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PALSEA

Sea-level budgets at decadal to millennial timescales to bridge paleo and instrumental records

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The PALeo constraints on SEA level rise 2 (PALSEA2) working group recently convened for its fourth meeting, hosted by Oregon State University, at Timberline Lodge on Mt. Hood. This meeting focused on constraining sea-level budgets at decadal to millennial timescales in an effort to connect modern-instrumental and paleo sea-level records. Presentations addressed recent findings in terrestrial and marine sediment records, ice-sheet and ocean models, data analysis, and methods of linking modern sea-level observations with the paleo record.

Sea-level change since the Little Ice Age is preserved and widely studied in saltwater marshes. Saltwater marshes have potential to provide a biostratigraphic mechanism (using diatom assemblages) for linking past sea-level change data with instrumental observations to create a continuous record of Late Holocene sea-level change, and offer valuable near-, intermediate-, and far-field records of ice-sheet influence on sea level. However, the uncertainties associated with marsh records, including compaction and tidal range, must be taken into consideration when using these records to constrain ice-sheet sources. While existing global marsh records make up an extensive database of sea-level change (Fig. 1a), regions outside the northern Atlantic basin are understudied. This large data gap emphasizes the need for future field efforts in the Southern Hemisphere and the Pacific basin.

Uncertainties in current global sea-level records highlight the need to close the sea-level budget since the Last Glacial Maximum (LGM) and account for 4-32 m of missing ice and water (Fig. 1b). These uncertainties in the sea-level budget result from incomplete understanding of the system and are thus perpetuated by incomplete models of parameters such as ocean density, transient processes of ice sheets, global isostatic adjustment, dynamic topography and mantle rheology, groundwater and surface water systems, and land processes. Time periods in Earth history, including Marine Isotope Stage 3 (MIS 3), are also understudied, resulting in disagreement of sea-level reconstruction in the order of ~40 m between different records, and require more attention in the research community. Presentations on the complexity of this problem showed that the success of various global isostatic adjustments and earth models is largely dependent on choosing the right model for a specific research question to a specific region.

While datasets on Holocene paleoclimate and sea-level change are extensive, there is a need to compile these datasets into an open-access, intuitive database to spatially and temporally link these records at global and local levels. An ideal database would include all significant metadata, allowing researchers to improve upon dating techniques and standardize methods of data and statistical analysis. As it stands, there are significant uncertainties and inconsistencies between research groups in dating and modeling sea-level change, highlighting the need for incremental improvements of these methods within the paleoclimate community.

In the final discussion, there was a consensus that research on sea-level change could benefit significantly from collaboration with experts in other fields. Future work with Earth-system modelers, statisticians, and geophysicists who have an interest in paleoclimate studies, is necessary to address critical questions in glacial isostatic adjustment modeling, geochronology, database compilation, and data analysis. These collaborations would help better understand a system that has important implications for monitoring ongoing (and predict future) global sea-level change, and, ultimately, to make more robust predictions on the effect of climate change on local and global sea level. For the final phase of the working group, PALSEA2 will reconvene in 2017 with a focus on the phasing of sea-level and ice-sheet responses to climate change, and the processes and timescales which govern these responses.

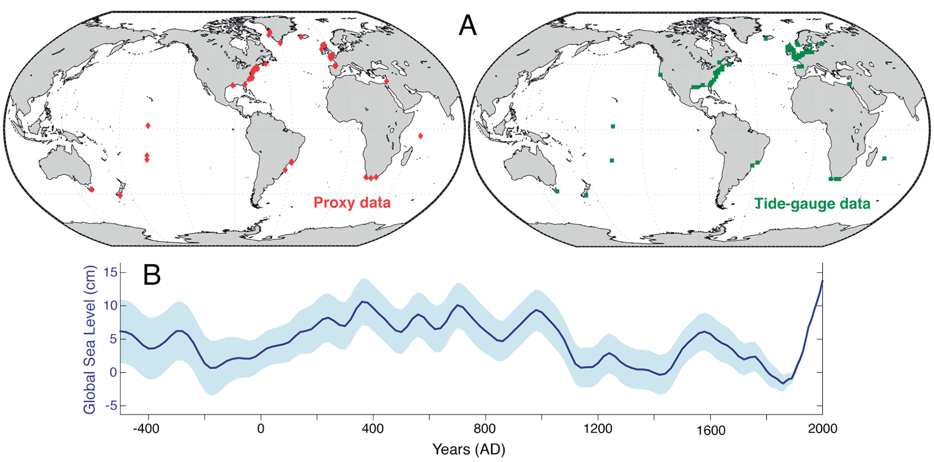

Figure 1: (A) Global distribution of paleoclimate proxy and modern tidal gauge sites, and **(B)** reconstruction of late Holocene sea-level changes (from Kopp et al. 2016; Copyright, 2016, National Academy of Sciences). Shading gives the 67% credible interval.

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