Integration of top-down and bottom-up approaches for a complementary high spatial resolution satellite rainfall product in South Korea

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Substance

Large-scale and accurate observations at fine spatial resolution through a means of remote sensing offer an effective tool for capturing rainfall variability over the traditional rain gauges and weather radars. Although satellite rainfall products (SRPs) derived using two major estimation approaches were evaluated worldwide, their practical applications suffered from limitations. In particular, the traditional top-down SRPs (e.g., IMERG), which are based on direct estimation of rain rate from microwave satellite observations, are mainly restricted with their coarse spatial resolution, while applications of the bottom-up approach, which allows backward estimation of rainfall from soil moisture signals, to novel high spatial resolution soil moisture satellite sensors over South Korea are not introduced. Thus, this study aims to evaluate the performances of a state-of-the-art bottom-up SRP (the self-calibrated SM2RAIN model) applied to the C-band SAR Sentinel-1, a statistically downscaled version of the conventional top-down IMERG SRP, and their integration for a targeted high spatial resolution of 0.01º (~ 1-km) over central South Korea, where the differences in climate zones (coastal region vs. mainland region) and vegetation covers (croplands vs. mixed forests) are highlighted. The results indicated that each single SRP can provide plus points in distinct climatic and vegetated conditions, while their drawbacks have existed. Superior performance was obtained by merging these individual SRPs, providing preliminary results on a complementary high spatial resolution SRP over central South Korea. This study results shed light on the further development of integration framework and a complementary high spatial resolution rainfall product from multi-satellite sensors as well as multi-observing systems (integrated gauge-radar-satellite) extending for entire South Korea, toward the demands for urban hydrology and microscale agriculture.

Keywords : high spatial resolution, satellite rainfall, top-down, bottom-up, integration, SAR Sentinel-1

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