Ocean Modelling at CMCC

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Euro-Mediterranean Center on Climate Change (CMCC)
State-of-the-art

Global eddy-permitting (1/4°) configurations

- NEMO + LIM2 + \{3DVar, BFM\}
- Coupled CESM-NEMO

Regional/global eddy-resolving (1/16°) configurations

- Nordic Seas domain embedded in an 1/4° Atlantic/Arctic system (AGRIF package)
- GLOB16
State-of-the-art

- ORCA025 + 3DVar

In Situ Data:
WOD05, WOCE, ARGO, etc. (Temperature and Salinity)

Forcing:
ERA-Interim CORE bulk formulas

Assimilation:
OceanVar
(Dobricic and Pinardi 2008)

Ocean Model:
ORCA025

BG Covariances:
Vertical EOFs from Model + Recursive Filter

Altimetry Data:
(Storto et al. 2011)

SST and SIC Data
State-of-the-art

- ORCA025 + 3DVar
- ORCA025 + BFM
- ORCA025 in coupled mode (in progress)

Based on the Community Earth System Model (CESM) developed by NCAR

**Motivation**
- larger flexibility in coupling
- MOU between CMCC and NCAR
- expected higher performances (developed on same machines as CMCC)
- CMCC has joint the NEMO consortium in 2011

**Resolutions**
- NEMO: ORCA1 and ORCA025
- CAM: 1 degree and ¼ degree
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- ORCA025 + 3DVar
- ORCA025 + BFM
- ORCA025 in coupled mode

- Nordic Seas 1/16°: eddy-resolving configuration embedded in an eddy-permitting regional ocean model of the Arctic-North Atlantic Ocean. (see D. Iovino’s poster)

NEMO 3.2 + LIM2 + AGRIF package
- horizontal resolution: ~4 km
- grid: 664x704x46
- two-way nesting, ice refinement included
State-of-the-art

- ORCA025 + 3DVar
- ORCA025 + BFM
- ORCA025 in coupled mode
- Nordic Seas 1/16

- GLOB16 (in progress)

**MODEL:**
- NEMO + LIM2
- horizontal resolution 1/16° (~ 5800 x 4000)
- 98 levels

**OCEANVAR:**
- assimilation of Argo floats and satellite SLA
- daily cycle of analysis
Scientific questions

- **ORCA025 + 3DVar:** estimate of the past ocean changes and variability at eddy-resolving scales
Scientific questions

• ORCA025 + 3DVar

• ORCA025 + BFM: simulate ocean plankton dynamics

Comparison

SeaWiFS-PELAGOS2/025

(Surface Chl, mg/m³)

Year 2000
Main challenges

- Definition of metrics and availability of observations for evaluation
- Computer Resources (PRACE project Ens4Ocean)

Awarded to CMCC from PRACE to run on Barcellona Supercomputing Center
Apr 2014 – Mar 2015

Objectives:

i) 10-year Ocean Simulation with 1/16 resolution model covering Argo era (2003-2012)

ii) Predictability studies at 1/16 (1-month ensemble simulation starting from selected dates)

iii) Study of 1/16 model error covariances for further use in 3DVAR

No Assimilation
Questions

• Can we go further (to coastal scales) with the same models that we use for large scale applications or do we need for instance unstructured grids?

• How can we manage the big amount of data that we are producing? Shouldn’t we start to design and implement open source solutions addressing efficient access, analysis and mining of large volumes of scientific data?

• How do we plan to maintain the code development at the forefront of the computational technology (optimization of numerical models on HPC architectures)?

• How can we handle a coordinated validation of high resolution models (same observational reference)?
Thanks