Geophysical Research Abstracts
Vol. 13, EGU2011-8966, 2011
EGU General Assembly 2011

Satellite-Based Passive Microwave Retrieval of Ice-Phase Precipitation

Benjamin Johnson (1,2) and Gail Skofronick-Jackson (2)
(1) University of Maryland, Baltimore County, Joint Center for Earth Systems Technology, Baltimore, MD, USA (jbenjam@gmail.com), (2) NASA Goddard Space Flight Center, Greenbelt, MD, USA

In the middle and high latitudes, cold-cloud precipitation is dominant. However, ice-phase precipitation, e.g., snowfall, remains difficult to observe using satellite-based passive remote sensing observations alone due to the wide variability of the physical characteristics of snowfall and underlying surface; and due to the the sensitivity (or lack thereof) of the wavelengths employed to infer the physical characteristics of interest.

The upcoming Global Precipitation Measurement mission, slated to launch in 2013, will provide a comprehensive, near-global, set of passive and active microwave observations of the Earth. The present research supports the efforts of detecting precipitating snow using passive microwave observations.

The key problems in detecting and measuring ice-phase precipitation are primarily due to:

1. Contrast of the signal from ice-phase precipitation with the surrounding surface or underlying rain/water vapor layers, and;

2. The relationships between the physical and radiative properties of the scene being observed, and the associated uncertainties with respect to the actual physical variability of those properties within the scene.

For observational data, we use AMSU-B observations at 89, 150, at 183.31+/-1,3,7 GHz limited to a 5° x 5° region of Canada approximately centered around the CARE site (http://www.c3vp.org/) as an inputs to a recursive Bayesian precipitation retrieval algorithm.

The retrieval methodology was developed with the following goals in mind:

1. To successfully detect ice-phase precipitation, and

2. To estimate the physical properties of the precipitation, such as ice water path (IWP) and near-surface snowfall rate (S). In this paper, we address both problems (1) and (2) above. In particular, we focus on improvements in the following key elements of the retrieval algorithm:

(a) The physical database employed for retrieval algorithm: we employ a variety of non-spherical representations of hydrometeor shapes, and size distributions based on previously published size-“density” relationships, and retrieved surface emissivities from nearby clear-sky pixels.

(b) The retrieval framework: For observational data, we use AMSU-B observations at 89, 150, at 183.31+/-1,3,7 GHz as an input to a recursive Bayesian algorithm, conceptually similar to the Ensemble Kalman Filtering (EnKF) approach. The retrieval algorithm is designed with the following goals in mind: (i) to successfully detect ice-phase precipitation, (ii) to estimate the physical properties of the precipitation, such as ice water path (IWP) and near-surface precipitation rate; and (iii) estimate the uncertainties in the retrieved physical properties due to known uncertainties in the observations and assumptions in the forward and retrieval models used.

(c) Sensitivity analysis: Error covariance matrices, in both the models and observations, are combined to obtain a forward error covariance, which is propagated into the retrieval algorithm. We perform a Jacobian sensitivity analysis for reasonable variations in the physical properties described by the forward model/database. A similar analysis is performed for the retrieved quantities, where sensitivity to observable quantities, such as land surface temperature, is tested.

(d) Validation: Using an existing observation dataset obtained from the 2006 CARE-C3VP field experiment (http://www.c3vp.org/), we validate our retrievals by comparison with the surface-based snowfall observations for two case: (i) shallow but intense lake-effect snowfall, and (ii) a deeper synoptic snowfall event. We also compare our retrievals to standard retrieval products, such as the official AMSU-B snowfall algorithm, to determine if any skill is obtained by the retrieval vs. standard products.