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Long term mass balance of the Helheim and Kangerdlugssuaq glaciers in southeast Greenland

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Observations over the past decade show huge ice loss associated with speeding up of glaciers in southeast Greenland in 2003, followed by a deceleration in 2006. These short-term episodic dynamic perturbations have a major impact on the mass balance at decadal scale. However, to improve the projection of future sea level rise, a long-term data record that reveals the mass balance between episodic events is required. Here, we extend the observational record of marginal thinning of Helheim glacier (HG) and Kangerdlugssuaq glacier (KG) from 7 to 30 years. Our measurements reveal that, although the frontal portion of HG thinned by more than 100 m during 2003–2006, it thickened by more than 50 m during 1981–1997. During the same periods, KG was stable until 1998 and experienced major thinning only after 2003. Analyses of their sensitivity to sea surface temperature (SST) anomalies and variations in air temperature suggest that both outlet glaciers respond immediately to small fluctuations in both the SST and air temperature. Furthermore, we compare our observations of ice flow speed and elevation changes with predictions based on the The Parallel Ice Sheet Model (PISM) software.