Geophysical Research Abstracts
Vol. 17, EGU2015-10537, 2015
EGU General Assembly 2015

Tropospheric mid-latitude geopotential wave characteristics associated with strong wind events in the North Atlantic/European region

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The variability of strong synoptic scale wind events in the mid-latitudes have long been linked to baroclinic wave activity in the mid troposphere. Previous studies have also shown that greater amplitudes of planetary waves in the mid troposphere are likely to increase the occurrence of regional extremes in temperature and precipitation. In this study we examine whether characteristics of planetary and synoptic mid-latitude waves show systematic anomalies in the North Atlantic/ European region which can be related to the occurrence of a strong surface wind event.

We will mainly focus on two questions: 1) Do amplitudes for waves with different wave lengths show a systematic anomaly when a strong wind event occurs? 2) Can phases of the individual wave components be detected that favour strong wind events?

In order to decompose the mid-tropospheric flow into longitudinal waves we employ the fast Fourier transform to the meridional mean of the geopotential height in 500hPa between 35° and 60°N for i) the entire latitude belt and ii) for a North Atlantic/European sector (36°W to 36°E). Our definition of strong wind events is based on the Storm Severity Index (SSI) alongside a wind tracking algorithm identifying areas of exceedances of the local 98th percentile of the 10m wind speed.

First results using ERA-Interim Reanalysis from 1979 – 2014 for the extended winter season (ONDJFM) for the 50 most intense strong wind systems with respect to the SSI reveal a greater amplitude for all investigated wave numbers. Especially waves with wave lengths below 2000km show an increase of about 25% of the daily standard deviation on average. The distribution of wave phases for the different wave numbers with respect to the location of a strong wind event shows a less homogenous picture. There is however a high proportion of events that can be associated with phases around $3\pi/4$ and $5\pi/4$ of waves with lengths of around 6000km, equivalent to wave number 5 on a planetary scale. These phases correspond to the time shortly before or after the passing of a trough.

We will further show results for the NOAA 20th Century Reanalysis (1871-2011) in order to corroborate our results and to extent the analysed time period. The 56 ensemble members of this data set will also allow a quantification of uncertainty estimations of our methods.