Defining models of glacial isostatic adjustment in West Antarctica and the Antarctic Peninsula (UKANET): better constraints on Earth structure and uplift

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Accurate predictions for the evolution of WAIS require an understanding of the *dynamics* of present-day ice mass change. A first step towards this goal is the quantification of the *spatial distribution* of this change. Two key methods for deriving spatially-variable ice mass change are satellite gravimetry and altimetry. Crucially, both of these techniques - in particular satellite gravimetry, as carried out by the GRACE satellites - are susceptible to errors introduced by correcting for the uplift response of the solid Earth to past ice mass loss. This process, Glacial Isostatic Adjustment (GIA), is strongly dependent upon the underlying Earth structure.

In West Antarctica the gravitational signal due to GIA is of the same order of magnitude as the signal due to current ice mass change, but of the opposite sign. Separating out the contribution from these competing signals is the greatest barrier to accurately determining the distribution of present-day ice mass change in Antarctica. Current GIA models show strong disagreement across West Antarctica due to uncertainties in both ice history and Earth rheology. In particular, absolute values of mantle viscosity are poorly constrained, and most GIA models only consider vertical variations in Earth structure. By independently determining even the order of magnitude of upper mantle viscosity, significant inroads can be made into reducing the uncertainty associated with the GIA correction. The inclusion of lateral variations in Earth structure is a key step towards more realistic models. We will determine Earth structure through a new passive seismological experiment. We will deploy a network (UKANET) of 10 broadband seismometers in West Antarctica for 2 years to estimate 3D variations in Earth rheology by determining shear-wave velocity models down to depths of c. 400 km from surface wave dispersion.

In addition, 10 existing GPS sites on the Antarctic Peninsula will be maintained for the duration of the seismic deployment. Whilst this sparse network of GPS will constrain the deformation pattern on a broad scale, we expect smaller wavelength variability in deformation due to present-day ice mass change, which is localised to individual glaciers. These present-day processes can be distinguished from the long term GIA by their differing spatial pattern. We will apply InSAR to outcrops on the Antarctic Peninsula to increase the spatial sampling of the deformation field by orders of magnitude. This technique has been widely applied to tectonic and volcanic settings and has the potential to revolutionize our understanding of the spatial field of solid Earth deformation in response to rapid ice mass change in Antarctica. Because distances between rock outcrops can be large, assumptions from weather models need to be made about the spatial variability of the tropospheric radar propagation delay during interferometric processing. We will test these assumptions with a temporary GPS deployment on the Antarctic Peninsula.

Marine ice sheet instability *(Free Fallin')*