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# The influence of ocean gateways on climate: Numerical sensitivity studies on ocean circulation rearrangements

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Climate transitions may be triggered by tectonic changes of ocean gateways causing the reorganisation of the global ocean circulation. During the last 50 million years major tectonic changes occurred. The opening of Drake Passage and Tasman Passage (around 40 Ma before present) and the closure of the Isthmus of Panama (around 3 Ma ago) are thought to be a reason for major Cenozoic climate changes, but the actual climate impact of these events is not yet clear, as other driving mechanisms have to be considered as well.

Here, we present model results of advective oceanic heat transport changes which were obtained in idealised numerical experiments employing a global ocean general circulation model coupled with a simple atmospheric energy balance model. Using present-day forcing, we investigated the effects of various historical ocean gateway configurations.

Our preliminary results support the hypothesis that oceanic heat transport is sensitive to tectonic gateway forcing. Significant changes in ocean circulation patterns and temperatures are visible. Compared to the present-day simulation, a gateway configuration characteristic of 40 Ma ago (Drake Passage closed, Panama Strait opened, Tethys opened) reduces the maximum northward oceanic heat transport by more than 50 percent, while the maximum southward oceanic heat transport more than triples. Other gateway configurations lead to meridional heat transports in between these two experiments.

Using an ocean carbon cycle circulation model we also study the distribution of marine $\delta^{13}$C associated with the ocean circulation changes, and interprete the outcomes with respect to the paleoclimatic record.