National Aeronautics and Space Administration
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Discovery of solitary waves of ice loss

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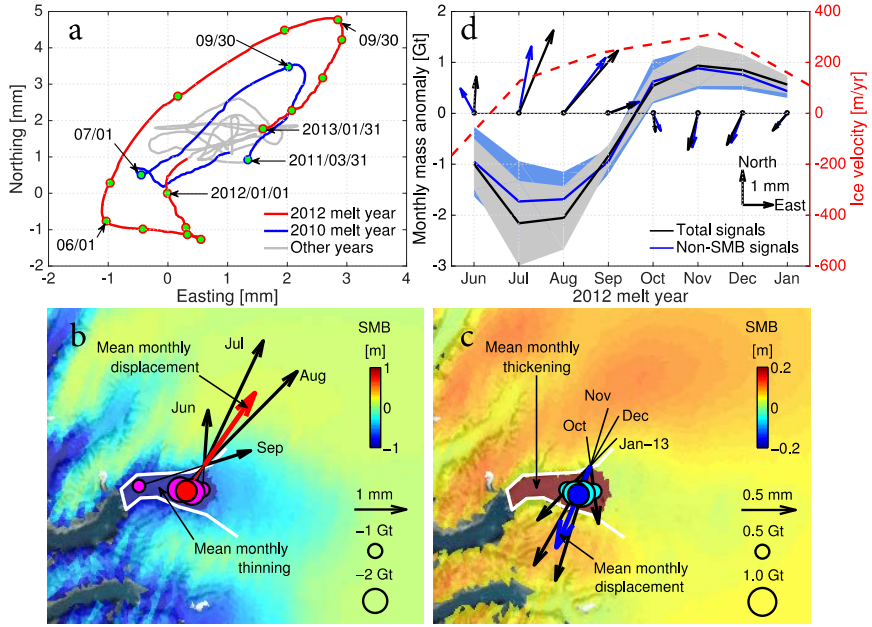

Mass transport waves detected in solid Earth deformation. (a) Measurements of horizontal crustal motion by a single GNSS station, located on bedrock next to the Rink Glacier. Notice anomalous signal in 2012. (b) Horizontal crustal displacement vectors (arrows) and inferred mass anomalies (circles) traveling through the Rink Glacier trunk (white boundary) during July-Sept 2012. Background map shows mean monthly surface mass balance (SMB). (c) Same as (b), but during Oct 2012 – Jan 2013. (d) Summary of (b) & (c), revealing seasonal wave of mass transport.

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Science Question: Can horizontal crustal displacements adjacent to Greenland fast moving outlet glaciers reveal loading associated with ice dynamics? Might we anticipate this during expect intense Greenland melt years (2012 & 2010)? A bedrock GNSS station, located 2 km from the Rink Glacier, recorded systematic horizontal crustal motions (Fig. a). We then aimed at answering: What were the causal mechanisms for this?

Data & Results: We combined satellite geodetic observations (GRACE, CryoSat-2), climate reanalysis (SMB), & measurements of glacier velocity and calving front positions to conclude that solitary waves carrying substantial ice traveled down the Rink Glacier during two of Greenland's intense melt years. During June-Sept 2012, the wave speed was about 7 km/month, ultimately dumping a total of 6.7 Gt of ice/water into the oceans.

Significance: 1st quantitative measurement of solitary mass transport waves on any glacier in Greenland or Antarctica. This "new mode" of rapid pulse of ice loss in the form of waves may strengthen the sustained ice loss from Greenland, with important implications for the future sea-level rise.