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Dynamic aspects of windstorm Kyrill (January 2007)

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Several dynamical and mesoscale aspects concerning severe windstorm Kyrill (January 2007) are analysed by results of high-resolution simulations with the regional climate model (RCM) COSMO-CLM. After explosive cyclogenesis south of Greenland takes place while crossing a very intense upper-level jet stream, Kyrill underwent secondary cyclogenesis over the North Atlantic Ocean just west of the British Isles. The secondary cyclogenesis (Kyrill II), was located on the occlusion front of the mature cyclone (Kyrill I), which is very unusual compared to typical frontal cyclogenesis generally occurring along the trailing cold fronts of existing cyclones. The mechanisms of secondary cyclogenesis are investigated based on moderate-resolution (0.0625° grid spacing) RCM simulations. The formation of Kyrill II along the occlusion front follows common mechanism for secondary cyclogenesis like breaking up of a local, low tropospheric PV strip along the front and diabatic heating with associated development of a vertical extended PV tower. Kyrill II propagated further towards Europe, and its development was favoured by a split jet structure aloft the surface cyclone, which maintained the deep core pressure (around 961 - 965 hPa) for at least 36 hours. The strong cold front produces gale winds in many places over Western and Central Europe. In particular, the occurrence of hurricane force winds over North and Central Germany is analysed with help of high-resolution (0.025° grid spacing) RCM simulations. The stratification of the lower troposphere exhibits some convectively instability together with a low gradient Richardson numbers indicating a turbulent flow. High momentum (horizontal wind speed at 850 hPa widely exceeding 45 ms-1) is potentially mixed down towards the surface and is thus accountable for the widespread severe surface wind gusts. In order to further quantify this, two wind gust estimation methods implemented in the RCM are compared at moderate (0.0625° grid spacing) and high (0.025° grid spacing) resolution with station data. While wind gusts are generally simulated appropriate, results indicate only partially improvements for high-resolution wind gusts. Nevertheless, the confirmed proper representation of storm related gusts by COSMO-CLM is essential as, for instance, for further impact studies.