Improving Quantitative Precipitation Estimation in Complex Terrain over the San Francisco Bay Area Using a Gap-Filling Radar Network

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The San Francisco Bay Area is covered by two operational S-band WSR-88D: KMUX and KDAX. However, the KDAX radar beams are partially blocked at low elevation angles due to the mountainous terrain, whereas the KMUX radar is deployed at an elevation of over 1000 m, which can easily overshoot precipitation during the winter storm season in Northern California. As a result, these two radars are not sufficient to provide detailed precipitation information for quantitative hydrometeorological applications. NOAA is building the Advanced Quantitative Precipitation Information (AQPI) system to improve monitoring and forecasting of precipitation and coastal flooding in the San Francisco Bay Area. As part of the AQPI program, high-frequency (i.e., C and X band) high-resolution gap-filling radars are being deployed over the Bay Area to improve precipitation observations and investigate the detailed precipitation microphysics over such complex terrain. To date, two X-band radars have already been deployed and collected a substantial set of precipitation measurements that contribute to the development of local radar rainfall algorithms. This paper presents the preliminary design of a real-time rainfall system for the gap-filling AQPI radars, as well as the strategy to integrate the AQPI and the WSR-88D radar data for improved precipitation estimation over the Bay Area. In addition, the polarimetric radar rainfall algorithms are detailed. Case studies during the 2018-2019 winter storm season are presented. The high-resolution rainfall products are evaluated through cross-comparison with surface rain gauge measurements. Results show that the products generated by the AQPI radar rainfall system have better performance compared to the operational products currently available in this particular domain.

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