Inter-satellite calibration of microwave sounders for climate trend monitoring

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Climate change monitoring and research require development of long-term satellite data products as well as comprehensive reanalysis data products. However, calibration and data consistency have been a major issue in producing reliable satellite climate products. Many long-term satellite climate products suffer from spurious climate jumps induced by satellite transition and calibration-related instrument changes. To reconcile the problem, inter-satellite calibration is required for inter-satellite biases removal before satellite data are used for climate trend analysis and reanalysis data assimilation.

NOAA/NESDIS is inter-calibrating MSU/AMSU observations from NOAA, NASA, and MetOp orbiting satellite series for development of consistent climate data record. An inter-calibration method based on simultaneous nadir overpass (SNO) matchups was developed. It is recognized that calibration nonlinearity determined in satellite pre-launch calibration was generally inaccurate and thus responsible for a great deal of warm target related, time-varying inter-satellite biases. The SNO method obtains optimum nonlinear calibration coefficients through a SNO regression procedure. Due to orbital geometry, the SNO matchups are confined to the polar regions, where the brightness temperature range is slightly smaller than the global range. Nevertheless, the resulting calibration coefficients are applied globally to the entire life cycle of an MSU/AMSU satellite. Such inter-calibration reduces warm target errors by an order of magnitude compared to pre-launch calibration and, thus, results in well-merged time series for the MSU/AMSU channel based atmospheric deep layer temperature.

In addition to instrument root-level inter-calibration, bias corrections of error sources from different incident angle, diurnal drifts, short overlap problem, and channel frequency differences, etc., are also required for developing climate quality atmospheric temperature long-term data records. With appropriate correction algorithms for these errors, we have developed a 30-year MSU/AMSU deep layer atmospheric temperature

climate data record for the mid-troposphere (T_2), upper-troposphere (T_3), and lower stratosphere (T_4) (Figure 1).

This presentation will review the calibration methodology and current status on the MSU/AMSU dataset development. We will focus on biases of the AMSU observations on NOAA-15 through NOAA-18 and MetOp-A. Bias-drift of NOAA-16 and its calibration will be discussed. Updated 30-year atmospheric temperature trends derived from the MSU/AMSU dataset will be presented.

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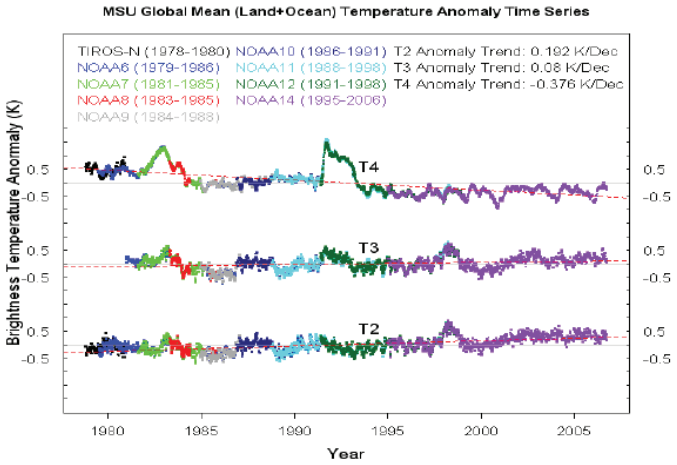

Figure 1 28-year (1979-2007) well-intercalibrated and merged MSU channel observations of the deep-layer temperature of the mid-troposphere (T_2), upper-troposphere (T_3), and lower stratosphere (T_4)