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Line Integrated Precipitation Quantification by Microwave Attenuation in Alpine Terrain

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The estimation of spatial and temporal distribution of precipitation is of crucial importance for hydrological analyses, particulary in regions with a coarse station network density or high spatial precipitation variability. A new means to accomplish this task is exploiting attenuation data from commercial back-haul links operated by cell phone providers: What is a pain to engineers, who plan backhaul links for cell phone communication, is useful for the remote sensing of precipitation. The power transmitted on a microwave backhaul link, usually operated at frequencies between 10 GHz and 40 GHz, is significantly influenced by precipitation and atmospheric conditions. Even light rain events cause a measureable attenuation of the transmitted signal. This is a useful complementary to traditional rain gauge- and radar derived estimations, since it is based on a different spatial and temporal scale.

An overview on the technique is given with a special focus on an application of the technique in alpine and prealpine terrain in the area around Garmisch-Partenkirchen (Germany). Multivariate statistical methods based on Copulas are presented, showing how link-, gauge-, and radar derived estimates can be combined. Additionally, results from a custom built own microwave transmission experiment are shown that allows not only the investigation of the physics of microwave attenuation by hydrometeors in dependence of wavelength, polarization and phase shifts, but also the quantification of line integrated water vapour.