Blowing snow detection: a comparison of satellite imagery with ground-based remote sensing observations at Princess Elisabeth Station, East Antarctica

Alexandra Gossart[1], Niels Souverijns[1], Irina V. Gorodetskaya[2,1], Stef Lhermitte[3,1], Jan T.M. Lenaerts[4,1,] Stephen P. Palm[5,6], and Nicole M.P. van Lipzig[1]

[1] Department of Earth and Environmental Sciences, KU Leuven, Belgium

[2] Centre for Environmental and Marine Sciences, Department of Physics, University of Aveiro, Portugal

[3] Department of Geosciences and Remote sensing, Delft University of Technology, The Netherlands

[4] Institute for Marine and Atmospheric Research, Utrecht University, The Netherlands,

[5] Science Systems and Applications Inc. , Lanham, MD 20706 , USA

[6] NASA Goddard Space Flight Center, Greenbelt, MD 20771 , USA

Blowing snow occurs when snow particles are lifted by the wind to a substantial height. This process affects the local surface mass balance (SMB) of the Antarctic continent, by deposition (addition) or erosion (removal) of the snow particles from the surface. Blowing snow particles, having undergone displacement and collision, are usually more rounded and smaller than the falling snow crystals. The intensity and frequency, as well as the total mass displaced by such blowing snow events are typically investigated on the field by means of a network of snowdrift instrumentation and specific sensors placed close to the ground, or using regional climate models equipped with blowing snow schemes. However, the remoteness of the Antarctic continent, the scarcity of data and challenges of climate modeling in the area limit our current understanding of the process.

We have thus developed a new algorithm to investigate the effect of blowing snow using long-term observations available at the Princess Elisabeth (PE) station. PE station is located in the escarpment area of Dronning Maud Land, East Antarctica (72°S, 23°E). Several instruments analyze atmospheric conditions and cloud and precipitation properties. The ground-based remote sensing instruments include a ceilometer providing 910 nm attenuated backscatter profiles at 15-sec temporal resolution. In addition to yielding information on cloud base height and vertical structure, the ceilometer also provide information on the particles present in the boundary layer. We developed a new algorithm to detect blowing snow from the ceilometer attenuated backscatter for the first time, that is able to detect strong blowing snow signal from layers thicker than 15 m.

We further apply the blowing snow algorithm at PE to evaluate the blowing snow events detection by satellite imagery. The near-surface blowing snow layers are apparent in lidar backscatter profiles (532 nm attenuated backscatter) and enable snowdrift events detection (spatial and temporal frequency, height and optical depth). These data are available for the period 2007-2015 and is processed from CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations), at a high resolution (1x1 km digital elevation model extending from 40 km altitude to below sea level). However, the remote sensing detection of blowing snow events is limited to layers of a minimal thickness of 20-30 m. In addition, thick clouds, mostly occurring during winter storms, can impede drifting snow detection from satellite products. Here, we study the concordance of the retrieval of blowing snow events from satellite imagery with the observations and we will present case studies focusing on the days when strong blowing snow conditions were observed at PE.