Ice sheet climate interactions: Implications for coastal engineering

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The 5th annual PAGES PALSEA Working Group workshop held in June 2012 was dedicated to understanding paleo constraints on future sea level rise. The main focus of this workshop was on ice sheet climate interactions and their implications for coastal engineering, although discussions also addressed a broader range of issues such as database efforts (A. Rovere, Columbia University, USA), ongoing challenges for modelers and observational scientists, and how and where these issues intersect. The workshop drew 39 participants, with strong international representation, bearing the hallmark of previous PALSEA workshops. A broad range of expertise was represented including climate and ice sheet modeling, glacial-isostatic modeling, and field-based techniques addressing prior ice sheet extent and relative sea level position – all the techniques needed to estimate future local sea level rise.

The sessions revolved around several themes, largely addressing ice sheet response and ice-climate interactions on a variety of timescales – from the early and late Holocene to previous interglacials as well as the Pliocene and the future.

In particular, among the variety of topics discussed, there was focus on the quantitative sources of additional water to the last interglacial sea level highstand. New analyses of Greenland Ice Sheet behavior during this time period were presented (Helsen et al. 2011; Stone et al. 2013; A. Quiquet, CNRS, France and D. Dahl-Jensen, University of Copenhagen, Denmark), in addition to a synthesis of Greenland Ice Sheet contributions from the past 20 years that generated in-depth discussion on the likely budget from Greenland and Antarctica. The geometry of the Greenland Ice Sheet during this time period was also discussed with different methodologies showing similar patterns of substantial loss of ice from the southwest (Fig. 1).

Another prominent topic was the deterministic versus stochastic nature of ice sheet response and the concept of ice sheet "weather" (M. Siddall, University of Bristol, UK). This led to a debate on the ability to use hazard analysis tools to assess the possible ice sheet contribution to sea level over the coming century based on the idea that outlet glaciers of ice sheets may not behave smoothly. Other discussions included assessments of the present (see Figure 1) and future behavior of the Greenland and Antarctic Ice Sheets from both a paleo and present modeling perspective (P. Applegate, Stockholm University, Sweden; P. Whitehouse, Durham University, UK; R. DeConto, University of Massachusetts, USA).

The mechanism of saddle collapse between ice domes in North America via a simple height-mass-balance feedback was proposed to explain rapid meltwater events during the last deglaciation (Gregoire et al. 2012). The applicability of this mechanism to other ice sheets of various sizes during different time periods was also discussed.

Data-oriented presentations focused on a wide range of questions and techniques on the Greenland and Antarctic Ice Sheets during the Holocene (J. Anderson, Rice University, USA; R. Hindmarsh, British Antarctic Survey, UK; Anders Carlson) and Pliocene (R. Ackert, Harvard University, USA), featuring summaries of field data for the 8.2-ka event (Törnqvist and Hijma, 2012) and of late Holocene ice sheet behavior (A. Long, Durham University, UK).

In addition to the scientific themes, workshop participants held discussions with Ben Strauss from Climate Central (climatecentral.org) to identify effective and appropriate public communication pathways on issues related to past sea level position and future sea level behavior.

On behalf of the workshop participants in Madison this year as well as those of previous PALSEA workshops, we would like to take this opportunity to thank Mark Siddall, Bill Thompson (Woods Hole Oceanographic Institution, USA), and Claire Waelbroeck (CNRS, France) for their leadership and vision over the past 5 years. PALSEA has been instrumental in bringing together diverse expertise to address common questions in the study of past ice sheet and sea level behavior with the goal of exploring what this knowledge brings to bear on future sea level change. We look forward to the ongoing multiplier effect of this collaboration throughout our community in the years to come, as Anders Carlson, Andrea Dutton, Antony Long and Glenn Milne (University of Ottawa, Canada) assume leadership.

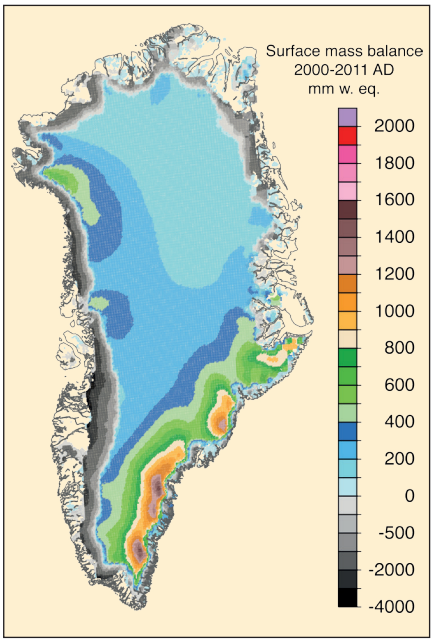

Figure 1: Surface mass balance in mm water equivalent (mm w. eq.) averaged spanning a 12-year period (2000-2011) according to mass accumulation rate simulations. Gray areas indicate the ablation area. Models from the last interglacial period discussed at the workshop identify the southwest region of Greenland as an area of significant retreat similar to present patterns of areas dominated by ablation versus accumulation. Figure from Box et al. (2012).

Acknowledgements

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