Geophysical Research Abstracts
Vol. 13, EGU2011-13162, 2011
EGU General Assembly 2011

The challenges of studying uplift rates in polar regions by means of InSAR

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Over the past 30 years our planet has experienced an increase in temperature of approximately 0.6° C and consequently a positive trend of the global sea level. Providing reliable estimates of future sea-level changes requires knowledge of ice-mass changes in polar regions. The ice-mass balance has been estimated using Gravity Recovery and Climate Experiment (GRACE) data. However, these data are dominated by uncertainties in the correction for the Glacial Isostatic Adjustment (GIA).

Zooming in on the Antarctic peninsula and comparing the modeled GIA to the uplift rates acquired by the GPS network, a large deviation is observed. Moreover, the different GIA models do not agree. These disagreements indicate that these models are not well-constrained. In order to improve the GIA models, more geodetic measurements are required. The remote location of the continent as well as the hostile climate encourage the use of space geodetic techniques as an alternative means to in-situ instruments. As such, we present here the first results of the time series InSAR technique on the Antarctic Peninsula, a region which has experienced rapid ice melt, and, as a consequence, is undergoing high uplift rates.

Due to its global coverage and high spatial resolution, radar interferometry (InSAR) is a good alternate means with respect to ground-based observations to measure uplift rates. InSAR is established as a major scientific tool to study geophysical processes causing surface deformation. However, it is limited by temporal and geometrical decorrelation. Due to the fact that the peninsula is mainly covered by snow, it is even more difficult to find coherent pixels. This causes problems in the coregistration of the radar images, a process which gets even more difficult by floating ice shelves and glacier movements. In order to find coherent pixels we use time series SAR interferometry methods. Specifically, we apply persistent scatterer interferometry combined with a small baseline approach (StaMPS). The main challenge in applying these techniques on large scale areas covered by ice is that coherent pixels are located only on the rocky outcrops. The fact that these outcrops are dispersed across Antarctica makes the phase-unwrapping difficult.

Since most of the rocky outcrops are parallel to the many glaciers on the peninsula, we perform the first test runs on smaller areas along the east coast. For this first analysis both ERS SAR and Envisat ASAR data are processed. Despite the afore mentioned complications, we successfully apply both the PS-InSAR and Small Baseline approach. As future work, the area of interest will be enlarged until to the whole peninsula is covered. Data from other SAR sensors will be included and the resulting relative velocity maps will be tied with the GPS network. This will result in an absolute velocity map and should narrow the range of plausible ice-mass loss estimates.