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Permafrost carbon controls $\delta^{13}CO_2$ during glacial termination T2 as well as T1: The importance of ice sheet size for land carbon stock

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Paleo-data from glacial terminations provide us with a means of testing hypotheses on the processes controlling climate variability. During the last glacial termination, the concentration of CO_2 in the atmosphere rose by around 80ppm between 18ka to 10ka BP. A significant drop in $\delta^{13}CO_2$ occurred in the early deglaciation, indicating a light carbon-13 source. We had previously shown that we could reproduce the evolution of CO_2 and $\delta^{13}CO_2$ in the atmosphere during the last glacial termination (T1) in our model (CLIMBER-2), with a key component being permafrost-related soil carbon dynamics. During the penultimate glacial termination (T2, $\sim$140ka to 128ka BP), data shows a rise of CO_2 of the same magnitude as T1, but a different evolution of $\delta^{13}CO_2$, especially so at the onset of the termination. In this work I will present simulations of T2, in which modelled CO_2 and $\delta^{13}CO_2$ show a good agreement with data, as with T1. The size of ice sheets during the glacial maximum and the role of orbital forcing are essential in explaining the data evolution. The model successfully reproduces the previously unexplained 0.3‰ difference between Last Glacial Maximum and Penultimate Glacial Maximum $\delta^{13}CO_2$, which I suggest is due to permafrost carbon and ice sheet interaction. This has implications for the interpretation of ocean $\delta^{13}C$ data. These simulations imply a system which does not require an AMOC shut down to promote a rise in atmospheric CO_2 at the onset of these deglaciations, but does require the gradual release of carbon from the deep Southern Ocean to result in a complete glacial termination.