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Experiences in using conditional probability in short-range fog forecasting at Zagreb Airport

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Long-lasting fog events at major airports can cause significant delays. Therefore, studies of fog are important for aviation meteorology, as improved forecasts can lead to considerable savings. During last cold season a simple statistical model for probabilistic short-range visibility forecasting was put into use at the operational weather forecasting service in the Croatian Air Navigation Service (CroControl). The model was originally proposed by Juras and Pasaric in 2006 as a reference method for forecast verification. But in addition to that, it can provide operational forecasters with a helpful tool for low visibility forecasting, despite being a simple method that includes fog physics only implicitly, through climatology.

The data used in the model consists of half-hourly METAR reports spanning the period from Jan 1, 1994 to Dec 31, 2016. A first-order autocorrelation process is the theoretical foundation of the model, which in essence combines climatology and persistence (hence the amalgam CLIPER). From that, a relatively simple forecast equation for a given meteorological element, such as visibility (developed by Gringorten, 1971), can be defined. It links the correlation between values of the meteorological element at different time steps with conditional probability for onset of pre-defined values. Hourly correlation coefficients, which describe the climatological persistence of visibility, are calculated for each month from cumulative frequencies of visibility. These correlation coefficients are then used to forecast visibility for each successive hour, 9 hours in advance. In addition to the median forecast of visibility (which is basically the 50th percentile), 50 % and 80 % confidence intervals are calculated as well. These provide a measure of forecast uncertainty. The forecast by percentile, which is assumed to be more suitable for very rare events, is also provided for comparison.

This conditional probability model was presented to the forecasters at a 3-day seminar held in September 2017. After additional brief training with each forecaster, its use in forecasting low visibility at Zagreb Airport began in October. In February a short formative assessment was made for each forecaster, with the goal of determining how this new knowledge is being applied. Results of the assessment show that forecasters are able to accurately use conditional probability and related knowledge in fog forecasting. There are some minor issues that can be corrected along the way, but in general, conditional probability theory can be successfully applied in improving short-range fog forecasting.