Towards Characterization of ATMS Observation Error under Cloudy Conditions Using GMI/DPR Data

Lin Lin[1], Fuzhong Weng[2], Frank Tilley[1], and Mike Pettey[1]

[1] I. M. Systems Group, Inc., Rockville, Maryland, U.S.A.

[2] NOAA/NESDIS/Center for Satellite Application and Research, College Park, Maryland, U.S.A.

Introduction

Direct satellite radiance assimilation has resulted in a steady increase of forecast precision of global medium range forecast models at all major Numerical Weather Prediction (NWP) centers. However, large amoun of satellite data are excluded by quality control procedure that usually consists of cloud detection algorithm to remove cloud- or rain- affected data. In fact, cloudy radiances provided by satellite instruments naturally contain some useful information about clouds and precipitation presented in the field-of-vies (FOVs) of the instruments, and should be desired by NWP models. In order to benefit from the assimilation of cloud- or rain-affected microwave radiance data, it is necessary to first understand the biases from the satellite observations and corresponding simulations.

In this study, the Community Radiative Transfer Model (CRTM) developed by the US Joint Center for Satellite Data Assimilation (JCSDA) will be used to simulate brightness temperatures from the Advanced Technology Microwave Sounder (ATMS) by using the atmospheric state profiles from European Centre for Medium-Range Weather Forecasts (ECMWF) and the retrieved hydrometeor profiles from collocated JAXA Global Precipitation Measurement/Dual-frequency Precipitation Radar (GPM/DPR) as inputs. Then, the simulated brightness temperatures are compared against the ATMS observations. Because the GPM is capable to measure the amount, size, intensity, and type of rain, and the DPR can provide the information of particle drop size distribution and rain types, the combination of GPM and DPR data makes possible to characterize the biases of observed and simulated ATMS radiances under various types of cloud and rain.

Collocation Between ATMS and GMI/DPR Data

Collocation Criteria

Time difference < ± 15 minutes and spatial distance < 7.9 km.

(All GMI/DPR pixels satisfy the collocation criteria are retained for the ATMS pixel.)

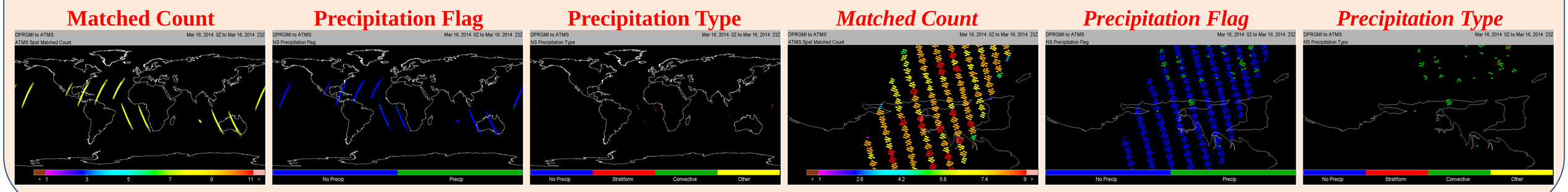
Key Variables in Matchup File

ATMS	latitude, longitude, satellite azimuth angle, satellite zenith angle, antenna temperature, spot matched count, distance from matched GPM/DPR pixel, temporal difference from matched GPM/DPR Pixel
GPM/DPR	latitude, longitude, air pressure, air temperature, cloud ice water content, cloud liquid water content, ellipsoid bin offset, local zenith angle, scan position, FOV position, precipitation PSD parameter, total precipitation liquid water content, precipitation flag, precipitation type, surface air pressure, surface air temperature, surface emissivity, surface type

Matchup Example – March 16, 2013

zoom in

Matched Count **Precipitation Flag** **Precipitation Type** ***Matched Count*** ***Precipitation Flag*** ***Precipitation Type***



Summary and Future Work

- ATMS TDR is collocated with GMI/DPR data using the collocation criteria of time difference < ± 15 minutes and spatial distance < 7.9 km
- On a good day, about 150 of 2700 ATMS granules are matched to GPM data. That is just over 5% of ATMS granules.
- Less than 0.1 % of the matchups are under precipitation conditions.
- The collocation is currently running for July-August 2014 and January-February 2015.
- Simulation of ATMS using the atmospheric state profiles from ECMWF analysis and the GPM/DPR retrieved hydrometeor profiles as input to CRTM will be calculated at each GMI/DPR spot.
- The numerical mean of simulated brightness temperature at all GMI/DPR pixel (B) will be used to compare with the observed brightness temperature of the correspondingly collocated ATMS pixel (O).
- The O-B at collocated matchups will be characterized under difference precipitation conditions.

I.M. Systems Group, Inc.

JCSDA
Joint Center for Satellite Data Assimilation
A multi-agency research center created to improve the use of satellite data for analyzing and predicting the weather, the ocean, the climate and the environment