Ensemble-Based Data Assimilation for Wind Forecasting – Application to Wind Farm

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The purpose of this study is to develop an ensemble-based data assimilation method to accurately predict wind speed in wind farm and provide it for the use of wind energy intelligent forecasting platform. As Taiwan government aimed to increase the share of renewable energy generation to 20% by 2025, among them, the uncertain wind energy output will cause electricity company has to reserve a considerable reserve capacity when dispatching power, and it is usually high cost natural gas power generation. In view of this, we will develop wind energy intelligent forecasting platform with an error of 10% within 72 hours and expect to save hundred millions of dollars of unnecessary natural gas generators investment. Once the wind energy can be predicted more accurately, the electricity company can fully utilize the robustness and economy of smart grid supply. Therefore, the mastery of the change of wind speed is one of the key factors that can reduce the minimum error of wind energy intelligent forecasting.

There are many uncertainties in the numerical meteorological models, including errors in the initial conditions or defects in the model, which may affect the accuracy of the prediction. Since the deterministic prediction cannot fully grasp the uncertainty in the prediction process, so it is difficult to obtain all possible wind field changes. The development of ensemble-based data assimilation prediction is to make up for the weakness of deterministic prediction. With the prediction of 20 wind fields as ensemble members, it is expected to include the uncertainty of prediction, quantify the uncertainty, and integrate the wind speed observations of wind farms as well to provide the optimal prediction of wind speed for the next 72 hours. The results show that the prediction error of wind speed within 72 hours is 6% under different weather conditions (excluding typhoons), which proves that the accuracy of wind speed prediction by combining data assimilation technology and ensemble approach is better.