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Using Holocene palaeoclimates to improve our dynamical understanding of the modern-day midlatitude storm tracks

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The mid-latittude storm tracks are a fundamental component of the Earth's climate system and are the dominant mechanism for transporting heat poleward from the subtropics to polar latitudes. They have a profound impact on both the weather and climate of the mid-latitudes, particularly in North West Europe and the Mediterranean, and they are highly sensitive to a complex mixture of tropical and extra-tropical surface forcings.

This interaction between the tropical and extratropical forcing of the storm track is highly relevant to the modern-day climate change problem. Most GCM simulations of the future storm tracks suggest a poleward and upward shift in the storm tracks, based on an enhanced temperature gradient in the upper troposphere and reduced extratropical surface temperature gradients. However, even in the zonal-mean, it is difficult to fully understand the dynamical and physical processes involved with these changes.

The insolation changes produced in response to the Earth's orbital variation during the Holocene period (broadly the last 12,000 years) offer an excellent opportunity to test our understanding of this interplay between the tropical and extratropical forcings on the storm track. A new set of model simulations, using the HadSM3 GCM, are presented covering a range of time slices across the Holocene period. The impacts of the gradual reduction in the seasonal cycle of insolation in the Northern Hemisphere and the increases in the annual-mean equator-to-pole insolation gradient over the last 10,000 years are discussed in terms of changes in the tropical Hadley Cell, the subtropical jet, baroclinicity and the midlatitude storm tracks. Finally, the atmospheric response during the Holocene is compared to palaeo-observations and results from idealised GCM simulations pertaining to "present-day" climate.