Disentangling atmospheric biases in the tropical Atlantic in the CNRM climate model

Romain Roehrig[1,*], Claudia Frauen[1], Aurore Voldoire[1], Florent Brient[1]

[1] CNRM, Météo-France/CNRS, Toulouse, France.
[*] romain.roehrig@meteo.fr

Most state-of-the-art coupled general circulation models (GCMs) have serious biases in the tropical Atlantic, which strongly impact the representation of the regional climate in those GCMs, in particular the West African monsoon. One of this bias consists of a westerly bias in the equatorial surface winds, which has been shown to already exist in the CMIP3/CMIP5 atmosphere-only simulations, forced with observed sea surface temperatures (AMIP). Using CNRM-CM5, an ad-hoc correction of this low-level wind bias has been shown to strongly reduce the SST warm bias in the equatorial Atlantic.

In the present study, an AMIP simulation performed with the CNRM-CM5 model and an ensemble of initialized experiments following the so-called Transpose-AMIP protocol are analyzed to further understand the origin of this wind bias. As the wind bias develops in a few days, the Transpose-AMIP framework allows us to track the development of the model bias away from a well-defined initial state and relate it to other regional biases. The analysis of the zonal momentum budget highlights the important role of biases in the east-west pressure gradient, in agreement with previous studies. Biases in convection in some parts of the tropical Atlantic and adjacent continents appears to be critical, through a large-scale adjustment of the regional zonal circulation. Further sensitivity experiments are carried out to further assess the role of these convection biases. The results provide some indications on how to improve coupled GCMs in the region.