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Combined effects of beam blockage and anomalous propagation in radar rainfall estimation

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Quality control of weather radar observations has become a topic of increasing interest because of their need in advanced quantitative applications such as hydrological modelling or assimilation in numerical weather prediction models, as shown in the recent EU COST 717 concerted action. Among others, one of the aspects that may affect seriously radar estimated rain fields is the existence of anomalous propagation (AP) of the radar beam due to variations in the atmospheric temperature and moisture profiles from standard conditions.

The presence of AP usually implies an increase in quantity and intensity of ground clutter which may be diagnosed and corrected with a number of techniques (Doppler processing, postprocessing volumetric analysis, etc..). However, such processing is usually agressive with real precipitation and part of it is removed. Moreover, the variation in the echo height caused by AP may also be relevant in other procedures such as orographic beam blockage corrections.

In this work, an analysis of beam blockage effects under AP upon radar precipitation is performed. Beam blockage is simulated taking into account the effects of AP in the beam height using a ray tracing approach. A case study in the Po Valley is presented, where rainfall and AP coexisted for several hours. Several sources to diagnose AP are considered (high resolution and standard radiosonde observations, NWP Lokal Modell forecasts). A discussion on the results compared with rain-gauges is provided, as well as the potential and limitations of implemeting the analysis in a real-time quality control procedure.