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The global signature of post-1900 land ice wastage on vertical land motion

Riccardo Riva (1), Thomas Frederikse (1), Matt King (2), Ben Marzeion (3), and Michiel van den Broeke (4)

(1) Delft University of Technology, Geoscience and Remote Sensing, Delft, Netherlands (r.e.m.riva@tudelft.nl), (2) Surveying and Spatial Sciences, School of Land and Food, University of Tasmania, Hobart, Tasmania, Australia, (3) Institute of Geography, University of Bremen, Bremen, Germany, (4) Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, The Netherlands

The amount of ice stored on land has strongly declined during the 20th century, and melt rates showed a significant acceleration over the last two decades. Land ice wastage is well known to be one of the main drivers of global mean sea-level rise, as widely discussed in the literature and reflected in the last assessment report of the IPCC.
A less obvious effect of melting land ice is the response of the solid earth to mass redistribution on its surface, which, in the first approximation, results in land uplift where the load reduces (e.g., close to the meltwater sources) and land subsidence where the load increases (e.g., under the rising oceans). This effect is nowadays well known within the cryospheric and sea level communities. However, what is often not realized is that the solid earth response is a truly global effect: a localized mass change does cause a large deformation signal in its proximity, but also causes a change of the position of every other point on the Earth's surface. The theory of the Earth's elastic response to changing surface loads forms the basis of the 'sea-level equation', which allows sea-level fingerprints of continental mass change to be computed.
In this paper, we provide the first dedicated analysis of global vertical land motion driven by land ice wastage. By means of established techniques to compute the solid earth elastic response to surface load changes and the most recent datasets of glacier and ice sheet mass change, we show that land ice loss currently leads to vertical deformation rates of several tenths of mm per year at mid-latitudes, especially over the Northern Hemisphere where most sources are located. In combination with the improved accuracy of space geodetic techniques (e.g., Global Navigation Satellite Systems), this means that the effect of ice melt is non-negligible over a large part of the continents. In particular, we show how deformation rates have been strongly varying through the last century, which implies that they should be properly modelled before interpreting and extrapolating recent observations of vertical land motion and sea level change.