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Improving commercial microwave link rainfall estimation by in situ measurement of the wet antenna effect

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When estimating precipitation through signal fading in commercial microwave links (CMLs), the wet antenna attenuation (WAA) is a relevant source of error and uncertainty. Knowledge about the instantaneous value of the WAA and its relation to to rainfall intensity helps to improve the accuracy of rain rate estimation.

We developed an instrument that allows us to measure the additional path attenuation of six microwave links and the matching of the link antennas simultaneously. Antenna matching is a fundamental parameter that is also influenced by any objects in the close environment of the antenna. Hence, the presence of water, like rain in the radiated near-field or wetness on the radome surface, has a significant impact to the matching due reflection and absorption. That is why the matching correlates with the WAA of a link. Monitoring the matching of the antenna is not just helpful for detection if the radome is wetted or dry. It can also be used for estimating the magnitude of the WAA effect. Additional video monitoring of the radomes and their grade of wetness is also included in the system. Our instrument simultaneously operates six CML antennas in the frequency range from 18 GHz to 40 GHz along a shared propagation path which ensures that the data from the six links is fully comparable with respect to time, path length, weather pattern, and atmospheric conditions.

We show that the wet antenna attenuation and the matching of the antenna correlates. This correlation allows us to estimate the WAA and use it to compensate for the wet antenna effect in the precipitation estimation. Also the evolution of the WAA over time, while the antenna is drying, is a subject matter of our study.

The correlation of antenna matching with the WAA is not only restricted to CMLs. Using this technique for detecting and compensating the wet radome effect at weather radars is technically feasible as well.