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Seasonal acceleration of Russell Glacier, Western Greenland during 2009 & 2010

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Seasonal changes in surface velocity of the Russell Glacier catchment, Western Greenland, have been derived using a combination of interferometry and satellite image feature tracking and are compared with the output of a well calibrated distributed energy balance model. Analysis is conducted between the extent and longevity of melt-driven flow acceleration between two contrasting years, the relatively short melt season of 2009 and the record high melt season of 2010. In both 2009 and 2010 the largest horizontal surface acceleration occurred at the ice margin soon after initiation of melt with the effect propagating up-glacier with reduced magnitude as the melt-season evolved. In both years ice flow near the margin of the Ice Sheet (within 14 km) had returned to winter values within $\sim$80 days of the first recorded melt. However, within each 100m elevation band, melt-induced flow acceleration and magnitude of observed speedup in 2010 exceeded that of 2009. Up glacier (to 35 km), ice speed in 2010 continued above the background winter mean 126 days after the initiation of melt, in contrast to only 102 days in 2009. Structural changes in surface velocity patterns are also evident during the winter months, with measured velocities in February 2010 (22-57km) 26% greater at the end of winter compared to values from November 2010. This study highlights the large heterogeneity in spatial and temporal velocity structure occurring at the land terminating margin of the Greenland Ice Sheet and lends support for the idea that the evolution of the subglacial drainage system acts to regulate basal flow near the ice margin, thereby limiting the feedback between meltwater and ice flux. Further up glacier (>35km) the effect of this behavior is reduced even though large fluxes of surface meltwater were still generated in 2010, which suggests that in the upper zone of the catchment (where ice thickness exceeds 1000m) there is limited evolution of the subglacial meltwater system.