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Simulating regionally varying sea-level changes over the past glacial cycles with a coupled ice-sheet sea-level model

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Relative Sea Level (RSL) variations during the late Pleistocene cannot be reconstructed regardless of the estimates of ice-sheets volume fluctuations. For the latter, however, the knowledge of regional and global RSL variations is necessary. Overcoming this problem of circularity demands a fully coupled system where ice sheets and sea level vary consistently in space and time and dynamically affect each other. Here we present results over the past 500,000 years from the coupling of a set of 3-D ice-sheet-shelf models to a global sea-level model based on the gravitationally self-consistent Sea Level Equation (SLE) and incorporating feedbacks from Earth rotation and coastlines variations. Ice volume is computed with four 3-D ice-sheet-shelf models for North America, Eurasia, Greenland and Antarctica. With an inverse approach ice volume and temperature are derived from a benthic δ^{18}O stacked record. The ice-sheets thickness variations are then provided into the SLE model to compute the bedrock deformations, the mean sea surface and the RSL changes for the next time-step. To quantify the impact of RSL variations on ice-volume evolution, we have performed coupled and uncoupled simulations. The largest differences of ice-volume change are observed close the edges of the ice sheets, where RSL significantly differs from the global averaged sea level. Moreover, we have compared our simulated regional sea level with local reconstructions from observational RSL data, showing a good comparison for several records over the globe.