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Path-averaged rainfall estimation using a microwave link: uncertainty due to rainfall spatial variability.

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Microwave links allow to estimate the path-averaged rainfall intensity along the link when precipitation occurs. They take advantage of the near proportionality between the specific attenuation affecting the link signal and the rainfall intensity, variable of interest for many hydrometeorological applications. This work focuses on an aspect of the technique that has received relatively little attention in the past, namely the influence of the spatial variability of rainfall along the link on the accuracy of the rainfall estimates. We focus on single-polarization single-frequency links operating at frequencies ranging from 5 to 50 GHz and with path lengths ranging from 500 m to 30 km. A Monte Carlo approach is used to estimate an optimal frequency for a microwave link with respect to rainfall estimation (found to be about 30 GHz) for intense Mediterranean precipitation. In addition, the uncertainty associated with path-averaged rain rate estimates is investigated. The uncertainty appears to be limited although non-negligible when the coefficients of the power law used to relate rain rate and attenuation are known. However, it becomes more significant when using inappropriate power-law parameterizations. Moreover, it is possible to quantify the expected error for existing commercial or research microwave links.