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A fundamental climate data record of intercalibrated brightness temperature data from SSM/I and SSMIS

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The first Special Sensor Microwave/Imager (SSM/I) was launched in June 1987 on the Defense Meteorological Satellite Program's (DMSP) F08 spacecraft and started what is now a nearly continuous 24-year record of passive microwave imager data that can be used to monitor the climate system. This includes such fields as precipitation (over both land and ocean), the extent of sea ice and snow, sea ice concentration, total precipitable water, cloud liquid water, and surface wind speed over oceans. A total of nine window channel radiometers have been launched to date in the DMSP series including the SSM/I instrument on board F08, F10, F11, F13, F14, and F15 followed by the Special Sensor Microwave Imager/Sounder (SSMIS) on board F16, F17, and F18, which is expected to operate for at least the next decade. As a result, this data record provides the best available source of long-term global observations of several hydrological variables for climate applications. Although the DMSP sensors provide a long-term record, because the sensors were developed for operational use there are a number of issues that must be addressed to produce a dataset suitable for use in climate applications. There are a several quality control and calibration issues including, but not limited to, quality control of the original antenna temperatures, geolocation, cross-track bias corrections, solar and lunar intrusion issues and emissive antennas. The goal of producing an FCDR of brightness temperature data involves not only addressing many of these instrument issues, but also developing a well-documented, transparent approach that allows for subsequent improvements as well as a framework for incorporating future sensors. Once the data have been quality controlled and various calibration corrections have been applied, the goal is to adjust the calibration of the various sensors so that they are physically consistent. Such intercalibration does not correct for changes due to local observing time, which leads to legitimate temperature differences due to diurnal variability. Our approach to intercalibration is to implement multiple independent approaches, compare the differences between them and use the variability between techniques to give an estimate of the inherent error in the intercalibration. Four intercalibration approaches have been applied. (1) Direct matchups of pairs of DMSP satellites in the polar regions; (2) Matchups with Tropical Rainfall Measuring Mission (TRMM) Microwave Imager TMI, where TMI provides a calibration transfer standard with similar channels as SSM/I and SSMIS; (3) Vicarious calibration, where the minimum brightness temperature for each frequency is used for comparison; and (4) simulation of brightness temperatures for each satellite from model reanalysis data (MERRA) where the model is the transfer standard. Each of these four techniques have weaknesses, so a synthesis is required in order to fully intercalibrate the FCDR. This contribution will describe our progress to date towards a Fundamental Climate Data Record (FCDR) of quality controlled, inter-calibrated brightness temperatures from the DMSP passive microwave imagers (SSM/I and SSMIS). We will discuss the impact and importance of our quality control procedures and calibration corrections as well as present results from our intercalibration activities.