

13.12 X-BAND RADAR ATTENUATION STATISTICS: HOW OFTEN DO WE LOSE THE SIGNAL?

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X-band radars are becoming increasingly popular for urban hydrology. Their relatively small size and low cost makes them ideal for such applications. Furthermore, because they are generally only used for quantitative precipitation estimation at short ranges, the spatial resolution of derived precipitation products is generally high, and measurements are close to the ground. The well-known challenge with X-band radars is signal attenuation. This can partly be compensated by using polarimetry, but this will only be able to provide rainfall estimates if the signal-to-noise ratio is sufficiently high. It is therefore highly relevant to know how often conditions occur in which the signal attenuation is so strong that this is no longer the case.

The rate of exceedance of different levels of X-band radar attenuation at different ranges is investigated. From this it is possible to derive how often an X-band radar is no longer able to provide any precipitation estimate due to attenuation, given its characteristics (transmit power, antenna gain, noise floor, etc.) and the rate of the rain that should still be detectable. The same can be done for virtual networks of X-band radars, where it is expected that a second radar will fill in if the first radar is too strongly attenuated. The influence of wet-radome attenuation is also investigated in this framework.

A 10-year radar-rain gauge product (1-km, 5-min resolution) over the Netherlands is used to simulate X-band attenuation, assuming a known relation between specific X-band attenuation and rainfall intensity. For a given virtual X-band radar location, attenuation is computed for every 5-minute interval and for all ranges and azimuths of the X-band radar by integrating the specific X-band attenuation fields over range. Rates of exceedance of attenuation levels are then computed as a function of radar range.

The rate of signal loss (i.e., signal-to-noise ratio less than 1) is investigated for several common types of radars for given minimum detectable rain rates. This rate is typically on the order of several minutes to hours per year for a minimum detectable rain rate of 1 mm/h, depending on the radar type.
