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The improvement of 1- to 3-hour ahead wind forecasts has the potential to lower the cost of integrating wind power into the electric grid system and reduce the potential impact of occasional extreme wind power variability on grid reliability. One approach to improving short term wind forecasts is to deploy additional atmospheric sensors in the vicinity of the wind power production facilities. However, a significant issue associated with this approach is which locations and variables should be measured to obtain the optimal value from particular sensor deployment scenarios. This issue has been addressed through the use of an ensemble sensitivity analysis (ESA) technique to obtain quantitative information about the impact of variations in the initial conditions on a forecast metric. Climatological forecast sensitivity patterns obtained from the ESA for a particular target location can provide objective guidance for the development of a sensor deployment plan that will have significant impact on the forecasts of the desired parameters.

The specific objective of this project was to test the ESA technique as a tool to identify measurement locations and variables that have the greatest positive impact on the accuracy of wind forecasts in the 1- to 3-hour look-ahead periods for selected wind generation areas in the Mid-Columbia Basin. The ESA for this application was based on the execution of a 48-member Weather Research and Forecast (WRF) model ensemble for a 50-day period over a domain covering the Mid-Columbia Basin and surrounding region of Washington and Oregon. A nested grid configuration with an outer grid resolution of 12 km and an inner grid resolution of 4 km was employed. Observations from rawinsondes, aircraft, and surface-based sensors were assimilated every 6 hours using a square root ensemble Kalman filter (EnKF) with perturbed boundary conditions from the North American Mesoscale (NAM) model.

The sensitivity of the 1- to 3-hour 80-m wind forecasts to a set of initial condition parameters was analyzed for three forecast target areas in the Mid-Columbia Basin region. The study focused on forecast sensitivity during the warm season. Areas of high sensitivity values indicate that a small change in the initial conditions is correlated to a large change in 80-m wind speed over the target region. These areas are good locations for additional observations to improve the short-term forecast of wind speed over the target region.

Preliminary sensitivity results show that the magnitude of the wind speed within the target regions of the Mid-Columbia Basin is sensitive to 1- to 3-hour earlier values of the 80-meter wind speed and stability-related parameters along the Columbia River that is co-located with the area of channeled flow. In addition to raw sensitivity results for the period, the frequency of statistically significant sensitivity and the average amount of explained variance for the forecast metric were also examined. The latter parameter appears to be the most useful in identifying locations at which measurements could most significantly benefit short-term forecast performance. A Multiple Observation Optimization Algorithm (MOOA) was developed to find the "optimal combination" of multiple initial condition variable-locations for a specified forecast metric and look-ahead period. The MOOA addresses the issue that the forecast sensitivity among variables and locations is often highly correlated and therefore the greatest benefit to the forecast will be obtained from a set of highly sensitive locations-variables that have the least inter-correlation. The MOOA was used to obtain objective guidance for sensor deployment in three forecast target areas. The conference presentation will highlight the methods and key results of the study.