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Editorial

HYPAM

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Absorption, scattering and emission are the interaction mechanisms of the atmosphere with electromagnetic radiation. They are highly variable e.g. with frequency and particle size. Therefore, the atmosphere itself (composition, thermodynamic structure and dynamics) and the Earth's surface can be remotely sensed from space, whereby the accuracy depends only on wavelength or frequency chosen and on the instantaneous field of view of the satellite sensor. In principle global observations at short time intervals are possible. In 1995 a small group of microwave remote sensing specialists applied for funding at the German Science Foundation (DFG) under the acronym HYPAM (remote sensing of HYdrometeorological PArameters by Microwave radiometry) in order to improve algorithms for passive microwave satellite sensors that have the potential to become the work horses for operational meteorology, climatology and other disciplines; because the microwave region allows temperature and humidity profiling in a cloudy atmosphere, cloud water and cloud ice determination, surface wind speed and temperature estimation, sea ice cover and type determination, surface emissivity and precipitation rate measurements. The Defence Meteorological Satellite Program (DMSP) of the Navy of the United States of America has guaranteed since 1987 with the Special Sensor Microwave/Imager (SSM/I) continuous measurements in seven microwave channels centered at 19, 22, 37 and 85 GHz with vertical and horizontal polarization for all except the 22 GHz channel that probes a water vapour line. The data are given on request nearly free of charge to the global scientific community. Most of the time more than one sensor has been operated. This allows daily global coverage also in the tropics and a more frequent one in higher latitudes.

Nearly all projects, funded for four years, have used this data set as the backbone for their algorithm development. One of the projects went far beyond algorithm development and improvement by deriving the first thirteen-year net water balance climatology for the global ocean since 1987.

This combined publication in a special issue of Meteorologische Zeitschrift is part of the reporting to the funding agency and a sign for a successful completion.

At the Free University of Berlin a surface emissivity model for land surfaces has been developed and tested that now reduces errors in emissivity between 0.9 and 2.5 percent depending on frequency at emissivities ranging from 0.8 to 0.98 (BENNARTZ et al.)

At the Institute of Oceanography at Kiel University the errors in cloud liquid water path retrievals due to cloud inhomogeneities have been modelled for SSM/I frequencies. The comparison to plane-parallel clouds, the so-called beam-filling effect depends differently on liquid water path at different frequencies and on polarization, it increases at 19 and 22 GHz with liquid water path and inhomogeneity but it decreases at 37 GHz and also for 85 GHz for large liquid water path (VON BREMEN et al.).

At the Institute of Environmental Physics of the University of Bremen a rather sophisticated algorithm for nighttime cloud detection over sea-ice and land-ice covered areas has been developed, using DMSP sensors only. It has been applied to a case study in the Weddell Sea with ground truth data from the research vessel "Polarstern" (SCHLÜTER and HEYGSTER).

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At the German Aerospace Centre (DLR) in Cologne a new algorithm to detect rain over land surfaces has been applied to the TRMM Microwave Imager (TMI) (similar to SSM/I) data onboard the Tropical Rainfall Measuring Mission (TRMM) over Africa, North and South America as well as India. The new approach is superior to earlier attempts and also delivers near surface rainfall intensities (BAUER et al.).

At the Meteorological Institute of the University of Bonn the polarisation effects of non-spherical ice particles and larger raindrops have been investigated. The brightness temperature differences are strongest for the 85 GHz channel of SSM/I. Thus ice clouds over rain (the normal case) may cause large errors in rain estimates if no additional information on the ice crystal shape is used (CZEKALA and SIMMER).

At the Meteorological Institute of the University of Hamburg improved algorithms for sea surface parameters, surface energy and freshwater fluxes were applied to SSM/I data from July 1987 until December 1998. The first climatology, the Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data (HOAPS) is now available on the web and used at many institutions worldwide (JOST et al.).

One of the outstanding results of HYPAM is the detection of a very high precipitation maximum over the Gulf Stream and its northward extension, the North Atlantic Current, that originates from frequent cold air outbreaks from the North American continent. The yearly precipitation amount there reaches values of about 3 m that compete with the value over the warm pool in the West Pacific. It was not detected by in situ observations as only a rain rate of 2.8 mm per hour was allowed if a ship had reported violent showers or very heavy rain.

In spite of the large progress achieved in the atmospheric remote sensing with passive microwave sensors in the last two decades, there is still a high potential in unexploited information content in these data, especially for cloud microphysical parameters. Therefore, some members of the HYPAM team and others have put forward a new proposal on Microwave Remote Sensing of Clouds to DFG.

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