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Design and Performances of the Passive Microwave Neural Network Precipitation Retrieval (PNPR) Algorithm for the Conical Scanning GMI Radiometer

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Precipitation is an essential element of the global hydrological and energy cycles, and its measurements are of great importance in a variety of research areas, such as climate studies, management of water resources, natural hazards, and hydrology. Despite the measurement of the precipitation on a global scale is therefore crucial in many aspects of economic and social life on Earth, yet it still has many problems to overcome to meet the demands of hydrological and climate research, and of operational applications. An important step forward towards the improvement of global precipitation monitoring has been achieved with the advent of the Global Precipitation Measurement (GPM) mission thanks to the availability of the NASA/JAXA GPM Core Observatory (GPM-CO) (equipped with the GPM Microwave Imager (GMI) and the Dual frequency (Ku and Ka) Precipitation Radar (DPR)), expected to provide accurate precipitation estimates, and contributing to the constellation of pre-existing and future radiometers to ensure 3-hourly global coverage between 65°S and 65°N. In this direction, the EUMETSAT program H-SAF (Satellite Application Facility on Support to Operational Hydrology and Water Management) designed to deliver satellite products for hydrological applications (precipitation, soil moisture and snow parameters) to research and operation users worldwide, is being carried out in Europe.H-SAF precipitation products are based on the exploitation of all overpasses of present and future Low Earth Orbit (LEO) satellites carrying cross-track and conically scanning passive microwave radiometers orbiting around the globe. Within this framework we have developed a new algorithm, based on the Passive microwave Neural network Precipitation Retrieval (PNPR) approach, designed to work with the conically scanning GMI radiometer. As opposed to the PNPR algorithm originally developed for cross-track scanning radiometers (AMSU/MHS and ATMS), and based on a training database obtained from cloud resolving model simulations coupled to a radiative transfer model, the new PNPR for GMI is based on observational databases. The purpose was to develop a Neural Network (NN) based algorithm, able to handle the extremely large and rich observational datasets available from combined GPM-CO observations and to exploit the advanced observational capabilities of the GMI both in terms of channel assortment, and spatial resolution. The PNPR-GMI algorithm uses a single NN to retrieve the surface precipitation over different background surfaces of the GPM global coverage area. For this purpose the algorithm uses GMI TB derived variables in a new Principal Component Analysis (PCA) approach to detect the precipitation signal over different backgrounds reducing the number of inputs to the NN. Ancillary meteorological parameters (including ECMWF Total Precipitable Water (TPW) and 2m temperature) are also used as input. The details concerning the design and development of the NN, and the algorithm input selection procedure will be presented. Results of the algorithm performance for some case studies of interest over the GPM coverage area will be shown. Furthermore results from an extensive comparison of PNPR-GMI with the GMI Goddard profiling algorithm (GPROF) performance will be also presented.