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Assimilation of Lightning and Reflectivity Texture Fraction in ICON-LAM

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Since mid-2024, the German Weather Service's Rapid Update Cycle (RUC) has been running operationally, marking the culmination of work that began in 2016, in response to catastrophic floods caused by extreme summer precipitation. The core of the RUC is the ICON-LAM regional model, running with 2-moment microphysics and a 1-hourly data assimilation cycle.

A key feature of the RUC's data assimilation process is the incorporation of not only conventional observations but also cloud- and precipitation-dependent data, such as radar reflectivities and radial winds, and visual and infrared wavelengths from the SEVIRI instrument. The implementation of 2-moment microphysics has notably improved the simulation of convection and precipitation, leading to a reduction in the rejection rate of precipitation-related observations during data assimilation and weaker a priori biases for the assimilation increments to overcome. These advancements have paved the way for the inclusion of additional precipitation-related observations, including lightning flash rate and convective object features derived from the cell-tracking system used in nowcasting.

Nevertheless, substantial challenges remain in constraining convective processes via hourly data assimilation, in particular because convective systems are nonlinear, non-Gaussian, and often discontinuous, making them difficult to constrain with typical assimilation methods. Here we investigate how the assimilation of convection-related quantities can be improved by considering the so-called texture fraction, a quantity that measures observation-model misfit on customizable scales and thresholds. We apply this principle to two convection-related observation types: two-dimensional radar reflectivity composites and lightning flash rates from ground-based antennas. We show that judiciously choosing the length scales and thresholds of this quantity can improve forecast precipitation within the first one to three forecast hours following an assimilation update.

VAT

Session

Seamless Prediction: Data assimilation integrating nowcasting and new observations

Preferred Contribution Type

Oral Presentation

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