Revealing snowpack properties in the Antarctica ice cap using radar altimeter measurements

Lacroix Pascal, Dechambre Monique,Legresy Benoit,Remy Frŕdйrique
Legos

lacroix@notos.cst.cnes.fr

Remote sensing is an important tool for the understanding of the large Antarctica ice sheet. Until now, most of the on-board sensors provides surface information: altimetry is used to retrieve topography, SAR-interferometry for the surface velocity ... . However, an important amount of geophysical information is contained within the first meters of the firn. For instance, snow grain size, that partly controls radar penetration, or internal stratification, revealed by radars, are indicators of the snow compaction and accumulation rate, one of the most pertinent climate parameter. The ability of low frequency radar to penetrate the ice sheet is a real opportunity to recover snowpack properties. For the first time the radar altimeter of ENVISAT acts at Ku-band (13.6 GHz) and S-band (3.2 GHz) and surveys 80% of the Antarctic ice sheet. This study focus on the ice stratification over Antarctica ice-cap. The bifrequency mode allows us to better differentiate internal and surface contribution to the signal. A model is then built to estimate the characteristics of the layering (snow grain size, density profiles, interface roughness) for the first 100 meters of the firn. An usual limitation for the models is the validity condition of the approximation used. Our model considers the solutions for each approximation to cover the whole validity domain. The data inversion is performed over the plateau and compared with in situ measurements. For each band, we compare the stratification and the snow-grain size contribution. We expect the use of the dual frequency to allow us to discriminate the two effects. We will discuss our results for the estimation of the accumulation rate. The geophysical parameters will be mapped and interpreted in terms of climatic consequences.Our study will also focus on lower frequency concept such as MIMOSA (P-band), to show future prospective on radar ice sheet sounding. Low frequency radars penetrate deeply in the ice and are sensitive among other to conductivity changes produced by volcanic erruptions. Hence, low frequency radars, can image deep stratification in Antarctica. The combining of mid-low frequency radar (S and Ku band) and low frequency radar (P-band) altimeters provides an unique opportunity to image the ice cap over all its depth.