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Building the High-Quality Sensor Data Records from NOAA Operational Satellites for Climate and Weather Applications

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Long-term climate data records can be developed from the observations of the operational satellite systems. The operational weather satellites are designed primarily to provide measurements for short-term weather and environmental prediction. Instrument calibrations lack traceability to International Standards (SI) units, sensors and onboard calibration sources degrade in orbit, long term data sets must be stitched together from a series of overlapping satellite observations, orbital drift—leading to a changing time of satellite observing time during the satellite's lifetime—introduces artifacts into long term time series, and, most importantly, insufficient attention is paid to pre- and post-launch instrument characterization and calibration. This study presents a series of efforts conducted in NOAA to reduce inter-satellite measurement biases to help meet climate monitoring and NWP data assimilation applications. In the past decades, we have developed advanced algorithms for cross-calibration of microwave and infrared measurements to their respective reference instruments. For example, microwave sounding instruments from MSU, AMSU and ATMS are spatially re-sampled prior to simultaneous nadir overpassing (SNO) collocations. The resulted climate data records after cross-calibration display continuity and reasonable trends. Recently, an effort was also made to develop an atmospheric temperature profile from MSU/AMSU using 1dvar retrieval system. It is found that the temperature near tropopause shows much stronger warming than that previously derived from radiosondes and MSU radiances. This new temperature data set can be used for directly validating the climate model results. It is also demonstrated that the emission and scattering from precipitating clouds have significant influence on the temperature trends from microwave sounding instruments and the impacts and implications of their presence in the MSU radiance set and the 1dvar retrievals on the tropospheric trend are assessed