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Virtual Institute PROCEMA

Regional Precipitation Observation by Cellular Network Microwave Attenuation

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1. Motivation

Estimating the spatial and temporal distribution of precipitation is of crucial importance for hydrological analyses. This is particularly true in regions with a high spatial precipitation variability like the Alps. But the established precipitation observation methods often lack the desired accuracy in complex terrain. To improve this situation the PROCEMA project exploits attenuation data from commercial microwave backhaul links. Line integrated rain rates are derived complementing rain gauge and radar derived measurements.

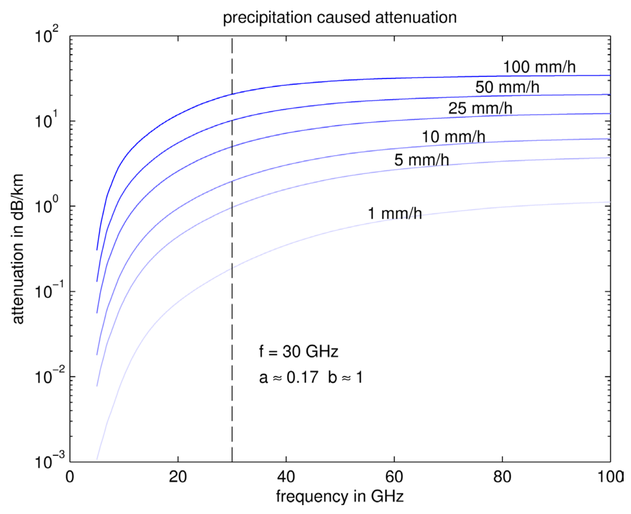
A typical microwave backhaul link tower

2. Basics of microwave attenuation

- Wavelength (λ ~ 1cm) is same order of magnitude as rain drop diameter (r ≤ 0.5 cm)
  ↳ *Mie-Scattering*
- Power law relation between rain rate *R* in mm/h and line integrated attenuation *A* in db/km

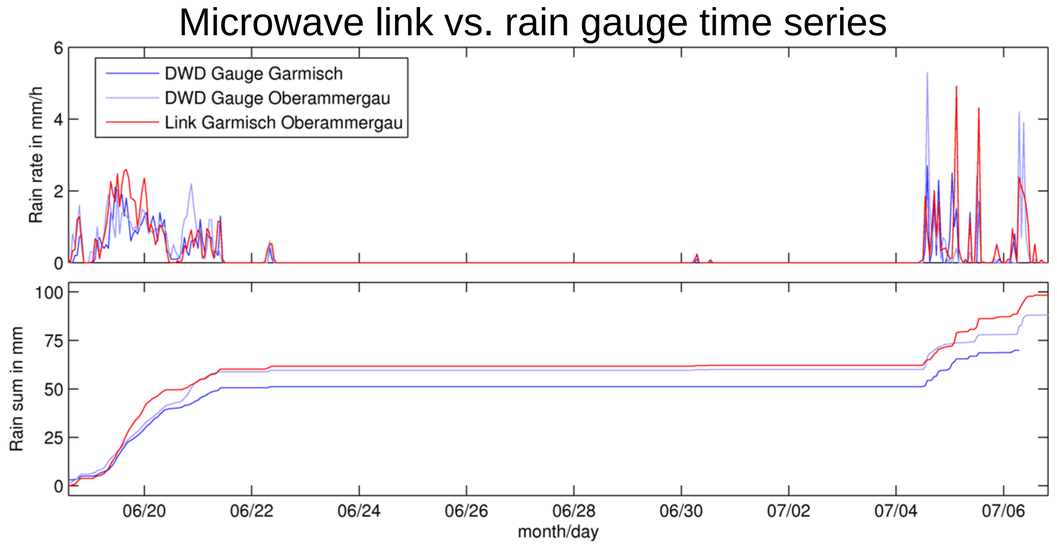
$$A = aR^b$$

with constants *a* and *b* depending on frequency
↳ Considerable attenuation even for light rain

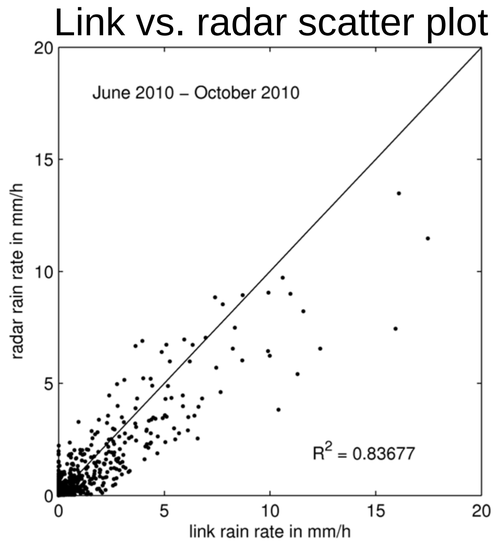


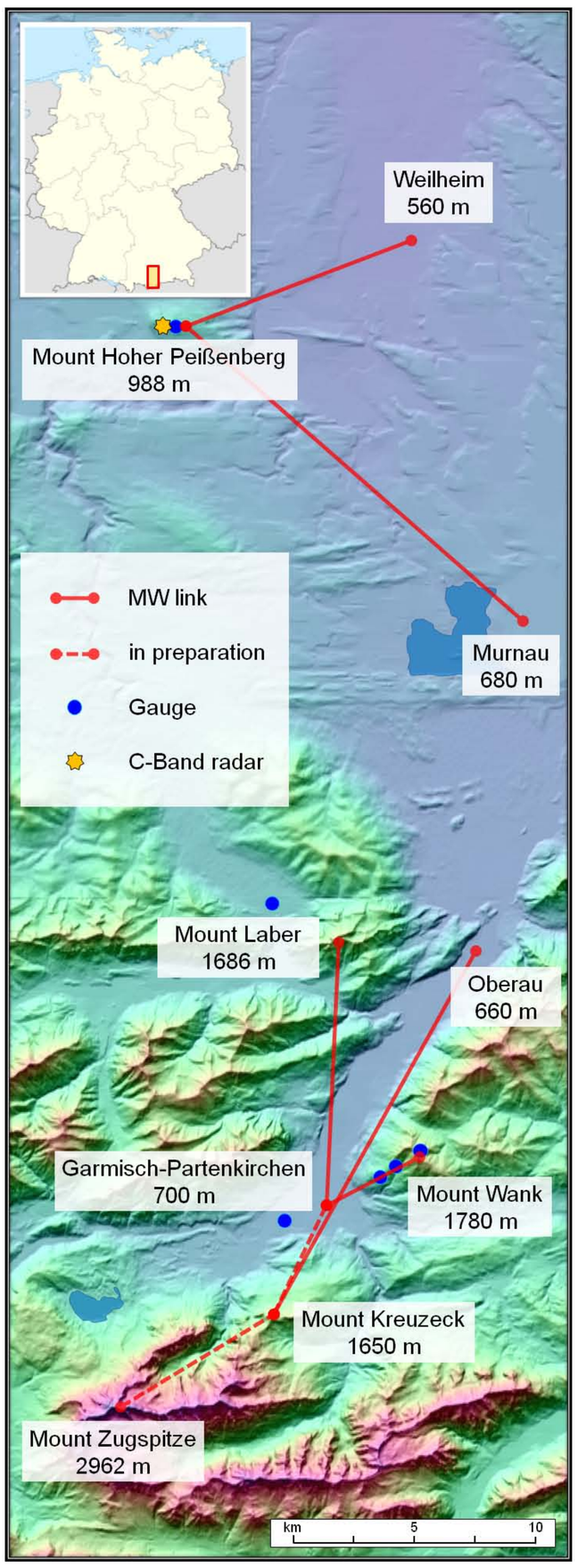
3. Rain rates derived from commercial microwave link attenuation

Microwave link vs. rain gauge time series



Link vs. radar scatter plot

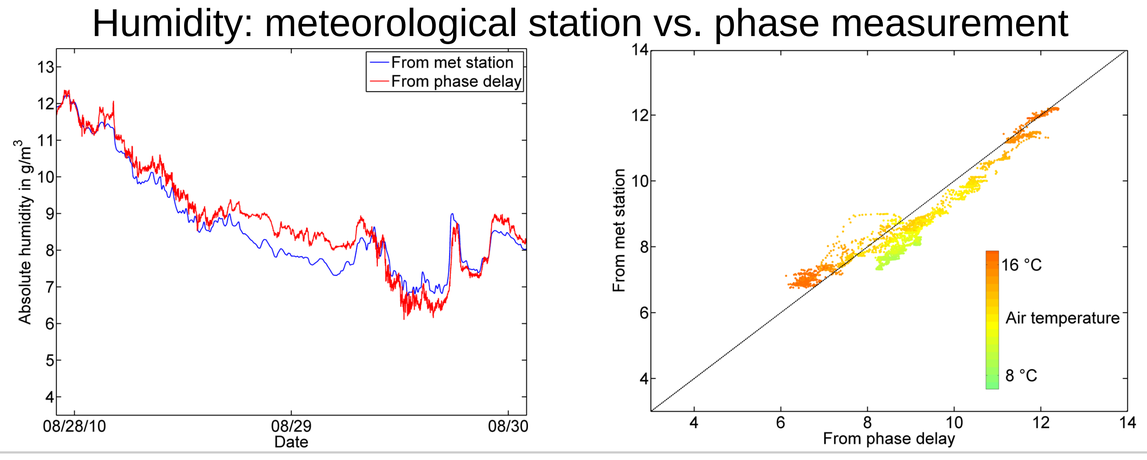


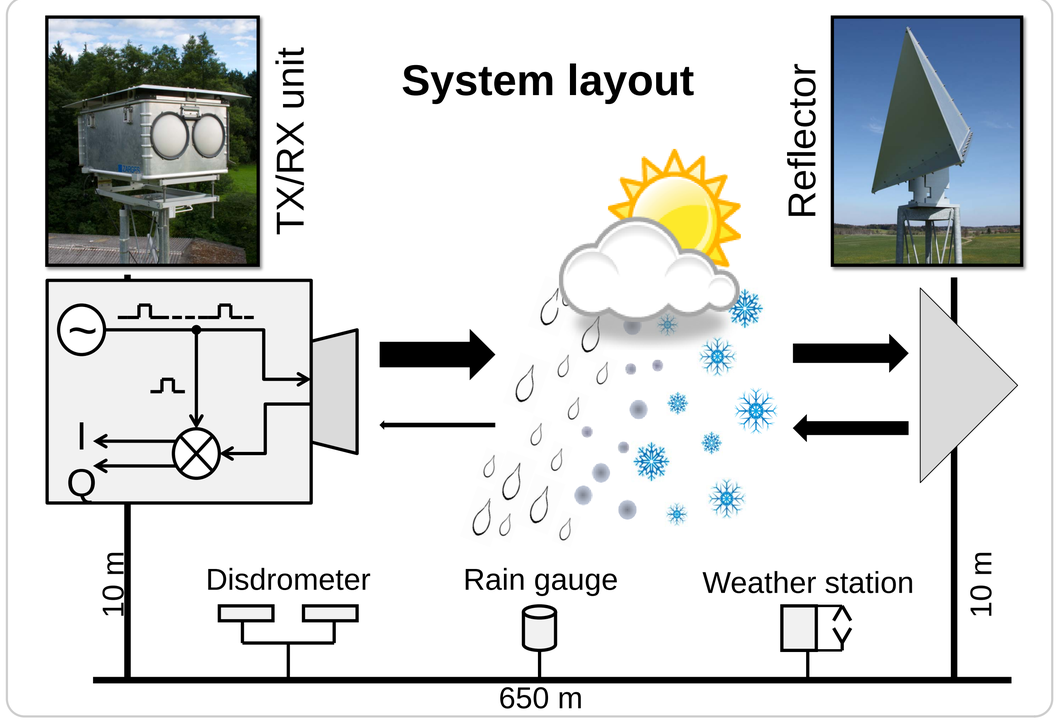


4. Supporting coherent transmission experiment

- Two frequencies: 34.8 GHz & 22.235 GHz
- Horizontal and vertical polarization
- Coherent monostatic configuration
  ↳ Additionally phase information → Absolute humidity measurement

Humidity: meteorological station vs. phase measurement





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