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Performance of High-Resolution Quantitative Precipitation Estimation from A Compact Dual-Pol X-Band Radar in Belgium with Evaluation of Different Gauge-Adjustment Techniques

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Accurate quantitative precipitation estimates with high spatial/temporal resolution (∼1km/less than 5min) are essential for urban hydrological applications. This study aims at assessing high-resolution rainfall estimates from a compact dual-pol X-band radar (FURUNO WR-2100) installed on the roof of Port of Gent in the city of Gent, Belgium, within the framework of the PLURISK project (Belgian Science Policy). The radar is designed to provide high spatial (100m in the range direction, 0.75° in the azimuth direction) and temporal (1 min) resolution radar images. It covers an area within a radius of 60km and scans horizontally at three elevations, namely 0°, 2° and 4°. In this study, a high-resolution radar Quantitative Precipitation Estimation (QPE) obtaining rainfall estimates from raw reflectivity is proposed and its performance is analyzed. The proposed algorithm includes an auto-updated noise removal and clutter removal algorithm with a special focus on removing speckle noise and random clutter objects, Z-R conversion, as well as a composite product generation algorithm orientated for Belgium. The QPE products for recent events are evaluated using two rain gauge networks: 22 rain gauges from a regional network and a dense network installed in Gent city specifically for this project.
Different gauge adjustment techniques (MFB, RDA, KED, BAYESIAN) in the context of real-time application are also tested for the QPE products for different spatial (100m/1km) and temporal (1min/5min) aggregation levels. Results are assessed through cross-validation. Further comparisons are made between aggregated X-band QPEs (1km/1min) and downscaled C-band radar rainfall estimates (1km/1min). It has shown that the high-resolution characteristic of X-band radar poses a challenge for advanced merging techniques like BAYESIAN-merging, in terms of computation power and rain gauge network density. By employing simple adjustment techniques, the adjusted X-band radar rainfall estimates could capture fine temporal evolution with good accuracy in comparison with the downscaled C-band radar data, which indicates their potential in urban hydrological modeling.