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Further basic ingredients of the Northern Hemisphere storm tracks

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The Northern Hemisphere storm tracks can be divided into two main regions, the North Atlantic and the North Pacific. Previous work by Brayshaw et al (2007, 2009 and 2011 submitted) used a matrix of GCM experiments with "semi-realistic" boundary conditions to explore the role of land-sea contrast, sea surface temperatures (SSTs) and orography in determining the structure of the North Atlantic storm track. This present paper extends this experimental hierarchy by using a newer atmospheric GCM (HadGAM1) to examine the impact of Eurasian topography and Pacific SST structures on the storm tracks in both the North Pacific and Atlantic sectors.

Consistent with Brayshaw et al (2009), the presence of a major upstream mountain range (the "Himalaya" and its north-eastward extension) is shown to play a major role in shaping the downstream storm track in the North Pacific. The northward deflection of the westerly flow around the northern part of the Himalaya generates an extensive pool of very cold air in the north-eastern tip of the Asian continent, strengthening the surface temperature gradient near the coast and favouring baroclinic growth in the western Pacific. Immediately to the east of the Asian coastline, the Kuroshio SST front further strengthens the Pacific storm track through its impact on near-surface baroclinicity. Stationary Rossby waves generated by anomalously warm tropical waters around Indonesia appear to weaken the Pacific storm track in this model configuration.

Further downstream, the North Atlantic storm track is also affected by the changes in the surface boundary conditions to the west of North America. In the model configuration used here, stationary Rossby waves generated in response to the Himalaya feature appear to weaken the North Atlantic storm track substantially, whereas those generated by anomalously cold waters off Peru appear to strengthen it. The simulations also suggest that enhanced eddy-driven surface winds associated with an enhanced Pacific storm track may act to strengthen the deflection of the background flow over North America by the Rocky Mountain range, which may in turn act to increase the strength of the North Atlantic storm track.