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Cloudsat-based assessment of ATMS snowfall observation capabilities

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The development of precipitation retrieval techniques, as well as the quality assessment of satellite-based global precipitation estimates, can now benefit from the availability of unique cloud and precipitation observations by the two spaceborne radars: the Dual-frequency Precipitation Radar (DPR) on board the NASA/JAXA Global Precipitation Measurement (GPM) Core Observatory, and the NASA CloudSat Cloud Profiling Radar (CPR). The multi-year, quasi-global, and complementary DPR and CPR measurements offer a unique and extensive resource to analyze spaceborne microwave radiometer precipitation observational capabilities. This can be particularly useful in remote areas and/or where ground-based observations are sparse or not available and in conditions and regimes where passive MW precipitation retrieval is more challenging. A recent study (Panegrossi et al., 2017) illustrated the potential of the use of these observational datasets to improve snowfall detection and retrieval techniques for MW radiometers at higher latitudes. Recently, a new algorithm for snowfall detection and retrieval for the Global Precipitation Measurement (GPM) Microwave Imager (GMI) (SLALOM, Snow retrievaL ALgorithm fOr gMi) has been developed (Rysman et al., 2018). The algorithm is tuned and evaluated against coincident observations of the CPR, and enables the detection of supercooled water and the retrieval of snow water path (SWP). From a forward-looking perspective we are currently investigating the use of cross-track scanning radiometers, in particular the Advanced Technology MicroWave Sounder (ATMS), for snowfall detection and retrieval. It is worth noticing that ATMS sensor is currently carried by near-polar operational LEO satellites, and therefore it could be used for investigating the higher latitudes. In particular, the potential for snowfall detection of the several high-frequency channels, i.e. the five channels in the 183.3 GHz water vapor absorption band, is being investigated. These channels are very sensitive to snowfall and are less affected by the background surface.
The results of a sensitivity study based on the analysis of snowfall events for which triple coincidences of CPR,ATMS, and GMI observations are available is presented. The events analyzed have been extracted from the 3B-CSATGPM dataset (Turk, 2018). A comparison of the different response of ATMS and GMI to the same snowfall event is carried out. In particular, the TBs measured by both radiometers and different channel combinations have been compared considering snowfall profiles obtained by CPR and environmental conditions (i.e. moisture and temperature profiles, and presence of supercooled droplets). Some intense snowfall events has been taken into account, such as an event that took place in Eastern Siberia in 2014/04/30, an event which took place on the Greenland coast 2014/09/21, and an event that took place in the Andes region in 2016/06/03.
These studies pave the way towards the definition of future missions for snowfall global monitoring by combining a core satellite equipped with a multi-frequency radar in synergy with current and future MW radiometers (such as the EPS-SG Microwave Imager and Microwave Sounder).