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Modern sediment redistribution in pro-glacial areas of King George Island, South Shetland Islands

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Drivers of cryosphere dynamics in polar environments include a wide range of factors such as temperature, solar radiation, aerosols and precipitation, which are often site-specific. However, changes in the mass balance of glaciers and snow cover dynamics are expected to cause alterations in the sedimentation processes downstream, affecting ecosystem quality of these polar environments.

This study summarizes results from two expeditions- in 2011 and 2015- to King George Island (62° 25'S, 58° 53'W), part of the South Shetland Islands, 120 km off the west coast of Antarctica. The expedition aim was to better understand the link between cryosphere dynamics and changes in sediment redistribution. The assessment was based on the distribution of the fallout radionuclides ^{137}Cs and ^{210}Pb$_{ex}$, environmental radionuclides ^{40}K, ^{226}Ra, ^{238}U and ^{232}Th and landscape geochemical fingerprints, including sediment cores. In total 9 cores were taken (depth ranging between 0.8 and 1.26m) in 9 lakes located in the drainage basin related to the Bellingshausen Dome at the Fildes Peninsula and complementary at pro-glacial areas of the Admiralty Bay. These data were used to understand the ongoing erosion processes, calculate sedimentation rates, and identify possible sources of sediments. Further, high resolution digital surface models were made based on UAV surveys to assess the geomorphological processes taking place. These surveys took place in 2015 and 2017 and will be repeated in 2018.

Local historical data from 1968 until 2009 showed that the Bellingshausen glacier lowered significantly, almost without boundaries changing. However, after 2009 until present, the glacier is showing an increase. The previous change in mass balance (Equilibrium-line altitude) could be correlated in this study positively correlated to a change in summer temperature (R^2= 0.76) in this study, only a limited correlation was found with summer rains (R^2=0.25).

The sediment cores taken during the 2015 expedition showed a strong acceleration in sediment redistribution since the 1980s, not only in the pro-glacial zone, with an increase in sedimentation rate in the studied lakes of up to 5 times until the end of the first decade of the 21st century as compared to before the eighties of last century. Results will be shown from the assessment of sediment fingerprints to demonstrate whether sediments are coming mainly from the proglacial areas or from the areas not linked with the glacier. This may show if rapid snowmelt due to higher summer temperatures may have caused such acceleration.

This information shows that the South Shetland Islands are undergoing a rapid shift in geomorphological processes. As glaciers are currently increasing, this increase in sedimentation may be ground to a halt, particularly in the pro-glacial areas. The question is how fast this process will be and how long will it last.

This study contributes to a better understanding of impacts of glacier and snow cover changes on landscape dynamics in polar environments. It was supported by the IAEA Technical Cooperation Programme through the INT/5/153 project „Assessing the Impact of Climate Change and its Effects on Soil and Water Resources in Polar and Mountainous Regions “.