JP5.13 NetCDF SSM/I data publicly available: an improved and extended period of record

Hilawe Semunegus* and John J. Bates
NOAA National Climatic Data Center, Asheville, North Carolina

ABSTRACT

Satellite measurements from the Defense Meteorological Satellite Program's (DMSP), Special Sensor Microwave/Imager (SSM/I) have been produced since July 1987 and used extensively to generate climate datasets (including rain, snow, ice, cloud liquid water, and total precipitable water). The National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) has served as the active archive of SSM/I data which are produced by Navy's Fleet Numerical Meteorology and Oceanography Center. Quality flags based on threshold parameters were used to identify errors in temporal, geolocation and radiance values in the SSM/I period of record. A climatology quality flag was also developed to identify SSM/I radiances that were found to be +/- 10 standard deviations from the climatology mean. Statistical parameters such as minimum, maximum, mean, standard deviation, skew and kurtosis were calculated for radiance data to monitor SSM/I instrument health. All SSM/I data were reformatted to network Common Data Format (netCDF) in order to insulate users from previous format changes, to preserve the original data and to add quality flag variables in the orbital dataset. NetCDF SSM/I data can be accessed publicly at NOAA's Comprehensive Large-Array Stewardship System (CLASS) Operations website. NetCDF Special Sensor Microwave Imager/Sounder (SSMIS) data are also available from CLASS Operations without quality flags. Data quality flags and reprocessing in a self-describing format significantly improved the quality of SSM/I data for use in support of both national and international programs.

1. INTRODUCTION

The SSM/I period of record has been valuable for seasonal and interannual climate studies, especially in the hydrological field (Ferraro et al., 1996). However, there are significant issues with errors in the Temperature Data Record (TDR) such as sensor-specific biases, nonphysical antenna temperatures, mislocated scans, and geolocation problems. These issues can result in large errors in climate estimates of geophysical variables. NCDC's netCDF SSM/I TDR data identifies these problems in order to improve the ability of scientists to describe, assess and monitor Earth's climate. This data can be accessed at NCDC through <www.class.noaa.gov>.

Corresponding author address: Hilawe Semunegus, National Climatic Data Center, 151 Patton Avenue, Asheville, NC 28801; e-mail: Hilawe.Semunegus@noaa.gov

2. METHODOLOGY

As part of NCDC's effort to create an improved and extended SSM/I TDR period of record, quality flags were embedded in a new netCDF SSM/I TDR period of record that extends back to August 1993 (previously extended to February 1997). The climatology quality flag used a climate mean and standard deviation gridded database of SSM/I antenna temperature data, separated by month, platform and channel. For each footprint and corresponding geolocation in the SSM/I TDR period of record, a climatological anomaly value was calculated from the gridded climate record. Climatological anomaly values or z-scores that were out of the range of +/- 10 standard deviations were flagged as suspect. Temperature, geolocation and time quality flags were also effective in identifying and warning users of potential errors, as shown by Berg and Kummerow (2005). By using quality flags, original values for flagged temperature, geolocation and time values were preserved.

Statistical metadata such as minimum, maximum, mean, standard deviation, skew and kurtosis were calculated for each orbit file and also embedded as a global attribute, allowing any user to monitor the instrument health of SSM/I data.

3. RESULTS

Applied climatological and threshold quality flags improved the SSM/I TDR dataset significantly, as shown in Figures 1a and 1b. Figure 2 shows scattered or noisy on-board warm calibration counts corresponding with SSM/I TDR F-13 85 gigahertz (GHz) vertical antenna temperatures in Figure 1a. Most of the antenna temperature data that have been identified and flagged are the result of biases or errors in the cold or warm calibration counts. SSM/I instrument characteristics documentation has shown that erroneous cold calibration count readings will affect the resulting antenna temperature during ground processing (Hollinger et al., 1987).

4. FUTURE WORK

This study is part of an NCDC Scientific Data Stewardship effort to homogenize and intercalibrate the SSM/I TDR period of record. The ongoing effort to include 1987-1993 data into the netCDF SSM/I period of record will allow a complete dataset that customers can use for their various applications.

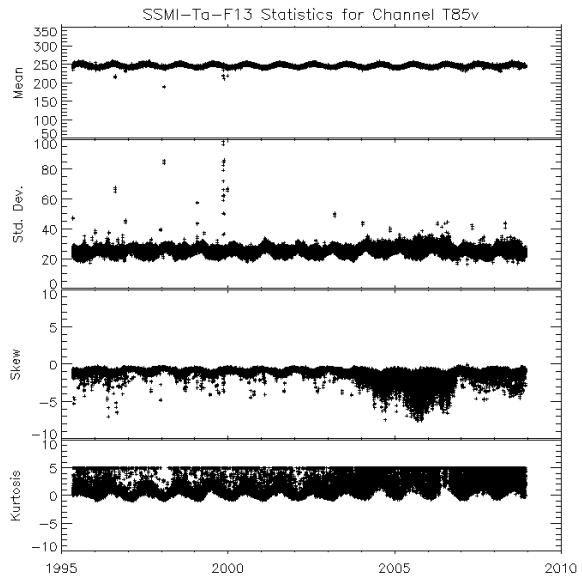

Figure 1a - SSM/I TDR F-13 85 GHz vertical antenna temperature statistics without quality flags applied.

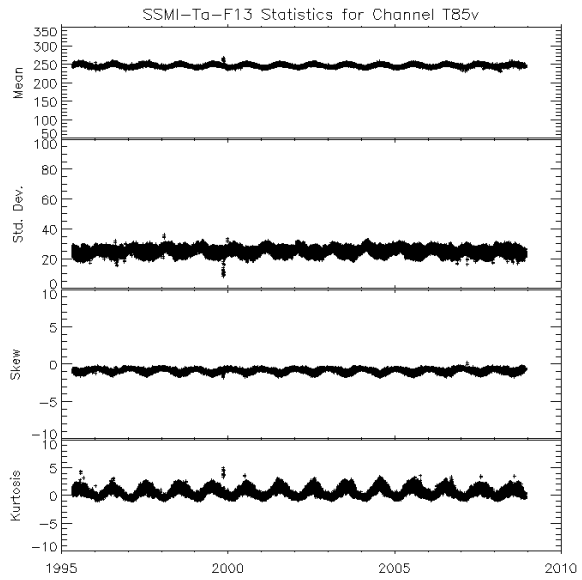

Figure 1b - SSM/I TDR F-13 85 GHz vertical polarization antenna temperature statistics with quality flags applied. Noisy data can still be found in this improved period of record (e.g. late 1999).

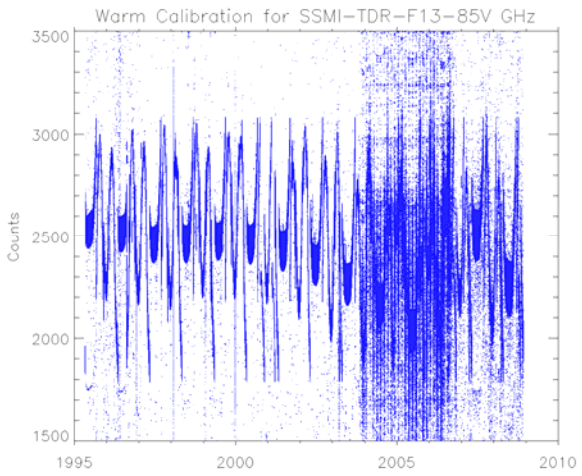

Figure 2 - SSM/I TDR F-13 85 GHz vertical warm calibration readings. Notice how very noisy warm calibration count data between late 2003 and 2007 correspond with noisy data in Figure 1a (skew) for the same time interval.

5. REFERENCES

Berg, W, C. Kummerow, 2005: *Common calibrated brightness temperature data file specification*, Retrieved October 5, 2006, from Colorado State University, Department of Atmospheric Science Web site: http://mrain.atmos.colostate.edu/LEVEL1C/doc/SSMI_L1C_Specification.pdf

Ferraro, R.R., F. Weng, N.C. Grody, and A. Basist, 1996: *An eight year (1987-94) climatology of rainfall, clouds, water vapor, snowcover, and sea-ice derived from SSM/I measurements*. Bull. of Amer. Meteor. Soc., 77, 894-905.

Hollinger, J., R. Lo, G. Poe, R. Savage, and J. Peirce, 1987: *Special Sensor Microwave/Imager User's Guide*. Naval Research Laboratory, Washington, DC.