Validation and evaluation of cloud physics parameterizations in climate models using satellite observations

Ralf Bennartz

AOS/CIMSS/SSEC

University of Wisconsin – Madison

Satellite data provide the only means to globally observe clouds and aerosols. Significant progress has been made in this field over the last decades. Long-term satellite climatologies, covering 20+ years, have become increasingly valuable not only to characterize the current state of the climate system but also to identify trends.

This presentation will focus on our efforts to use satellite data to help constrain climate model cloud physical parameterizations and cloud-aerosol interactions. Emphasis will be given in particular to two parameters. Firstly, a global climatology of cloud liquid water path (LWP) derived from passive microwave data and, secondly, a global climatology of cloud droplet number concentration (CDNC) based on visible and near infrared observations. It is argued that these two quantities are key variables for understanding cloud climate interactions. Reasons for this are related to (1) the role of cloud liquid water path and droplet number concentration in cloud microphysical and radiative processes, (2) the availability of long-term passive microwave and visible/near-infrared observations, and (3) the objective nature of the definition of LWP and CDNC as compared e.g. to the more subjective nature of the definition of cloud fraction.

As a result, LWP and CDNC provide excellent diagnostics for Global Climate Model (GCM) validation. The role of these datasets in climate model verification will be discussed and application examples both at the cloud process level as well as the climate system level will be given.