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Long-term monitoring of glacier dynamics of Fleming Glacier after the disintegration of Wordie Ice Shelf, Antarctic Peninsula

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The Antarctic Peninsula is one of the world‘s most affected regions by Climate Change. Dense and long time series of remote sensing data enable detailed studies of the rapid glaciological changes in this area.

We present results of a study on Fleming Glacier, which was the major tributary glacier of former Wordie Ice Shelf, located at the south-western side of the Antarctic Peninsula. Since the ice shelf disintegrated in a series of events starting in the 1970s, only disconnected tidewater glaciers have remained today. As a reaction to the loss of the buttressing force of the ice shelf, Fleming Glacier accelerated and dynamically thinned. However, all previous studies conducted at Wordie Bay covered only relatively short investigation periods and ended in 2008 the latest. Hence it was not well known how long the process of adaption to the changing boundary conditions exactly lasts and how it is characterized in detail.

We provide long time series (1994 – 2016) of glaciological parameters (i.e. ice extent, velocity, grounding line position, ice elevation) for Fleming Glacier obtained from multi-mission remote sensing data. For this purpose large datasets of previously active (e.g. ERS, Envisat, ALOS PALSAR, Radarsat-1) as well as currently recording SAR sensors (e.g. Sentinel-1, TerraSAR-X, TanDEM-X) were processed and combined with data from other sources (e.g. optical images, laser altimeter and ice thickness data). The high temporal resolution of our dataset enables us to present a detailed history of 22 years of glacial dynamics at Fleming Glacier after the disintegration of Wordie Ice Shelf. We found strong evidence for a rapid grounding line retreat of up to 13 km between 2008 and 2011, which led to a further amplification of dynamic ice thinning. Today Fleming Glacier seems to be far away from approaching a new equilibrium. Our data show that the current glacier dynamics of Fleming Glacier are not primarily controlled by the loss of the ice shelf anymore, but by other sources of external forcing, such as oceanic warming.