Remapped ATMS Radiance and its Validation for the Suomi NPP Mission

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Introduction
The cross-track infrared and microwave sensor suite (CrIMSS) on the Suomi NPP satellite is comprised of the cross-track infrared sounder (CrIS) and the advanced technology microwave sounder (ATMS). The primary purpose of CrIMSS is to produce measurements of the atmospheric temperature and moisture profiles to support weather forecasting applications. The microwave instrument ATMS provides a stable initialization for the retrieval when only minor cloud obstruction is present, and a backup product when substantial cloud is present which prevents a successful use of infrared data. The synergistic use of CrIS and ATMS product when substantial cloud is present which prevents a successful use of infrared data. The synergistic use of CrIS and ATMS requires the footprints of the two instruments to cover nearly identical areas on the Earth’s surface. Since the 22 channels of ATMS have different sizes of footprints, as shown in Figure 1, the requirement of a data set met by the production of the remapped ATMS brightness temperature with prescribed footprints as represented by the gray areas in Figure 1.

Modeling of Effective ATMS Footprint
The resampling algorithm used in the generation of the remapped ATMS SDR uses a set of coefficients $w_k$ specific for each CrIS FOR and ATMS band independent of the orbital position of the satellite. The factors taken into consideration in the modeling of the effective footprints include:

1. Synchronization between CrIS and ATMS scans;
2. Alignments of the two instruments measured prior to NPP launch;
3. Projections of the antenna pattern for each channel measured during the prelaunch TVAC test, shown in Figure 2, at each FOR position, and
4. The continuous scan mode of the ATMS measurement.

In fact, due to the continuous scan mode of the ATMS during the capturing of an Earth scene, the effective footprints are larger in the cross-track direction than the instantaneous position of the ATMS antenna pattern at any nominal FOR position as shown in Figure 3. On the other hand, the need to have a constant set of resampling coefficients requires us to assume a spherical satellite orbit and a spherical Earth without self-rotation.

Validation
A preliminary part of the validation consists of examination of the optimal composite gain pattern in comparison with the desired gain pattern. As shown in Figure 4, the composite gain patterns given by the optimal resampling coefficients provide reasonably accurate representation of the desired gain patterns for all FORs and bands. However, there are still significant differences between the desired and optimal gain composite patterns. In fact, the actual antenna gain does not decrease as rapidly as the desired Gaussian gain pattern when the view angle moves away from the center of a FOR. On the other hand, Figure 4 also demonstrates the necessity of the resampling because the gain pattern of the nearest native ATMS FOR is much more proper representation of the desired pattern than the composite gain, especially for channels with small footprints such as channel 17 shown in Figure 4.

Remapped ATMS SDR provides an accurate representation of microwave radiance with desired gain patterns. The methodology of the resampling has been validated by analyses, as well as, by onboard ATMS data. The remapped ATMS data is currently used in the generation of the CrIMSS EDR products.