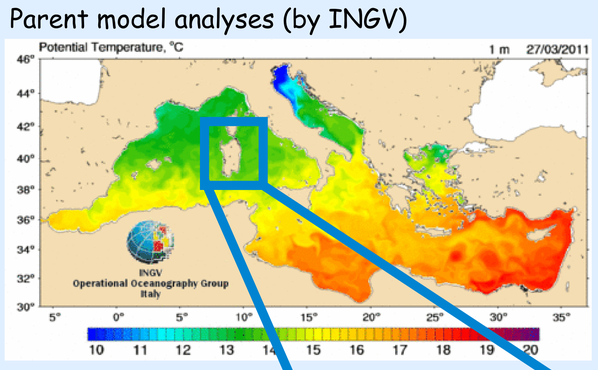
Impact of surface fluxes formulation on the circulation around Sardinia

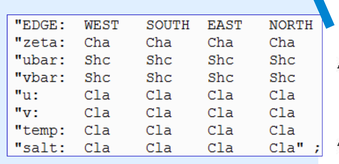
Antonio Olita*[1], Ilaria Iermano[2] and Roberto Sorgente[1]
[1] CNR – Institute for Coastal Marine Environment, Oristano Section, Torregrande (OR) – Italy
[2] Department of Sciences and Technologies , Parthenope University, Naples - Italy
*antonio.olita@cnr.it (*uranoscopus* in roms users forum)

1 – AIM AND OBJECTIVES

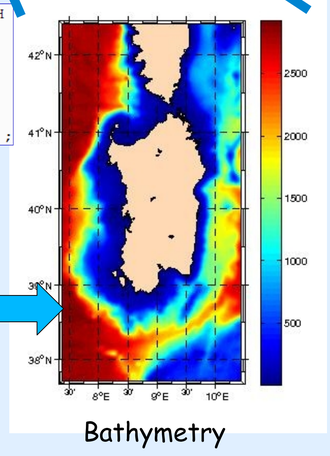
The impact of different surface flux formulations [AF) momentum and heat fluxes prescribed by the atmospheric model; BF) interactively computed by the model thorugh bulk formulae; BFC) same as BF but with currents included on stress computation in BULK_FLUXES.F] on the circulation of the seas around Sardinia (Western Mediterranean sea) is investigated trough a set of three experiments performed with ROMS. The aim is to find an optimal setup to simulate the coastal circulation in such a complex area.

Parent model analyses (by INGV)





ECMWF
ERA-INTERIM



Bathymetry

2 - MODEL

SESAMO (SEas of SArdinia MOdel) is a (sub-)mesoscale resolving implementation of the three-dimensional hydrodynamic model ROMS (v3.6). **ROMS** is a free-surface, terrain-following, primitive equations ocean model widely used by the scientific community for a diverse range of applications (Shchepetkin and McWilliams, 2003; 2005).
The model is implemented between 7.3° E - 10.5° E and 37.7° N - 42.5° N with a horizontal resolution of 2 km (meridional range 1.8 to 2.2 km).
In the vertical it uses 30 "s" terrain-following levels (Vtransform=2, Vstretching=4). Maximum depth is ~2600m while the minimum is set to 5m. The model bathymetry is interpolated from the 2' Smith and Sandwell topography (1997), derived from altimetric data. The model is forced at boundaries by the analyses fields produced by Mediterranean Forecasting System at 1/16° of horizontal resolution, provided by INGV through myocean portal.
At surface it receives 3-hourly re-analyses fields from ECMWF (ERA-INTERIM) at 0.125° of resolution.

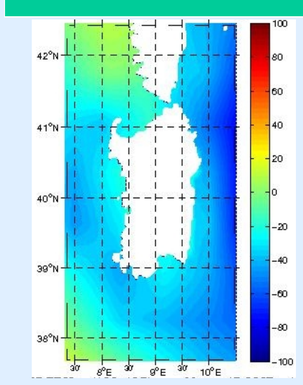
3 – EXPERIMENTS

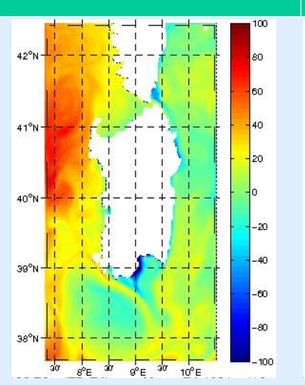
We performed three experiments (covering first 6 months of 2012) with the brand-new implementation of SESAMO above described in order to estimate the sensitivity of the system to the surface fluxes forcing. The impact of the use of prescribed fluxes or fluxes interactively computed (AF – Atmospheric model Fluxes and BF – Bulk Fluxes, respectively) was assessed. A third experiment concerned the inclusion of the effect of surface currents in stress computation (BFC - Bulk Fluxes with Currents experiment).
The table below resumes the three setups:

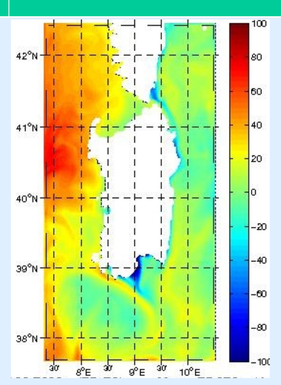
FLUX \ EXP	AF	BF	BFC
MOMENTUM	by Atm model	BULK_FLUXES (u and v @ 10 m)	Modified BULK (ocean currents)
NET HEAT	by Atm model	BULK_FLUXES (T-air, dew point etc)	BULK_FLUXES
E-P	by Atm model	EMINUSP	EMIUSP

4 – RESULTS

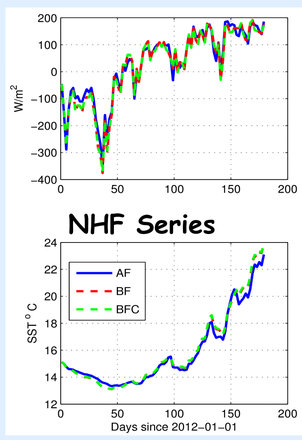
Heat fluxes and SST show large spatial variations between AF and BF, while the averaged budget seems maintained between the two setups. BFC setup shows his impact above all in terms of surface kinetic energies, as expected. Coastal dynamics seem better simulated by using BULK (modified or not) than using directly fluxes, as argued by a qualitative comparison with satellite data.

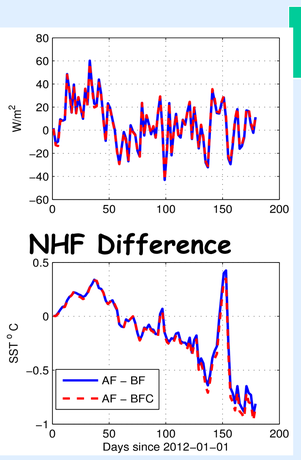






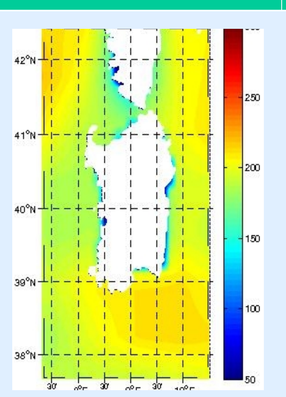
HEAT FLUXES AFTER 100 DAYS OF RUN

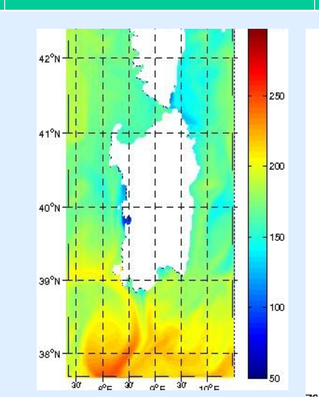


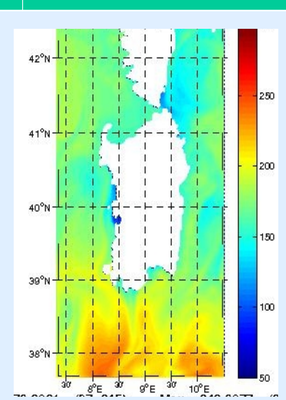


SST Series

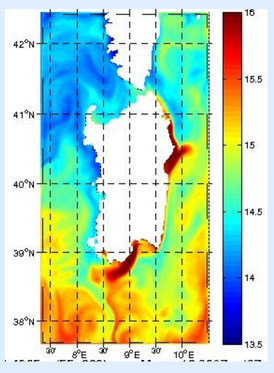
SST Difference

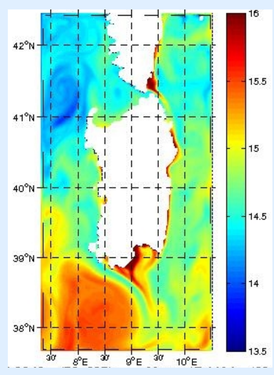


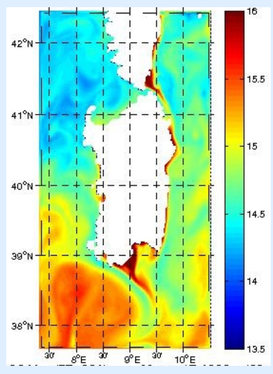




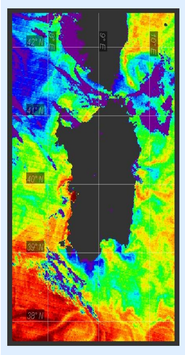
HEAT FLUXES AFTER 180 DAYS OF RUN



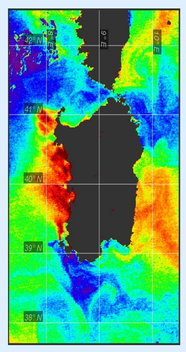




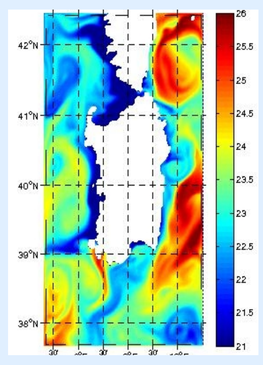
SST AFTER 100 DAYS OF RUN

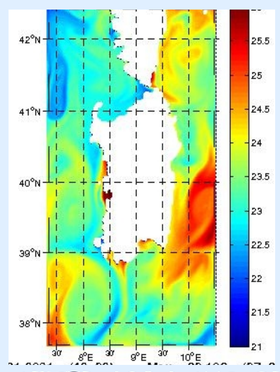


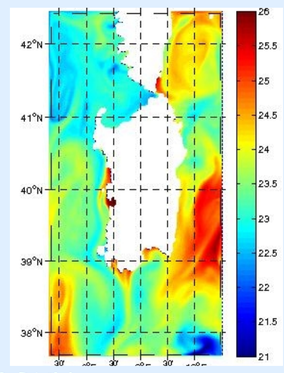
Sat SST



Sat SST







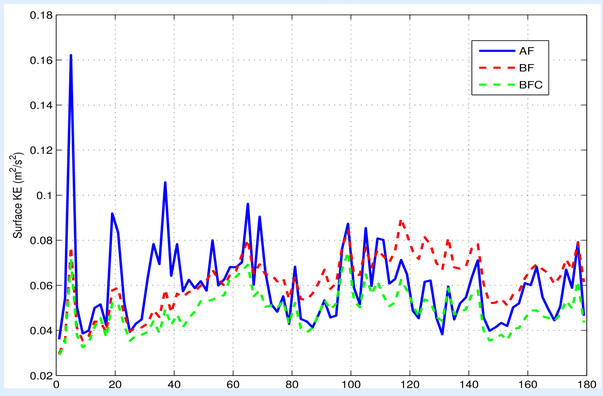
SST AFTER 180 DAYS OF RUN

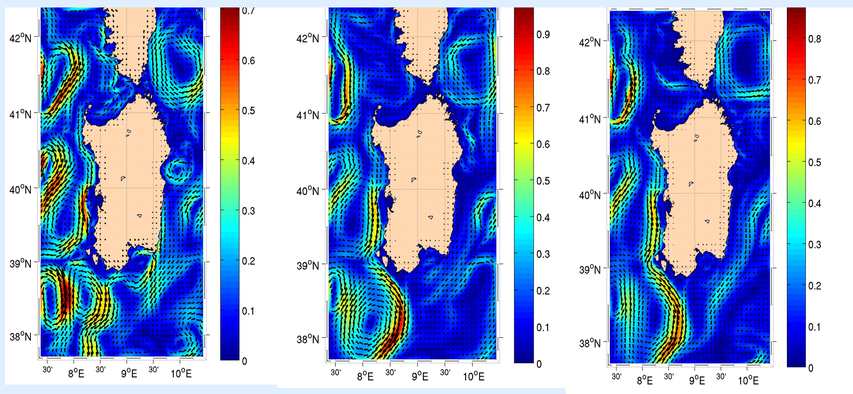
5 – Conclusions / Ongoing

First results of this new implementation of ROMS in Sardinian seas show the relevance of a good parameterization of surface fluxes to well describe coastal processes and dynamics. Results also evidenced issues/problems (bathymetry?) of the current implementation. Next work will be addressed to:
-Further sensitivity tests to surface forcings
-Change Boundaries (south and east boundary in land, other solutions). Alternative choices for OBC (Schepektin, rad-nud,...).
-Change bathy (DBDB1 or other hi-res)

Aknowledgments:
This work has been partially funded by the Flagship Project RITMARE - The Italian Research for the Sea - coordinated by the Italian National Research Council and funded by the Italian Ministry of Education, University and Research within the National Research Program 2011-2013."

Surface KE





SURFACE VELOCITY AFTER 180 DAYS OF RUN

Feel free to leave your comments and suggestions here:
-
-
...