Geophysical Research Abstracts, Vol. 9, 02166, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02166

A multi-model evaluation of systematic errors of the tropical seasonal cycle in IPCC AR4 20th century simulations

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In this study, we examine the systematic errors in state-of-the-art IPCC coupled general circulation models (CGCM). In particular, we focus on the seasonal cycle in the tropical region, an area where CGCMs typically fail in correctly reproducing the patterns of mean precipitation and SST (e.g., Lin 2006; submitted to J. of Climate). The 20th century from a subset of the IPCC AR4 simulations is analysed, by considering both atmospheric and oceanic fields. The purpose of this multi-model intercomparison is to highlight the main biases affecting the mean seasonal variability in last generation climate models which are currently used to simulate climate scenarios and predict tropical variability and global teleconnections. In addition to a more traditional approach, we define several error indices, quantifying model biases (e.g., the double ITCZ), and try to relate them to the model ability in reproducing specific processes, such as, among the others, the monsoon and tropical/extra-tropical teleconnections. The role played by different parameterizations and horizontal/vertical resolution on the mean seasonal cycle, is also analysed within the selected multi-model framework. Results indicate that a proper simulation of tropical seasonal cycle is still far from being reached due to the presence of spurious double-ITCZ, anomalously westward-extended cold tongue and missing upwelling in the eastern tropical Atlantic.