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Optimizing Wet Antenna Attenuation Models for Improved Rainfall Estimation Using Commercial Microwave Links

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Accurate rainfall estimation using commercial microwave links (CMLs) is set back by wet antenna attenuation (WAA), which could lead to overestimation of rainfall intensity when not properly accounted. This study introduces a novel framework for minimizing WAA effects through an optimized calibration approach. The proposed methodological framework utilizes an effective distance metric to associate CML data with rain gauge (RG) assessment, integrating a weighted calibration process that gives more importance to high-intensity rainfall events. As a preliminary step, a comparative assessment of several existing WAA models - including Schleiss, Rieckermann, and Berne (SRB), Leijnse, Uijlenhoet, and Stricker (LUS), Kharadly and Ross (KR), Garcia-Rubia, Riera, Benarroch, and Garcia-del-Pino (GRBG), and Valtr, Fencl, and Bareš (VFB) was carried out. Most of the models that predict WAA from rainfall intensity, attenuation or rainfall attenuation are basically equivalent. The WAA compensation process was applied to data from 77 CMLs in the Seveso River basin (Northern Italy) across different types of rain events in 2019-2020. A modified version of VFB model (VGBm –calibrated VFB model), showcases analytically better performance across various CML lengths, frequencies, and rainfall intensities. In particular, VFBm model leads to much better results than SRB (a commonly used model that predicts a saturation of WAA to a relatively small 2.3 dB value) over all the relevant key performance indicators. These findings highlight that correcting WAA is important for accurate rainfall intensity estimates from CML data and emphasize the need to adjust the WAA models to local conditions for improved hydro-meteorological applications.

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Authors: Mr DOSHI, Smit (Alfred Wegener Institute Helmholtz Center for Polar and Marine Research); DE MICHELE, Carlo (Politecnico di Milano); CAZZANIGA, Greta (LSCE- CEA, CNRS); NEBULONI, Roberto (CNR)

Presenters: Mr DOSHI, Smit (Alfred Wegener Institute Helmholtz Center for Polar and Marine Research); DE MICHELE, Carlo (Politecnico di Milano); NEBULONI, Roberto (CNR)

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