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Frequency and intensity of synoptic-scale winter storms under anthropogenic climate change

Tim Kruschke, Gregor C. Leckebusch, Dominik Renggli, and Uwe Ulbrich
Freie Universitaet Berlin, Institute of Meteorology, Berlin, Germany (tim.kruschke@met.fu-berlin.de)

Windstorms of synoptic scale, often related to extratropical cyclones, especially in winter, are meteorological phenomena highly relevant from a socio-economic perspective, constituting a threat to human lives and infrastructure resulting in enormous economic losses from individual storm events.

This study addresses the influence of anthropogenic climate change on the frequency (*wsf*) and intensity (*wsi*) of winter storms. These are defined as extensive fields of extreme surface wind speeds exceeding the local climatological 98^{th} percentile for at least 18 hours. The development of winter storm climate from 1860 to 2100 is analyzed by the means of three transient simulations, i.e. 720 model years of the ECHAM5/MPI-OM1 AOGCM utilizing the SRES-A1B emissions scenario for the 21^{st} century. The evolution is evaluated in comparison to the natural climate as derived from a 506-year pre-industrial control run of the same model with identical configuration.

It is shown that *wsf* and *wsi* until present generally exhibited similar properties as in the pre-industrial climate. The projections for the 21^{st} century show some significant differences comprising remarkable regional distinctions.
While the North Atlantic domain shows a significant trend to decreased *wsf* but significantly increased *wsi*, for the North Pacific domain only the latter is evident.
For Northern Europe and the Mediterranean area lower *wsf* and no change of *wsi* is projected. In contrast to this, Alaska will experience increased *wsf* without any significant changes of *wsi*. For the US-Canadian westcoast no changing winter storm climate is detectable in the model projections. However, Central Europe and the area around Kamchatka will be faced with significantly higher *wsf* and *wsi*.