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Title and abstract for CIMSS seminar on April 1st, 2008

Effect of Cloud Macroscale Properties on Climate Forecasting in the Tropics

In the last decade numerous advances have been made in parameterizing cloud-radiation interactions. One recent area of improvement involves statistical representations of the influence of three-dimensional cloud fields on the domain averaged radiation. In this talk I will discuss the results from an off-line comparison of a stochastic shortwave radiative transfer model against a traditional plane-parallel model and observations. The simulations are performed using four years of data from the Atmospheric Radiation Measurement Program (ARM) Clouds and Radiation Testbed (CART) site at Nauru Island in the Tropical Western Pacific. Statistical cloud properties are derived from observed cloud chord lengths and input into the stochastic model, removing the necessity of explicitly simulating individual cloud fields and allowing for extended model runs. It is found that for certain cloud field geometries, as observed from the Nauru surface station, the stochastic radiative transfer model simulates more accurate surface fluxes than the traditional plane-parallel model. Results suggest that the relationship between vertical extent of liquid cloud and liquid water path is one indicator of radiatively significant cloud field configurations as is the relationship between solar zenith angle and cloud fraction. A simple parameterization based on criteria developed from these results is applied to the plane-parallel modeled downwelling surface flux to represent the impact of complex cloud field geometry on the domain-averaged radiation.