High-resolution nesting in the North-Western Mediterranean Sea: assessment and impact on the larger scale circulation.

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Introduction

This study takes place in the North-Western Mediterranean Sea, more precisely in the Var coast region and its "îles d'Or" islands. In this area, the major current is the Northern Current (NC), which is a boundary current and a part of the general cyclonic circulation in the western Mediterranean basin. Moreover, this region is an area of transition between the eastern shelf-free area and the Gulf of Lions (GoL) shelf and so implies a strong bathymetric influence on the NC path.
It is now acknowledged that a kilometer-order resolution is a minimum requirement to model the meso-scale dynamics of the area. However, the effective resolution of such configurations, ranging between 5 to 10 km, can still be inappropriate as eddies and NC meanders can sometimes be of lower dimensions. It is therefore proposed to assess the impact of a very high resolution configuration (∼500 m) compared to a regional configuration of lower resolution (∼1.5km)[2]. On a technical point of view, this work is the first attempt to implement the NEMO general circulation model to this coastal zone at such high resolution.

Model settings

Config.	Spatial Resolution	Vertical Resolution	Atmospherics forcings	Oceanic forcings
GLAZUR64	1/64° ∼ 1.5km	130 levels (1→30m)	ARPEGE MétéoFrance, 3h, 1/10°	OBC from PSY2V4R4 Mercator, 1/12°
NIDOR192	1/192° ∼ 500m	130 levels (1→30m)	ARPEGE MétéoFrance, 3h, 1/10°	AGRIF interp. from GLAZUR64, 1/64°

Adaptive **G**rid **R**efinement **I**n **F**ortran [1]

2 nesting options available :

- 1-WAY : coarse ⇒ fine grid
- 2-WAY : coarse ⇔ fine grid

Added value of 2-WAY nesting:
Transfer of high-resolution dynamics into the coarser grid configuration

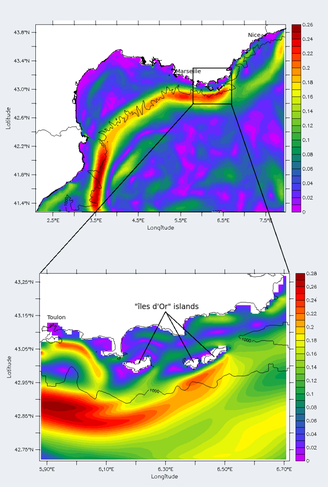


Figure : Location of the zoom, black line is the 1000m isobath, top: GLAZUR64, bottom: NIDOR192

Nesting assessment of NIDOR192

Validation of the 1WAY configuration:
→ Consistency of the NC trajectory across open boundaries
→ Good agreement for tracers between the two nested configurations

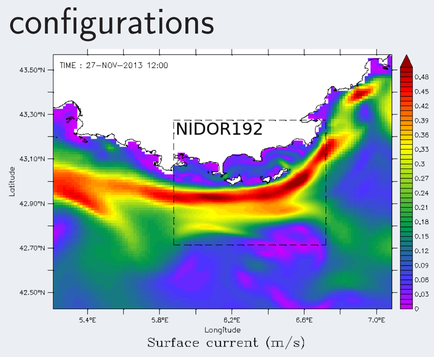


Figure : Surface current (m/s) for GLAZUR64 and NIDOR192-1W

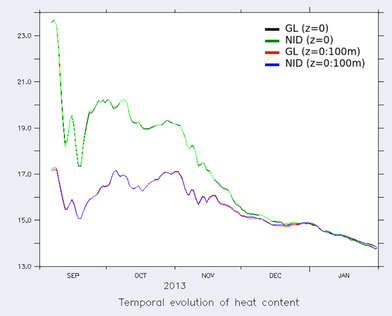
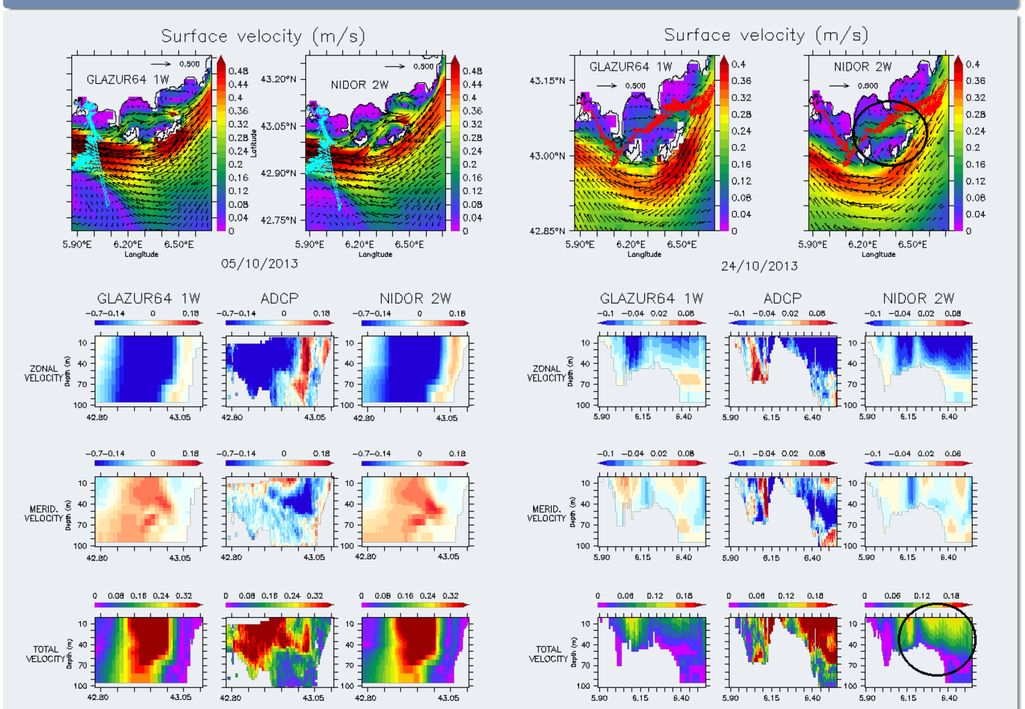


Figure : Mean temperature evolution averaged over the box at the surface

Improvement of coastal circulation: comparison with hull-mounted ADCP data



ADCP transect across the NC

- Correct positioning of the vein for both configurations
- Modeled NC intensity lower than observations

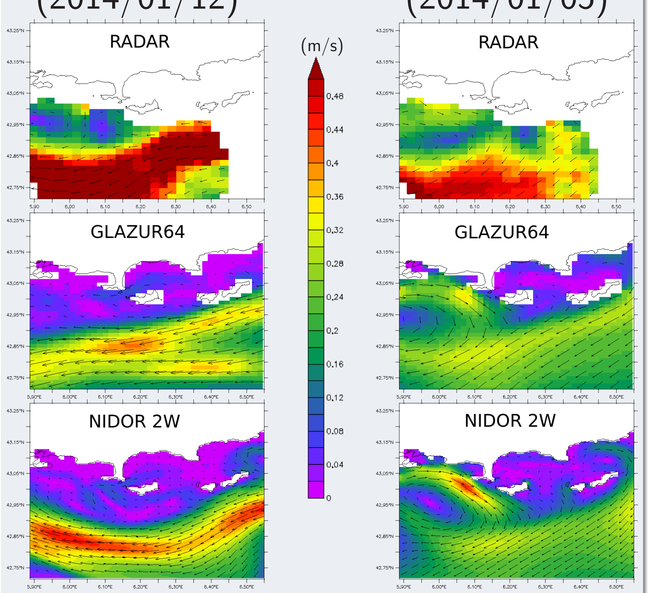
ADCP transect between the coast and the islands

- Coastal circulation more intense in the zoom
- Complex circulation in the bay favored by the resolution

⇒ Satisfactory results for the NC and the bay dynamics

Improvement of NC dynamics: comparison with HF RADAR data

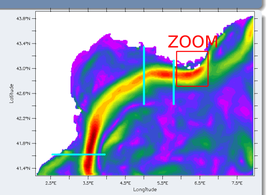
MIO HF RADAR (http://hfradar.univ-tln.fr)

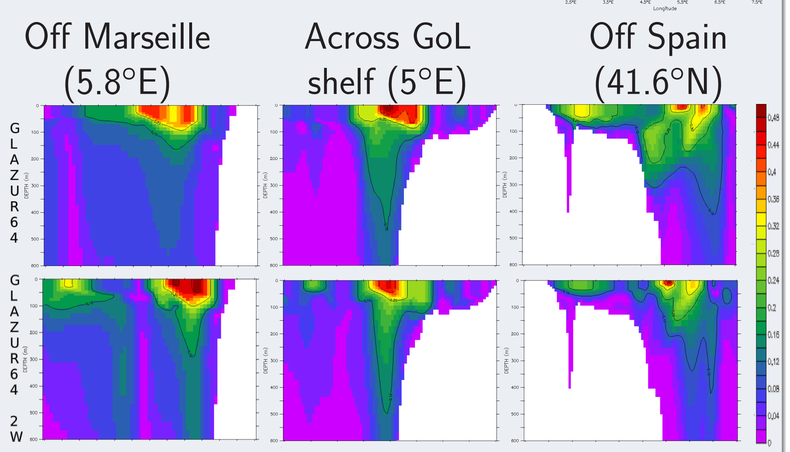


- Improvement of the variability of the positioning of the NC vein with the high-resolution configuration.
- Better positioning of an eddy at the south of Toulon with the high-resolution configuration

Zoom impact on the downstream simulated dynamics

Vertical sections of NC intensity on 2013/12/14:





- Off Marseille: NC vein more intense, closest and nearest to the coast in the 2WAY configuration
- Across the Gulf of Lions shelf: NC still closer and deeper than the GLAZUR64 configuration but further from the shelf
- Off Spain coast: NC more similar between the two configurations (→OBC constraints?)

⇒ Little impact of the resolution on the simulated NC outside the zoom

Conclusions & Perspectives

Conclusions

- Better coastal dynamics inside the bay
- Little impact of the zoom on the NC in the study area NIDOR :
  → NC quite resolved at 1/64 ?
- Impact on the downstream NC trajectory :
  → Improvement?

Perspectives

- To improve the bathymetry and the coastline
- To better evaluate the impact of the zoom on the GoL circulation
- To evaluate the validity and interest of even higher resolution dynamics
- To evaluate the impact of the hydrostatic hypothesis

Bibliography

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