Earth's anthropogenic carbon dioxide increase is unprecedented

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Concordia research station in Antarctica at 3233 m asl. Credit: Thibaut Vergoz, Institut polaire français.

A new measurement technology developed at the University of Bern provides unique insights into the climate of the past. Previous CO_2

concentrations in the atmosphere could be reconstructed more accurately than ever before, thanks to high-resolution measurements made on an Antarctic ice core. The study, which analyzed the Earth's atmospheric composition between 330,000 and 450,000 years ago, was made possible by the commitment of experts, and their decades of experience, at the University of Bern. The results of the study have been published in *Science*.

Melting ice masses disturbed the ocean circulation

In 2008, the Bern ice core specialists were able to show that the CO_2 concentration in the atmosphere during the last 800,000 years was consistently much lower than today. Since then, the ice core experts have built upon those findings enabling a much more detailed reconstruction of the 330,000 to 450,000 year time window. Until now, the maximum speed and frequency of naturally occurring centennial scale jumps in the CO_2 concentration remained unknown.

This study shows that abrupt CO_2 rises are a pervasive feature of our climate system and that they can even occur during interglacial periods. "Until now, it had been assumed that the climate was very stable during previous interglacial periods and that there were no abrupt changes in the atmospheric CO_2 concentration," explains Christoph Nehrbass-Ahles, lead author of the study, who earned a doctorate from the University of Bern and is now based at the University of Cambridge. According to Nehrbass-Ahles, the abrupt rises were always evident when melting ice masses in Greenland or Antarctica considerably disturbed the ocean circulation. If the CO_2 in the atmosphere rose quickly, simultaneous changes in the Atlantic Ocean's circulation could also be detected.

CO_2 increase was ten times slower than today

The fact that rapid CO_2 jumps could be detected not only during glacial

periods but also during two previous interglacial periods surprised the researchers. "We measured these events in the ice several times and always came to the same conclusion," explains Nehrbass-Ahles. Why the CO_2 concentration in the atmosphere suddenly rose during previous interglacial periods cannot be conclusively explained by the researchers. "We do not know why this happened yet," explains Bernese climate researcher Thomas Stocker, co-author of the study: "This raises new research questions." However, the CO_2 jumps in previous interglacial periods are far exceeded by the current development: "These natural jumps in the CO_2 concentration in the atmosphere happened almost ten times slower than the human-driven increase over the last decade," Nehrbass-Ahles emphasizes.

The largest jump in the past corresponds to the current CO_2 emissions over only six years

The researchers compared the CO_2 jumps of the past with the ongoing human-driven rise of CO_2 concentration in the atmosphere. According to Stocker, the largest centennial CO_2 jump in the past was around 15 ppm (parts per million is the unit for atmospheric CO_2 concentration), which is approximately equivalent to the increase caused by humankind over the last of six years. "This may not seem significant at first glance," says Stocker, "but in light of the quantities of CO_2 that we are still allowed to emit in order to achieve the 1.5°C climate target agreed in Paris, such increases are definitely relevant." The findings of this study put us under even greater pressure to protect the climate.

More information: Nehrbass-Ahles, et al, "Abrupt CO2 release to the atmosphere under glacial and early interglacial climate conditions," *Science* 21 Aug 2020: Vol. 369, Issue 6506, pp. 1000-1005 DOI: 10.1126/science.aay8178