The backscattered signals from the atmosphere are used for deriving an estimate of the brightness temperature, $T_b$, using the following equation:

$$\frac{1}{T_b} = \frac{1}{T} + \frac{1}{T_0},$$

where $T_0$ is the atmospheric brightness temperature and $T$ is the brightness temperature of the underlying surface.

The brightness temperatures from SNPP ATMS are now well merged into the AMSU-A data family after remap and cross-calibration. The inter-sensor biases are derived for each pair of channels. It is shown that the brightness temperatures from SNPP ATMS are now well merged into the AMSU-A data family after remap and cross-calibration.

ATMS and AMSU-A Difference

The differences in standard deviations introduced by remapping for channels 1 and 2 are also shown. Figure 6 is a continuation of the results shown in Figure 5, and it is evident that the differences are much smaller after remapping.

Cross Calibration between Resample ATMS and AMSU-A

The SLP from NCEP GFS fields is plotted by contours (contour interval: 5 hPa) at a 5-hPa interval. The differences in the brightness temperatures from SNPP ATMS are now well merged into the AMSU-A data family after remap and cross-calibration.

Production of AMSU-A Like ATMS Resample Data with Backus-Gilbert Algorithm

The Backus-Gilbert (B-G) inversion method is a process of finding an optimal set of optimal weighting coefficients $w_{ij}$ such that

$$\sum_{i,j} w_{ij} G_{ij} = \delta_{ij},$$

under the constraint (Doyen, 1973):

$$\int \sum_{i,j} w_{ij} dA = 1.$$

The B-G algorithm solves an optimal weighting coefficients $w_{ij}$ by minimizing the following least-square problem

$$\min \left( \sum_{i,j} (G_{ij} - \delta_{ij})^2 \right),$$

where $G_{ij}$ is the cross-correlation matrix between the ATMS and AMSU-A data, and $\delta_{ij}$ is the Kronecker delta function.

Coregistration of SNAP ATMS and NOAA-18 AMSU-A using the simultaneous nadir overpass (SNOP) method

The SLP from NCEP GFS fields is plotted by contours at a 5-hPa interval. The differences in the brightness temperatures from SNPP ATMS are now well merged into the AMSU-A data family after remap and cross-calibration.

Outliers Removal Between $O^{ATMS\_resample}$ and $O^{AMSU\_A}$

An outlier point is taken as an outlier if the brightness temperature difference of ATMS channel 3 is greater than 1 K or less than -2 K.

Summary and Conclusions

The AMSU-A instrument has been on board NOAA and European meteorological satellites since the launch of NOAA-15 in 1991. The AMSU-A was replaced by the Advanced Technology Microwave Sounder (ATMS) on the NOAA-18 satellite in 2013. The AMSU-A data have been remapped and cross-calibrated with the ATMS data for long-term monitoring of climate change.

Generation of AMSU-A Like ATMS Resample Data with Backus-Gilbert Algorithm

The Backus-Gilbert (B-G) inversion method is a process of finding an optimal set of optimal weighting coefficients $w_{ij}$ such that

$$\sum_{i,j} w_{ij} G_{ij} = \delta_{ij},$$

under the constraint (Doyen, 1973):

$$\int \sum_{i,j} w_{ij} dA = 1.$$