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Data Mining and Artificial Neural Networks for Short-range Wind Speed Forecasts

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A step-wise approach was chosen starting with a basic ANN which was, as first step, modified and adapted by changing the amount of hidden layer and input neurons. Second, an ensemble of neural networks was used. Third, the output neuron vector size (intervals) was adapted. Thus, the forecast lengths of each ANN was changed to e.g., forecasting hour two or seven to nine and forecast intervals were used. This interval based ensemble approach results is an improvement of the basic ANN, the ZiANN (ZAMG interval based ANN). Based on the ZiANN varying training lengths and input feature sizes were evaluated. By temporal data mining we extract a good set of input data from numeric weather predictions (NWP) and observations and use them for this station based model. Furthermore, a spatial grouping of stations is applied. Here, we investigate how to exploit the spatial groups in ZiANN and the effect of different groups, which were tested for selected stations.

Results of the different ANN methodologies and data mining approaches were evaluated using two test months, July 2016 and January 2017. Predictions were made for up to 40 hours ahead. Results show that the ZiANN approach is able to outperform the NWP-input models, META (a model output statistics method based on a set of NWP models), and the persistence model. For most stations we achieve better results than with INCA, a statistical method using model trends. The temporal and spatial methods were able to further improve our results. In particular in the nowcasting range using spatially similar and/or close data and an extended training period gave the overall best wind speed forecasts for our selected test scenarios.