Evaluation of the Impact of Instrument Noises on F18 Special Sensor Microwave Imager/Sounder Measurements and Noises Correction

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Abstract

The Special Sensor Microwave Imager/Sounder (SSMIS) on board the Defense Meteorological Satellite Program (DMSP) F-16, F-17, F-18 satellites platform is a series of passive microwave conical scan instruments which can provide atmospheric temperature, water vapor profiles as well as surface parameters by combining AMSU like temperature and water vapor sounding channels and Special Sensor Microwave Imager (SSMI) like window channels. The SSMIS measurement is affected by instrument issues like solar intrusions into the warm calibration load and main reflector emissions. These issues greatly reduced the data quality and need to be considered before assimilating SSMIS observations in weather forecast system.

The first part of the poster is noise filtering. The high frequency noises in warm count and platinum resistance thermometer (PRT) temperature are filtered after application of fast Fourier transform (FFT). After that the brightness temperature observations are reconstructed. In the second part, the reflector face temperature is reconstructed from measured arm-rim temperature. Then the reflector emissions are removed from the reconstructed brightness temperatures. The mean value and standard deviation of the observation bias from CRTM simulation are reduced after removal of reflector emissions.

PRT and Warm Count Reconstruction

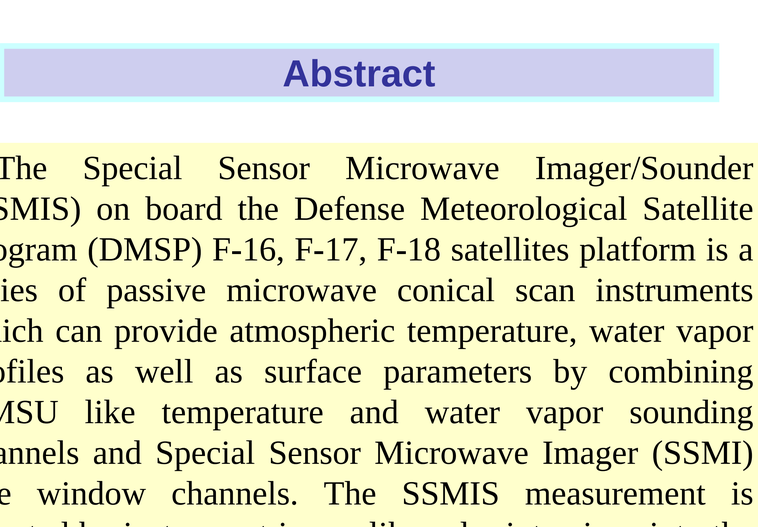

Fig. 1 F-18 PRT temperature (top) and warm count (bottom) for channel 4 on Apr. 20, 2011. Blue curve show the original data, and the red curves show the reconstructed data when signals with the frequency larger than the 2nd harmonics are filtered.

Observation Bias from Simulation

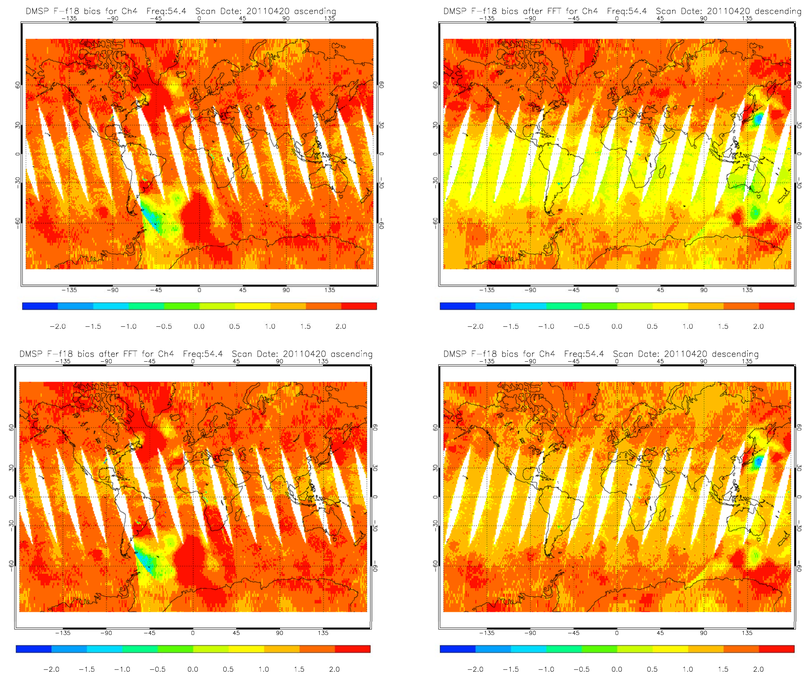

Fig. 2 Bias of observation from CRTM simulation for channel 4 on Apr. 20, 2011. Top: with original warm count and PRT temperature. Bottom: with reconstructed warm count and PRT temperature. Left: ascending orbits. Right: descending orbits

Reflector Emission Removal

Empirical function that retrieve reflector face from lagged reflector arm temperature:

$$T_{refl}(t) = T_{arm}(t) + c_F \int_0^L e^{(-\tau/\alpha)} \frac{dT_{arm}}{dt}(t-\tau)d\tau$$

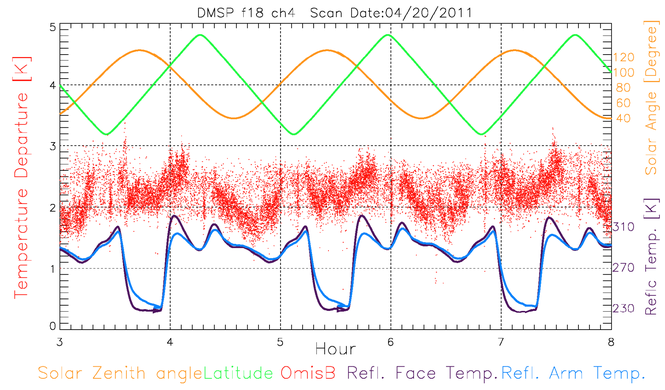

Fig. 3Time series of latitude, solar zenith angle, OmisB reflector face temperature, and reflector arm temperature

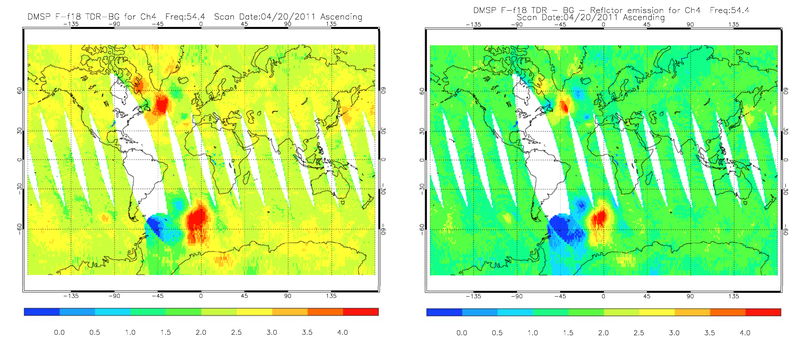

Fig. 4 Bias of observation from simulation (left) and bias of observation from simulation after removal of reflector emission (right) for channel 4 ascending orbits on Apr. 20, 2011.

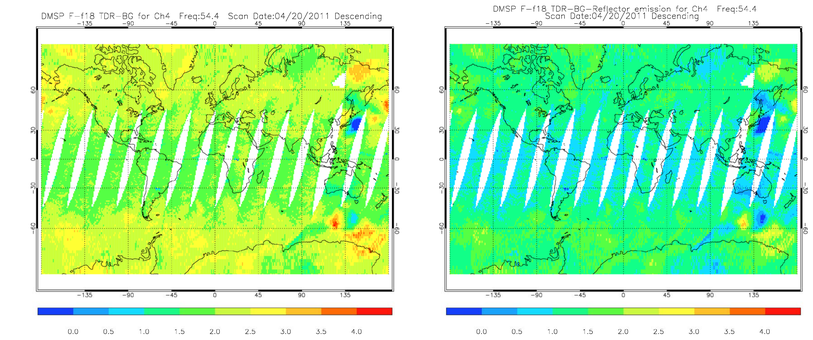

Fig. 5 Bias of observation from simulation (left) and bias of observation from simulation after removal of reflector emission (right) for channel 4 descending orbits on Apr. 20, 2011.

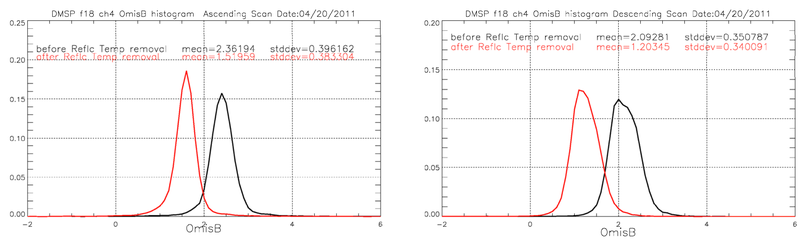

Fig. 6 Bias histogram for fig. 4 (left) and fig. 5 (right). The blue curve shows the histogram of bias before reflector emission removal and the red curve shows the histogram of bias after reflector emission removal.

Summary

Reflector face temperature shows stronger latitude dependence on ascending nodes than descending nodes.

Bias of observation from simulation shows stronger latitude dependence on descending nodes than ascending nodes.

Histogram of bias shows removal of reflector emissions can improve data quality by decreasing standard deviation of bias.

The improvement of data quality is not obvious with reconstructed PRT temperature and warm count

References

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