Statistical assessment of future extreme rainfall and wind events

Dr. Frank Kreienkamp, Dr. Wolfgang Enke, Arne Spekat

The method KlaMuKo (German: Klassifikation mit multipler Korrelation, English: Classification using multiple correlation) establishes relations between a regional climate variable, e.g., surface temperature, and fields from the atmosphere (source: reanalyses). By way of multiple correlation analysis a set of atmospheric variables is selected which adequately describes this regional climate variable. The classification itself uses a modified k-means clustering method.

Episodes of heavy rainfall and strong wind constitute extremes of daily weather. They bear a high relevance for civil protection, infrastructure, ecosystems and other vulnerable sectors. A feasibility study, carried out between the end of 2012 and the beginning of 2013, investigated the context of convective events with extreme rainfall and wind. It was instrumental in identifying thematic areas for which there is further need for research and development.

Within the frame of the project *Statistical assessment of future extreme rainfall and wind events*, for which this final report has been compiled, studies focused on (i) the use of SYNOP-data as a source of information with respect to rainfall and wind extremes; (ii) further development and improvement of a classification method which is particularly suitable for extremes; (iii) enlargement of the pool of potential predictors, particularly implementing measures of atmospheric stability, taking into account extreme rainfall and wind events, and (iv) analyses of future developments of extreme rainfall and wind events using the improved method and its application on climate projections of the Global Circulation Model MPI-ESM forced with scenario RCP8.5 for the time frame 1951-2100.

Relevant results of this project include:

- Employing the KlaMuKo classification method yields a good separation of meteorological variables into classes with the aim of obtaining classes that represent extremes.

- In order to describe complex atmospheric properties, such as the occurrence of thunderstorms, this classification makes good use of numerous atmospheric stability measures.

- The classes that were identified in the current climate are also well identified in simulations by a climate model.

- When analyzing simulation data of a climate model, it was found that classes which represent strong extremes frequently only exhibit minor trends.

- Trend-like developments over time have a tendency to occur for classes with a lesser degree of „extremity", yet the robustness of these result is somewhat reduced.

- With the above precaution, the future development of days with rainfall of 10mm or more indicates a decrease of those extremes in summer.

- With the above precaution, the future development of days with strong wind indicates a slight decrease of those extremes in summer.

- For the future development of the occurrence of thunderstorms no clear trend can be given.