Geophysical Research Abstracts
Vol. 18, EGU2016-10477-2, 2016
EGU General Assembly 2016

Links in CGCMs among biases in the Southern Ocean and in the Tropics

C. Roberto Mechoso (1), Teresa Losada (2), Shunya Koseki (3), Belen Rodriguez-Fonseca (2,4), Noel Keenlyside (3), Elsa Mohino-Harris (2), and Antonio Castaño-Tierno (2)

(1) UCLA, Atmospheric Sciences, Los Angeles, CA, United States, (2) Departamento de FTAAI, Facultad de CC. Físicas, Universidad Complutense de Madrid, Spain, (3) Geophysical Institute, University of Bergen/Bjerknes Centre for Climate Research, Norway, (4) Instituto de Geosciencias (CSIC-UCM) , Facultad de CC. Físicas, Universidad Complutense de Madrid, Spain

Coupled atmosphere-ocean models (CGCMs) tend to simulate too warm sea surface temperature (SST) over the southeastern equatorial Pacific and Atlantic oceans (SEP and SEA, respectively). Moreover, they tend to produce a too persistent double Inter-tropical Convergence Zone (ITCZ). CGCMs also show substantial errors in the extratropics, such as too warm SSTs in the Southern Ocean. The present study examines the possible links between CGCM biases in the tropics and in the Southern Ocean. These latter biases are interpreted as evidence of excessive energy absorbed by the southern hemisphere in comparison to the northern hemisphere. We use the CGCM of the University of California Los Angeles (UCLA CGCM), and the Earth System Model of the University of Norway (Nor-ESM). Our approach compares the climatology simulated by both models with experiments in which the energy input to the southern hemisphere is artificially decreased between 30S and 60S. The maximum decrease is $\sim$ 30 W m-2 at approximately 45S.

In the two models we find that less short wave incident results in a general cooling of the SST. In association with this cooling, the Hadley and Ferrel circulations intensify primarily in the southern hemisphere. The ITCZ moves northward and convection decreases south of the equator. In the southern hemisphere the core of the subtropical jet moves equator ward, while in the northern hemisphere upper level westerlies decrease in the tropics. Sea-level pressure increases in the southern tropical Atlantic and Pacific, and over the North Pacific. In the upper ocean, the gyres intensify in the south Pacific and Atlantic, and the northward heat transport decreases. In the Indian Ocean, changes are much smaller in general. Notable changes in the cloud and radiation fields accompany those in the large-scale circulation. Also in both models, there is a modest increase in low-level clouds around 30S-45S and a larger increase in the SEP and SEA. Upper level clouds decrease over the western tropical Pacific and Atlantic. There is, however, a significant difference between the response of the two models. In the UCLA CGCM, the incidence of stratocumulus clouds is greatly enhanced and more realistic over the SEP and SEA. This enhancement is consistent with enhanced cold advection into the regions and enhance local subsidence. In the Nor-ESM, changes in low-level clouds are much smaller. The difference in impacts in the two models is attributed to their different parameterization of low-level clouds.

In summary, reduced short wave incident over the Southern Ocean results in a more realistic simulation of the tropical Pacific and Atlantic climate in both models. The warm SST biases over the Southern Ocean, SEP and SEA are substantially reduced, and the double ITCZ syndrome is alleviated. These results support the hypothesis of a remote connection among CGCM biases in the tropics and extratropics. It is suggested that reduction of CGCM errors in the tropics will require improvements in the global simulation of cloud incidence and radiative effects.