Geophysical Research Abstracts
Vol. 20, EGU2018-10956-1, 2018
EGU General Assembly 2018

An Multinomial Regression Model with Nonlinear Effects for Probabilistic Low-Visibility Nowcasting

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Aviation is sensitive to visibility conditions at airports why capacity reducing procedures are triggered during low-visibility events to ensure aviation safety. These low-visibility procedures typically have several states which are dependent on airport specific horizontal and vertical visibility thresholds. We showed already that a statistical nowcasting approach based on ordered logistic regression is able to provide probabilistic forecasts of the categorical procedure states and supports airport decision makers in economic air traffic regulations. However, the question arises if it is possible to improve this nowcasting system by increasing the flexibility of the statistical regression framework. Therefore we replace ordered regression with a multinomial regression model and exchanged the linear with nonlinear ones. We fit this model with meteorological point measurements and generate forecasts for lead times up to two hours. The results show that both, the change to the multinomial model and the replacement of the linear by nonlinear effects lead to an overall improvement of the forecast accuracy. Remarkable is that especially during situations with severe low-visibility conditions the forecasts improve most. The improvements results on the one hand from the structure of the multinomial model which allows to represent low visibility formation and dissipation processes and the processes responsible for low visibility intensity separately. On the other hand the nonlinear effects allows to capture the changing impact of an model input over its range which is not the case for linear effects. Altogether the improved framework provides good support for airport decision makers with its accurate and computational fast forecasts.