Geophysical Research Abstracts
Vol. 14, EGU2012-6680, 2012
EGU General Assembly 2012

Model Evaluation for Low-Level Cloud Feedback

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The purpose of this research is to address the cloud feedbacks in future climate predicted using global climate models. To understand the variability of low clouds in current climate, variations in cloud cover as well as relationship between cloud cover and other variables are examined using the adjusted International Satellite Cloud Climatology Project (ISCCP) data and Intergovernmental panel on climate change (IPCC) Fourth Assessment Report (AR4) models.
The study focuses on the low-cloud amount, which variability is very critical in balancing earth's radiation budget. The correlations of the observed low cloud cover anomalies with a variety of variables suggest that low clouds in tropical marine areas (persistent low cloud regions) are associated with a cool sea surface, stronger stability, and higher sea level pressure, and subsidence. An increase in SST causes a reduction in lower tropospheric stability. And the reduced stability allows for more vertical motion within and around the cloud deck, leading to increased entrainment of dry air. This brings about a reduction in cloudiness and a transition from low cloud to high cloud types. Higher SLP could also produce more subsidence aloft, increasing LTS independent of SST.
The understanding of the physical processes that control the cloud response to climate variability and the evaluation of some components of cloud feedbacks in current models should help to assess which of the model estimates of cloud feedback is the most reliable. Being rooted on this observed features of total and low-cloud variability, we evaluate the performance and the realism for the model simulations form various coupled GCMs, which lead the selection of reliable models, CGCM3 (from CCCMa) and HadGEM1 (from UKMO). These two models exhibit considerably good agreement in net cloud radiative forcing and produce a reduction in cloud throughout much of the Pacific in response to greenhouse gas forcing (i.e. a positive feedback). In this study, we give a courteous answer to the question of whether low-level clouds act as a positive or negative feedback to climate change.