Geophysical Research Abstracts
Vol. 17, EGU2015-3495, 2015
EGU General Assembly 2015

Topographic impacts on jet streams and storm tracks: the Mongolian mountains matter

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The sub-tropical and eddy-driven jets, and related storm tracks, greatly affect weather and climate in the northern hemisphere (NH) mid-latitudes. Jet location and strength has been shown to be influenced by high orography, in particular the Rocky Mountains and Tibetan Plateau (e.g. Molnar et al. 2010). GCM simulations by Brayshaw et al. 2009, using idealised continental distributions and topography, show that the NH storm-tracks are influenced by topographic features similar to the Tibetan Plateau. We perform 30-year experiments using the CESM1 GCM at $\sim$2 degree horizontal resolution, to study the impact of removing particular topographic features. We find that it is in fact the mountains to the north of the Tibetan plateau (including the Altai mountains) that have the greatest influence on the jet and storm tracks, much more than the higher altitude, but lower latitude, topography of the Tibetan plateau and Himalayan mountains. Using simulations with a combination of realistic and semi-idealised topography changes with fixed SSTs, we study the mechanisms behind this finding. We show that the dominant mechanism is changes to surface temperature gradient; however the increase in jet stream speed from the northern mountains is also helped by low-level wind changes. EP fluxes are calculated to quantify the feedback from the storm track changes onto the jet stream. Further simulations with a slab ocean show the influence of SST changes on the topographic impact.

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