P4.6 CALIBRATION/VALIDATION OF NOAA-18 AMSU-A AND MHS FOR THE MICROWAVE SURFACE AND PRECIPITATION PRODUCTS SYSTEM (MSPPS)

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The Microwave Surface and Precipitation Products System (MSPPS) project is dedicated to the retrieval of near-real-time operational surface hydrological products using brightness temperatures from the microwave instruments (AMSU-A, AMSU-B and MHS) on board NOAA's polar orbiting environmental satellites (POES). The launch of the newest NOAA satellite, NOAA-18 on May 20, 2005, presented a new challenge to the MSPPS project due to a new instrument, the Microwave Humidity Sounder (MHS), which replaced the AMSU-B on board the previous three NOAA POES. The NOAA-18 post-launch work for MSPPS also includes cal/val of the radiances and products.

A major difference between MHS and AMSU-B (both five channel radiometers) is the measurement frequency at channel 2 and channel 5: MHS has 157 GHz and 190 GHz while AMSU-B operates at 150 GHz and 183 +/- 7 GHz. In order to generate MSPPS products from MHS data, synthetic AMSU-B data are generated based on MHS at these two channels. The equations for the conversion were derived pre-launch through linear regression from radiative transfer simulations and were later adjusted based on actual match-up data from NOAA-16 AMSU-B and NOAA-18 MHS measurements as the two satellites are only about 40 minutes apart. Figure 1 compares one rain rate field derived from NOAA-16 with those from NOAA-18 before and after the adjustment. The MHS rain image after the post-launch calibration agrees better with the AMSU-B rain image than the one before calibration.

As was the case for the previous AMSU-A sensors placed into operation, a cross-track asymmetry is observed in the NOAA-18 AMSU-A radiances and products. The asymmetries in radiances were characterized using forward model calculations and were then corrected. Figure 2 and 3 show the cross-track asymmetry of the brightness temperatures at four window channels: 23.8, 31.4, 50.3, and 89.0 GHz. The equation for the asymmetry correction takes a general form:

$$correction = a_0 \exp\left[-\frac{(\theta - a_1/a_2)^2}{2}\right] + a_3 + a_4\theta + a_5\theta^2$$

where θ is local zenith angle, a_0 to a_5 are correction coefficients and vary for different channels and orbit directions (ascending or descending). The impact of the asymmetry on the MSPPS products can be exemplified by Figure 4 which compares the global cloud liquid water (CLW) derived from NOAA-18 AMSU-A with and without the asymmetry corrections in place. The asymmetry effect across the scan line is clearly seen in the images as false CLW signals along the scan line edges are removed after the asymmetry correction is implemented. The NOAA-18 MSPPS products are also validated against other satellites before their operational implementation.

The views, opinions, and findings contained in this report are those of the author(s) and should not be construed as an official National Oceanic and Atmospheric Administration or U.S. Government position, policy, or decision.

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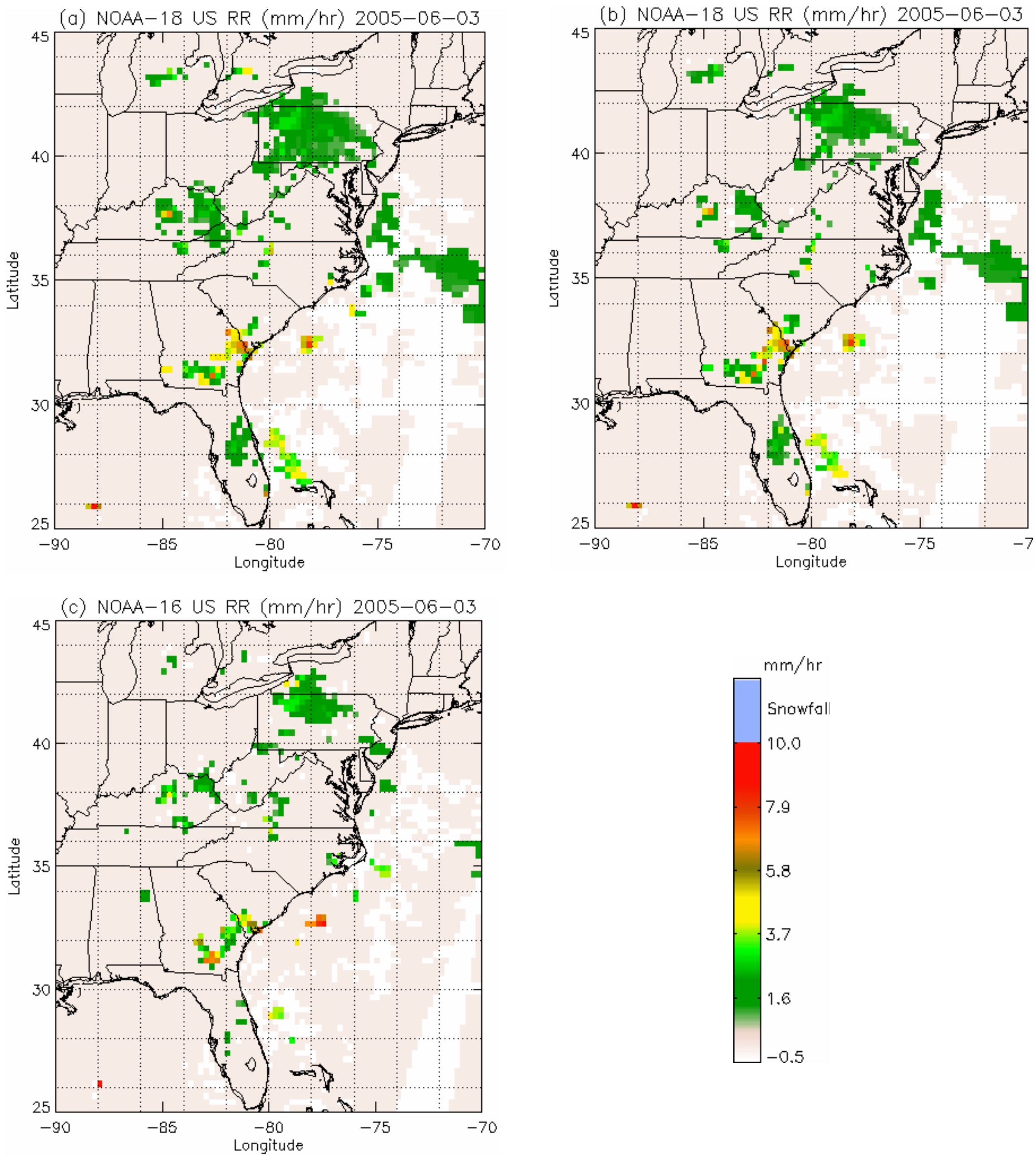


Figure 1. Rain rate over eastern U.S. derived from (a) NOAA-18 MHS before calibration, (b) NOAA-18 MHS after calibration, and (c) NOAA-16 AMSU-B.
NOAA-16 is approximately 40 minutes later than NOAA-18.

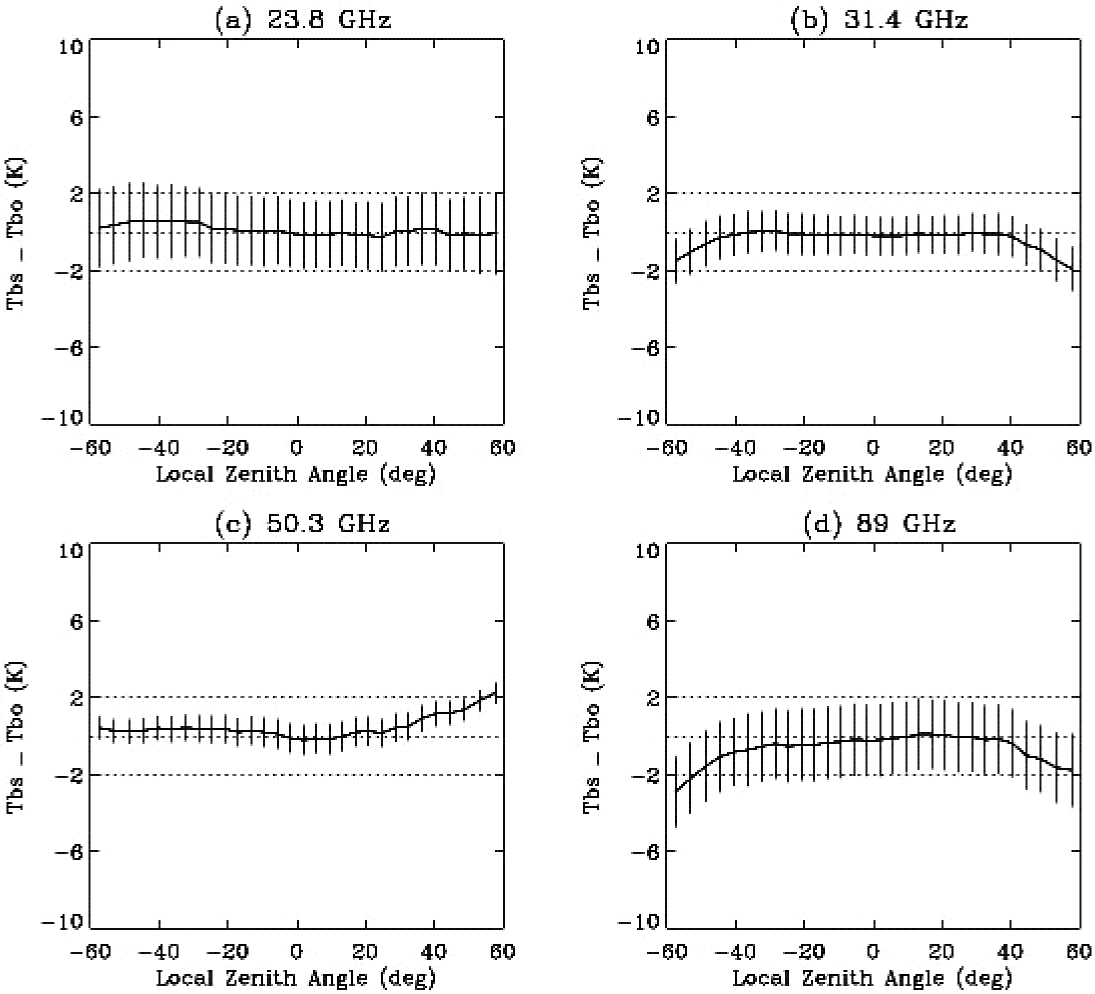


Figure 2. Cross-track asymmetry of NOAA-18 AMSU-A ascending brightness temperatures (presented as the difference between the simulated and the observed brightness temperatures) at (a) 23.8 GHz, (b) 31.4 GHz, (c) 50.3 GHz, and (d) 89.0 GHz.

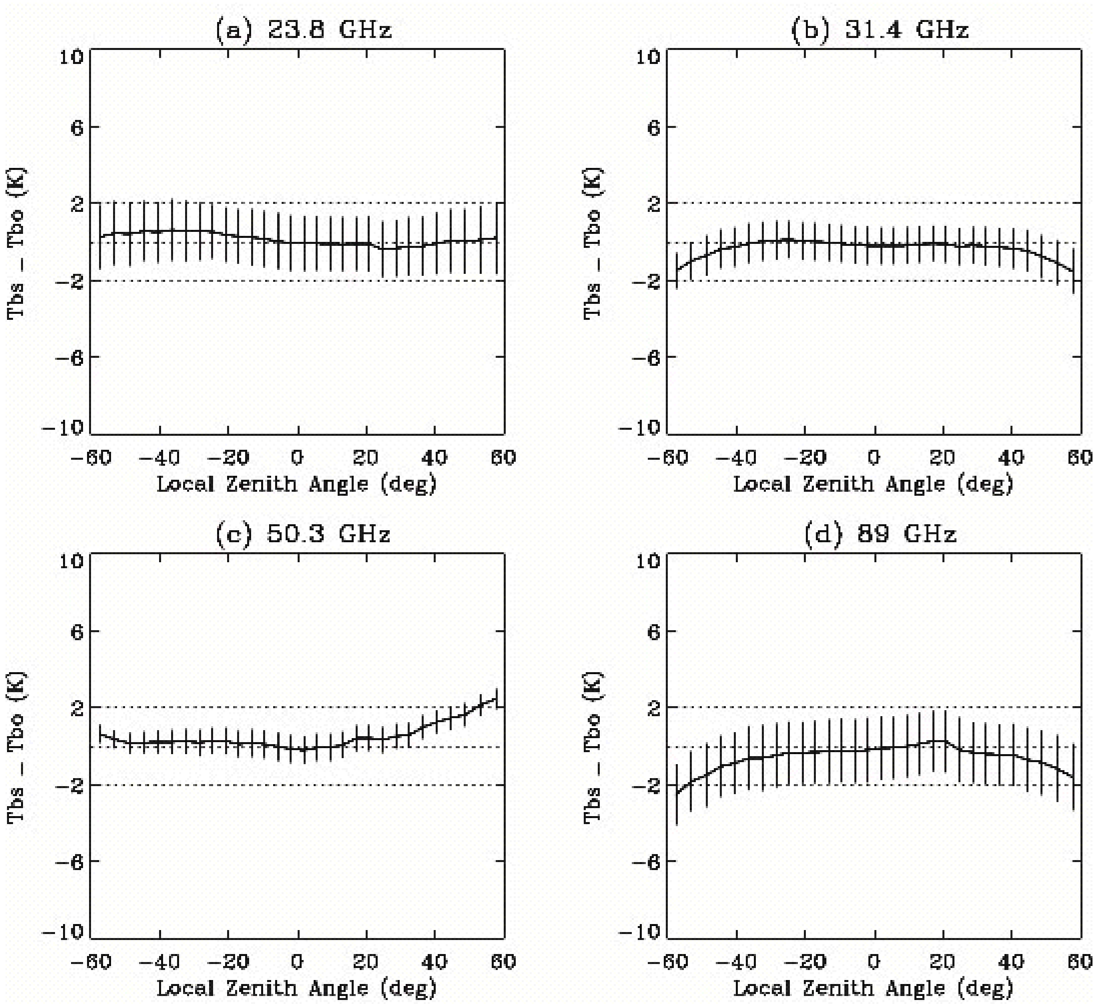
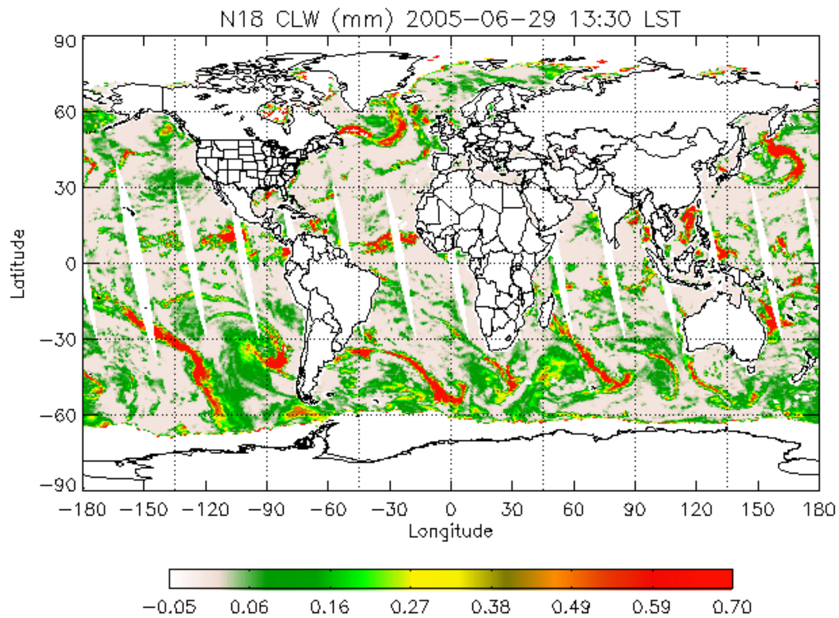


Figure 3. Cross-track asymmetry of NOAA-18 AMSU-A descending brightness temperatures (presented as the difference between the simulated and the observed brightness temperatures) at (a) 23.8 GHz, (b) 31.4 GHz, (c) 50.3 GHz, and (d) 89.0 GHz.

(a)



(b)

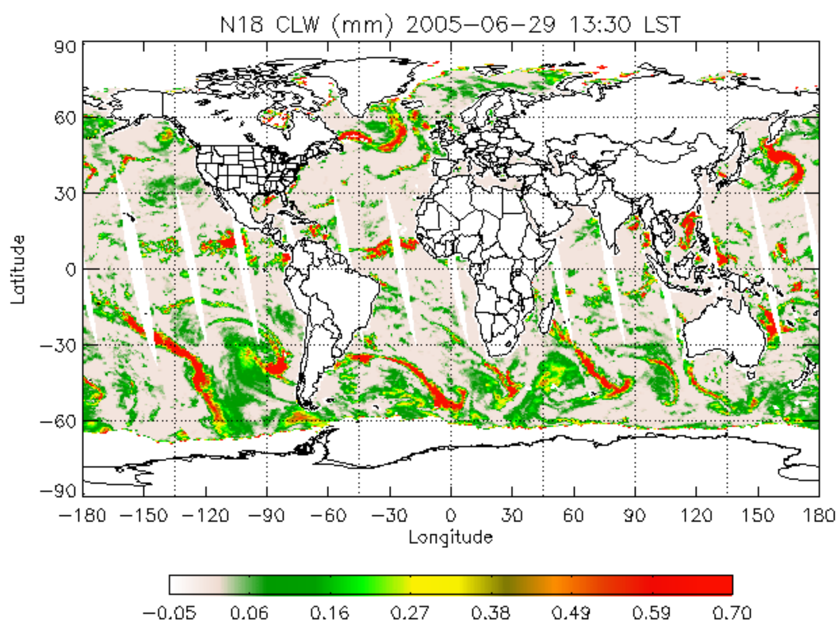


Figure 4. Images of cloud liquid water derived from NOAA-18 AMSU-A (a) without asymmetry corrections, and (b) with asymmetry corrections.