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Understanding the storm track and large-scale flow response to midlatitude SST anomalies

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The impact of a midlatitude SST anomaly on the tropospheric circulation has been shown to be highly sensitive to the position of the SST anomaly within the background state. This behaviour is investigated through a series of aquaplanet simulations using a high-resolution version of the Hadley Centre atmosphere model (HadAM3) under perpetual equinox conditions. These simulations show that the tropospheric response can be best understood by examining the changes in the meridional gradient of SST, rather than in terms of the SST anomaly itself.

Changes in the midlatitude SST gradient impact upon the large scale flow through changes in the storm track and, consequently, eddy feedback processes. In particular, increased midlatitude SST gradients are shown to generally lead to stronger storm tracks which are shifted slightly poleward, consistent with changes in the lower-tropospheric baroclinicity. The overall large-scale tropopheric response is, however, dependent on the position of the SST gradient anomaly relative to the subtropical jet. For example, when SST gradients are increased very close to the subtropical jet, the Hadley cell is intensified and the subtropical jet strengthened while the storm track and eddy-driven jet are shifted equatorward. The reverse situation occurs when the subtropical SST gradients are reduced and the midlatitude gradients increased, with the storm track shifting poleward and developing a strong eddy-driven jet.

These findings are used to provide a new and consistent interpretation of some previous GCM studies concerning the atmospheric response to midlatitude SST anomalies.