COASTAL OBSERVATIONS
& FORECASTS

PREVIMER: Downscaling from MyOcean regional scale to coastal scale

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The challenge

Our coastal zones are subject to increasing **anthropogenic pressure**. Monitoring systems are required to protect them, prevent or mitigate risks, ensure a sustainable management of their resources and assess coastal seas energy potential.
PREVIMER provides **coastal observations, hindcasts and 4 days forecasts** for the French coasts of the English Channel, Atlantic Ocean and Mediterranean Sea: currents, water levels, waves, temperature, salinity, turbidity, nutrients and plankton concentrations (Dumas *et al.,* 2014).

Modelling strategy

PREVIMER models are coupled to MyOcean modelling system. The modelling strategy consists in **downscaling from regional to coastal scale**, nesting fine resolution configurations within regional configurations. Strategy has to be adapted to tackle the appropriate scales relevant of the coastal ocean dynamics: **processes with (1) high frequency** linked to tidal, meteorological and rivers forcing and **(2) short spatial scale**, du to morphology of the basins and first baroclinic internal radius - e.g. in the bay of Biscay it varies from 2 km next to the coast to 30 km at the shelf edge. Catching such processes implies :
(1) **a high spatial resolution** far beyond this (i.e. around 200 m), due to the effective resolution of numerical models which is large than grid space (7-9 Δx)
(2) **adapted meteorological forcing** to catch the fine structure (fronts, drop-off, breeze…) that drive the coastal circulation
(3) **correct rivers run-off**, which are a major inputs of buoyancy in the coastal seas.

PREVIMER regional model resolution has been settle to **1.2 km** in the northwest Mediterranean Sea (MENOR) and to **2.5 km** in the bay of Biscay and English Channel (MANGAE), with a multigrid downscaling dropping the resolution down to **500 m** next to the coast. The meteorological forcing is provided by Météo-France AROME analysis (1 hour, 0.025°, 2-3 km). Main runoffs are introduced with the daily monitored fluxes.

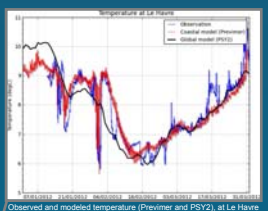
Downscaling from global (MyOcean) to regional and coastal scale (PREVIMER)

Downscaling with two-way nested models

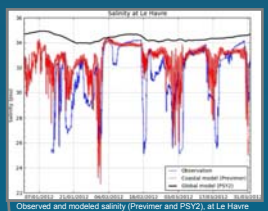
Two-way nested models, with a spatial resolution of 500 m, are being developed and validated along bay of Biscay and English Channel. The system relies on **AGRIF** (Adaptive Grid Mesh Refinement In Fortran, Debreu *et al*., 2008), which concept is a full overlapping domain decomposition method. These models are validated comparing results with **high frequency observations**, adapted to the fast dynamics of coastal areas, and collected in the framework of PREVIMER project.

Sea surface temperature and salinity are compared with observations from Smatch buoys. Taylor diagrams, based on comparisons between model and observations, give a synthetic view and confirm the **improvement of statistics with coastal models**, except for temperature in Houat island. The winter times series showed on top panels (middle en right) illustrate the typical high frequency contents of surface temperature and salinity, that is caught next to a large estuary (Seine): drops of several psu (up to 10) or temperature (around 3°C) that may occur within a day. The rapid variation in the signals are **properly simulated** (duration and amplitude) **by the coastal focused models,** because it accounts for the main sources of variability (river runoffs from large ones -eg the Seine- to small ones -eg the Orne-, fine structures of wind that varies rapidly, tides, part of the coast line fragmentation) inherent to the coastal dynamics. It seems that a 500 m resolution model allows to capture a large part of this variability, even if dynamical or morphological arguments let think the system resolution should be enhanced by a factor 2.

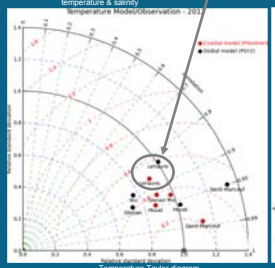
Location of Smatch buoys measuring surface temperature & salinity



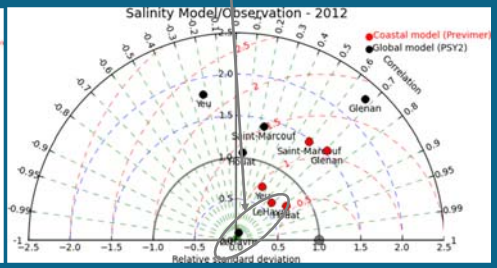
Observed and modeled temperature (Previmer and PSY2), at Le Havre



Observed and modeled salinity (Previmer and PSY2), at Le Havre



Temperature Taylor diagram

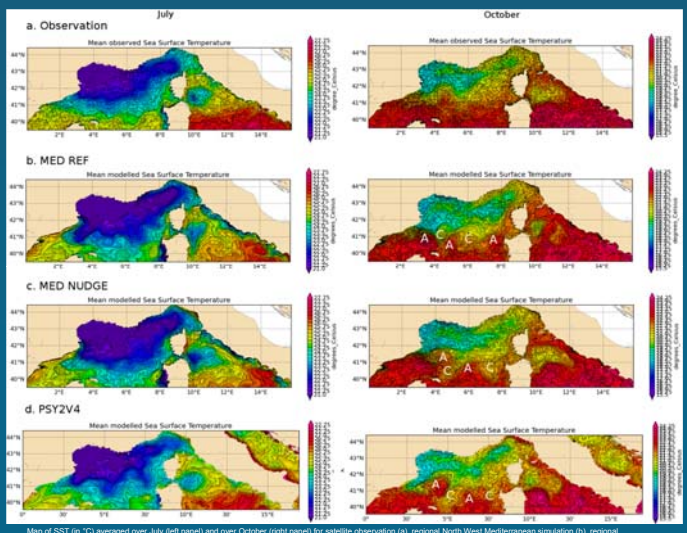


Salinity Taylor diagram

Improving coherence between global and regional scale

Improvement of coupling between MyOcean global/regional models and PREVIMER regional/coastal models is essential to ensure **consistency during downscaling** and provide to users a **continuous view of the ocean**. This is possible thanks to innovative techniques, such as **spectral nudging** (Herbert *et al*., 2014).

The regional hydrodynamic model (North West Mediterranean sea, 1.2 km) is here forced by a coarser global model (PSY2V4, 9-10 km), which assimilates observed data. The regional model temperature and salinity are spectrally nudged towards global numerical solution using nudging terms in the tracer equations. This technics allows to **match the regional solution with the global one**, taking advantage from global model data assimilation at large scale. Positions of anticylonic and cyclonic eddies are properly corrected thanks to spectral nudging.



Map of SST (in °C) averaged over July (left panel) and over October (right panel) for satellite observation (a), regional North West Mediterranean simulation (b), regional North West Mediterranean simulation nudged (c), and global model PSY2V4 (d). The anticyclonic and cyclonic eddies are respectively indicated by A and C.

References

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Acknowledgements

The authors would like to thank Météo-France for providing meteorological data, French Hydrographic Offiice (SHOM) for providing bathymetric data, SCHAPI and partners for providing river flows and ACTIMAR for their collaboration on VACUMM tools for the validation of ocean models.

Project co-funded by the European Union and coordinated by Ifremer and SHOM