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Sensitivity of global ocean tides to Antarctic ice-shelf cavity changes

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Tidal constituents have changed, and are continuing to change, along large sections of the world's coastlines, but associating these long-term variations to specific environmental forcing factors has remained a challenge. Here we explore the possibility that significant portions of the globally observed trends in ocean tides are far-field manifestations of geometric changes in the cavities under the Antarctic ice shelves. A dedicated global tide model is used to simulate the main partial waves (M_2, K_1) for unperturbed reference conditions and bathymetries with realistic adjustments for Antarctic ice-shelf thinning (or thickening) and grounding line migration. Spatially non-uniform rates of thickness changes are taken from a published analysis of satellite radar altimetry observations (1994–2012). First results with scalar values of ice gain or loss at 42 major and minor ice shelves show that the response of M_2 is largest in the Weddell and Ross Seas, but long-term changes of order 1 mm decade^{-1} in amplitude are evident throughout the world ocean. Ice-shelf configuration appears to exert a considerable control on tides in the Indian Ocean and on the Patagonian Shelf, exceeding by far tidal impacts of contemporary sea level rise. However, simulated amplitude changes are sensitive to model resolution and to assumptions made in relation to Antarctic grounding line migration.