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Inter-Calibration of Small Satellite-based Microwave, Infrared and Radio Occultation Sensors and Demonstration with Proxy Data

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Abstract

In the era of increasing demand for timely and accurate Numerical Weather Predictions (NWP), miniaturization of satellite components is making the use of small satellite (SmallSat) data in NWP increasingly more promising. This paper addresses the initiative of developing a new framework for integrated inter-calibration/validation among multiple and diverse sensors on SmallSats. The framework enables ingestion, calibration and validation of the data with disparate cadence such as from microwave (MW), infrared (IR) and radio occultation (RO) sensors on SmallSats. The MW, IR and RO sensors all measure or retrieve atmospheric temperature and other profiles. Using ATMS/CrIS on SNPP and NOAA-20, and IASI on MetOP satellites as proxy SmallSat instruments, the MW/IR SmallSat measurements are inter-calibrated and trended using Simultaneous Nadir Overpass (SNO) method. The RO instrument measurements from COSMIC and KOMPSat are inter-compared using collocation method. To reconcile and cross-compare multi-SmallSat measurements of diverse types, the brightness temperature from multiple MW/IR SmallSat sensors are further compared with the RO-retrieved atmospheric temperature profile by using CRTM-based retrieval tool to convert RO temperature profile to brightness temperature. This approach explores alternatives to the traditional approach of processing and using legacy MW and IR satellite data and provides assessment of derived variables and challenges in calibration and validation of SmallSat data.