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The influence of mantle viscosity structure and past decadal to millennial-scale ice mass changes on present-day land motion in Greenland.

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We show predictions of present-day vertical land motion in Greenland using a recently developed Glacial Isostatic Adjustment (GIA) model, calibrated using both relative sea-level observations and geomorphological contraints on ice extent (Simpson et al., 2009). Predictions from our GIA model are in good agreement to the relatively small number of GPS measurements of absolute vertical motion from south and southwest Greenland. This suggests that our model of ice sheet evolution over the Holocene period is reasonably accurate. The uplift predictions are highly sensitive to variations of upper mantle viscosity; depending on the Earth model adopted different periods of ice loading change dominate the present-day response in particular regions of Greenland. We shall present a suite of results to demonstrate this sensitivity. We also consider the possible influence of more recent changes in the ice sheet by applying a second ice model; specifically, a surface mass balance (SMB) model (Wake et al., 2009), which covers the period 1866 to 2005. Predictions from this model suggest that decadal-scale SMB changes over the last c. 140 years play only a small role in determining the present-day viscous response. However, high rates of peripheral thinning from 1995 to 2005 in the SMB model produce large elastic uplift rates in west and southwest Greenland. Using the same SMB model, we extend our study period to cover the last thousand years (for which there is less accurate climate data) and constrain ice mass changes over this time using new high resolution records of relative sea-level change. Our preliminary findings suggest that century-scale ice mass variation over the last thousand years may contribute significantly to the present-day viscous response.

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Wake, L.M., Huybrechts, P., Box, J.E., Hanna, E., Janssens, I., Milne, G.A., 2009. Surface mass-balance changes of the Greenland ice sheet since 1866. Annals of Glaciology 50, 178-184.