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Microwave radiometer data quality monitoring and retrieval development framework for network operation

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Ground-based microwave radiometers (MWR) provide valuable information on thermodynamic profiles and cloud liquid water by measuring the thermal emission, expressed as brightness temperatures (TB), of atmospheric gases and hydrometeors in several channels, and have thus become a widely used tool in atmospheric remote sensing. MWR are being deployed for process studies of boundary layer structure and development, as well as for operational data assimilation in numerical weather prediction models (NWP). Due to their robustness and ability to operate unattended in long-term deployments, MWR are currently implemented into two observation networks in Europe. EUMETNET's profiling network E-PROFILE and the European Research Infrastructure ACTRIS are both establishing centralized near-real-time processing and provision of MWR data at about 30 stations, covering different climate zones.

Assessing the quality of long-term data sets in a network configuration is a crucial part for ensuring continuous operation and detecting instrument malfunctions. Near-real-time monitoring of data streams can be utilized to help station operators with instrument maintenance and statistical analysis of critical instrument parameters can unveil degradation and resulting drifts. In ACTRIS, a centralized monitoring is being developed with an online graphical interface and instrument specific alerting system, allowing for quick responses and initiation of mitigation strategies to avoid a prolonged impact of instrument failures on data quality. For MWR the stability of all receiver components, which can be prone to the environmental temperature, is an important factor in the quality assessment and needs to be monitored together with the spectral behavior of observed TB for automated data flagging. In addition, parameters of regularly performed relative calibrations (automated procedure) and absolute calibrations (with a liquid nitrogen cooled target) should be considered in any long-term operation for a better evaluation of the system status.

Another tool for judging the instrument performance is the detection of systematic errors by comparing the observations to a model background (O-B). During scenes with no liquid water clouds present, TB are simulated by a radiative transfer model with input from a NWP model. The resulting differences to the observations are exploited in a statistical way to detect drifts, erroneous absolute calibrations, and for TB bias corrections. A similar approach of simulating TB will also be used to serve as training data set for developing a statistical retrieval, which is based on a common data input, needed to ensure homogeneous MWR data streams throughout the network. The performance of the retrieval method will be evaluated in an inter-comparison study, involving different retrieval algorithms, based on observations during the “PAris region urbaN Atmospheric observations and models for Multidisciplinary rEsearch” (PANAME) campaign.