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Title: *Influence of melt water supply on the dynamics of the Greenland Ice Sheet*

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Current understanding of ice dynamics predicts that increasing amount and variability of melt water supply will likely have a major influence on basal motion, and therefore on the evolution and future behavior of the Greenland Ice Sheet. We instrumented four boreholes at two sites with sensor systems to better understand the processes controlling seasonal and episodic flow velocity variations in the marginal zone of the Greenland Ice Sheet. We present measurements of borehole deformation, subglacial water pressure and surface motion during one year (July 2011 to September 2012). Subglacial water pressure and ice deformation show periodic variations on several time scales which are delayed by up to half a period, depending on sensor depth. These observations are interpreted as ice motion in a caterpillar-like fashion, as opposed to the conventionally assumed shear flow. Using a time-dependent, Full-Stokes ice flow model we find that spatially and temporally varying basal motion can explain the observed variations in deformation, and the delayed reaction at different depths. These new data show that the reaction to basal motion is not uniform throughout the ice column, but varies with depth.