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Towards long-term characterization of AVHRR sensors for the NOAA/NESDSIS science data stewardship program: Focus on NOAA-16 and NOAA-17 in 2003

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Three generations of AVHRR sensors have been flown onboard 12 consecutive NOAA satellites in orbit since the late 1970s. A new reprocessing of the entire AVHRR data record has been recently initiated at NOAA/NESDIS. The objective is to ultimately generate improved climate data records (CDRs) of sea surface temperature (SST), aerosol, cloud, and vegetation. This challenging task requires better long-term characterization of NOAA orbits and AVHRR sensors.

Originally, we focus on one full year, 2003, of NOAA AVHRR/3 L1b data obtained from the afternoon NOAA-16 and mid-morning NOAA-17 (nominal equator crossing times 2 pm and 10 am, respectively). More than 5,200 orbits for each platform have been obtained from the NOAA Comprehensive Large Array-data Stewardship System (CLASS). All L1b files have been processed, to extract only calibration and instrument maintenance information, which is saved in the specially developed calibration HDF files (size of each cal HDF file is only 10% of the original NOAA L1b file).

This study summarizes results of the analyses of calibration and instrument maintenance AVHRR information during 2003. Calibration coefficients of the thermal bands on both instruments have been undergoing noticeable systematic changes in orbit.

In addition, AVHRR/3 onboard NOAA-16 experienced a noticeable discontinuity in September 2003, after its motor started spiking around 17 September 2003, and the whole instrument was heated on 23 September to reduce scan motor lubricant viscosity. This resulted in loss of a few orbits of AVHRR data, and changing overall instrument temperature (including not only motor but also base plate, black body, electronics, and A/D converter). As a result, all thermal calibration coefficients have also experienced discontinuity. Changes in solar reflectance bands cannot be traced, as those bands lack high-radiance calibration target onboard.

Instrument changes similar to the one described above need to be carefully analyzed, understood, and accounted for before any geophysical data products generated from AVHRR radiances are used for analyses of long-term climate variability. Further improvements in the calibration coefficients are planned. Once implemented, they will lead to more accurate and self-consistent calibration for each AVHRR instrument, and also improve cross-consistency between AVHRRs flown on different platforms. These improvements will directly support climate studies from AVHRR. Lessons learned from these analyses will be also applied to future real-time L1b processing from AVHRR onboard five future platforms: NOAA-N and N', and METOP 1 to 3.