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The Last Interglacial Ocean Circulation: model-data comparison of deep sea δ^{13}C and flow speeds.

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The Last Interglacial period (LIG) provides an excellent possibility to assess the impact of future Greenland Ice Sheet (GIS) melt on the Atlantic meridional overturning circulation (AMOC), as the LIG climate is characterised by warmer than present-day high-latitude temperatures and a partially melted GIS. For a direct model-data comparison of the evolution of the AMOC in this palaeoclimatic context, we focus on deep sea δ^{13}C and flow speeds. Here we present the results of a 12ky transient LIG simulation with a 3-dimensional global climate model that resolves carbon cycle dynamics in all compartments of the climate system. Through an idealized GIS melt water scenario, we force the AMOC to evolve from a shutdown state to a weakened state and finally a full strength state after the GIS melt forcing is removed. This model scenario allows us to characterize the simulated evolution of deep sea δ^{13}C and flow speeds in the Atlantic Basin and compare with proxy-based reconstructions from key locations.

The simulation reveals large scale correlation patterns between the evolution of deep sea δ^{13}C on the one hand and the evolution of the AMOC strength and the Northern and Southern Hemispheres δ^{13}C source region signals on the other hand. Moreover, these correlation patterns differ with depth and latitude, reflecting the positioning of the different Atlantic water masses. The simulated evolution of deep sea flow speeds reveals a much more local character compared to δ^{13}C, with a strong correlation to the evolution of the AMOC strength in specific regions, like the deep western boundary current (DWBC), but a local origin in many other regions. Based on this analysis we perform a model-data comparison of the LIG evolution of deep sea δ^{13}C and flow speed for key sites around the DWBC. We are able to show that deep sea δ^{13}C and flow speed reconstructions from such relatively small regions can differ widely. More importantly, we can connect these variations to the differential impact of changes in the ratio of northern versus southern sourced waters, changes in the δ^{13}C source region signals and local, non-climatic features.