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Shifts in the extra-tropical storm track in response to SST changes

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Meridional shifts in the extra-tropical storm tracks have been identified in reanalysis data and scenario simulations. Inspired by this, the storm track response to changes in the sea surface temperatures (SSTs) have been investigated using an atmospheric GCM with prescribed SSTs. The storm tracks were studied using both Eulerian and Lagrangian methods.

In the simulations, the SST field was warmed or cooled by 2 K in different regions. The oceans were warmed uniformly in different latitude bands: in the low-latitudes (below 45 degrees), in the tropics (below 15 degrees), at high-latitudes (above 45 degrees) and at all latitudes.

First we consider bandpass-filtered Eulerian fields, such as the geopotential height. Fluctuations with periods between 2.5 and 6 days were retained. The results show that the storm tracks shift poleward or equatorward, depending where the SST was altered. Poleward shifts occur when increasing the SST at low-latitudes or decreasing them at high-latitudes. This is consistent with the poleward shift occurring in response to an increase in the mid-latitude SST gradient. However, a poleward shift is also observed when warming SST uniformly, implying the mean temperature is also important. An equatorward shift is found in response increasing the high-latitude SSTs (and thereby weakening the midlatitude SST gradient), but when the tropical SSTs are increased. In the latter case, the SST gradient is increased in region of the Hadley circulation. Consistent shifts are seen in the zonal wind, baroclinicity, Hadley and Ferrel cells and in the eddy heat and momentum fluxes.

Additionally, the simulations are studied from a Lagrangian approach, by tracking the storms directly using a routine to follow maxima in the relative vorticity field.