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Tidal mixing, deep ocean carbon storage, and the marine δ^{13}C record of the Last Glacial Maximum

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It is widely hypothesised that the $\sim$100 ppm of CO_2 absent from the atmosphere during the Last Glacial Maximum (LGM), relative to pre-industrial times, was stored principally in the deep ocean. The cause of this is not known; however, proposed mechanisms often depend on increased nutrient utilatization in waters upwelled from the deep ocean. One way this can be achieved is by reducing the proportion of global upwelling that occurs south of the "biogeochemical divide'' in the Southern Ocean.

We have used theoretical evidence and output from an intermediate complexity model to argue that the increase in LGM tidal dissipation, suggested by tide models, would reorganise global overturning (see Oliver & Edwards: *What causes ocean heat transport into the modern Atlantic Ocean?*, CL26). Here, it is proposed that this would increase deep ocean carbon storage, due to greater upwelling outside the Southern Ocean. We consider implications of this hypothesis on the distribution of marine δ^{13}C, using the new Quaternary QUEST data synthesis.

This preliminary study suggests that enhanced tidal mixing can help to explain several features of the proxy record of the LGM, including the existence of strong gradients at $\sim$2500 m in the North Atlantic and a reduced volume of Atlantic source water, without reducing deep water production in the North Atlantic Ocean. However, tidal mixing acts against the large decrease in Southern Ocean δ^{13}C, observed for the LGM. In future research, formal model-data comparison will be made with sediment core

records of δ^{13}C, δ^{14}C, Cd/Ca, and Pa/Th.