



Modelling Mediterranean Climate using a Coupled Regional Climate Model



MAX PLANCK GESELLSCHAFT

Objectives

- Working model for Mediterranean climate
- Assessment of hydrological cycle
- Better understanding of processes involved
- Reproduce ocean-atmosphere feedbacks
- Analyze the impact of the coupled system on climate simulations
- Perform climate change simulations

Models description

Atmosphere model

REMO (REgional atmosphere MOdel) (Jacob and Podzun, 1997)

Resolution 25km.

Domain size 241x145.

31 vertical levels.

Air temperature, specific humidity, wind components, surface pressure and surface temperature.

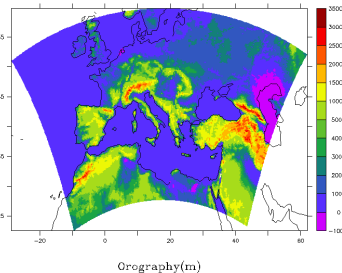


Fig. 1 Domain for the atmospheric component.

Ocean model

MPI-OM (Max-Planck-Institute Ocean Model) (Mars-Land et al, 2002)

Resolution aprox. ~11 km.

Domain size 503x231.

29 vertical levels.

Global model adapted to the Mediterranean region.

Temperature and salinity.

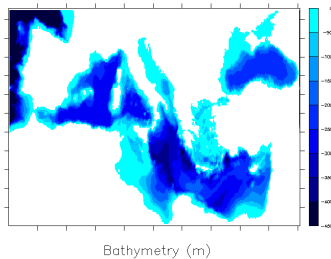


Fig. 2 Domain for the oceanic component.

Hydrological model

HD model (Hydrological Discharge model) (Hagemann and D'menil, 1998b)

Resolution 1/2°.

Accounts for the lateral waterflow on the land surface.

Global model adapted to the Mediterranean region.

non-rotated spherical grid.

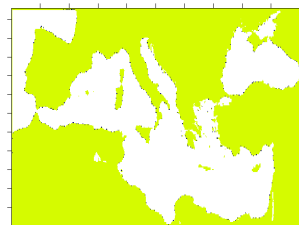


Fig. 3 Mouth rivers, in blue, projected in the ocean grid.

Coupling strategy

Oceanic output:

SST

Hydrological output:

Discharge

Atmospheric output:

Runoff

Drainage

Wind stress

Wind speed

Fresh water flux

Surface net downward

shortwave flux

Surface downward heat flux

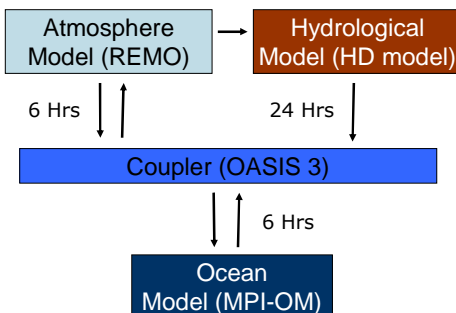


Fig. 4 Coupled system configuration.

Exchange methology:

Bilinear interpolation for ocean-atmosphere exchange

Assigned ocean grid boxes for mouth rivers points

Reanalysis data to cover none matching areas between both domains

Lateral boundary conditions:

Reanalysis data (ERA40) for the atmospheric component

Climatology values from Levitus for the oceanic component

Results

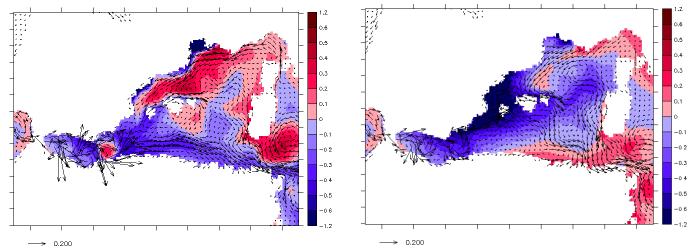


Fig. 5a & 5b. Arrows show Current Speed in m/s. Shaded areas represent salinity difference in psu between ocean model results and Medatlas observation dataset at -6 meters.

Preliminary tests for MPI-OM. Figure 5a left shows circulation and mean salinity for the last 10 years of a 70 years simulation driven by climatology values of ERA15. Figure 5b right is the same as figure 5a but for the last 10 years of a 30 years simulation driven by ERA40.

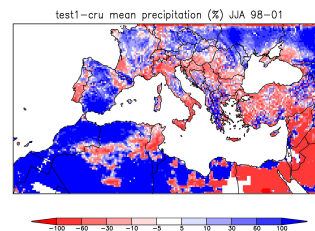


Fig. 6 Precipitation bias (in percentage) for the first domain. Comparison with Climate Research Unit observational dataset.

Second domain (Fig. 7). Large precipitation bias is displaced to the north. All the catchment areas for the rivers that have its discharge on the Mediterranean sea are included to account the lateral waterflow.

First domain test (Fig. 6). Too large precipitation is located near northern boundary that increase large values of moisture that could affect the hydrological cycle.

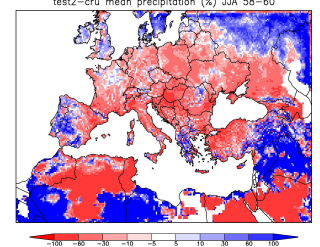


Fig. 7 Precipitation bias (in percentage) for the second domain. Comparison with Climate Research Unit observational dataset.

Conclusions

- Ocean model, driven by ERA40 reanalysis, is not able to reproduce Mediterranean Sea circulation.
- Hydrological cycle is affected by northern large precipitation that increases moisture values at surface rising values for runoff and drainage, also at low atmosphere moisture is transported to the center of the domain, with a cooling effect.
- Setting of atmospheric domain for a coupled simulations plays an essential roll.

Outlook

- Setting up of the coupling system
- Tests to adjust models parameters
- Perform validation of the coupling system
- Climate change scenarios



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References:

- Hagemann, S. and L. D'menil (1998b). A parametrization of the lateral waterflow for the global scale. *Climate Dynamics*, 14, 17-31.
Jacob, D. and R. Podzun (1997). Sensitivity studies with the regional climate model REMO. *Meteorology and Atmospheric Physics*, 63, 119-129.
Marstrand, S. J., H. Haak, J. H. Jungclaus, M. Latif, F. Röse (2002). The Max-Planck-Institute global ocean/sea ice model with orthogonal curvilinear coordinates. *Ocean Modelling* 5(2), 91.