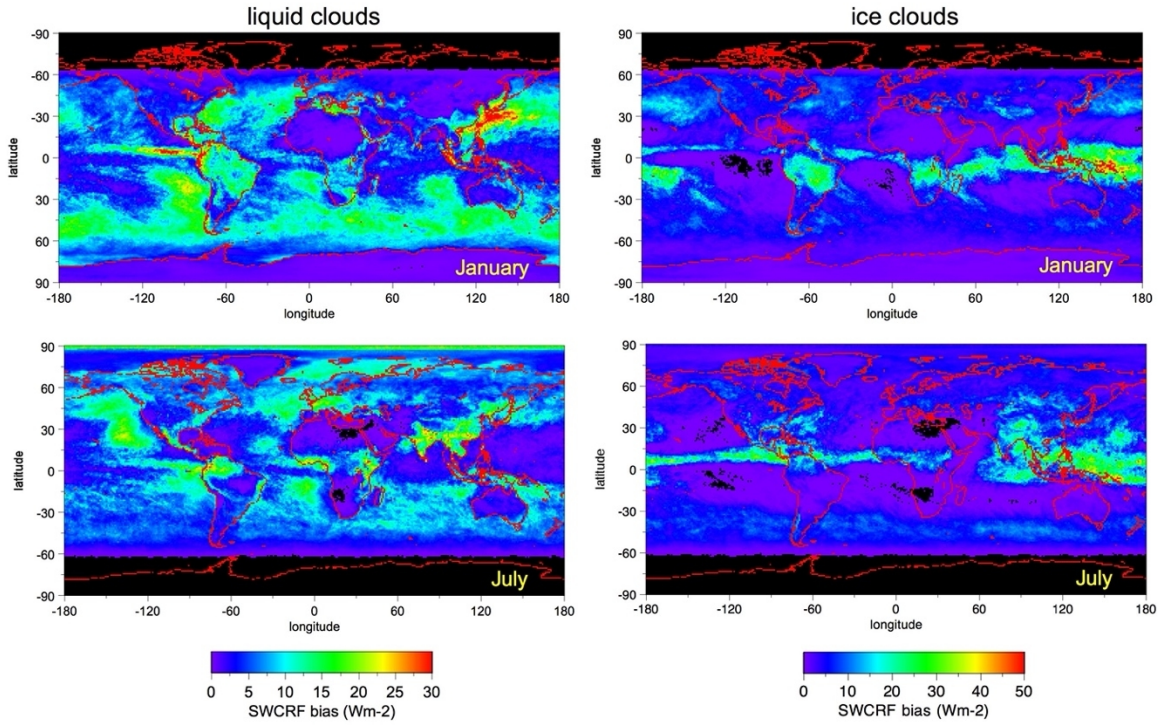
Shortwave cloud radiative forcing bias due to cloud inhomogeneity



The schemes that calculate the energy budget of solar and thermal radiation in Global Climate Models (GCMs), our most advanced computers tools for predicting climate change, commonly assume clouds are horizontally homogeneous at distances as large as 100 miles. However, this assumption, used for convenience, computational speed, and lack of knowledge on how to treat small scale cloud variability, is known to be inaccurate. In a recently published paper (see reference below) we provide a description of the errors in solar radiation reflected by the planet when cloud variability is neglected across distances approximating 60 miles. To make these error estimations possible, we use cloud retrievals from the instrument MODIS on the Terra and Aqua satellites, along with atmospheric and surface information, as input into an algorithm, of the type used in GCMs, that calculates the fraction of solar radiation reflected, transmitted and absorbed by the atmosphere-surface system. Since MODIS provides information on cloud variability below 60 miles we can run the radiation algorithm both for the variable and the (assumed) homogeneous clouds. The difference between these calculations for reflected or transmitted solar radiation constitutes the bias that GCMs would commit if they were able to perfectly predict the mean cloud properties, but assumed that clouds were homogeneous for radiation calculations. We find that the global average of this bias is at least as big as the additional amount of thermal energy that would be trapped if we were to double carbon dioxide from current concentrations. We should therefore intensify our efforts to predict horizontal cloud variability in GCMs and account for its effects on radiation calculations. The figure shows the geographical distribution of the bias at the time of satellite overpass for clouds classified to be of liquid and ice phase by the MODIS algorithm. Terra and Aqua values for January and July 2005 have been averaged. The patterns are distinctly different for the two cloud phases reflecting known cloud patterns and regimes (mid-latitude storm tracks, ITCZ, etc.) For a detailed analysis of the shortwave radiative forcing bias due to cloud inhomogeneity please see:\r\n\r\nOreopoulos, L., S. Platnick, G. Hong, P. Yang, and R. F. Cahalan, 2009: The shortwave radiative forcing bias of liquid and ice clouds from MODIS observations. Atmos. Chem. Phys. 9, 5865-5875.

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