Quantifying the Effects of the CrIS-FSR Radiance Polarization Corrections Using the NCEP Global Data Assimilation System

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Introduction

The Cross-track Infrared Sounder (CrIS) has polarization effects due to the design of the instrument. These polarization effects may be significant to Numerical Weather Prediction (NWP), especially for the shortwave bands. Scientists at the Space Sciences and Engineering Center (SSEC) have developed a theoretical model and convect for the polarization induced calibration errors. The polarization correction required for the correction were determined using data acquired by the CrIS instrument during the February 2012 Suomi NPP polarimetry. During the polarisation scan, all of the CrIS cross-track bands (1 reported that normally view the Earth, were looking in three space. In this configuration, both of signal and detector absorption, and emission of the scene was considered (polarization). For band 3 (shortwave), the uncorrected polarization induced calibration error can be as much as several degrees for cold Earth scenes.

Objective

To quantify polarization effects of the 6 CrIS detectors on shortwave (SUOMI-NPP). To do this, we used all three full spectral resolution bands (longwave, midwave, and shortwave) and 1,331 channels. Accumulation statistics are reviewed for each of the 3 detectors with and without the polarization corrections. We used the 2016 test resolution (FPA) 45x45 square version of the operational NCEP GDAS. All uncorrected experimental data was used. All CrIS bands were considered. Each detector was assimilated independently and the bias correction was unique to each detector. These statistics are for mean only. Radiation channels were switched to right only. Bias corrections had a 7 day spin up from 2083_10100 to 2018110710. The experiment run does from 201811010010 to 2018112110.

Results

The CrIS Full Spectral Resolution (FSR) radiances, from both Suomi-NPP and NOAA-20, with and without the polarization corrections are assimilated in the NCEP Global Data Assimilation System (GDAS) to quantify differences in assimilation statistics. NOAA-20 and Suomi NPP statistics for band 3 are shown in Figure 1 and 4 respectively. The average bias, detector bias, standard deviation average and detector bias difference standard deviations are shown in panels 1, b, d and 4 respectively in each figure. Detector specific differences for both the control and polarization corrected data, are examined using posterior work. Detect 3 is b) 3 and detector 2 is 1 in both NPP and NOAA (NOAA figures 19 and 21 respectively). The bias difference average, detector difference bias, standard deviation difference and detector difference standard deviations are shown in panels 3, b, d and 4 respectively. Overall differences between control and polarization, uncorrected data are smaller with the greatest differences in the high peaking (longwave) channels and minimal differences in the low peaking and midwave channels. Polarization corrections are greatest for longwave NPP data (NOAA-20 and the bias correction statistics condition bias). Polarization correction differences in the standard deviation statistics are minimal, especially for NOAA-20.

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