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Tornado Outbreaks in Europe

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Tornadoes in Europe have been documented and recorded in the European Severe Weather Database (ESWD) which is maintained by the European Severe Storms Laboratory (ESSL). The goal of this study is to find a useful definition of a tornado outbreak and to study the environmental differences between tornado outbreaks and individual tornadoes.

Tornado groups are created by an algorithm which dictates that if a tornado is located within a distance of 500km spatially and 6 hours temporally of another tornado, then these tornadoes belong to the same group. From these groups the groups which have a cumulative Fujita scale number of 7 or higher are given the tornado outbreak status. This way the tornado groups which have a high number of tornadoes or several strong tornadoes are retained.

Two reanalysis datasets are used in this study. The ERA-Interim reanalysis dataset provided by the ECMWF and the Climate Forecast System Reanalysis (CFSR) dataset provided by NCAR. Both datasets cover the 1979 - 2014 period. Several severe weather parameters are computed from these datasets which include mixed layer CAPE (MLCAPE), mixed layer lifting condensation level (MLLCL), deep layer shear (DLS), low level shear (LLS) and both 0-3km and 0-1km storm relative helicity (SRH).

By taking a local maximum (minimum for LCL) of each severe weather parameter in a local spatial and temporal domain, each tornado in the ESWD in the 1979 - 2014 period is assigned a value for each of the severe weather parameters. It is found that tornadoes inside outbreaks are associated with higher values of DLS, LLS and SRH compared to tornadoes outside outbreaks. In tornado environments significant differences exist between the reanalysis datasets. In the large majority of tornado occurences the CFSR severe weather parameters have higher values than the ERA-Interim parameters.