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The Last Interglacial History of the Antarctic Ice sheet

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In this paper we present a summary of the work which was conducted as part of the 'PAST4FUTURE -WP4.1: Sea Level and Ice sheets' project. The overall aim of this study was to understand the response of the Antarctic Ice sheet (AIS) to climate forcing during the Last interglacial (LIG) and its contribution to the observed higher than present sea level during this period. The study involved the application and development of a novel technique which combined East Antarctic stable isotope ice core data with the output from a Glacial Isostatic Adjustment (GIA) model [Bradley et al., 2012]. We investigated if the stable isotope ice core data are sensitive to detecting isostatically driven changes in the surface elevation driven by changes in the ice-loading history of the AIS and if so, could we address some key questions relating to the LIG history of the AIS.

Although it is believed that the West Antarctic Ice sheet (WAIS) reduced in size during the LIG compared to the Holocene, major uncertainties and unknowns remain unresolved: Did the WAIS collapse? What would the contribution of such a collapse be the higher than present LIG eustatic sea level (ESL)?
We will show that a simulated collapse of the WAIS does not generate a significant elevation driven signal at the EAIS LIG ice core sites, and as such, these ice core records cannot be used to assess WAIS stability over this period. However, we will present 'treasure maps' [Bradley et al., 2012] to identify regions of the AIS where results from geological studies and/or new paleoclimate data may be sensitive to detecting a WAIS collapse. These maps can act as a useful tool for the wider science community/field scientists as a guide to highlight sites suitable to constrain the evolution of the WAIS during the LIG.

Studies have proposed that the surface temperature across the East Antarctic Ice Sheet (EAIS) was significantly warmer, 2-5°C during the LIG compared to present [Lang and Wolff, 2011]. These higher temperatures are estimated primarily using the difference in the δD peak in the LIG stable isotope ice core data relative to the records for the present interglacial; a feature which is referred to as the 'LIG overshoot'. Generally studies have attributed most of this signal to changes in the Antarctic climate [Masson-Delmotte et al., 2011]. However, a previously overlooked contribution is the influence of changes in surface elevation driven by changes in ice-loading history of the EAIS [Bradley et al., 2013].
We will show that introducing a relatively moderate reduction in the amount of thickening of the EAIS over the LIG, can generate a significant elevation driven δD signal at the EAIS ice core sites, and as such elevation effects can account for a significant fraction of the LIG overshoot. We will conclude that the potential contribution of this process must be considered when using the EAIS stable isotope ice core data to make estimated of the LIG surface temperature.
Finally, we will provide estimates of the contribution of the AIS to both ESL and to the higher than observed relative sea level during the LIG.

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