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Analysis of Late Miocene heat transport mechanisms

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The Late Miocene belongs to the late phase of the Cenozoic climate cooling, but proxy data indicate that it was still a generally warm and humid episode as compared to today. Particularly high latitudes were warmer than today in the Late Miocene and, consequently, the equator-to-pole temperature gradient was less pronounced. On the one hand, the ocean heat transport was weaker in the Miocene because of an open Central American Isthmus. On the other hand, the atmospheric heat transport should have been weaker, too, as it is usually related to the meridional temperature gradient. Hence, it appears to be a paradox to understand warm polar regions in the Miocene with a weaker-than-present meridional temperature gradient. In order to focus on heat transport mechanisms, we present a climate modelling experiment for the Tortonian (Late Miocene) with a coupled atmosphere-ocean general circulation model. Boundary conditions such as the palaeorography and the palaeovegetation are adapted to represent Late Miocene conditions. On the global scale, the Tortonian run is warmer and more humid than a present-day control run. The northern high latitudes are warmer in the Tortonian run and the meridional temperature gradient is weaker than in the control experiment. The northward heat transport in the North Atlantic Ocean is weaker-than-present because we consider an open Central American Isthmus. Compensating for the weaker ocean, the atmospheric sensible and latent heat transport is more efficient in the Tortonian run. Primarily, the increased northward sensible and latent heat fluxes are due to transient eddies, while the stationary eddy heat transport remains almost unchanged.