BENEFICIOS DEL ACOPLAMIENTO EN LA SIMULACIÓN DEL CLIMA DE SUDAMÉRICA CON MODELOS REGIONALES

BENEFITS OF THE COUPLING IN THE DOWNSCALING THE SOUTH AMERICAN CLIMATE

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SUMMARY

We evaluate the benefits of the use of a regional coupled model over its stand-alone atmospheric component when forced by reanalysis data in the simulation of the South American climate. We find that the coupling allows for a better simulation of important features of the atmospheric circulation and surface temperature. The simulated 2 meters air temperature is improved over most of the continent, the sea level pressure over the South Pacific Anticyclone area is better represented in the coupled simulation and the location of the ITCZ is improved during the austral winter. The regionally coupled model not only improves the simulation of important features of the observed atmospheric fields but also demonstrates good skills in reproducing the Humbold upwelling system. Therefore, our study highlights the advantages of regional coupled models for the simulation of the South American climate, as the ocean-atmosphere interaction is of utmost importance for the circulation mechanisms that determine the climate of the region.

In this study, we propose to assess the ability of the atmosphere-ocean regionally coupled model, ROM (REMO-OASIS-MPIOM) to simulate the climate of the South American continent and the surrounding ocean, and compare it with its atmospheric component REMO, which prescribes the ERA-Interim SST. The model domain is represented in Figure 1.

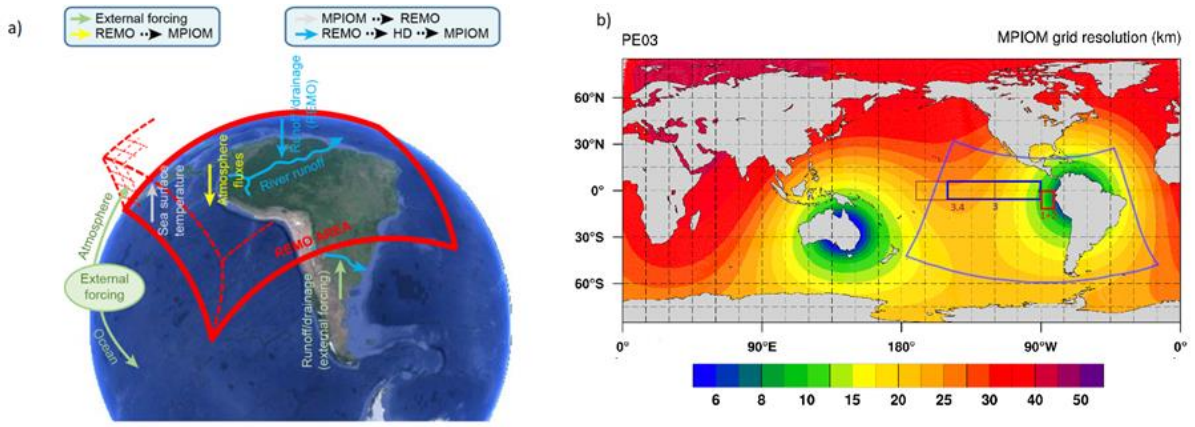

Figure 1 - a) Coupling scheme for ROM. The atmosphere and the ocean are coupled in the region covered by the REMO domain. The MPIOM and HD domains are global. b) Spatial domain of the MPIOM (shaded) and REMO (thick line over South America).

In order to simulate the climate of the South American continent and the relevant ocean-atmosphere interactions, our simulation covers a large domain that includes the eastern tropical Pacific and most of the Niño3 region. Therefore, it is important to assess the ability of our coupled model to accurately reproduce the most important large-scale mechanisms. For instance, both REMO and ROM reproduce well the upper-level high-

pressure centers (Bolivian high), reproducing well the associated atmospheric circulation and humidity distribution. This is not unexpected, as at the upper atmospheric levels, the influence of the coupling should not be important. However, the impact of the coupling is clearly seen in the simulation of the ITCZ, as it is heavily influenced by the location of the region of high SST, which is prescribed in the REMO case. But this specification leads to a too strong convection in REMO, due to the lack of the cooling of the SST by evaporation, which is present in ROM. These factors are reflected in the seasonality of the ITCZ precipitation: in DJF, REMO presents a better representation of the spatial distribution and intensity of the ITCZ precipitation. ROM presents a double band in the ITCZ, a common trait in coupled models (Zhang et al. 2015). However, in JJA the ITCZ over South America is better represented by ROM, and its precipitation is closer to ERA5, especially over the Amazon.

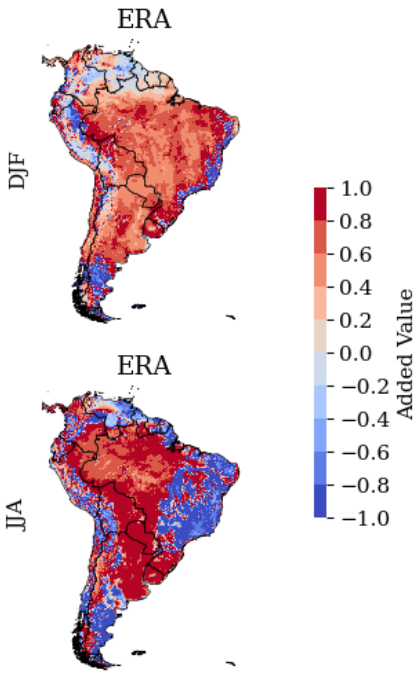

Figure 2 - Added value of seasonal temperature for South America in ROM compared to REMO. Reference data set is ERA5.

The precipitation, especially over the Andes, benefits less from the coupling, although a more realistic humidity transport leads to a reduction of the precipitation biases over extensive regions. The austral summer precipitation bias is reduced in areas such as eastern Colombia, northern Bolivia, eastern Brazil and central Argentina. For austral winter, the coupled model has a better performance in a large part of the Amazon region, in areas such as east of Peru, west Brazil, north Bolivia and south Argentina.

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