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Spatio-temporal ensemble predictions for wind and solar energy combining dispersion modelling methods and machine learning

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With the increasing usage of renewable energy systems to meet the climate agreement aims accurate predictions of the possible amount of energy production stemming from renewable energy systems are needed. The need for such predictions and their uncertainty is manifold: to estimate the load on the power grid, to take measures in case of too much/not enough renewable energy with reduced nuclear energy availability, rescheduling/adjusting of energy production, maintenance, trading, and more. Furthermore, TSOs and energy providers need the information as finegrained, spatially and temporarily, as possible, on third level hub or even on solar farm / wind turbine level for a comparatively large area.

These needs pose a challenge to numerical weather prediction (NWP) post-processing methods. Typically, one uses selected NWP fields aswell as observations, if available, as input in post-processing methods. Here, we combine two post-processing methods namely a neural network and random forest approach with the Flex_extract algorithm. Flex_extract is the pre-processing algorithm for the langrangian particle dispersion model FLEXPART and the trajectory model FLEXTRA. Flex_extract uses the three-dimensional wind fields of the NWP model and calculates additionally the instantaneous surfaces fluxes. Thus, coupling Flex_extract with a machine learning post-processing algorithm enables the usage of native NWP fields with a higher vertical accuracy than pressure levels. To generate an ensmeble in post-processing from deterministic sources different tools are available. Here, we will apply the Schaake Shuffle.

In this study a neural network and random forest approach for probabilistic forecasting with a high horizontal grid resolution (1 km) as well as a high temporal forecasting frequency of wind speed and global horizontal irradiance for Austria will be presented. Evaluation will be carried out against gridded analysis fields and observations.