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Validation of Land Surface Temperature Products and Site Characterisation with Ground Based Radiometric Measurements

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Land Surface Temperature (LST) is an important quantity for the energy and water exchange between the earth's surface and the atmosphere and, therefore, an important parameter of many environmental models. LST is derived operationally from several space-borne sensors, e.g. the Moderate Resolution Imaging Spectroradiometer (MODIS) on EOS-Terra and the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard Meteosat Second Generation (MSG) and AVHRR onboard NOAA and EPS satellites. Ground based validation of LST and Land Surface Emissivity (LSE) is largely complicated by the spatial scale mismatch between satellite sensors and ground based sensors: areas observed by ground radiometers usually cover about 10 m^2, whereas satellite measurements in the thermal infra-red typically cover between 1 km^2 and 100 km^2. Therefore, validation sites have to be carefully selected and need to be characterised on the spatial scale of the ground radiometer as well as on the scale of the satellite pixel. The permanent validation station near Gobabeb, Namibia, is one of KIT's four dedicated LST validation stations. Gobabeb is located on vast and flat gravel plains (several 100 km^2), which are mainly covered by coarse gravel, sand, and desiccated grass. The plains are highly homogeneous in space and time, which makes them an ideal site for validating a broad range of satellite-derived products. However, for reliable product validation the effect of the small scale variation of surface materials (e.g. dry grass, rock outcrops) and topography needs to be closely characterised. Using a mobile radiometer system, several field experiments were performed during which the radiometer was driven along tracks of 20 km to 40 km length through the gravel plains. The results show a high level of homogeneity and a stable relationship between station LST and LST determined along the tracks from the mobile measurements with a small bias of about 0.4°C. LSEs of the dominant surface cover types at Gobabeb were obtained with the so-called 'emissivity box method', which consists of a sequence of thermal infrared radiance measurements and employs a box with highly reflective inner walls to control the radiation from the environment. The in-situ LSEs for Gobabeb are compared to LSE products obtained with different operational algorithms from MODIS and SEVIRI data. Finally, the monitoring capability of the validation stations is demonstrated with a 5 year time series of LST derived operationally by the Land Surface Analysis – Satellite Application Facility (LSA-SAF) from MSG/SEVIRI data.