Geophysical Research Abstracts
Vol. 15, EGU2013-11275, 2013
EGU General Assembly 2013

Rossby wave breaking and extreme windstorms over Western Europe

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We investigate the role of upper-level Rossby wave breaking in the evolution of the most extreme windstorms affecting three regions in Western Europe: Britain and Ireland, Scandinavia and Western Continental Europe. Using ERA40 and ERA-Interim reanalysis data along with EC-Earth model output at two different spatial resolutions, we first construct an extreme wind climatology over the selected regions and inter-compare the model climatology with that computed from the reanalysis data. Using a storm destructiveness measure, we then select the top 25 most destructive storms in each region from a multidecadal climatology in each of our four datasets; track-by-track analysis reveals a good agreement in the trajectories and evolution of these storms in both model resolutions compared to the reanalysis data. Temporal MSLP reanalysis composites demonstrate that in each region, there exists a set of large-scale conditions conducive to the development of these storms; similar composites of model output data show that these surface conditions are broadly well captured by both model resolutions. Temporal composites of potential temperature on the 2-PVU surface using reanalysis data reveal that these regional large-scale surface patterns can be associated with exceptional cyclonic and anti-cyclonic wave breaking occuring contemporaneously in the North Atlantic; the precise location of these wave breaking events controls the position and orientation of an intense upper-level jet which in turn determines into which region the storms are steered. Similar composites using model output data show qualitively the same picture, but with an overall positive bias most likely due to a lower tropopause height in the model.