Recovery of partial blocked beams from a single-polarised weather radar system

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For quantitative precipitation estimation (QPE), the lowest sweep of a weather radar scan is at the same time the most important one. The lowest sweep angles, though, are particularly prone to beam blockage.

However, in case of partial blockage, even the central beams of shielded sectors show weak signals of reflectivity which are strongly correlated to the adjacent unaffected beams. Based on this phenomenon, we developed a straightforward approach to reconstruct reflectivity in these sectors: first, we compute the gate-wise average reflectivity from the two unaffected beams around the shielded sector. Then we calculate, for each shielded beam, the ratio of average unshielded reflectivities and average reflectivities affected by shielding. These ratios are then used to amplify the reflectivity for the shielded beams. This way, the beam is amplified as a whole without losing the consistency of values along the beam.

As a proof of concept, we present results for the German Weather Service C-band radar on top of mountain Feldberg, located in South-West Germany. This radar is partially blocked by a broadcasting tower on top of the same mountain. This tower is only 150 meters away from the weather radar antenna and geometrically blocks about 2° of the radar's field of vision. As a result of the antenna pattern and the properties of electromagnetic wave propagation the effective sector of partial beam blockage is about 6°. Even assuming that we use only a range of 100 km for QPE, this would correspond to a contiguous area of more than 500 km². We verified our approach with very promising results, using seven years of rain gauge records in the shielded sector, and using as a benchmark a simple interpolation of reflectivity from the edges of the shielded sector.