Precipitation-related radiance bias correction and how GPM can help

Sara Q. Zhang[1], Philippe Chambon[2], William S. Olson[1], Milija Zupanski[3], Arthur Y. Hou[1]

[1]Mesoscale Atmospheric Process Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA
[2]CNRM-GAME, Météo-France and CNRS, Toulouse, France
[3]CIRA, Colorado State University, Fort Collins, CO, USA

In the context of data assimilation for numerical weather prediction (NWP), bias between observed and model-simulated radiances represents a combination of instrument measurement bias, systematic errors in observation operators, and forecast errors projected into observation space. Precipitation-sensitive microwave radiances are susceptible to approximations and assumptions on physical properties of precipitation in radiative transfer calculations and model cloud physics schemes. To utilize precipitation-sensitive radiances optimally in NWP systems, we need a bias correction with predictors that are related to precipitation processes, and an independent data reference to constrain the estimation of bias model parameters.

The core observatory of upcoming Global Precipitation Measurements mission (GPM) will provide simultaneous measurements by the GPM microwave imager (GMI) and the dual-frequency precipitation radar (DPR). The observations from DPR contain additional information about the precipitating particle size distribution (PSD) that is critical in detecting systematic errors in radiance observation operators under precipitation conditions. In this work, we first conduct statistical studies on systematic errors of first guess departures of precipitation-sensitive microwave radiances in the Goddard cloud-resolving WRF ensemble data assimilation system (WRF-EDAS) with a symmetric sampling approach. Second, we choose predictors that are precipitation-related, such as hydrometeors in different phases with distinct scattering properties and parameters concerning surface emissivity. Third, we formulate an adaptive algorithm to estimate bias model parameters for selected channels of microwave radiances utilizing coincidental observations from DPR as a constraint. Experiments are carried out by WRF-EDAS using synthetic GMI and DPR data to examine the potential impact of the bias correction to the assimilation of precipitation-sensitive microwave radiances over land.