13.4 HOW TO BENEFIT FROM HIGH-RESOLUTION DIGITAL ELEVATION MODELS TO SIMULATE PARTIAL BEAM BLOCKAGE?

K. MÜHLBAUER[1], M. HEISTERMANN[2]
[1] University of Bonn, Germany
[2] University of Potsdam, Germany
kai.muehlbauer@uni-bonn.de

In complex terrain, partial beam blockage (PBB) is among the prime sources of uncertainty in radar-based quantitative precipitation estimation. While polarimetry offers strategies to mitigate the issue (as e.g. KDP is considered rather immune to PBB), the quantification of PBB remains important (e.g. for single-pol data processing, or for exploring suitable locations to set up new radar devices).

A common procedure to quantify partial beam blockage is to simulate beam propagation through the atmosphere, and to quantify interference with the terrain surface as represented by a digital elevation model. A couple of authors (e.g. Bech et al. 2007) have suggested to interpolate (or resample) the terrain altitude to each radar range bin location. As a consequence, beam blockage would be computed based on some "average" terrain altitude in the radar bin. This may produce errors in areas with rapid terrain variations. As long as the spatial resolution of the DEM is low (e.g. 1 km in GTOPPO30), the additional error introduced by interpolation and averaging might be negligible. However, modern DEMs provide resolutions of up to 1 meter - just resampling terrain altitude to the radar bin location is an unnecessary loss of information. Instead, we should consider all terrain values inside any radar bin.

In this study, we present a new algorithm based on the open source software wradlib, that reprojects high-resolution terrain altitude directly into the spherical coordinate reference system of the weather radar. That way, we explicitly represent the terrain cross section as seen by the radar, or, in other words, the variation of topography "inside" each radar bin. We then convolve, for each radar bin, the high-resolution terrain cross-section with a Gaussian power distribution of the radar beam in order to simulate the beam blockage fraction. We will systematically evaluate the effects of our technique on cumulative beam blockage along the beam propagation path, in comparison to the simple resampling approach: for different DEM resolutions, radar set-ups and terrain surfaces. Preliminary analysis suggests that the resulting changes in simulated beam blockage can be dramatic (> 50 %).

References

Bech, J., U. Gjertsen, G. Haase (2007): Modelling weather radar beam propagation and topographical blockage at northern high latitudes, Q. J. R. Meteorol. Soc. 133, 1191-1204.