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Probabilistic Low-Visibility Nowcasting and the Benefit from Ceilometer Backscatter Profiles

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Aviation is sensitive to low visibility which is considered by capacity reducing procedures to ensure aviation safety. Accurate forecasts of these low-visibility procedure states which dependent on horizontal and vertical visibility are needed to do economic air traffic regulation. We develop a multinomial logistic regression model with 10 min resolved probabilistic forecasts for Vienna International Airport based on a dense measurement system with lead times up to 2 hours. This nowcasting system outperforms persistence, which is already a benchmark for visibility forecasts, and is competitive with human forecasts. However it is challenging to capture the beginnings and endings of low-visibility events with their sharp and rapid transitions. Therefore strong additional predictors are needed to improve the predictions during these transitions. A candidate information source for such predictors is temporal and vertical highly resolved data from ceilometer backscatter profiles often available at airports. These profile measurements are related to the particle growth and could indicate the forming/advecting water droplets during fog development and lowering of stratus clouds. The aim is to extract the low-visibility related information from the extensive and noisy profile data and form it to strong predictors. Potential predictors are the size of the maximum/minimum particle growth and the height as well as the temporal evolution of the height of these extreme values. These predictors are entered to the statistical nowcasting system to quantify the benefit due to forecast improvement especially for the onset and offset of low-visibility events. The additional information from ceilometer measurements in combination with the rapid update cycle of the statistical nowcasting system improves the forecasts and provides better support for airport decision makers.