ASSESSMENT OF THE CONSISTENCY AND STABILITY OF CRIS INFRARED OBSERVATIONS USING COSMIC-2 RADIO OCCULTATION DATA OVER OCEAN

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The accuracy of brightness temperature (BT) from the Cross-track Infrared Sounder (CrIS) onboard the Suomi National Polar-orbiting Partnership (S-NPP) satellite and NOAA-20 is estimated using the Constellation Observing System for Meteorology, Ionosphere, and Climate 2 (COSMIC-2) Radio Occultation (RO) data as input to the Community Radiative Transfer Model (CRTM). The matchup criteria between RO and CrIS observations are time less than 30 minutes, a distance less than 50 km, and over oceans to reduce the collocation and simulation uncertainty. Based on the information provided in the CrIS and RO observations, only upper temperature sounding channels with weighting function peak height (WFPH) above 200 hPa (~12 km) at CrIS longwave infrared (LWIR) and shortwave infrared (SWIR) bands and water vapor channels at CrIS mid-wave infrared (MWIR) band with WFPH above 500 hPa (~6.3 km) are selected for comparison. The purpose is to minimize the impacts from the surface emission, cloud absorption/scattering, and atmospheric gaseous absorption. The absolute differences between CrIS observation and simulation using RO data as input are less than 1.0 K for the majority of those selected channels. The double differences between CrIS observations on NOAA-20 and S-NPP using CRTM simulations as transfer references are very stable. They range from -0.05 K to 0.15 K at LWIR channels and -0.20 K to 0.10 K at SWIR channels during the two years from 1 October 2019 to 30 September 2021. For MWIR channels, the double differences range from -0.15 K to 0.25 K but have significant variations at both daily mean and monthly mean time series. The results provide ways to understand the qualities of RO retrieval and CrIS measurements: RO data can be used to assess the consistency and stability of CrIS observations quantitatively, and CrIS measurements have the quality to assess the RO retrievals quality and stability. The results in this study demonstrate that the comparison approach can quantify the long-term stability for i) S-NPP CrIS, ii) NOAA-20 CrIS, and iii) between S-NPP CrIS and NOAA-20 CrIS. This approach can also quantify the CRTM simulation error at the CO2 4.3 μm band due to the nonlocal thermodynamic equilibrium (NLTE) effects during daytime by using the high accuracy and high stability of the RO temperature profiles. Due to the high accuracy and high stability of the CrIS observations, the BT difference in the daily time series can be used to detect the times for algorithm updates in the UCAR COSMIC-2 1DVAR system, which results in differences in bias characteristics.