PASSIVE MICROWAVE REMOTE SENSING OF FALLING SNOW AND ASSOCIATED GPM FIELD CAMPAIGNS

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Gail Skofronick-Jackson (Presenter)
NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA
Phone: 301-614-5720
E-mail: Gail.S.Jackson@nasa.gov

Abstract

Retrievals of falling snow from space represent one of the next important challenges for the atmospheric, hydrological, and energy budget scientific communities. Historically, retrievals of falling snow have been difficult due to the relative insensitivity of satellite rain-based channels as used in the past. We emphasize the use of high frequency passive microwave channels (85-200 GHz) since these are more sensitive to the ice in clouds and have been used to estimate falling snow from space. While satellite-based remote sensing provides global coverage of falling snow events and the science is relatively new, retrievals are still undergoing development with challenges remaining.

There are several current satellite sensors, though not specifically designed for estimating falling snow, are capable of measuring snow from space. These include NOAA's AMSU-B, the MHS sensors, and CloudSat radar. They use high frequency (>85 GHz) passive and active microwave and millimeter-wave channels that are sensitive to the scattering from ice and snow particles in the atmosphere. Sensors with water vapor channels near 183 GHz center line provide opaqueness to the Earth's surface features that can contaminate the falling snow signatures, especially over snow covered surface. In addition, the Global Precipitation Measurement (GPM) mission scheduled for launch in 2013 is specifically designed to measure both liquid rain and frozen snow precipitation.

Since falling snow from space is the next precipitation measurement challenge from space, information must be determined in order to guide retrieval algorithm development for these current and future missions. This information includes thresholds of detection for various sensor channel configurations, snow event system characteristics, and surface types. For example, can a lake effect snow system with low cloud tops having an ice water content (IWC) at the surface of 1.0 g m^{-3} be detected? If this information is known, we can focus retrieval efforts on detectable storms and concentrate advances on achievable results.

In this work, the focus is to determine thresholds of detection for falling snow for various snow conditions over land and lake surfaces. The results rely on simulated Weather Research Forecasting (WRF) simulations of falling snow cases [9] since simulations provide all the information to determine the measurements from space and the ground truth. This analysis relies on data from the Canadian CloudSat/CALIPSO Validation Program (C3VP) field campaign held from October 31, 2006 through March 1, 2007. In January 2012 GPM will return to the C3VP area for the GPM Cold Precipitation Experiment (GCPEx). This presentation will describe the thresholds-of-detection procedure and results, as well as the field campaign details.