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Construction of a Climate Data Record from PMW measurements

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Sea surface temperature (SST) is an essential climate variable that is critical for assessing the climate system and its changes, understanding of air-sea interactions and numerical weather prediction. Climate data records of sea surface temperature have been constructed for many years using infrared (IR) satellite observations, however, these observations are limited by cloud cover and aerosols. SST observations from microwave sensors, on the other hand, are not limited by clouds and the impact of aerosols is small.

A global SST climate data record for the period 2002-2016 has been constructed within the European Space Agency Climate Change Initiative (ESA-CCI) using passive microwave (PMW) data from AQUA's Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) and GCOM-W1's Advanced Microwave Scanning Radiometer - 2 (AMSR-2). A two-step linear multivariate regression model with localized regression algorithms is used to retrieve SST. In the first stage, the algorithm is trained to perform well orbit-wise and over restricted latitude domains, whereas in the second stage, the algorithm is trained to perform well over restricted SST and wind speed domains. The basis for the retrieval algorithm development and tuning is a Multi-sensor Matchup Dataset (MMD) created using a Multi-sensor Matchup System (MMS) software. The MMD includes AMSR-E and AMSR-2 orbital data matched to in situ observations from drifting buoys and Argo floats, as well as ERA-Interim NWP, referenced and spatially interpolated to each matchup.

The PMW SSTs are validated against drifting buoy measurements during the period 2002-2011. The results show an average difference of 0.01 K with a standard deviation of 0.54 K when considering the best 50% of retrievals. The PMW SSTs have been analyzed for dependencies with respect to a number of different parameters, such as wind speed, in situ SST and latitude. The satellite and in situ differences are highest in the dynamic oceanic regions due to the large satellite footprint size and the associated sampling effects. Uncertainty estimates for all PMW SST retrievals are available and have been validated to be accurate. In addition, benefits of a PMW climate data record over an IR climate data record have been assessed. In general, the results are promising and indicate that passive microwave observations are an alternative to infrared satellite observations for retrieving SST.