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Radar rainfall estimation in a hilly environment and implications for runoff modeling

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Radars are known for their ability to obtain a wealth of information about the spatial stormfield characteristics. Unfortunately, rainfall estimates obtained by this instrument are known to be affected by multiple sources of error. Especially for stratiform precipitation systems, the quality of radar rainfall estimates starts to decrease at relatively close ranges. In the current study the hydrological potential of weather radar is analyzed during a winter half-year for the hilly region of the Belgian Ardennes. A correction algorithm is proposed taking into account attenuation, ground clutter, anomalous propagation, the vertical profile of reflectivity (VPR) and advection. No final bias correction with respect to rain gauge data were implemented, because that does not add to a better understanding of the quality of the radar. Largest quality improvements in the radar data are obtained by ground clutter removal. The influence of VPR correction and advection depends on the precipitation system observed. Overall, the radar shows an underestimation as compared to the rain gauges, which becomes smaller after averaging at the scale of the medium-sized Ourthe catchment. Remaining differences between both devices can mainly be attributed to an improper choice of the Z-R relationship. Conceptual rainfall-runoff simulations show similar results using either catchment average radar or rain gauge data, although the largest discharge peak observed, is seriously underestimated when applying radar data. Overall, for hydrological applications corrected weather radar information in a hilly environment can be used up to 70 km during a winter half-year.