Biases in the UCLA-MIT global model

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Abstract

In this work we present an evaluation of the main biases of the UCLA-MIT global model in the tropical Atlantic region. First we describe both the atmospheric and oceanic uncoupled components. We assess the biases in a 40-year long simulation of the UCLA v.7.1-SsiB atmospheric global model, prescribing observed monthly SST from 1975 to 2014. Then, we compare these results with the outputs of a 35-year long fully coupled simulation, focusing on the amplification of the biases with respect to the uncoupled runs.

Methods

The climatological means of several variables have been computed from the output of the atmospheric component of two runs of the UCLA global model[1], one with prescribed monthly SSTs (AGCM_run) and another one coupled with the MITGCM ocean component[2]. The results have been compared against the long term climatologies of the NCEP reanalysis[3], except for the SST, which has been compared against the climatology of the HadISST 1.1 dataset[4], and precipitation, which has been compared against the GPCP dataset[5].

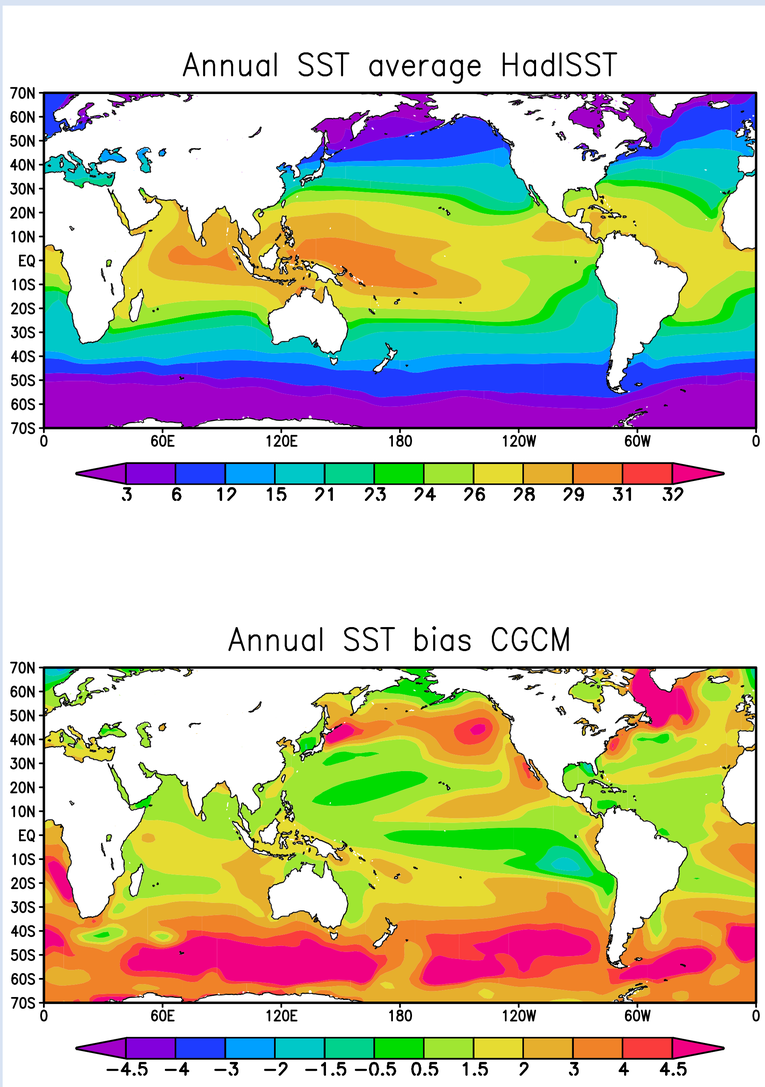

Figure 1: sea surface temperature

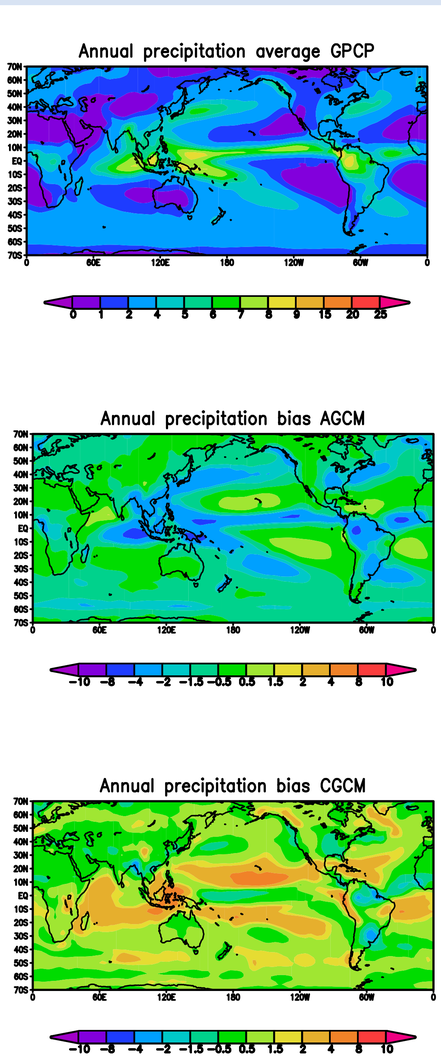

Figure 2: precipitation

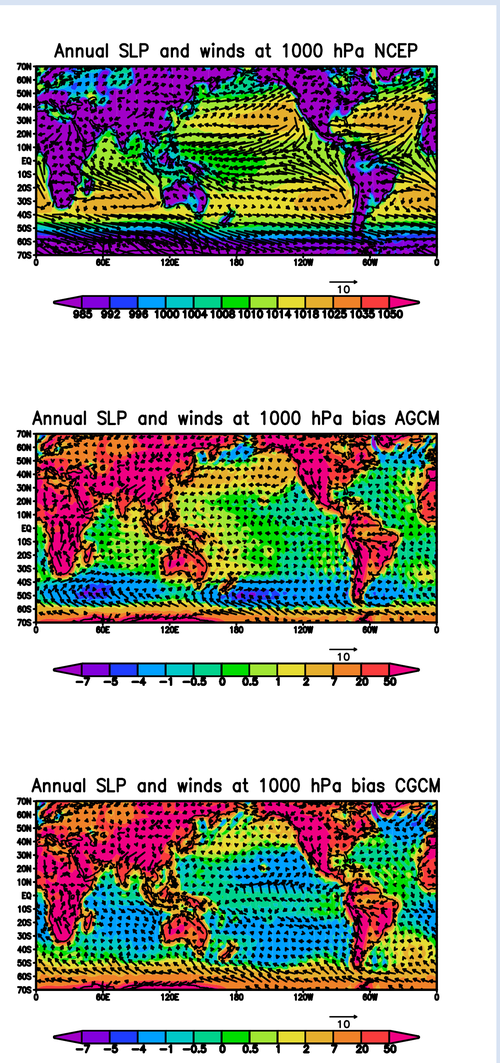

Figure 3: SLP and winds at 1000 hPa

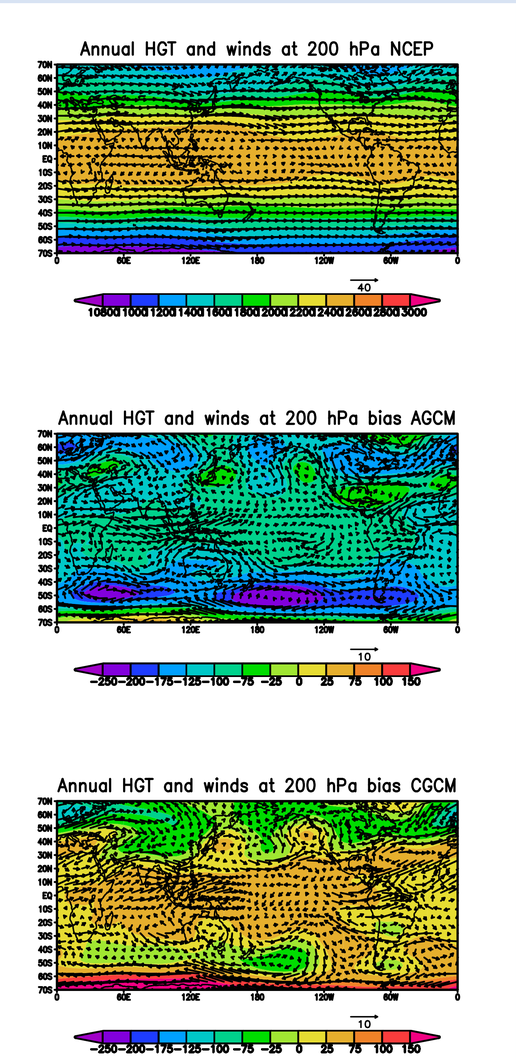

Figure 4: geopotential height and winds at 200 hPa

For figure 1, panel **a** shows the annual mean of the HadISST, and panel **b** the bias of the coupled model UCLA-MIT model (CGCM_run).

For figures 2 to 4, panels **a** show the long term climatological mean for the NCEP (GPCP in the case of precipitation) dataset (observations). Panels **b** show the UCLA atmospheric component bias (AGCM_run-obs). Panels **c** show the bias of the coupled UCLA-MIT model (CGCM_run-obs).

Figures 3 and 4 show the sea level pressure (Fig. 3) and geopotential height at 200 hPa (Fig. 4) in colour, and the winds at 1000 hPa (Fig. 3) and 200 hPa (Fig. 4) with arrows.

Results

The SST in the CGCM is generaly higher than in the HadISST data. The difference is more evident in the southern hemisphere, where there is a warm bias everywhere except for the east Pacific just south of the equator. The warm biases are bigger in the west boundaries of the oceans (West Africa, California and Chile, although the Peruvian coast, where CMIP5 models show a strong warm bias[6], is cold). There is a cold bias along the equator in the Pacific Ocean.

Regarding precipitation, both the AGCM global mean is slightly drier than observations, while the CGCM is much wetter. The AGCM is drier along the equator and in the extratropics, and wetter between 0 and 30 degrees, both north and south. The CGCM is wetter all over the globe, with the biggest biases mimicking those of the AGCM. The double ITCZ problem[7] is present here, both in the Pacific and the Atlantic oceans.

The SLP bias is weaker (better) for the AGCM than for the CGCM. However, in the northern Pacific the Aleutian low is better represented in the CGCM. There are negative SLP biases north and south of the equator, which are consistent with the double ITCZ problem. The winds at 1000 hPa are worse represented by the CGCM, specially in the tropics over the Pacific Ocean: the easterlies are weaker than they should, specially along the west coasts of Africa and South America. There is also a decreased convergence on the equator, at the same time as there is convergence both north and south of that region.

At the 200 hPa level the generally negative bias of the geopotential height in the AGCM turns into a slightly positive bias in the CGCM. The winds at this level are weaker than they should be along the west coasts of Africa and South America, and also in the northern Atlantic.

Conclusions and future work

-The CGCM_run temperature biases are similar to those shown by previous works for the CMIP5 models.
-Precipitation biases are not very big in the AGCM, and seem to be due mainly to the ITCZ problem. In the CGCM, this problem intensifies, and the bias is more important.
-Future work will assess the decadal to multidecadal variability of the UCLA model, in order to perform sensitivity experiments.

References and aknowledgments

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The research leading to these results has received funding fromthe European Union Seventh Framework Programme (FP7/2007–2013) under Grant Agreement No. 603521The authors thank the Ministerio de Economía y Competitividad for its funding of this work through the project MULTISCALE CLIMATE VARIABILITY. AGRONOMICAL AND ECONOMIC IMPACTS (MULCLIVAR, ref: CGL2012-38923-C02-01). They also thank the Campus de Excelencia Internacional Moncloa for the use of the high-performance computer Eolo, in which all the simulations have been performed.