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Sounding-Derived Parameters Associated with Convective Hazards in Europe

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Observed proximity soundings from Europe are used to highlight how well environmental parameters discriminate different kind of severe thunderstorm hazards. In addition, the skill of parameters in predicting lightning and waterspouts is also tested. The research area concentrates on central and western European countries and the years 2009–15. In total, 45 677 soundings are analyzed including 169 associated with extremely severe thunderstorms, 1754 with severe thunderstorms, 8361 with nonsevere thunderstorms, and 35 393 cases with nonzero convective available potential energy (CAPE) that had no thunderstorms. Results indicate that the occurrence of lightning is mainly a function of CAPE and is more likely when the temperature of the equilibrium level drops below $^{-1}0°$C. The probability for large hail is maximized with high values of boundary layer moisture, steep mid- and low-level lapse rates, and high lifting condensation level. The size of hail is mainly dependent on the deep layer shear (DLS) in a moderate to high CAPE environment. The likelihood of tornadoes increases along with increasing CAPE, DLS, and 0–1-km storm-relative helicity. Severe wind events are the most common in high vertical wind shear and steep low-level lapse rates. The probability for waterspouts is maximized in weak vertical wind shear and steep low-level lapse rates. Wind shear in the 0–3-km layer is the best at distinguishing between severe and extremely severe thunderstorms producing tornadoes and convective wind gusts. A parameter WMAXSHEAR multiplying square root of 2 times CAPE (WMAX) and DLS turned out to be the best in distinguishing between nonsevere and severe thunderstorms, and for assessing the severity of convective phenomena.