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On the use of Cloud Profiling Radar to detect solid precipitation over Antarctica at different scales

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Precipitation is a key geophysical parameter in understanding the Antarctic climate. However, the particular environmental conditions of the Continent make it difficult to measure directly solid precipitation rate and accumulation from either ground based instruments or passive space-borne sensors. A significant improvement in the study of solid precipitation over Antarctica is possible by using active space-borne instruments: the Cloud Profiling Radar (CPR), a nadir-pointing 94 GHz radar, on board the low earth orbit CloudSat satellite. Five years (2006-2011) of CPR data and products over Antarctica are analyzed to investigate the characteristics of solid precipitation.
The aim of this work is twofold: 1) to compare a global snowfall rate retrieval algorithm (Kulie and Bennartz, 2009) with the official CloudSat product (2C-SNOW-PROFILE) over the Antarctic environment, evaluating the sensitivity of the estimated snow fields to: ground clutter, choice of reflectivity-snowfall rate relationship (Z-S), presence of melting snow/liquid precipitation; 2) to provide snow fall rates and accumulation at different scales over Antarctica, evaluating the impact of background physiography and seasonal cycle on the precipitation distribution. Further comparisons are also performed with ERA-Interim snowfall fields and point-like snow stack height measurements by acoustic depth gauges.
Results show that the difference between the Kulie and Bennartz (2009) algorithm and the 2C-SNOW-PROFILE product is mainly due to the choice of the Z-S relationship. Furthermore, despite the CPR limited temporal and spatial sampling capabilities, CPR is able to evidence precipitation characteristics difficult to study from conventional ground-based instruments, at spatial and temporal scales of interest for the study of the hydrological cycle over Antarctica. This is of particular relevance given that the CPR follow-on mission on EarthCare will ensure a long-term coverage.