Backward estimation of precipitation from high spatial resolution SAR Sentinel-1 soil moisture: a case study for central South Korea

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Substance

Accurate characterization of terrestrial precipitation variation from high spatial resolution satellite sensors is beneficial for urban hydrology and microscale agriculture modeling, as well as natural disasters (e.g., urban flooding) early warning. However, the widely-used top-down approach for precipitation retrieval from microwave satellites is limited in several hydrological and agricultural applications due to their coarse spatial resolution. In this research, we aim to apply a novel bottom-up method, the parameterized SM2RAIN, where precipitation can be estimated from soil moisture signals based on an inversion of water balance model, to generate high spatial resolution terrestrial precipitation estimates at $0.01°$ grid (roughly 1-km) from the C-band SAR Sentinel-1. This product was then tested against a common reanalysis-based precipitation data and a domestic rain gauge network from the Korean Meteorological Administration (KMA) over central South Korea, since a clear difference between climatic types (coasts and mainlands) and land covers (croplands and mixed forests) was reported in this area. The results showed that seasonal precipitation variability strongly affected the SM2RAIN performances, and the product derived from separated parameters (rainy and non-rainy seasons) outperformed that estimated considering the entire year. In addition, the product retrieved over the mainland mixed forest region showed slightly superior performance compared to that over the coastal cropland region, suggesting that the 6-day time resolution of S1 data is suitable for capturing the stable precipitation pattern in mainland mixed forests rather than the highly variable precipitation pattern in coastal croplands. Future studies suggest comparing this product to the traditional top-down products, as well as evaluating their integration for enhancing high spatial resolution precipitation over entire South Korea.

Keywords : high spatial resolution, precipitation, bottom-up, SAR Sentinel-1, satellite, soil moisture

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