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Snowfall retrieval algorithm for the GPM Microwave Imager (GMI) exploiting CloudSat/CALIPSO observations

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Passive microwave sensors with high-frequency channel diversity offer a unique opportunity for significant advances in surface snowfall retrieval. However, surface snowfall rate quantification using spaceborne microwave radiometers remains a challenging task due to the complex microphysics of snow clouds, and to the many sources of signal contamination (e.g., frozen background, presence of supercooled droplets). Recently, Panegrossi et al. (2017) highlighted the impact of falling snow on the high frequencies channels of GPM Microwave Imager (GMI). In particular: 1) they identified the environmental conditions under which the snow detection could be optimally achieved (e.g., atmospheric moisture, sea ice coverage); 2) they analyzed the sensitivity of GMI high-frequency channels and of the polarization signal at 166 GHz to falling snow as identified by CloudSat Cloud Profiling Radar (CPR); 3) they analyzed the impact of supercooled droplets as identified by CALIPSO/CPR observations on the GMI signal. Building on these results we developed a brand new algorithm to retrieve snowfall, based on the exploitation of the global GMI/CloudSat snowfall coincidence dataset, mainly occurring at latitudes between 55 and 65°N/S. This algorithm makes use of all GMI channels brightness temperature measurements and of ancillary environmental variables (atmospheric water vapor content and 2-meter temperature, ground classification). The retrieval is achieved in three steps and uses Cloudsat 2C-SNOW-PROFILE product as a reference. A first module detects snowfall events in the field of view of GMI high-frequency channels. Then, a second module is devoted to the detection of supercooled droplets, since its presence can strongly affect the GMI channels response to snowfall. Finally, a third module provides the snowfall rate quantification. The new GMI snowfall retrieval algorithm is presented, and results from case studies and from global applications are shown.