Geophysical Research Abstracts
Vol. 16, EGU2014-13107, 2014
EGU General Assembly 2014

Eliminating bias in rainfall estimates from microwave links due to antenna wetting

Martin Fencl (1), Jörg Rieckermann (2), and Vojtěch Bareš (1)

(1) Dept. of Hydraulics and Hydrology, Czech Technical University in Prague, Prague, Czech Republic (martin.fencl@fsv.cvut.cz), (2) Dept. of Urban Water Management, Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

Commercial microwave links (MWLs) are point–to-point radio systems which are widely used in telecommunication systems. They operate at frequencies where the transmitted power is mainly disturbed by precipitation. Thus, signal attenuation from MWLs can be used to estimate path-averaged rain rates, which is conceptually very promising, since MWLs cover about 20 % of surface area. Unfortunately, MWL rainfall estimates are often positively biased due to additional attenuation caused by antenna wetting. To correct MWL observations a posteriori to reduce the wet antenna effect (WAE), both empirically and physically based models have been suggested. However, it is challenging to calibrate these models, because the wet antenna attenuation depends both on the MWL properties (frequency, type of antennas, shielding etc.) and different climatic factors (temperature, due point, wind velocity and direction, etc.). Instead, it seems straight forward to keep antennas dry by shielding them.

In this investigation we compare the effectiveness of antenna shielding to model-based corrections to reduce the WAE. The experimental setup, located in Dübendorf-Switzerland, consisted of 1.85-km long commercial dual-polarization microwave link at 38 GHz and 5 optical disdrometers. The MWL was operated without shielding in the period from March to October 2011 and with shielding from October 2011 to July 2012. This unique experimental design made it possible to identify the attenuation due to antenna wetting, which can be computed as the difference between the measured and theoretical attenuation. The theoretical path-averaged attenuation was calculated from the path-averaged drop size distribution.

During the unshielded periods, the total bias caused by WAE was 0.74 dB, which was reduced by shielding to 0.39 dB for the horizontal polarization (vertical: reduction from 0.96 dB to 0.44 dB). Interestingly, the model-based correction (Schleiss et al. 2013) was more effective because it reduced the bias of unshielded periods to 0.07 dB for the horizontal polarization (vertical: 0.06 dB). Applying the same model-based correction to shielded periods reduces the bias even more, to -0.03 dB and -0.01 dB, respectively.

This indicates that additional attenuation could be caused also by different effects, such as reflection of sidelobes from wet surfaces and other environmental factors. Further, model-based corrections do not capture correctly the nature of WAE, but more likely provide only an empirical correction. This claim is supported by the fact that detailed analysis of particular events reveals that both antenna shielding and model-based correction performance differ substantially from event to event. Further investigation based on direct observation of antenna wetting and other environmental variables needs to be performed to identify more properly the nature of the attenuation bias.

Schleiss, M., J. Rieckermann, and A. Berne, 2013: Quantification and modeling of wet-antenna attenuation for commercial microwave links. IEEE Geosci. Remote Sens. Lett., 10.1109/LGRS.2012.2236074.