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Reassessing global ice volume: uncertainty and structure in sea level records

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Geologically recorded sea-level variations represent the sum total of all contributing processes, be it known or unknown, and may thus help in finding the full range of future sea-level rise. Significant sea-level-rise contributions from both northern and southern ice sheets are not unprecedented in the geological record and offer a well-constrained range of natural scenarios from intervals during which ice volumes were similar to or smaller than present (i.e., interglacial periods), to intervals during which total ice volume was greater (i.e., glacial periods).

The last deglaciation is the most recent period of widespread destabilisation and collapse of major continental ice sheets. Records spanning the last deglaciation (as well as the ice volume maxima) are few, fragmentary and seemingly inconsistent (e.g., the timing and magnitude of melt-water pulses), in part due to locational (tectonic and glacio-isostatic) as well as modern analogue considerations (e.g., palaeo-water depth or facies formation depth). We present a new synthesis of sea-level indicators, with particular emphasis on the geological and biological context, as well as the uncertainties of each record. Using this new compilation and the novel application of statistical methods (trans-dimensional change-point analysis, which avoids “overfitting” of noise in the data), we will assess global ice-volume changes, sea-level fluctuations and changes in climate during the last deglaciation. Finally, we discuss the implications of these uncertainties on our ability to constrain past cryosphere changes.