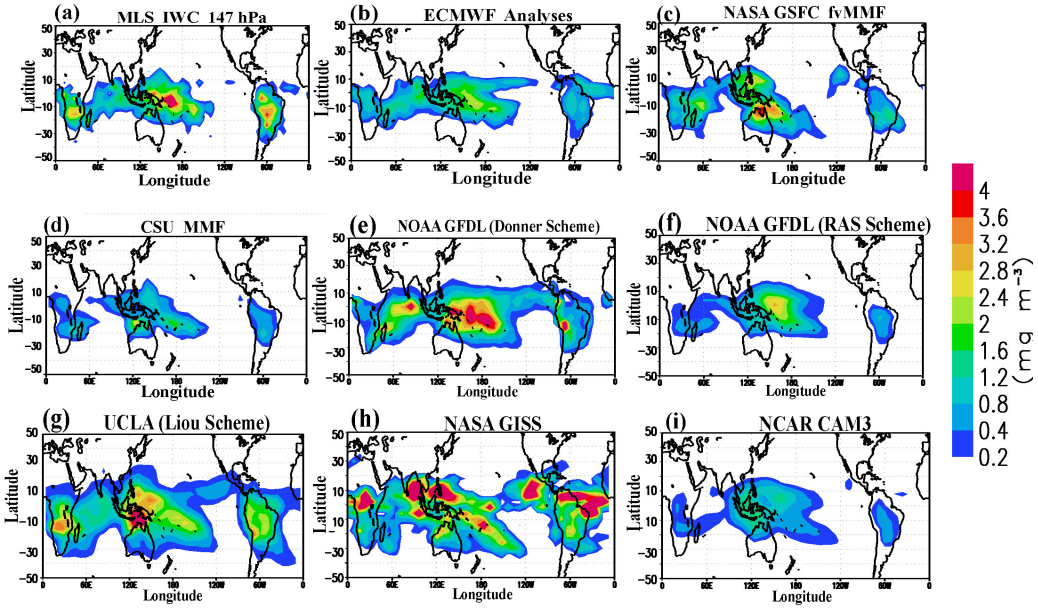
MLS Scientific Publication

Scientific Theme: Clouds and Global Climate Modeling

Comparisons of EOS MLS Cloud Ice Measurements with ECMWF analyses and GCM Simulations: Initial Results. J.-L. Li, D. E. Waliser, J. H. Jiang, D. L. Wu, W. Read, J. W. Waters, A. Tompkins, L. J. Donner, J.-D. Chern, W.-K. Tao, R. Atlas, Y. Gu, K.N. Liou, A. Del Genio, M. Khairoutdinov, and A. Gettelman, *Geophys Res. Lett*., vol. 32, L18710, doi:10.1029/2005GL023788, 2005.

Summary

Present-day shortcomings in the representation of cloud processes in global climate models (GCMs) introduce a major source of error for both weather and climate (e.g., monsoon, El Nino) forecasts as well as account for the principal uncertainty in climate change predictions. An ongoing challenge in rectifying these shortcomings is the availability of adequate high-quality cloud process observations. The NASA EOS Microwave Limb Sounder (MLS) observations provide a rich new data set to help address the above problems. In particular, MLS' vertical profiles of cloud ice, in concert with its collocated values of temperature and water vapor, represent a new and important observational capability. In this study, we use MLS observations of cloud ice to assess the capability of GCMs in simulating upper-tropospheric ice water content (IWC). Comparisons are made with atmospheric analyses from the European Centre for Medium-Range Weather Forecasts (ECMWF) and simulations from several GCMs (see figure). For January 2005 monthly and daily mean values, the spatial agreement between MLS and ECMWF is quite good, although MLS estimates are higher by a factor of 2-3 over the W. Pacific, tropical Africa and S. America. For the GCMs, the model-data agreement is within a factor of 2-4 with the larger values of disagreement occurring over E. Pacific and Atlantic ITCZs, tropical Africa and S. America. While these results are subject to a number of uncertainties associated with sampling, the retrieval technique, and the manner the comparisons are made, they help illustrate the need for high-quality observations of cloud-related quantities in order to evaluate GCM performance and guide future development efforts. These observations, combined with MLS's observations of temperature and water vapor as well as measurements from other NASA EOS "A-Train" platforms – including the upcoming CloudSat mission – provide an altogether new and innovative opportunity to understand upper-tropospheric hydrological processes as well as to assess and improve cloud processes in GCMs.



(a-d) Maps of monthly mean cloud ice water content (mg m^{-3}) for January 2005 at 147 hPa from the (a) MLS-based satellite observations and (b) the ECMWF analyses and single arbitrary Janary from (c) NASA fvMMF and (d) CSU-MMF. (e-i) Same, except for mean monthly January values based on multi-year simulation: (e) GFDL-Donner, (f) GFDL-RAS, (g) UCLA-Liou, (h) NASA GISS (i) NCAR CAM3.