

Review of the paper “The wind farm as a sensor: learning and explaining orographic and plant-induced flow heterogeneities from operational data” by R. Braunbehrens, A. Vad and C. L. Bottasso with MS No. wes-2022-67

3 November 2022

General comments:

This paper describes a method to identify the heterogeneous flow characteristics that develop within a wind farm in its interaction with the atmospheric boundary layer. The proposed method is based on augmenting an engineering model with an unknown correction field. Operational data is used to simultaneously learn the parameters that describe the correction field, and tune the ones of the engineering model. This approach is demonstrated on a mid-size onshore farm and a large offshore one. In both cases, the data-driven correction and tuning of the proposed model results in much improved prediction capabilities. The paper is generally well written and referenced, and represents a substantial contribution to scientific progress within the scope of Wind Energy Science (WES). Thus, I am very happy to recommend the paper for publication in WES.

Specific comments:

1. Line 295. It would be helpful to mention that the residuals \mathbf{r} with covariance \mathbf{R} is statistically independent within the set of N observations $\{z_1, z_2, \dots, z_N\}$.
2. Equation 19. Could the authors explain somewhat how to get the values of the rotation matrix \mathbf{V} and the diagonal matrix \mathbf{S} when the values of the matrix \mathbf{M} are already known?
3. Figures 3, 4, 5. Is the abscissa really the value of the new parameters θ_i ? Or should it be the index of the new parameters?

Technical corrections:

1. Lines 45-46: Remove one “only”, and “pant” should be “plant”.
2. Line 80. “frestream” should be “freestream”.
3. Line 101. “it” should be “is”.
4. Figure 8. The title misses “(c)”.
5. Line 701. “1” should be “0”.