

Seasonal velocity variations of 11 outlet glaciers from the Greenland ice sheet derived from *in situ* GPS instruments

A. P. Ahlstrøm¹, M. L. Andersen¹, F. M. Nick^{2,3}, C. H. Reijmer³, R. S. W. van de Wal³, J. E. Box^{1,4}, A. Hubbard⁵, A. Behar⁶, M. Citterio¹, D. van As¹, R. S. Fausto¹, S. B. Andersen¹, H. Machguth¹

1. Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen, Denmark

2. Laboratoire de Glaciologie, Université libre de Bruxelles, Brussels, Belgium

3. Institute for Marine and Atmospheric research Utrecht, Utrecht University, Utrecht, The Netherlands

4. Byrd Polar Research Center and Department of Geography, Ohio State University, Columbus, USA

5. Institute of Geography & Earth Sciences, Aberystwyth University, Aberystwyth, United Kingdom

6. School of Earth & Space Exploration, Arizona State University, Tempe, USA

Correspondence to: A. P. Ahlstrøm (apa@geus.dk)

Abstract

The marine ice loss of outlet glaciers is largely determined by the speed with which they flow towards the ocean. The magnitude of the changes in the flow speed of the Greenland ice sheet outlet glaciers from year to year has turned out to be hard to understand, much less predict. Yet, future projections of sea level rise depend on our understanding of the physical processes driving this change and our ability to put this understanding into models. A first requirement is a comprehensive dataset of outlet glacier velocity change, preferably spatially extensive. Satellite-derived maps can provide the spatial velocity pattern, but rarely provides the required temporal detail. Here, we present over 20 continuous velocity records derived from *in situ* stand-alone single-frequency Global Positioning System (GPS) receivers placed on 11 major marine-terminating ice sheet outlet glaciers in South, West, East and North Greenland, covering varying parts of the period summer 2009 to winter 2012. Common to all the observed glacier velocity records is a pronounced seasonal variation, with an early melt season maximum. The velocity records are related to available records of surface melt to examine the large-scale influence on outlet glacier dynamics and satellite imagery is employed to examine the relation between the early melt season maximum and fjord ice cover.