Geophysical Research Abstracts
Vol. 12, EGU2010-4912, 2010
EGU General Assembly 2010

The basic ingredients of the North Atlantic storm track

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Understanding changes in the North Atlantic atmospheric circulation, whether for climate change or seasonal-to-decadal predictions, is a challenging problem. This is due, in part, to the unique characteristics of the North Atlantic storm track which are dependent on a complex range of forcings including land-sea contrast, orography and sea-surface temperatures.

The role of each of these forcing mechanisms is investigated using a hierarchy of high-resolution GCM simulations with simplified "semi-realistic" boundary conditions. This framework captures the essence of features such as the North and South American continents, Eurasia and the Rocky mountains, enabling the results to be applied more directly to realistic modelling situations than most previous idealised studies. The physical processes by which the forcing mechanisms impact upon the storm tracks and the large-scale flow are discussed.

The simulations indicate that the characteristics of the North American continent are important for generating the southwest-northeast tilt in the storm track and upper tropospheric jet over the North Atlantic. In particular, the southward deflection of westerly flow incident on the Rocky Mountains leads to enhanced storm development along an axis close to that of the eastern coastline of North America. Furthermore, the roughly triangular shape of North America, when coupled with the stationary waves generated by the Rocky Mountains, allows a cold pool of air to develop in the north east. This intensifies the surface temperature contrast across the eastern coastline, further enhancing the baroclinicity and storm growth. Eddy feedbacks are consistent with further enhancing the southwest-northeast tilt of the jet.