Remote sensing of glaciological and climatological variables to drive and validate glacier mass balance estimates of the inland ice cap of King George Island, West Antarctica.

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The Antarctic Peninsula is amongst the fastest warming places on Earth and further temperature increase is to be expected. Exceptional rates of surface air temperature increases (2.5K in 50 years) are concurrent with retreating glacier fronts, an increase in melt areas, surface lowering and rapid retreat, break-up and disintegration of ice shelves. The South Shetland Islands are located on the northern tip of the Antarctic Peninsula and are especially vulnerable to climate change due to their exposure to transient low pressure systems and their maritime climate. For King George Island/Isla 25 de Mayo, we have compiled a unique meteorological and glaciological data set on the Warszawa Icefield from November 2010 and ongoing. In combination with long-term synoptic data sets and reanalysis data, we look at changes in the climatological drivers for glacier melt processes and sensitivity of the inland ice cap with regard to winter melt periods and pressure anomalies. Analysis show a positive trend in minimum air temperatures of central winter months of 5 degree Celsius over four decades, clearly exceeding the published annual mean statistics associated with a decline in mean monthly sea level pressure. This concurs with a positive trend in the SAM index that gives a measure for the strength and extension of the Antarctic vortex, and we connect this with a higher frequency of low pressure systems hitting the South Shetland Islands during austral winter bringing warm and moist air masses from lower latitudes. Remote sensing data is used to drive the model and to validate the model output.

In combination with data time series of glacier mass balance stake measurements on several transects, differential GPS kinematic grids in consecutive years, and the application of a glacier melt model, we aim at assessing the impact of the long-term climatological changes on the equilibrium line altitude. Glaciological measurements and literature review suggest a change of more than 150m in 15 yr's. The glacier model is used to give a projection into future mass balance estimates based on the more moderate IPCC scenario of air temperature change. Analysis of area changes in accumulation zone to the total glacier area are used to define a tipping point where the negative trends in glacier mass balance is becoming irreversible.

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