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The Medieval Warm Period–Little Ice Age Relative Sea Level Slowdown in Western Greenland: A response of the Greenland Ice Sheet to a phase shift of the North Atlantic Oscillation?

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Changes in mass balance can force spatially variable sea-level changes in both the near- and far-field of an ice sheet (Farrell and Clark, 1976; Mitrovica et al. 2001). During the period spanning the Medieval Warm Period and the Little Ice Age (LIA), reconstructions of century-scale relative sea-level (RSL) extracted from salt marsh deposits in Greenland (Long et al. 2011, Woodroffe and Long, 2009) reveal that the century-scale RSL trends differ significantly to millennial-scale trends inferred from isolation basin data in their respective areas. At sites in west Greenland (Sisimiut: 68.6^{o}N, 52.6^{o}W; Aasiaat: 68.6^{o}N, 52.6^{o}W), RSL rise slows from $\sim$3 mm/yr to $\sim$0 mm/yr at $\sim$1600AD and is stable thereafter. In south Greenland (Nanortalik, 60^{o}N, 44.7^{o}W), a similar trend is observed, but the slowdown occurs 200 years later.

Sensitivity tests show that substantial contributions from oceanographic changes can be ruled out as drivers of RSL slowdown at Aasiaat and Sisimiut but could be more important at Nanortalik. Dynamic ice loss from Jakobshavn Isbrae is predicted to produce an extremely localised RSL signal and is likely to be only a secondary contributor to RSL changes at Aasiaat. For Sisimiut and Aasiaat, regional-scale changes in ice load are the most likely candidate to explain the observed RSL signals. Marginal ice loss in western Greenland beginning around 1600AD is required to initiate local sea-level fall to counteract the background viscous sea-level rise associated with GIA from non-Greenland sources. However, ice loss is deemed an unlikely scenario since this is incompatible with widely-perceived climatic conditions associated with the Little Ice Age.

Recently it has been shown that the North Atlantic Oscillation (NAO) was predominantly in a positive phase prior to the LIA (Trouet et al., 2009), switching to a variable positive/negative phase since $\sim$1600AD. This offers a mechanism to explain the RSL changes at Sisimiut and Aasiaat at 1600AD. We present the results of a sensitivity study which support the hypothesis first proposed in Long et al. (2011) that the western part of the Greenland Ice Sheet may have been losing mass as a result of warmer conditions associated with NAO-, during a time when the many glaciers around the world were expanding.