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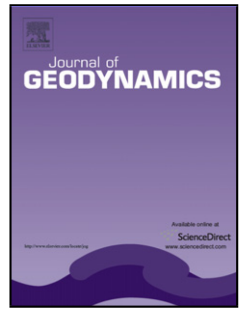

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Detection of ice mass variation using GNSS measurements at Svalbard

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Abstract

We compare observed uplift rates of Global Navigation Satellite Systems (GNSS) with geophysical predictions at sites located on Spitsbergen. We show here that using modern postglacial rebound models, realistic mass balance for Present Day Ice Melting (PDIM) and taking the deglaciation of the Little Ice Age (LIA) into account, we can close the overall uplift budget at a level of a few millimetres per year. For this study we used GNSS data from well-established geodetic sites in Ny-Ålesund and the new data from Hornsund. The significant increase of uplift rates since the beginning of 2011 was observed at both GNSS sites. These height changes are attributed to recent increased ice mass loss of $6.0\,\mathrm{Gt\,yr^{-1}}$ for Svalbard. The total mass loss is estimated at $14.7\,\mathrm{Gt\,yr^{-1}}$. Ice unloading caused also a noticeable increase of distance between Ny-Ålesund and Hornsund. We show that the specific location of the two sites facilitates inference of differential mass loss within the Svalbard Archipelago.

Keywords: mass balance, Glacial Isostatic Adjustment, Present Day Ice Melting, GNSS, loading deformations, Svalbard

1. Introduction

The Svalbard archipelago has an area of $61 \cdot 10^3\,\mathrm{km}^2$ of which more than 60 % is covered with ice (Fig. 1). The region's ice masses are sufficiently well concentrated and the region itself sufficiently distant from other territories where melting takes place (more than 500 km to north Greenland) that it presents a test field in its own right to study the response to contemporary ice mass variation. At this time scale the response is expected to be predominantly elastic. Investigations can draw support from a range of glaciological studies and employ available geodetic equipment. The significant ice mass loss for this region was already reported (Kohler et al., 2007; Matsuo and Heki, 2013). According to

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