EGU26-14263, updated on 06 Jun 2026
https://doi.org/10.5194/egusphere-egu26-14263
EGU General Assembly 2026

Linking Spectral Power to Path-averaged Rainfall Rate in Microwave Link Data

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Raindrop motion can induce measurable high-frequency fluctuations (“scintillations”) in the variance and power spectral density (PSD) of received power from microwave links. This phenomenon was observed in earlier research along with turbulence-induced scintillations. The rain-induced scintillation signature may provide insight into rainfall dynamics at fine spatiotemporal scales (sub-second; meters). Here, we analyze a 26 GHz, 2.2 km microwave-link dataset collected in Wageningen. Using a 20 Hz sampling rate, we compute variance-normalized PSDs over 30 s windows and stratify them by crosswind, using measurements from a weather station located 3 km from the link. We find a roughly monotonic relationship between the integrated spectral power in the 9–10 Hz band and the path-averaged rainfall rate measured by disdrometers. However, substantial unexplained variability remains. Our findings indicate that crosswind effects alone may be insufficient to fully account for the observed variability in the signal. Future work will focus on improved characterization of the local crosswind field and analyzing other rainfall characteristics (e.g. parameters of the raindrop size distribution).