SST modelling in the Sea of Iroise. Assessment of boundary conditions.

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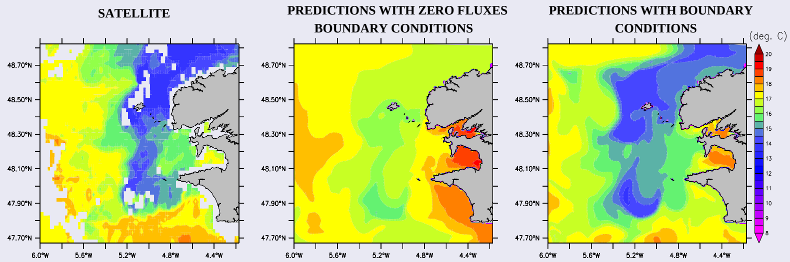
Purpose

Objective

Analyse the sensitivity of Sea Surface Temperature (SST) predictions in the Sea of Iroise to open boundary conditions of temperature.

An example in 30 August 2011

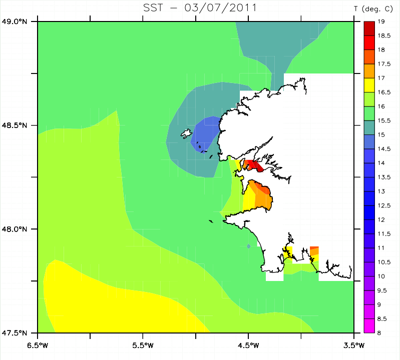


Purpose

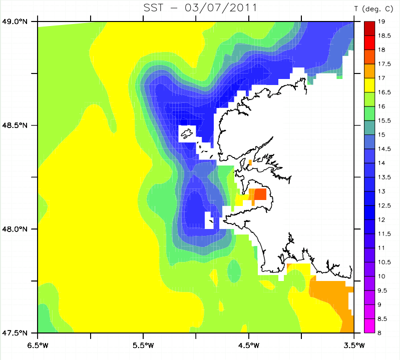
Two types of boundary conditions tested

MyOcean products available on the website **http ://www.myocean.eu/**.

The Mercator Global Ocean system (MGO)



The Iberian Biscay Irish system (IBI)



Purpose

Forecasting Systems Description

MGO

- Mercator PSY2V4 HAM - North Atlantic Ocean
- 7 days of forecast
- Based on **NEMO** model (Nucleus for European Models of the Ocean) (Madec, 2008)
- 1/12 deg. of horizontal resolution
- 43 vertical levels

↓ ↓

MyOcean product

PSY2V4R2 HAM

IBI

- Daily run by Puertos del Estado and Mercator Ocean
- 5-day of forecast
- Based on **NEMO** model
- 1/36 deg. of horizontal resolution
- 50 vertical levels
- High frequency processes (tidal forcing, surges, fresh water discharges)

↓ ↓

MyOcean product

IBI ANALYSIS FORECAST PHYS 005 001 b

Model Description

COHERENS

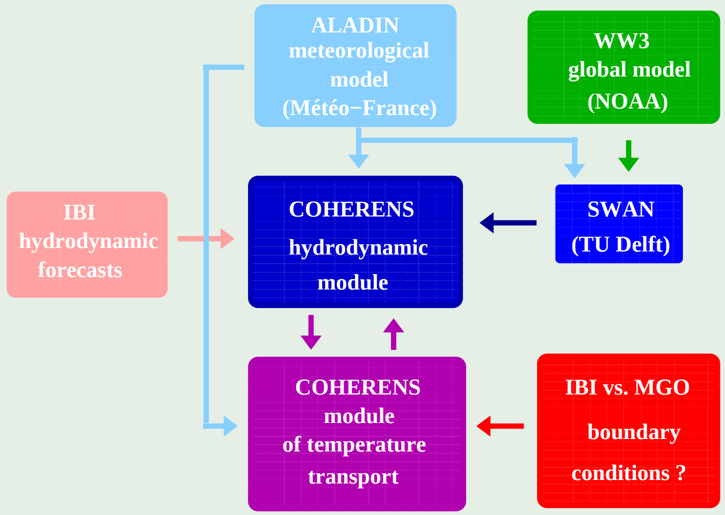
- COupled Hydrodynamical Ecological model for RegioNal and Shelf seas
- Management Unit of the North Sea Mathematical Model (MUMM, Bruxelles, Belgium) (Luyten et al., 1999)
- MAST projects PROFILE, NOMADS and COHERENS (EU) (1990-1999)
- **http ://www.mumm.ac.be/coherens**

Physical processes integrated

1. 3D hydrodynamic mode
2. Temperature and salinity transport
3. Effects of the waves on sea surface roughness (Pan et al., 2008) and apparent bottom roughness (Grant and Madsen, 1979) parameters

Model Description

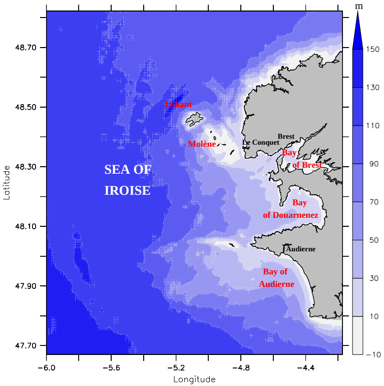
Flow chart of the modelling system



Model Setup

Computational domain

- $\Delta\lambda = 0.015$ ^{o},
  $\Delta\phi = 0.009$ ^{o} (1 km)
- $N_x = 124$, $N_y = 129$,
  $N_\sigma = 10$
- $z_0 = f(d_{sed})$
  (Hinschberger et al., 1968 ; SHOM, 1996)



Forcings

1. ξ and $\overline{U}$ from **IBI** at one-hour interval
2. Meteorological data of **ALADIN** model (**Météo-France**)
3. **SWAN** driven by global **NOAA** predictions
4. River outflows from measurements (Elorn and Aulne rivers)

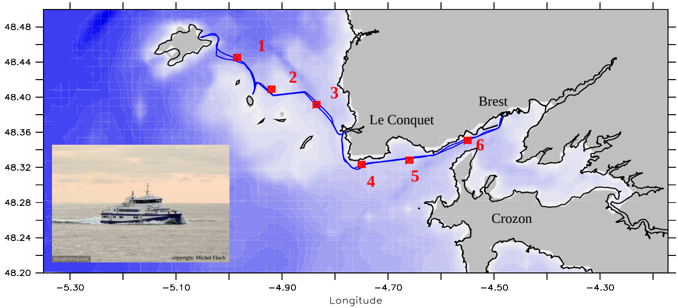
Comparison With In-Situ Measurements

S !RANO project **(Duvieilbourg et al., 2012)**

"**S**urveillance des eaux de surface en mer d'**I**roise et **RA**de de Brest par des **N**avires d'**O**pportunités"

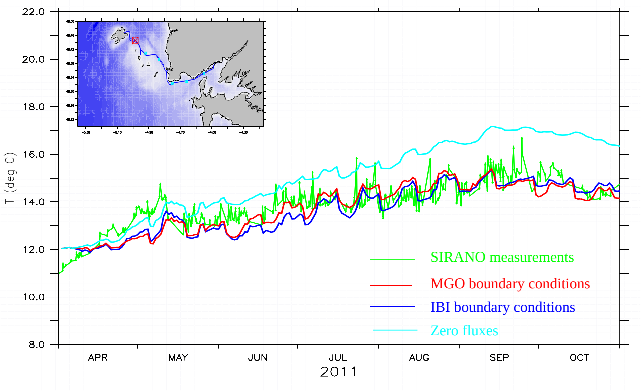
http ://memphys-lgce.fr.ht

- Nearshore along the routes of "Enez Eussa III" vessel until end of 2011 → "Fromveur II" vessel later in 2012
- SST time series extracted in a series of 6 points along the route of the vessel
- Data gathered at a distance less than 500 m of each point



Comparison With In-Situ Measurements

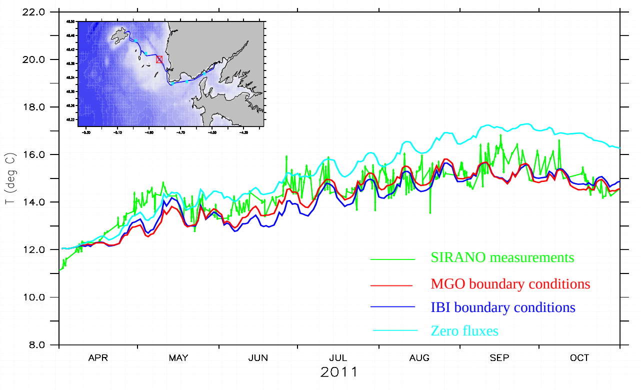
Point #1



1. Predicted SST with MGO BC over predicted SST with IBI BC in summer(the reverse happens in spring and autumn)
2. SST predictions modulated by spring-neap tidal cycles

Comparison With In-Situ Measurements

Point #3



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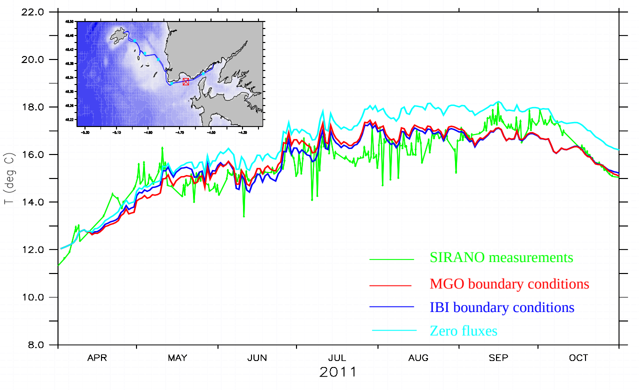
Comparison With In-Situ Measurements

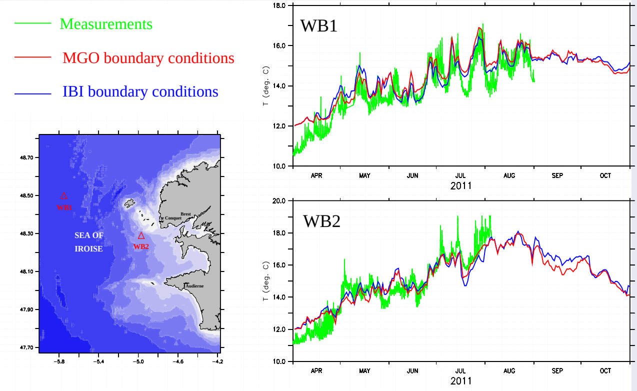
Point #5



1. Predicted SST with MGO BC over predicted SST with IBI BC in summer (the reverse happens in winter)
2. SST predictions modulated by spring-neap tidal cycles

Comparison With In-Situ Measurements

Offshore stations WB1 and WB2



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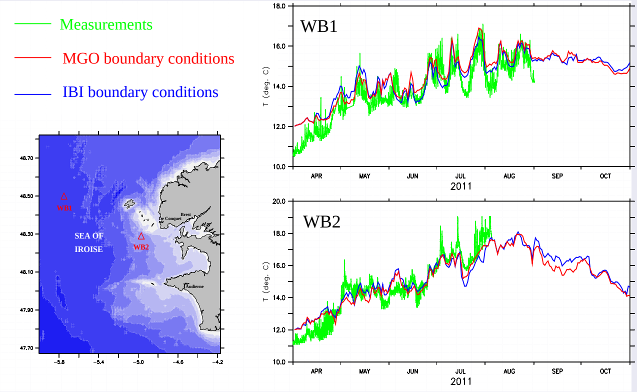

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2. Spring-neap tide variability of SST reproduced

Comparison With In-Situ Measurements

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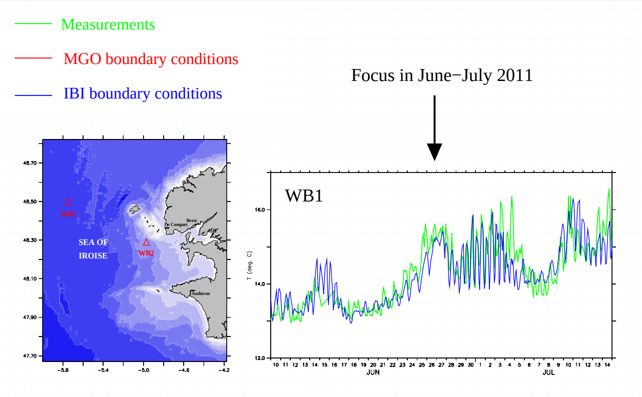
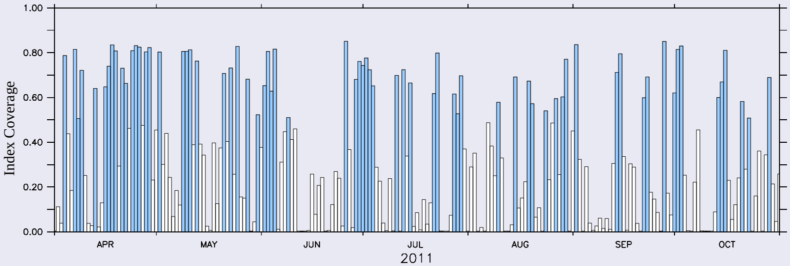


1. Lack of data at the end of the period of interest
2. Spring-neap tide variability of SST reproduced
3. Night-day variability of SST reproduced

Comparison With Satellite Images

European Ocean-SST Multi-Sensor L3 Observations

Available on **MyOcean** website (http ://www.myocean.eu/).



Index coverage of satellite data over the computational domain (blue light = $r_{ind} > 50$ %, red = selection).

- Selection of 3 images for different periods of the year

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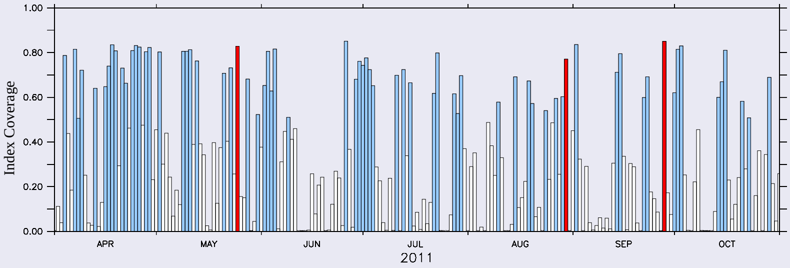

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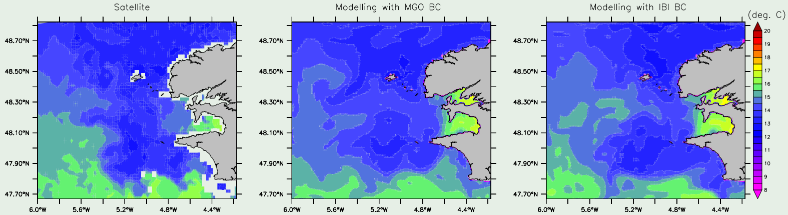
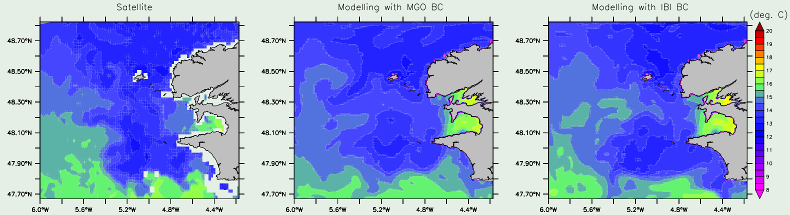
Comparison With Satellite Images

25 May 2011

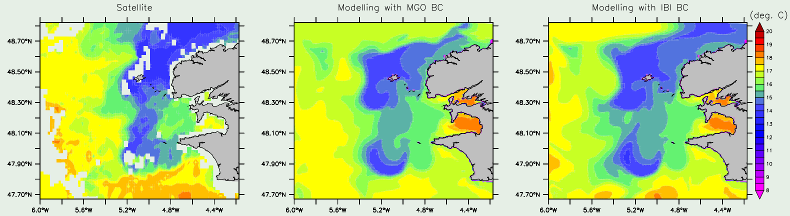


Comparison With Satellite Images

25 May 2011

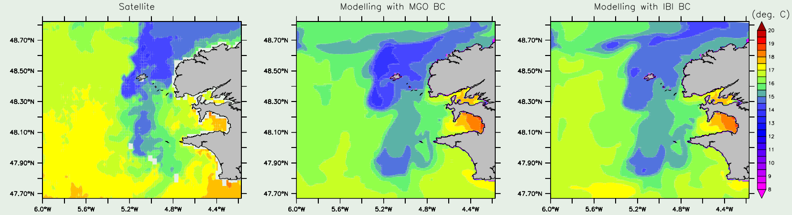


30 August 2011



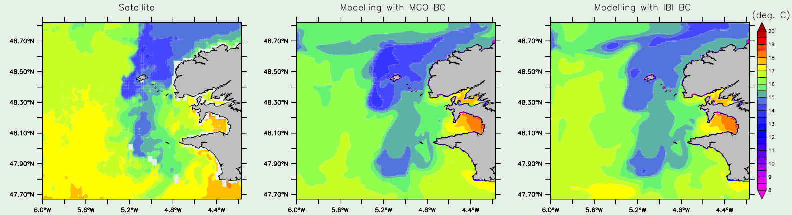
Comparison With Satellite Images

28 September 2011



Comparison With Satellite Images

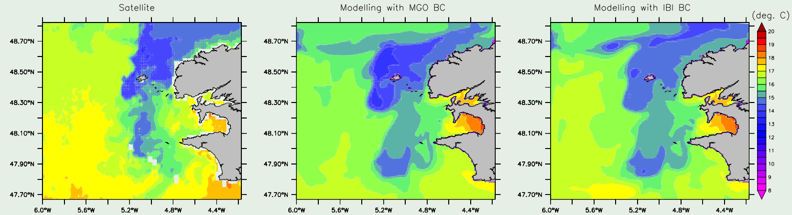
28 September 2011



- Moderate differences between both simulations
- Major differences close to boundary conditions till water depths > 50 m

Comparison With Satellite Images

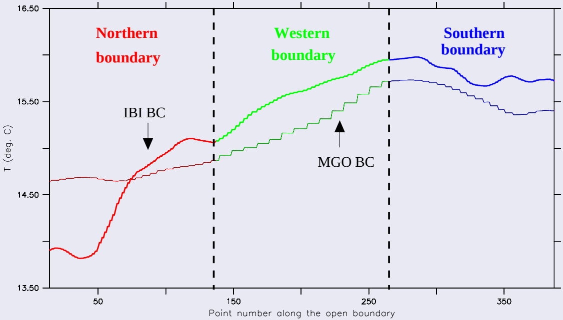
28 September 2011



- Moderate differences between both simulations
- Major differences close to boundary conditions till water depths > 50 m
- Horizontal thermal gradient from offshore boundaries till nearshore areas between the isles of Ushant and Sein slightly better reproduced with IBI BC
- Northern thermal front more clearly with IBI BC

Analysis of Boundary Conditions

Spatial evolution of prescribed SST for the period of simulation



- Intrusion of cold water at the north-eastern boundary with IBI BC
- Warm water along the western and northern boundaries with IBI BC

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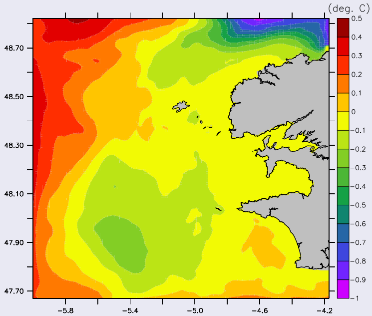
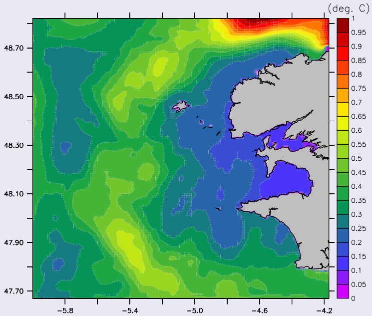
May increase horizontal thermal gradients in the vicinity of Ushant front.

Analysis of SST Predictions

Averaged relative differences between IBI and MGO forcings



Absolute averaged differences between IBI and MGO forcings



1. Major difference at the north-eastern boundary $\rightarrow$ related with the intrusion of cold water with IBI BC
2. Warm water offshore and cold water nearshore with IBI BC (in average)
3. Slight difference in nearshore areas, mainly close to the external thermal front

Conclusions and Perspectives

Summary

1. Implementation of a hydrological model compared to SST measurements in the nearshore areas of the Sea of Iroise
2. Importance of temperature boundary conditions to reproduce the horizontal thermal gradients and associated features (Ushant thermal front)

Conclusions

1. Slight differences between IBI and MGO BC in nearshore areas
2. Major differences related to the intrusion of cold water at the north-eastern boundary and offshore in water depths > 90 - 100 m

Perspectives

1. Extending comparison with measurements in these areas

Thank you very much for your attention.