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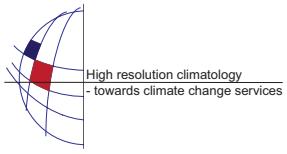

Synoptic- and Mesoscale Weather Situations Associated with Tornadoes in Europe

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Tornado research is mainly practiced in and focused on the United States, but tornadoes occur all over the world and cause damage and casualties. In this study, the focus is given to the synoptic- and mesoscale environment which leads to tornadoes in Central Europe. Consideration is given to 15 significant events (defined to be equal to F2 tornadoes) between 2005 and 2006 and in a band north of the Alps and extending from Eastern France to Poland with focus on Germany. Tornado data are taken from the European Severe Weather Database (ESWD), which includes the date, time, location and intensity on the Fujita scale of the event.
Three aspects are discussed: (a) The synoptic- and mesoscale weather situation is analysed. The tornado events are characterised with respect to upper-level (jet streaks, PV anomalies) and low-level (fronts) forcings by operational ECMWF analysis data. Moreover, satellite data and surface weather charts of the German Weather Service are taken into account. In many cases, tornadoes took place close to an upper-level PV anomaly (streamer or cut-off). Most events occur under the cyclonic left side (exit and entrance region) of the jet stream. (b) The applicability of US tornado indices is investigated. Consideration is given to typical tornado indices used in the US: convective available potential energy (CAPE), storm-relative helicity (SRH) and the energy helicity index (EHI). It will be shown that the indices are only partly applicable to European settings. On average all indices are significantly lower than in the US. (c) Factors that predetermine the atmosphere for severe convection and tornadoes are discussed. For this reason, regions of moisture source are determined by Lagrangian backward trajectories. In most cases European trajectories start over the Atlantic, whereas US trajectories origin in the Gulf of Mexico. Due to the Alps the moisture transport from the Mediterranean is hindered. Moreover, it can be shown that the destabilization caused by advection (by enhancing vertical theta-e gradients) is significantly lower than in the US.