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Glacial abrupt climate change as a result of internal oscillations

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The study of Greenland ice cores revealed two decades ago the abrupt character of glacial millennial-scale climate variability. Several triggering mechanisms have been proposed and confronted against growing proxy-data evidence. Although the implication of North Atlantic deep water (NADW) formation reorganisations in glacial abrupt climate change seems robust nowadays, their final cause remains unclear. Here, the role of CO_2 and Southern Ocean winds is investigated using a coupled model of intermediate complexity in an experimental setup designed such that the climate system resides close to a threshold found in previous studies. An abrupt surface air temperature (SAT) increase over the North Atlantic is simulated in response to increasing atmospheric CO_2 levels and/or enhancing southern westerlies. The simulated abrupt warming shows a similar pattern and amplitude over Greenland as registered in ice-core records of Dansgaard-Oeschger (D/O) events. This is accompanied by a strong Atlantic meridional overturning circulation (AMOC) intensification. The AMOC strengthening is found to be caused by a northward shift of NADW formation sites into the Nordic Seas as a result of an increase in sea surface salinity in the Northeastern Atlantic. The latter is caused by a northward retreat of the sea-ice front in response to higher temperatures. In this way, a new mechanism that is consistent with proxy data is identified by which abrupt climate change can be promoted.