

Abrupt climate change events from the past could help predict the ones ahead

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Coping with climate change will already be difficult enough without worrying about Dansgaard-Oeschger (DO) events that could come on top of it. However, their possible occurrence cannot be dismissed: We need to know more about these events, how they impacted our planet in the past, and how they could continue to do so in the future. The world's most well-preserved ice cores could provide all this information while allowing for improved climate models.

There is a risk that increasing atmospheric greenhouse gas levels could trigger abrupt changes in the climate system—that is, changes so abrupt that they could seriously challenge the ability of humans, plants and animals to adapt. Ice core records can help us better understand this risk: they notably show that, during the last glacial period (around 100 000 to 20 000 years ago), temperature over the Greenland ice sheet could change by up to 16°C within a few decades.

With his INTERCLIMA (Inter-hemispheric Coupling of Abrupt Climate Change) project, Dr Joel Pedro of the University of Copenhagen has been trying to advance understanding of the governing mechanisms and inter-hemispheric coupling involved in abrupt [climate change](#). By doing so, he hopes to help scientists trying to understand the extent and nature of the anthropogenic climate change we are witnessing to improve their climate predictions.

How can past climate change events inform us on

future risks?

The Ice Age temperature jumps, termed Dansgaard-Oeschger events, are thought to be associated with natural instabilities or 'tipping points' in ocean and atmospheric circulation. A crucial distinction between anthropogenic climate change and these natural events is that today land and ocean temperatures are increasing almost everywhere, whereas during the Dansgaard-Oeschger events temperature quickly warmed in Greenland and the North Atlantic while at the same time cooling in large parts of the Southern Hemisphere. There was basically a redistribution of heat in the climate system. Trying to understand whether [anthropogenic climate change](#) could push the climate system over similar tipping points is an important motivation for studying the Dansgaard-Oeschger events.

By studying ice cores and other climate records from around the world, we gain information on the potential triggers of such abrupt changes, the processes which are involved, and their global impact.

Accurately documenting past [abrupt climate change](#) events also helps with testing [climate models](#). We can gain more confidence in models used to make predictions about future climate if our models are able to simulate the full range of what climate has done in the past.

Why did you specifically base your research on Law Dome and Greenland ice cores?

For my research I selected ice cores which preserve the most detailed records in time (the highest temporal resolution). Abrupt climate change occurs by definition extremely quickly so to really get to the details of the where, how and why of past abrupt climate change, high time resolution records are essential. On the polar ice sheets the time

resolution of an ice core is set by how much snow falls every year and then how much those annual layers are later compressed and smeared out by ice flow. The North Greenland Ice Core Project ice core (drilled by Danish researchers) and the Antarctic Law Dome and West Antarctic Ice Sheet Divide cores (drilled by Australian and US researchers, respectively) are amongst the highest resolution climate records available for the past tens of thousands of years.

However, my research was not restricted to ice cores. I also reached out to communities working with lake, marine and cave sediment records. Bringing in data from these sources was important to gain information about climate variability at lower latitudes during Dansgaard-Oeschger events.

How did you proceed to get the information you wanted?

The project greatly benefited from networking and data-input from many research groups in Europe, Australia, New Zealand, South America, Africa and the US. I used ice core data from my previous research group in Australia and I collaborated with colleagues in the US to obtain data from the excellent West Antarctic ice core record. At my host institute, the University of Copenhagen, I had access to data and expertise on the Greenland Ice cores.

Once the project built momentum, via presentations at international conferences and research trips, I was able to obtain input from researchers working with lake, marine and cave records. For the modelling component of the research I collaborated with researchers at the University of Wisconsin Madison and Kiel University.

What can you tell us about the results from the

project?

Making well-informed decisions on how to best adapt to future climate change and how to mitigate the worst effects of climate change requires information on what the climate system is capable of.

The INTERCLIMA project has improved our understanding of how abrupt climate change signals are communicated to different parts of the climate system. It showed that changes in meridional atmospheric heat transport drive abrupt climate variability in the southern hemisphere tropics and that slower ocean heat transport changes and sea ice feedbacks are more important in communicating abrupt climate change signals to the southern high latitudes.

How are you/do you plan to build upon the project's results for future research?

I'm working on the influence of abrupt climate variability on the Southern Ocean. The Southern Ocean is currently responsible for the uptake of around 75 % of the ocean storage of anthropogenic heat and around 40 % of the storage of anthropogenic carbon.

Whether the Southern Ocean will continue to take up so much heat and carbon in the future is not well known. I think that one way to try and close this knowledge gap is to use examples of how past abrupt climate change influenced heat and CO₂ uptake and storage. To do this I am working with paleoclimate observations, mainly ice cores and marine cores, along with model results and results from experiments and theory on Southern Ocean physical oceanography. I hope this work will improve our understanding of past and future sea ice, ice sheet–ocean interactions and CO₂ storage in the Southern Ocean.

I'm also working on an 'adjoint modelling' project in which we aim to directly input paleoclimate data to model simulations.

More information: Project page: cordis.europa.eu/project/rcn/108394

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