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The Passive Microwave Neural Network Precipitation Retrieval (PNPR) for AMSU/MHS and ATMS cross-track scanning radiometers

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Spaceborne microwave cross-track scanning radiometers, originally developed for temperature and humidity sounding, have shown great capabilities to provide a significant contribution in precipitation monitoring both in terms of measurement quality and spatial/temporal coverage. The Passive microwave Neural network Precipitation Retrieval (PNPR) algorithm for cross-track scanning radiometers, originally developed for the Advanced Microwave Sounding Unit/Microwave Humidity Sounder (AMSU-A/MHS) radiometers (on board the European MetOp and U.S. NOAA satellites), was recently newly designed to exploit the Advanced Technology Microwave Sounder (ATMS) on board the Suomi-NPP satellite and the future JPSS satellites.

The PNPR algorithm is based on the Artificial Neural Network (ANN) approach. The main PNPR-ATMS algorithm changes with respect to PNPR-AMSU/MHS are the design and implementation of a new ANN able to manage the information derived from the additional ATMS channels (respect to the AMSU-A/MHS radiometer) and a new screening procedure for not-precipitating pixels. In order to achieve maximum consistency of the retrieved surface precipitation, both PNPR algorithms are based on the same physical foundation. The PNPR is optimized for the European and the African area. The neural network was trained using a cloud-radiation database built upon 94 cloud-resolving simulations over Europe and the Mediterranean and over the African area and radiative transfer model simulations of TB vectors consistent with the AMSU-A/MHS and ATMS channel frequencies, viewing angles, and view-angle dependent IFOV sizes along the scan projections.

As opposed to other ANN precipitation retrieval algorithms, PNPR uses a unique ANN that retrieves the surface precipitation rate for all types of surface backgrounds represented in the training database, i.e. land (vegetated or arid), ocean, snow/ice or coast. This approach prevents different precipitation estimates from being inconsistent with one another when an observed precipitation system extends over two or more types of surfaces. As input data, the PNPR algorithm incorporates the TBs from selected channels, and various additional TBs-derived variables. Ancillary geographical/geophysical inputs (i.e. latitude, terrain height, surface type, season) are also considered during the training phase. The PNPR algorithm outputs consist of both the surface precipitation rate (along with the information on precipitation phase: liquid, mixed, solid) and a pixel-based quality index.

We will illustrate the main features of the PNPR algorithm and will show results of a verification study over Europe and Africa. The study is based on the available ground-based radar and/or rain gauge network observations over the European area. In addition, results of the comparison with rainfall products available from the NASA/JAXA Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) (over the African area) and Global Precipitation Measurement (GPM) Dual frequency Precipitation Radar (DPR) will be shown. The analysis is built upon a two-years coincidence dataset of AMSU/MHS and ATMS observations with PR (2013-2014) and DPR (2014-2015). The PNPR is developed within the EUMETSAT H/SAF program (Satellite Application Facility for Operational Hydrology and Water Management), where it is used operationally towards the full exploitation of all microwave radiometers available in the GPM era. The algorithm will be tailored to the future European Microwave Sounder (MWS) onboard the MetOp-Second Generation (MetOp-SG) satellites.