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Re-calibration of Infrared and Water-Vapor channels of imagers on EUMETSAT and JMA historical geostationary meteorological satellites using HIRS data

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Since more than 40 years, geostationary meteorological satellites observe the Earth to support weather nowcasting, forecasting and environmental applications. Due to their long observation period and their large spatial coverage these space-based observations could be of tremendous value for climate studies, such as on cloud properties and their impact on the global radiation budget. They also form a resource for studies on atmospheric dynamics as consecutive images can be used to derive atmospheric motion vectors.

The historical geostationary satellites and the instruments they carry were mainly built for weather applications. Climate applications require high accuracy satellite observations or at least a quantification and correction of effects due to changes in the characteristics of satellites and sensors that appear during their operational lifetime. The quantification of such effects can be used to harmonise and improve the calibration of individual instruments and to homogenise the calibration of time series of similar instruments.

This presentation addresses a common re-calibration approach that has been applied to the instruments operated on both EUMETSAT and JMA geostationary satellites, i.e., VISSR/JAMI/IMAGER on the GMS/MTSAT series and MVIRI/SEVIRI on the METEOSAT series. The approach re-calibrates measurements from infrared and water vapour channels at $\sim$11μm and $\sim$6μm. Data from the Infrared Atmospheric Sounding Interferometer (IASI), Atmospheric Infrared Sounder (AIRS) and High Resolution Infrared Radiation Sounders (HIRS/2, HIRS/3 and HIRS/4) were used as references to estimate the instrument changes quantitatively. The referencing was performed at the HIRS/2 channels spectral response that shows the best regression to the instruments in geostationary orbit. Because the spectral response for the water vapour channel on HIRS/3 and HIRS/4 was drastically changed, these instruments could not be used for the creation of a homogeneous time series back to the late 1970s. To keep the time series of reference measurements the same data of the AIRS and IASI hyper-spectral sounders were folded using the HIRS/2 spectral response, which revealed very small uncertainties as compared to directly using hyper-spectral sounder data folded with the spectral response from the geostationary instruments. The regression results are then used to derive re-calibration coefficients for each geostationary instrument.

This research contributes to the WMO initiative Sustained and Coordinated Processing of Environmental Satellite data for Climate Monitoring (SCOPE-CM) project No. 6: Inter-calibration of imager observations from time-series of geostationary satellites (IOGEO), which aims at establishing spatially and temporally homogeneous radiance data from all geostationary satellites.