Cb-LIKE – Thunderstorm forecasts up to six hours with fuzzy logic

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Thunderstorms with their accompanying effects like heavy rain, hail, or downdrafts cause delays and flight cancellations and therefore high additional cost for airlines and airport operators. A reliable thunderstorm forecast up to several hours could provide more time for decision makers in air traffic for an appropriate reaction on possible storm cells and initiation of adequate counteractions. To provide the required forecasts Cb-LIKE (Cumulonimbus-LIKElihood) has been developed at the DLR (Deutsches Zentrum für Luft- und Raumfahrt) Institute of Atmospheric Physics.

The new algorithm is an automated system which designates areas with possible thunderstorm development by using model data of the COSMO-DE weather model, which is driven by the German Meteorological Service (DWD). A newly developed "Best-Member-Selection" method allows the automatic selection of that particular model run of a time-lagged COSMO-DE model ensemble, which matches best the current thunderstorm situation. Thereby the application of the best available data basis for the calculation of the thunderstorm forecasts by Cb-LIKE is ensured. Altogether there are four different modes for the selection of the best member. Four atmospheric parameters (CAPE, vertical wind velocity, radar reflectivity and cloud top temperature) of the model output are used within the algorithm. A newly developed fuzzy logic system enables the subsequent combination of the model parameters and the calculation of a thunderstorm indicator within a value range of 12 up to 88 for each grid point of the model domain for the following six hours in one hour intervals. The higher the indicator value the more the model parameters imply the development of thunderstorms. The quality of the Cb-LIKE thunderstorm forecasts was evaluated by a substantial verification using a neighborhood verification approach and multi-event contingency tables. The verification was performed for the whole summer period of 2012. On the basis of a deterministic object comparison with heavy precipitation cells observed by the radar-based thunderstorm tracking algorithm Rad-TRAM, several verification scores like BIAS, POD, FAR and CSI were calculated to identify possible advantages of the new algorithm.

The presentation illustrates in detail the concept of the Cb-LIKE algorithm with regard to the fuzzy logic system and the Best-Member-Selection. Additionally some case studies and the most important results of the verification will be shown. The implementation of the forecasts into the DLR WxFUSION system, an user oriented forecasting system for air traffic, will also be included.