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Forecast Horizon of Low-Visibility Conditions at Vienna Airport

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Low-visibility conditions require special procedures at airports and reduce their capacity. Accurate and probabilistic forecasts help to minimize delays and maximize safety. This study investigates how far into the future such skillful forecasts are feasible.

Statistical models combine current and past observations and direct model output (DMO) from numerical weather prediction models to generate probabilistic low-visibility forecasts. The particular models are boosting trees, which combine several decision trees by fitting iteratively a new tree to the residuals of the previous model and merging the new tree to the previous model. Boosting trees provide probabilistic forecasts and additionally identify the most important input variables for the forecasts.

The boosting trees used in this study are trained with observations and climatological information at Vienna Airport and DMO from the ECMWF numerical weather prediction model - both separately and combined. The model based only on observations outperforms the DMO-based model up to a lead time of 8 hours. However, models with the combined predictor variable setup perform best at each lead time. Therefore, observations control the forecasts up to a lead time of 7 hours. Beyond a lead time of 12 hours observations are negligible for the forecast.

All three models outperform persistence even at the shortest lead time of one hour. The combined model outperforms climatology for forecasts up to four days and then converges to the climatology. The predictor variables contributing most to the forecast skill for lead times longer than 12 hours are boundary layer height and evaporation. Visibility, boundary layer dissipation, wind gust and cloud cover information add further skill.