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Rainfall variability measurements using geostationary satellite signals.

The present study investigates the development of a low cost microwave device devoted to rainfall measurement at a spatial resolution of about one square kilometre and at a temporal resolution in order of a few minutes. The principle of this device is to estimate rain attenuation along earth-space links to deduce the path average rain rate. A measurement campaign has been performed for four month near Paris. Measurements of atmospheric attenuation over earth-space links have been carried out by receiving TV channels from different geostationary satellites in Ku-band (10-12 GHz). These links are characterized by a 30° elevation angle that corresponds to a 6 km tropospheric path length. In practice, the proposed device only measures the received power. A critical issue in our approach is thus the ability to distinguish between rain feature and many other fluctuations of the received signal due to atmospheric scintillations or changes: in water vapour concentration, cloud water content, emitted power, satellite orbit, and temperature.

First part of the study deals with the estimation of rain attenuation observed on a unique earthspace link. We propose an algorithm based on an artificial neural network to identify and separate dry and rainy periods and to suppress the variability of the received signal due to no-rain effects. Taking into account the height of the rain layer, rain attenuation is then inverted to obtain path average rain rate. Obtained rainfall rate are compared with co-located rain gauges and radar measurements. On one hand accumulated rainfall and quantile – quantile plots of hourly accumulated rainfall obtained on the whole experiment period are compared, on the other hand the most significant rainy events are analyzed.

In a second part, the possibility of estimating rain field is discussed using measurements performed from four earth-space links associated with tomographic techniques. Simulations are performed using synthetics rain maps. Different geometric configurations and various meteorological situations are considered.

In conclusion, so as to evaluate if this features in terms of sensing local rainfall may lead to a better assessment of flood risk, the properties of the proposed device in comparison with meteorological radar or rain gauge network are analysed in terms of cost, maintenance constraint, measurement accuracy , spatial and temporal resolution, dimension of sensing area.