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Stronger winds could trigger rapid change in Southern Ocean

A new IMAS study has found that an increase in average wind speeds could lead to abrupt physical changes in the Southern Ocean, with significant implications for climate change.

Research by Dr Andreas Klocker, published in Science Advances, found that stronger winds could trigger rapid changes to Southern Ocean eddies and jets, potentially affecting how the ocean takes up atmospheric heat and CO_2 through a process known as ocean ventilation.

The study was carried out in collaboration with NCI, a research computing organisation based in Canberra which is home to Raijin, the fastest supercomputer in the Southern Hemisphere and the only one in Australia capable of managing the huge amount of data needed to model the complexity of the Southern Ocean.

Dr Klocker said the modelling showed that abrupt changes could be triggered with just a 25 per cent increase in Southern Ocean wind speeds, well within the range predicted by the end of this century as a result of climate change.

"Changes in ocean ventilation are thought to be important for both rapid transitions of the ocean's global circulation at the end of the last Ice Age and the uptake and storage of heat and CO_2 caused by anthropogenic climate change," Dr Klocker said.

"We knew from observations of Earth's past climate that these abrupt changes have occurred before, but no one could explain why.

"Our study linked them to changes in the structure of ocean eddies and jets when winds are stronger than in today's climate.

"The modelling showed that as winds increase you maintain equilibrium for a long time but when you reach a certain point there's a sudden change as ocean ventilation abruptly switches into a different regime.

"Based on our modelling it can be assumed that there could be rapid change as wind speeds increase with climate change.

"What the modelling cannot show, however, is what the full implications of such a sudden change might be and where it will lead."

Dr Klocker said the level of computing resources required means that it is currently not feasible to fully resolve the behaviour of Southern Ocean eddies and jets.

"If I had all of Raijin to myself I would very much like to extend this model to the entire Southern Ocean, or even the global ocean, but I can only do a much smaller area than I would ideally like to do," he said.

"In the long-term our aim is to feed our results back into the development of more detailed global climate models which can better encompass the behaviour and processes due to changes in winds in the Southern Ocean."

Media contact: Andrew Rhodes (03) 6226 6683, email: ajrhodes@utas.edu.au

Information released by:
Communications and Media Office
University of Tasmania
+61 3 6226 2124
Media.Office@utas.edu.au Twitter.com/utas_newsroom