EUMETSAT CM SAF CLIMATE MONITORING

70 Jahre Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

Fundamental Climate Data Record of Microwave Imager Radiances, Edition 4

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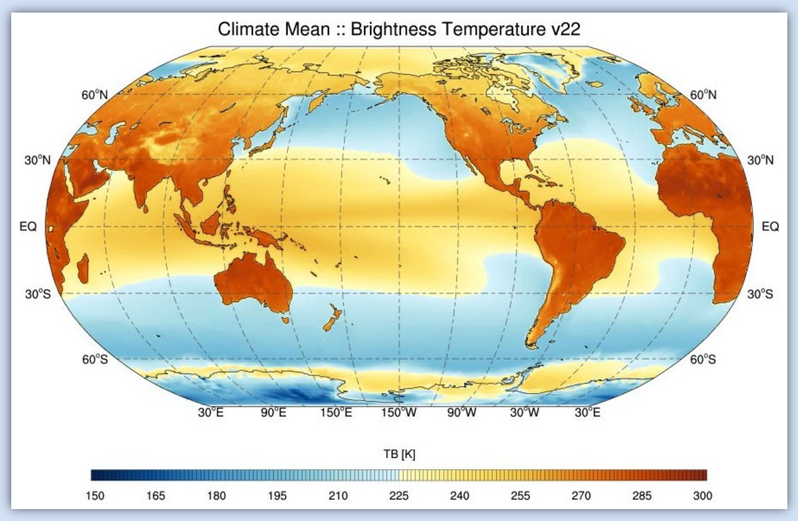
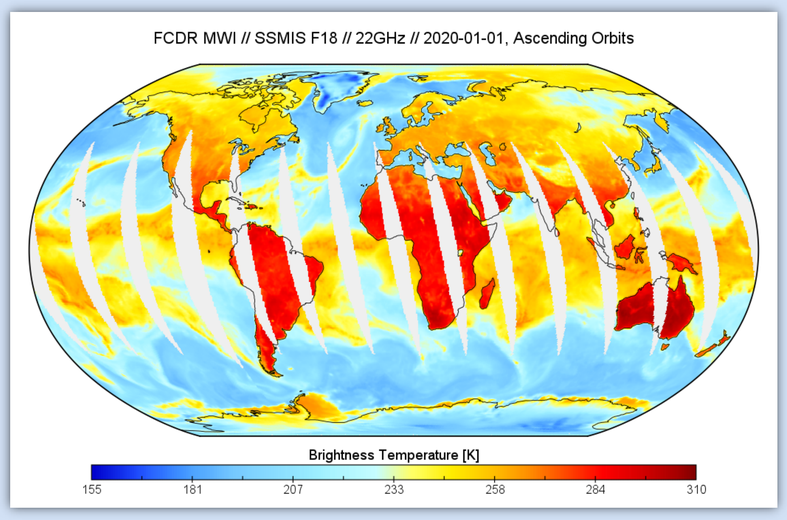




The CM SAF FCDR of Microwave Imager Radiances comprises inter-calibrated brightness temperatures from the SMMR, SSM/I and SSMIS radiometers. It covers the time period from October 1978 to December 2020 including all available data from the SMMR radiometer aboard Nimbus–7, the SSM/I radiometers aboard F08, F10, F11, F13, F14, and F15 and the SSMIS radiometers aboard F16, F17, and F18. It provides homogenised and inter-calibrated brightness temperatures in a modern user-friendly data format. The FCDR is used for a variety of applications, such as analyses of the hydrological cycle or input for reanalysis.

Dataset Fact Sheet

DOI
10.5676/EUM_SAF_CM/FCDR_MWI/V004

Satellite Data Availability
1978-10-25 to 2020-12-31

Temporal and Spatial Resolution
- Native SMMR, SSM/I, SSMIS

Spatial Coverage
- Global

Data Format
- NetCDF4
- Climate and Forecast (CF) Metadata Convention v1.7
- Attribute Convention for Data Discovery 1.3

Application Areas
- Water and energy cycle
- Sea ice
- Reanalysis
- Soil moisture

Motivation

HOAPS (*H*amburg *O*cean *A*tmosphere *P*arameters and Fluxes from *S*atellite Data) is a compilation of Thematic Climate Data Records (TCDRs) for analysing the water and energy cycle components over the global oceans. The *HOAPS* climate data records are primarily based on passive microwave measurements from the SSMI(S) (Special Sensor Microwave Imager/Sounder) sensor family. In order to derive reliable long term trend estimates of the global water cycle parameters, it is strictly necessary to carefully correct for all known problems and deficiencies of the radiometers as well as to inter-calibrate and homogenise the different instruments. Moreover, all applied corrections need to be clearly documented in order to provide a completely traceable calibration to compose a Fundamental Climate Data Record (FCDR).

FCDR Release

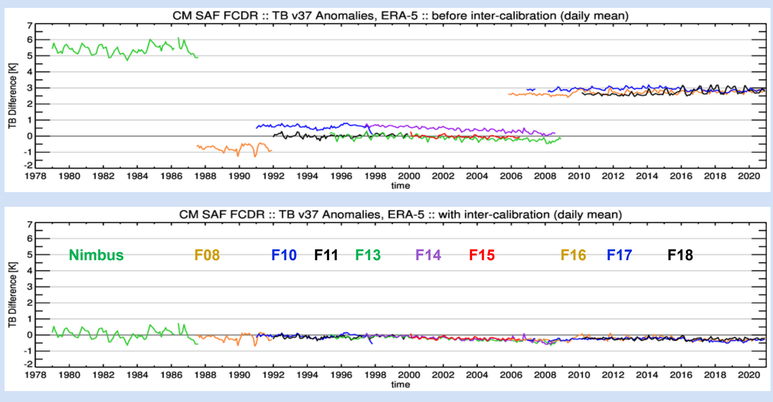
Following these requirements, CM SAF has released a 4th edition of the FCDR from Microwave Imager Radiances in 2022, freely available from the CM SAF web user interface (https://wui.cmsaf.eu/). A previous edition of this FCDR has already been used in the ESA CCI Sea ice project and also in the ECMWF reanalysis ERA5.

CM SAF has reprocessed five more years of the SSMIS (Special Sensor Microwave Imager Sounder) sensors aboard F16, F17, and F18. The FCDR now covers the time period from October 1978 to December 2020. A new adjustment to the SSMIS geolocation has been implemented in the new data record version in order to improve the consistency. Also issues with solar angle-depending differences in F17 and F18 data have been identified and corrected, leading to an improved inter-satellite calibration and stability.

FCDR Features

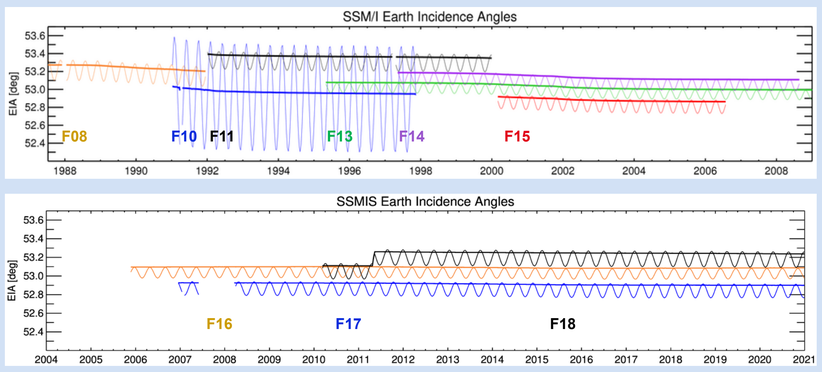
- Covered time period October 1978 – December 2020.
- Completely reprocessed data record, starting from available measured counts.
- Recomputed geolocation based on smoothed daily TLEs.
- Data processing accounts for identified instrument issues: moonlight-intrusions, sunlight-intrusions, along-scan non-uniformity, reflector emissivity, geolocation corrections, solar angle depending offsets.
- Synthetic 85 GHz data over ocean for SSM/I F08 and SSMIS.
- Earth incidence angle normalization (as separate offset).
- Scene dependent inter-calibration to F11 (as separate offset).
- Further details can also be found in Fennig et al. (2020).

Inter-calibration Validation



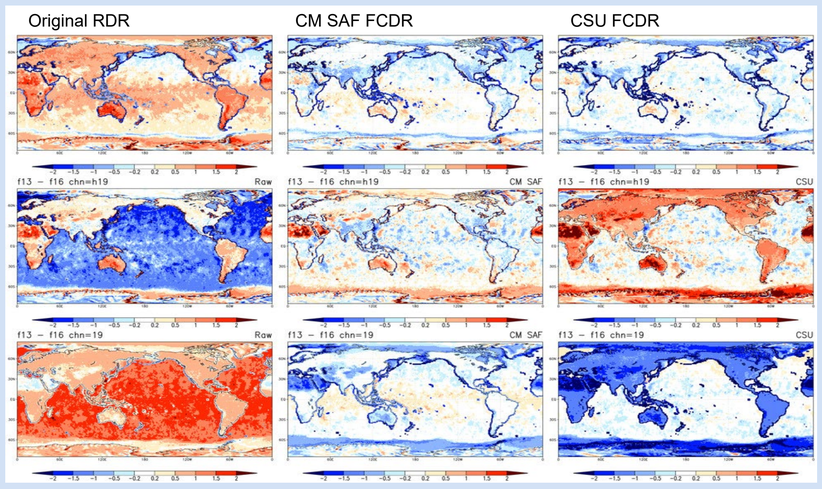
Time series of global monthly mean differences between observed and simulated (using ERA-5) brightness temperatures for SMMR, SSM/I and SSMIS instruments at 37 GHz vertical polarization for the raw data record without inter-calibration (top) and after inter-calibration offsets applied (bottom).

Platform Stability



Time series of DMSP platform Earth incidence angles for the SSM/I series (top) and the imager feedhorn of the SSMIS series (bottom). Thin lines are mean values at ascending equator crossing and thick lines depict complete orbit mean values.

Quality Assessment



Climatological means of brightness temperature differences at 19 GHz between SSM/I F13 and SSMIS F16. For the uncorrected raw data records (RDR), CM SAF FCDR and CSU FCDR (from left to right).

The top row depicts the vertically polarised channel, the middle row the horizontally polarised channel and the bottom row the double difference between both polarisations.

Summary / Outlook

All available raw data records have been reprocessed for the time period from 1978 – 2020 to a common standard, starting with the calibration of the raw Earth counts, to ensure a completely homogenized and traceable climate data record. The data processing accounts for several known issues with the SMMR, SSM/I and SSMIS instruments and corrects for a variety of calibration anomalies. Furthermore, the inter-calibration model incorporates a scene dependent inter- satellite bias correction and a non-linearity correction to the instrument calibration.

The data files contain all available original sensor data and metadata to provide a completely traceable climate data record. Inter-calibration and Earth incidence angle normalization offsets are available as additional layers within the data files in order to keep this information transparent to the users. The data record is complemented with radiometer sensitivities, quality flags, surface types, and Earth incidence angles.

It is planned to release an extension of this FCDR in 2023, extending the SSMIS covered time period to the end of 2022. It is also envisaged to improve the uncertainty characterization and incorporate new sensors like MWI and AMSR-3 for future usage.

Reference: Fennig, K., Schröder, M., Andersson, A., and Hollmann, R.: A Fundamental Climate Data Record of SMMR, SSM/I, and SSMIS brightness temperatures, Earth Syst. Sci. Data, 12, 647-681, https://doi.org/10.5194/essd-12-647-2020, 2020.

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