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Life cycle analysis of convective cells for Nowcasting purposes in consideration of atmospheric environment conditions

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Severe damage to property, large economical losses and even loss of life may crop up within a very short time scale in conjunction with severe convective storms associated with heavy precipitation, hail, strong winds and, in a few cases, tornadoes. Over recent decades, several nowcasting procedures have been developed with the objective of a more sophisticated on-line prediction of the evolution of convective cells. A large number of these methods is based on radar- or satellite-derived objective cell detection and tracking techniques. Whereas the cell path is already well extrapolated by these procedures, the representation of the cells' future life cycle, i.e. the temporal variation of cell extent and intensity, however, has not reached a satisfying state yet. Though, from the perspective of warning and precaution management, it is crucial to have spatially and temporally accurate predictions of cell size and intensity available, from which the potential threat for the general public, but also for specific stakeholders such as air traffic control or energy suppliers, can be estimated.

Supplementing the German Weather Service (DWD) project *Seamless integrated forecasting system* (SINFONY), physical-mathematical approaches are investigated in the current project, with the objective to improve the estimation of future convective cell properties. Fundamentals for a nowcasting procedure, which predicts the cell state in terms of an initial value problem, are explored. Therefore, cell state dynamics is to be extracted from statistical life cycle information in connection with corresponding atmospheric environmental conditions. Machine learning or clustering methods are to be used for a suitable classification of the general state. As a basis, historical cell observations of the DWD radar-based tracking algorithm KONRAD on the one hand, and analysis-derived data of the COSMO model relevant for deep moist convection on the other hand are employed.

A reasonable and comprehensive sample of convective cell life cycles has been extracted from the KONRAD cell tracking dataset of the summer half-years 2011 to 2017 by applying elaborated filters. Based on this sample, meaningful life cycle statistics illustrating historical cell evolutions will be presented in combination with prevailing atmospheric environmental conditions estimated from the COSMO analysis data. Moreover, different methodic approaches for the nowcasting of cell evolutions will be sketched. Case study findings will be presented as well to highlight the functionality of the nowcasting method. Last, future perspectives for its extension and sophistication will be discussed.