Geophysical Research Abstracts
Vol. 17, EGU2015-5341-1, 2015
EGU General Assembly 2015

Secondary cyclogenesis along an occluded front leading to damaging wind gusts: windstorm Kyrill, January 2007

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Windstorm Kyrill affected large parts of Europe in January 2007. In this study the formation of a secondary cyclone, Kyill II, along the occluded front of the mature cyclone Kyrill and the occurrence of severe wind gusts as Kyrill II passed over Germany are investigated with the help of high-resolution regional climate model simulations. Kyrill underwent an explosive cyclogenesis south of Greenland. Later in its life cycle secondary cyclogenesis occurred just west of the British Isles. The formation of Kyrill II along the occluded front was associated (a) with frontolytic strain and (b) with strong diabatic heating in combination with a developing upper-level shortwave trough. Sensitivity studies with reduced latent heat release feature a similar development but a weaker secondary cyclone, revealing the importance of diabatic processes during the formation of Kyrill II. Kyrill II moved further towards Europe and its development was favoured by a split jet structure aloft, which maintained the cyclone's exceptionally deep core pressure (below 965 hPa) for at least 36 hours. The occurrence of hurricane force winds related to the strong cold front over North and Central Germany is analysed using convection-permitting simulations. The lower troposphere exhibits conditional instability, a turbulent flow and evaporative cooling. Simulation at high spatio-temporal resolution suggests that the downward mixing of high momentum (the wind speed at 875 hPa widely exceeded 45 m s-1) accounts for widespread severe surface wind gusts, which is in agreement with observed widespread losses.