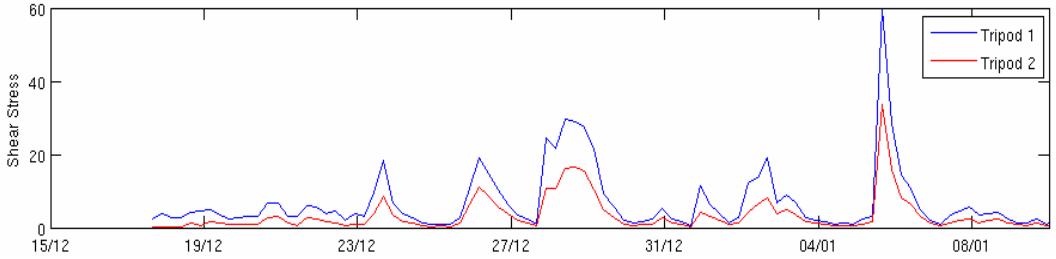
Salinity at 8m depth

Height and Class Change – Period 1 – Tripod 1

- Height increases in Tripod 1 as reported by Guillen et al (2005)
- Height changes associated to silt deposition







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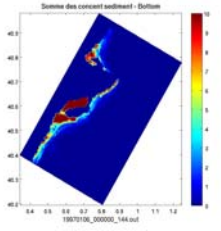
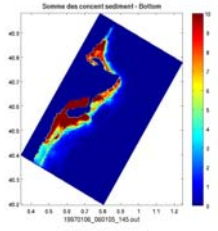
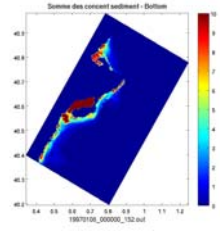
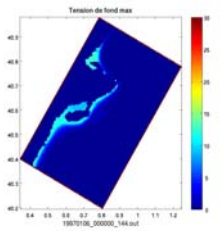
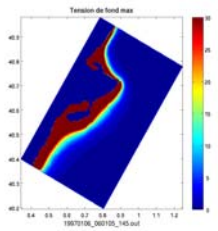
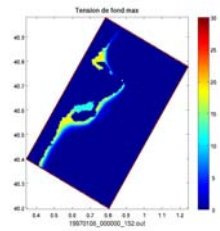
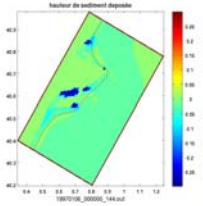
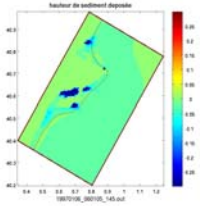
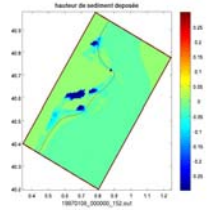
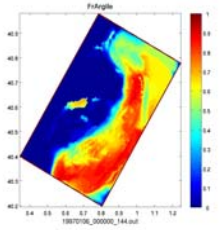
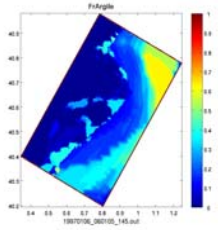
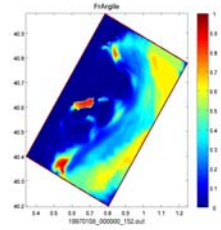
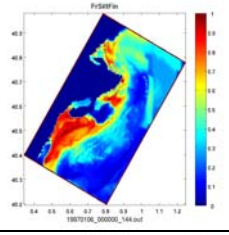
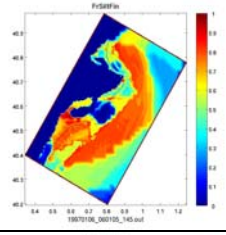
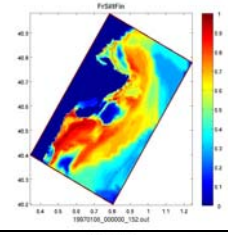
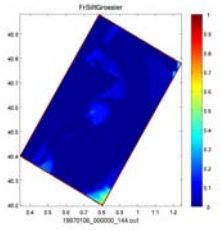
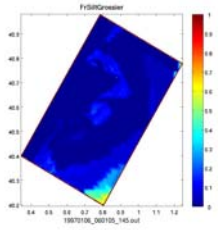
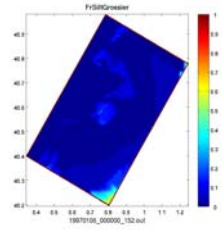
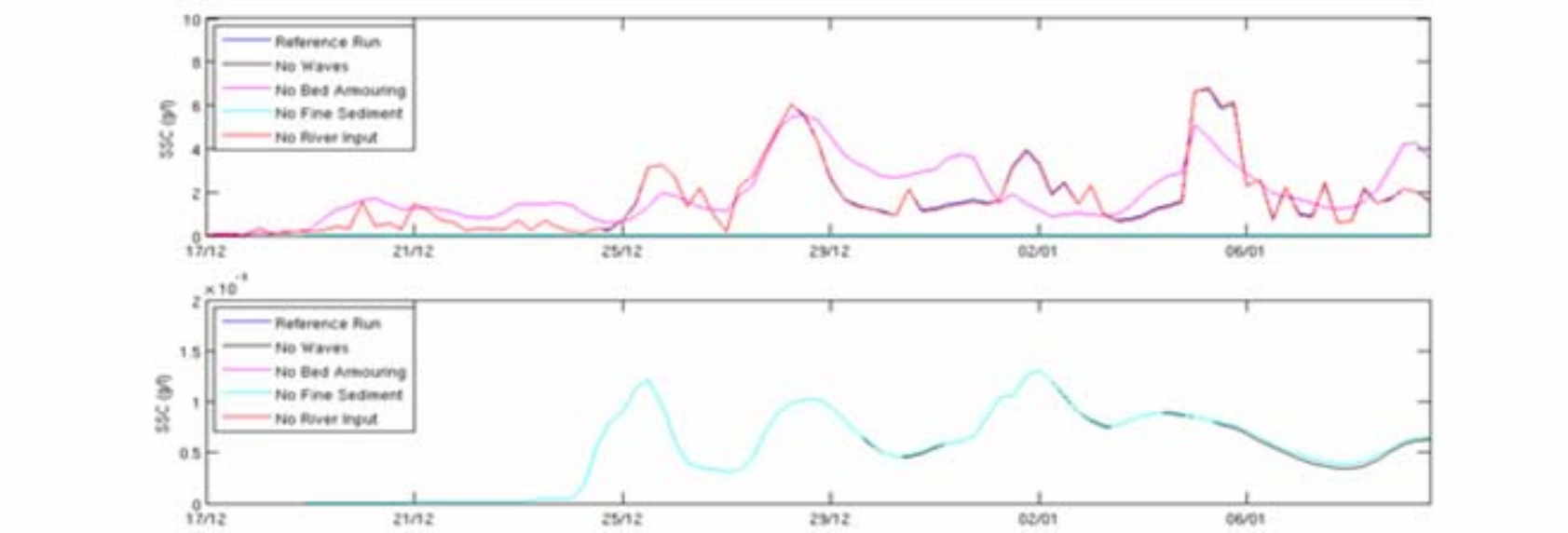
Height and Class Change – Period 1 – Whole Shelf

- Variables analyses around peak event
- Peak concentration around the Ebro Delta
- Clay material in suspension and off the model domain
- Silt becomes dominant class

	06/01/1997 00:00	06/01/1997 06:00	08/01/1997 00:00
Bottom SSC (g/l) (a)			
Shear Stress (b)			
Bottom Height Change (c)			
Clay Distri. (%) (d)			
Silt Distri (%) (e)			
Fine Sand (%) (f)			

Sediment Transport Sensitivity Tests

- No riverine input
- No waves
- No bed armouring
- No resuspension



- Great influence of waves and bed armouring
- Poor influence of river and currents role (in tripods area)

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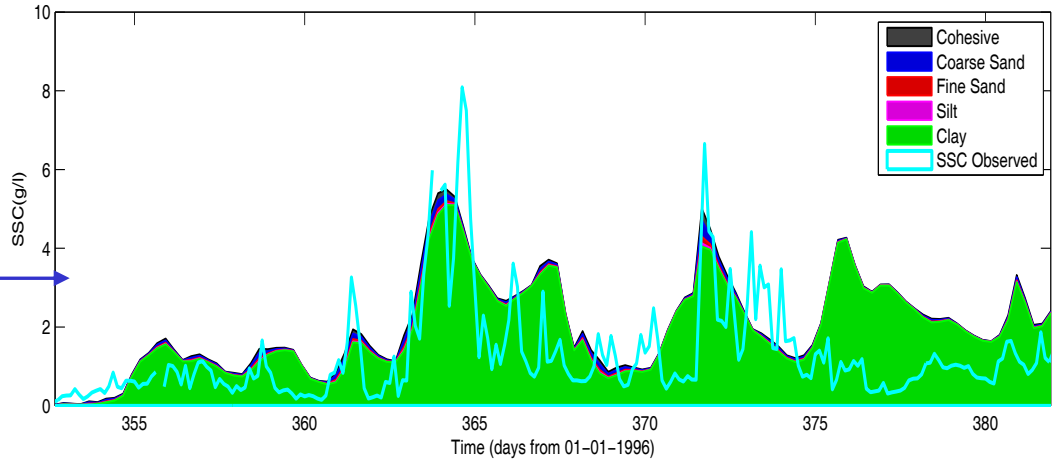
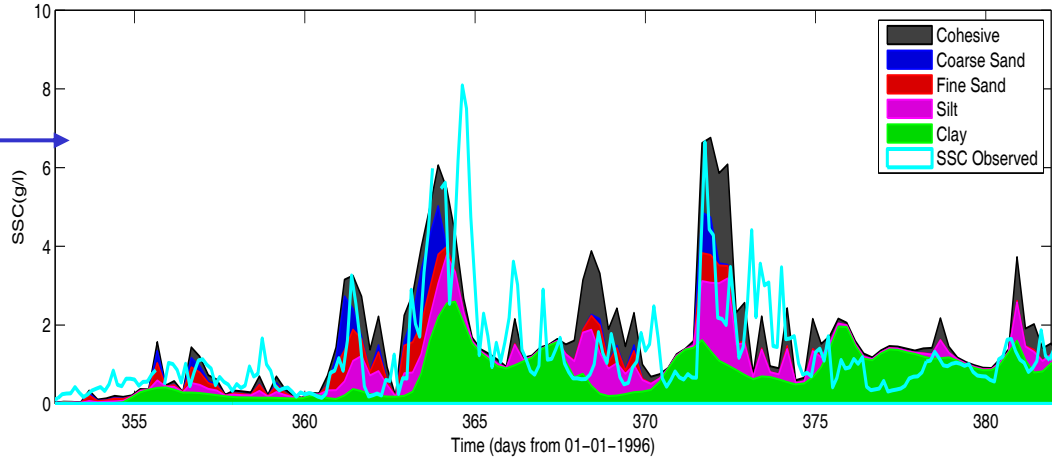
Bed Armouring

Bed armouring plays a major role in the model predictions

If bed armouring not included: finer class (clay) dominant



If bed armouring is included: other classes significant.



Bed armouring process limits the availability of fine grains

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Analysis of Forecasting possibilities

Main objectives are:

- Assess the sources of information required and their reliability
- Assess the difficulties on implementing an operational sediment transport model
- Assess the results accuracy

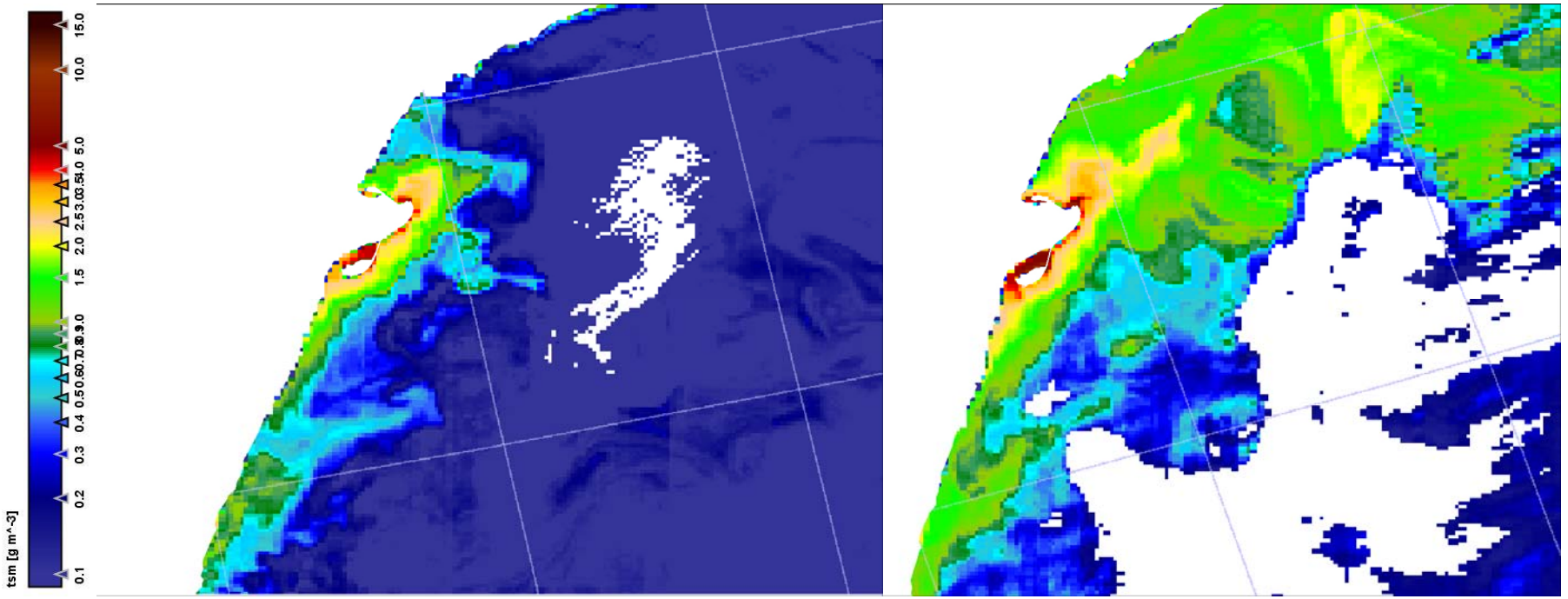
- Implementation carried out from February 2009 to June 2009.
- All data sources were analysed and compared to actual recorded data (Spanish Port Authority and XIOM data).
- Results for three 15 days continuos events (from 15/02/2009 to 21/03/2009) will be presented

Hydrodynamic Data Sources

- Hydrodynamic boundary conditions have or will be obtained from:
  - MFS
  - MERCATOR
  - ESEOMED
- Wind data: information gathered from:
  - AEMET
  - SMC
- Wave data: information gathered from:
  - SMC
  - Puertos
- Watercourse data:
  - Operational hydrological model data could not be gathered. Recorded data used.
  - Ebro River SSC-discharge relationship formula used.

Sediment Transport Data Sources

- Satellite images: Meris case II satellite images. Analysed and processed using the MERIS case 2 Regional Processor (Doerffer and Schiller, 2008). Data used for validation.



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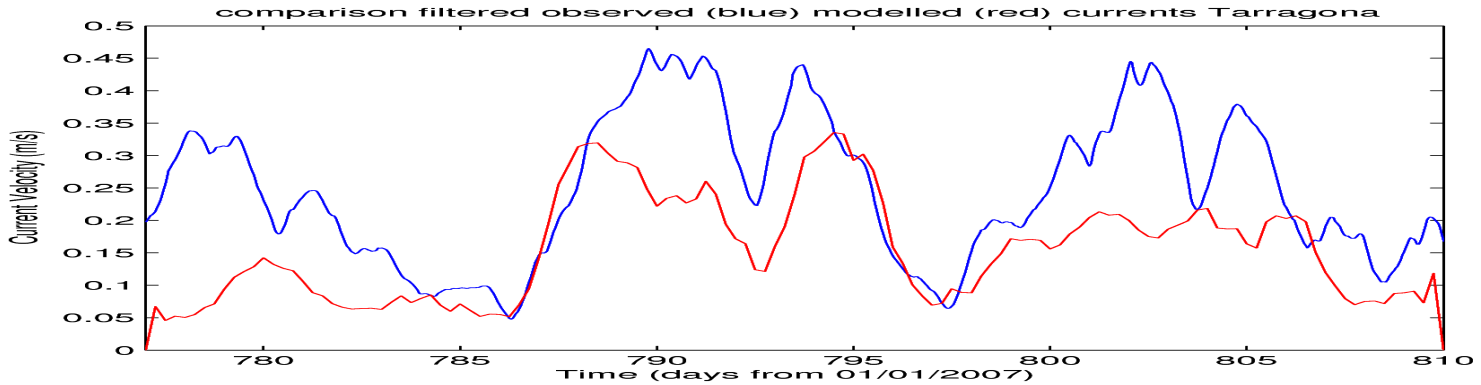
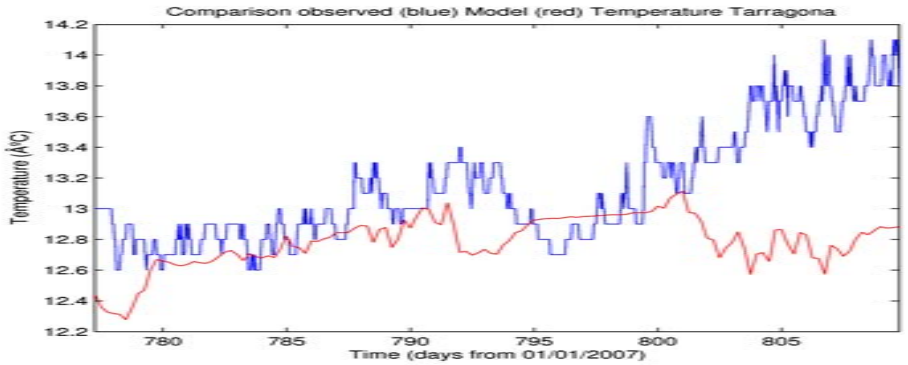
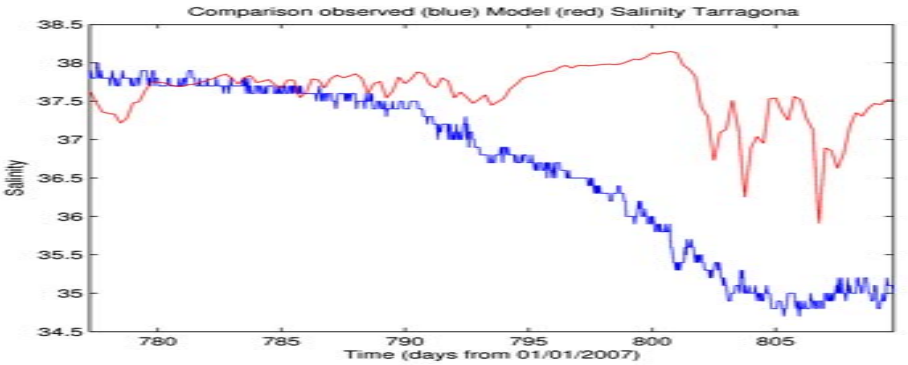
Validation Hydrodynamic Module

Current, temperature and salinity information from nearby buoys were used for the hydrodynamic model validation







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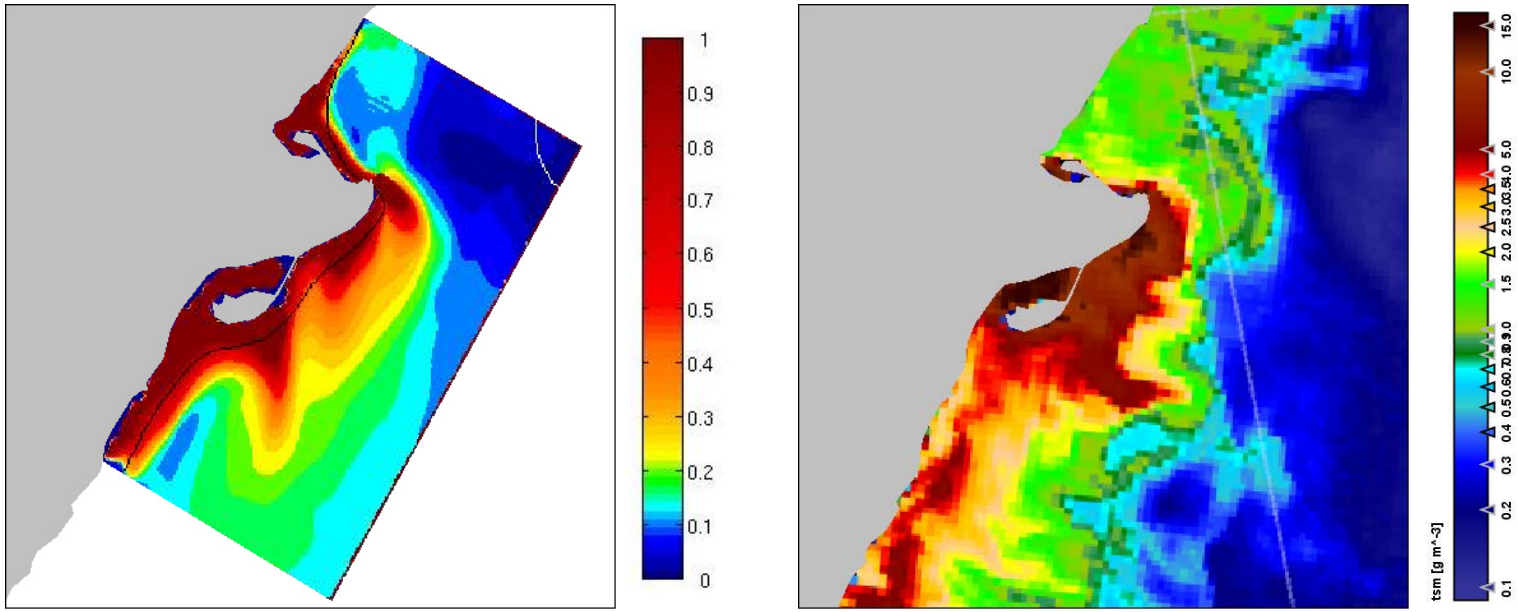
Validation Sediment Transport Module

Satellite images were used for the sediment transport model validation



Total suspended sediment concentration (g/m3) for 06/03/09, model results (a) and satellite observations (b).

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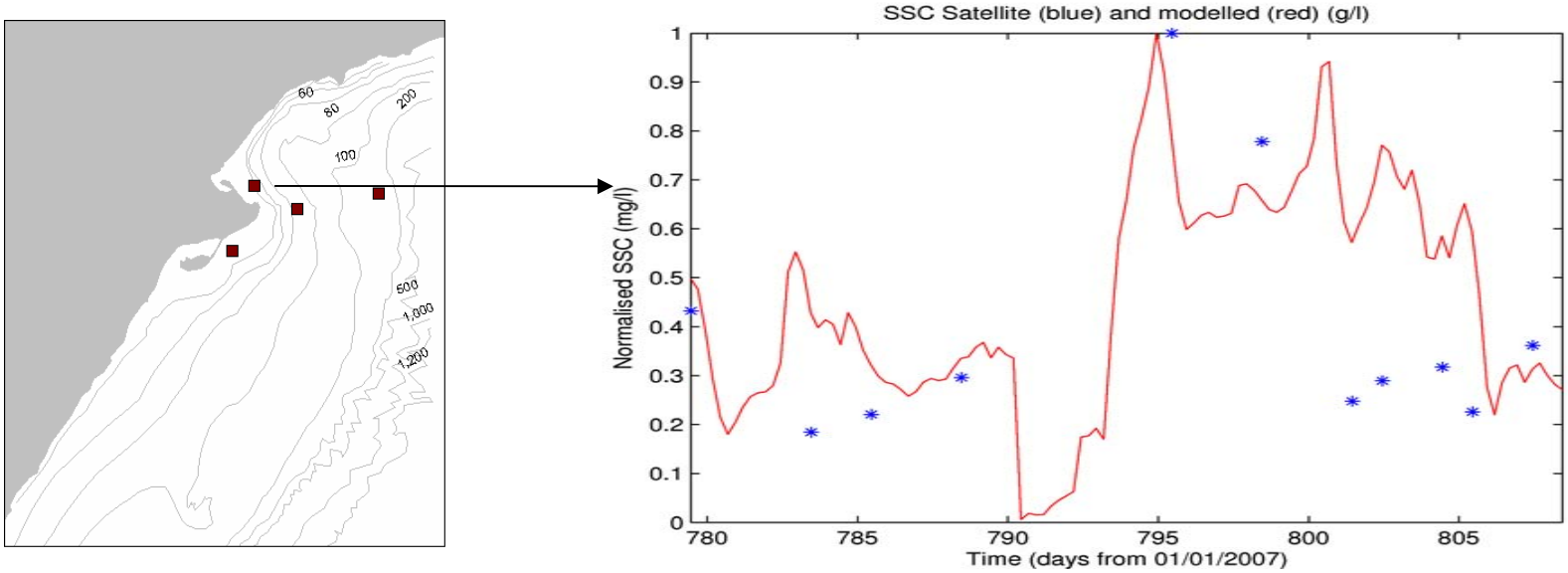
Validation Sediment Transport Module

Data from the satellite images at several surface points were compared to predicted data



Total suspended concentration (mg/l) comparison for recorded (blue stars) and predicted (red) data

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Findings and Issues

- Satisfactory 1996-1997 events hydrodynamic and sediment transport model calibration.
- Satisfactory pre-operational hydrodynamic and moderately satisfactory sediment transport validation undertaken
- Issues found with watercourse data gathering
  - Operational discharge not available
  - SSC non-existing
- Data sources quality may affect accuracy results
- Future work
  - Initialisation techniques
  - Assessment of different data sources to improve results.