



## **MARG - A Low Cost Solid State Microwave Areal Precipitation Measurement System**

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Water is an essential resource for us so the measurements of its movement throughout the whole cycle is very important. The rainfall is discontinuous in space and in time having large natural variability unlike many other meteorological parameters. The widely used method for getting relatively accurate precipitation data over land is the combination of radar rainfall estimations and rain gauge data. The typically used radar data is coming from long-range weather radars operating in C or S band, or from mini radars operating in X band which is attenuating heavily in strong precipitation. Using such radar data we are facing several constraints: operating costs and limitations of long range radars, X band radars can be blocked totally in heavy thunderstorms even in short range, dual polarization solutions are expensive, etc.

Recognizing that an important gap exists in instrumental precipitation measurements over land a consortium has been organized and a project has been established to develop a new measurement device, the so called Microwave Areal Rain Gauge (MARG). MARG is based on FMCW radar principle using solid state transmitter and digital signal processing and operating in C band. The MARG project aims to provide an innovative, real-time, low-cost, user friendly and accurate sensor technology to monitor and to measure continuously the rainfall intensity distribution over an area around some thousand square km. The MARG project proposal has been granted by the EU in FP7-SME-2012 funding scheme. The developed instrument is able to monitor in real-time intensity and spatial distribution of rainfall in rural and urban environments and can be operated by commercial weather data and value-added forecast product suppliers.

To achieve sufficient isolation between the transmitter and receiver modules, and to avoid using complex and expensive microwave components, two parabolic antennae are used to transmit and receive the FMCW signal. The radar frontend operates in the C-band at 5.6 GHz with a maximal output power of 20 W continuous and a rainfall detection range of up to 30 km. Doppler processing is included in the signal processing for the purpose of clutter elimination. The reflectivity – rainfall conversion is performed with adjustable parameters as a function of rainfall type derived from morphological parameters of reflectivity fields and disdrometer measurements. Several algorithms, including mean bias correction, range correction and kriging interpolation with existing rain gauge networks to calibrate radar rainfall estimations are also foreseen. The MARG sensor will provide reflectivity, Doppler and precipitation data, but all measurements are organized and stored on the user centre's web server. The database contains precipitation data, measurement identification, and all available auxiliary meteorological data (e.g. temperature and air pressure). Precipitation data are further processed and combined with geographic background information through a GIS system. Finally the processed products, e.g. rainfall accumulation maps, are provided to the users by the GIS-based web service in the MARG user-centre module.