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Probabilistic Nowcasting of Wind Speeds at Vienna International Airport

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Air traffic control needs accurate forecasts of the wind field for the final descent from about 2 km above ground down to the runway in order to direct airplanes to a safe landing. In particular, if cross- or tailwinds exceed certain thresholds, planes are not allowed to land or have to be redirected to a different runway. Therefore, air traffic control is in need of accurate forecasts for wind speed and potential wind shifts to maximize airport capacity, minimize delays, and avoid critical situations.

A strategy for near-realtime probabilistic wind forecasts along the final approach paths and at the touch-down points is proposed and applied for Vienna International Airport. As a first step, non-homogeneous regression models are used to predict cross- and tailwind conditions at the surface up to two hours in advance. These models can either be solely based on observations using all available surface measurements in the terminal area or using additional inputs from numerical weather prediction systems. Boosting and stability selection are used to automatically select the most relevant covariables among a large number of possible input variables such as wind data, temperature, radiation, humidity, as well as their spatial and temporal differences.

In order to obtain probabilistic forecasts, distributional regression models are applied which predict not only the mean but the whole probabilistic distribution. To account for the positivity of wind speeds, a truncated normal response distribution is used in this study. Preliminary results of calibrated wind speed forecasts show a mean improvement up to 45% in the continuous ranked probability score when compared to the raw ECMWF ensemble prediction system.