Geophysical Research Abstracts, Vol. 7, 05679, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05679

Non-linear effects of cloud variability on climate's heat budget

P. L. Langen (1) and R. Caballero (2)

(1) Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark (plangen@gfy.ku.dk), (2) Department of the Geophysical Sciences, University of Chicago, Chicago, Illinois, USA

Radiative cloud forcing is a nonlinear function of cloud amount and optical depth. This implies a rectification of cloud temporal variability onto the time-mean radiative forcing. For instance, fixing clouds at their time-mean value in NCAR's CCM3 GCM results in a climate much warmer than in the case with interactive clouds. Similar effects have been encountered by other investigators but with varying sign and magnitude. Here, we investigate these effects quantitatively using CCM3 and an offline radiative model. In the GCM, the amplitude of cloud variability is scaled between 100% and 0% and the resulting globally averaged top-of-atmosphere radiative imbalance is found to vary non-linearly from 0 to 8 Wm^{-2}. With full, but specified, variability the imbalance is not significantly different from that with model-calculated clouds, and it is concluded that the effect may be explained chiefly in terms of the cloud variability alone, disregarding feedbacks with the ambient fields. Variability patterns are identified at latitudes 30°N and 50°N and a non-linearity in the cloud extinction optical depth parameterization is found to give rise to a cooling effect unless the whole column displays a very uniform variability.