



ALFRED-WEGENER-INSTITUT  
HELMHOLTZ-ZENTRUM FÜR POLAR-  
UND MEERESFORSCHUNG

## Climate research

# How the climate can rapidly change at tipping points

**A new study shows: Gradual changes in the atmospheric CO<sub>2</sub> concentration can induce abrupt climate changes**

[19. June 2017] During the last glacial period, within only a few decades the influence of atmospheric CO<sub>2</sub> on the North Atlantic circulation resulted in temperature increases of up to 10 degrees Celsius in Greenland - as indicated by new climate calculations from researchers at the Alfred Wegener Institute and the University of Cardiff. Their study is the first to confirm that there have been situations in our planet's history in which gradually rising CO<sub>2</sub> concentrations have set off abrupt changes in ocean circulation and climate at "tipping points". These sudden changes, referred to as Dansgaard-Oeschger events, have been observed in ice cores collected in Greenland. The results of the study have just been released in the journal Nature Geoscience.

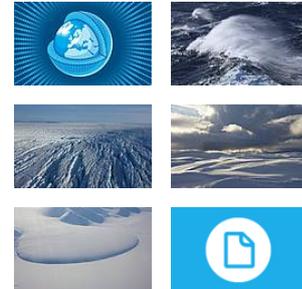


Previous glacial periods were characterised by several abrupt climate changes in the high latitudes of the Northern Hemisphere. However, the cause of these past phenomena remains unclear. In an attempt to better grasp the role of CO<sub>2</sub> in this context, scientists from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) recently conducted a series of experiments using a coupled atmosphere-ocean-sea ice model.

First author Xu Zhang explains: "With this study, we've managed to show for the first time how gradual increases of CO<sub>2</sub> triggered rapid warming." This temperature rise is the result of interactions between ocean currents and the atmosphere, which the scientists used the climate model to explore. According to their findings, the increased CO<sub>2</sub> intensifies the trade winds over Central America, as the eastern Pacific is warmed more than the western Atlantic. This in turn produces increased moisture transport from the Atlantic, and with it, an increase in the salinity and density of the surface water. Finally, these changes lead to an abrupt amplification of the large-scale overturning circulation in the Atlantic. "Our simulations indicate that even small changes in the CO<sub>2</sub> concentration suffice to change the circulation pattern, which can end in sudden temperature increases," says Zhang.

Further, the study's authors reveal that rising CO<sub>2</sub> levels are the dominant cause of changed ocean currents during the transitions between glacial and interglacial periods. As climate researcher Gerrit Lohmann explains, "We can't say for certain whether rising CO<sub>2</sub> levels will produce similar effects in the future, because the framework conditions today differ from those in a glacial period. That being said, we've now confirmed that there have definitely been

## Downloads



## Contact

### Science

 Gerrit Lohmann  
 +49(471)4831-1758  
 [Gerrit.Lohmann@awi.de](mailto:Gerrit.Lohmann@awi.de)

### Press Office

 Sebastian Grote  
 +49(471)4831-2006  
 [sebastian.grote@awi.de](mailto:sebastian.grote@awi.de)

## Photos

[Public media](#)  
[Press media](#)

## Abo/Share



Subscribe to AWI press  
release RSS feed

[The Institute](#)

abrupt climate changes in the Earth's past that were the result of continually rising CO<sub>2</sub> concentrations."

The study received funding as part of a major Federal Ministry of Education and Research initiative on paleo-climate modelling ([PalMod](#))

## Original publication

Nature Geoscience: Xu Zhang, Gregor Knorr, Gerrit Lohmann, Stephen Barker: „Abrupt North Atlantic circulation changes in response to gradual CO<sub>2</sub> forcing in a glacial climate state“ DOI: [10.1038/NAGE02974](https://doi.org/10.1038/NAGE02974)



The Alfred Wegener Institute



pursues research in the polar

regions and the oceans of mid and high latitudes. As one of the 19 centres of the Helmholtz Association it coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

## More information

### Related pages

[» Climate Sciences](#)

