



Contributions of polar ice-sheets retreat and glacial isostatic adjustment to the Last Interglacial sea-level highstand in the North Sea

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The potential melting of Greenland and Antarctic ice-sheets as a consequence of global warming poses a serious threat to the future stability of low coastal areas such as the Netherlands and Belgium. Accordingly, plans for coastal defense rely on the regional relative sea-level (RSL) response to the worst case scenarios of ice-sheets retreat. The geological record can provide us with valuable insight into an interesting time of the history of Earth, when climate was similar to what can be expected for the near future. Among the several warm intervals that characterized the past climate, the Last Interglacial Stage (Eemian, \sim 130–115 kyr BP) is likely the most representative analogue for future scenarios of 1–2°C global warming. In fact, the Eemian stage stands out in the subsurface of the central Netherlands as a marked stratigraphical unit of clay and sandy sediments rich in diatom fossils and shells and therefore records an interglacial marine transgression that is correlated to the Marine Isotope Stage (MIS) 5e. The latter is the oldest and warmest climatic optimum of the entire MIS 5 (\sim 130–75 kyr) and was characterized by an average temperature of 1.5–2°C warmer than the pre-industrial state. Several types of geological MIS 5e RSL indicators are found worldwide above the present-day mean sea-level, which suggest that Greenland and Antarctic ice-sheets retreated significantly causing the global sea level to exceed the present-day levels by 6–9 m. In this work we use a transient fully coupled ice-sheets and sea-level equation model which is compared with a detailed compilation of new and published geological RSL data to reconstruct the most plausible scenario for the Eemian transgression in the North Sea region. This, in fact, is strongly contaminated by GIA related to the preceding MIS 6 ice age (Saalian). We therefore show that constraining the Saalian ice-sheets retreat is of key importance to reconstruct the Eemian transgression in the North Sea. This provides us with the most likely scenarios for Greenland and Antarctica ice-sheets volume reduction.