Media Release

Chiefs of Staff, News Directors

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Ocean circulation cause of changed atmospheric CO2 during the ice ages

For decades scientists have struggled to understand why air temperatures around Antarctica over the past one million years were almost perfectly aligned with atmospheric carbon dioxide (CO_2) concentrations, with both dipping down during glacial ice ages and back up during warm interglacials.

By contrast, temperature in the tropics and Northern Hemisphere were less closely tied to CO_2.

“This differing relationship between Antarctica temperature and CO_2 suggested that somehow the Southern Ocean was pivotal in controlling natural atmospheric CO_2 concentrations,” said University of Tasmania’s Institute for Marine and Antarctic Studies (IMAS) physical oceanographer Dr Maxim Nikurashin.

“The colder atmosphere and extensive sea ice around Antarctica during the glacial periods was the key that unlocked the mystery. They fundamentally changed top to bottom ocean circulation around Antarctica and enabled more CO_2 to be drawn from the atmosphere.”

Dr Nikurashin is one of the authors on the paper *Southern Ocean buoyancy forcing of ocean ventilation and glacial atmospheric* CO_2 which will be published on Nature Geoscience’s website on Tuesday, September 29.

He and his fellow researchers at the University of Exeter in the UK found that during glacial periods when sea ice was far more extensive, deep ocean waters came to the surface much further north of the Antarctic continent than they do today.

This meant that the nutrients brought up from the bottom of the ocean spent more time on the surface of the ocean before the flow encountered Antarctica and circled back down to the bottom of the ocean.

Because the upwelled waters ran along the surface for a longer period of time, nutrients spent more time near the surface of the ocean allowing phytoplankton to feed on them for longer.

The biological processes that result from phytoplankton blooms directly take carbon out of the atmosphere. Some of this carbon then sinks to the bottom of the ocean when phytoplankton die, locking it away in the deep sea for thousands of years.

“The biological processes that take up carbon from the atmosphere can even take place in and under the ice, if that ice is not too thick, which is why the biological processes persisted,” Dr Nikurashin said.

“Our results suggest that this change in circulation and the consequent extended biological activity by itself can take 30-60ppm of CO_2 out of the atmosphere. That’s about one half of the glacial-interglacial change.”

Lead author Dr Andrew Watson, from the University of Exeter, said that when temperatures warm over the Antarctic regions, deep waters rise from the sea floor much closer to the continent. This means nutrients are near the surface for a shorter time before returning to the deep ocean.

He said that with less time on the surface there is less time for the biological processes to take place and less carbon is taken out of the atmosphere, the situation we see today.

“This is a major advance in understanding the natural carbon cycle, gained by applying a new understanding about how the "overturning circulation" of the Southern Ocean works.”

The Institute for Marine and Antarctic Studies (IMAS) pursues multidisciplinary and interdisciplinary work to advance understanding of temperate marine, Southern Ocean, and Antarctic environments.

For more background on Dr Nikurashin, visit:
http://www.utas.edu.au/profiles/staff/imas/max-nikurashin

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