

Interactive comment on “Assessing Spacing Impact on the Wind Turbine Array Boundary Layer via Proper Orthogonal Decomposition” by Naseem Ali et al.

Anonymous Referee #1

Received and published: 26 July 2016

This manuscript focuses on POD analysis of Stereo-PIV measurements performed upstream and downstream of the most downstream turbine in a 4 x 3 array. Four different layouts were investigated by varying two streamwise and spanwise separation distances.

Introduction is a bit unfocused and writing can be improved. From the abstract and the introduction, the scientific goal of this manuscript is unclear and, frankly speaking, it is still unclear even at the end of the document. Maybe is the reconstruction of the Reynolds stress through POD modes and then highlighting difference among the different layouts? This should be explained clearly.

In Sect. 2, POD is briefly described, not always in a very rigorous manner (see detail

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comments below). In Sect. 3 the experimental setup is described. In Sect. 4 power production for the different layouts and rotor angular velocities is reported. This section looks a bit disconnected with the remainder of the manuscript. No clear connections are made between power production and the wake velocity field. In Sect. 5A, mean velocity field and Reynolds stress are reported for the different layouts. In Sect. 5B, streamwise averaging analysis is described. In Sect. 5C, the POD results are provided, while in Sect. 5D, reconstruction of the Reynolds stress through POD modes is presented.

The main criticism on this manuscript is that the results presented do not provide a clear insight to improve understanding of wake turbulence for different wind farm layouts. I guess the main results should be better highlighted in the data analysis and conclusions. Furthermore, writing should be improved throughout the manuscript.

Detail comments

1. Abstract: possesses highest energy content, it sounds strange. Consider to rephrase it.
2. line 9: increased coalesce dynamic load. Consider to rephrase it.
3. line 13: Wake growth particularly depends on the shape and magnitude of the velocity deficit. What does it mean?
4. line 36: according to the Nested farm..Spacing within a real wind farm varies with wind direction. I suggest providing ranges of spacing according to the wind rose.
5. line 68: Maybe it is appropriate to write the mean kinetic energy budget?
6. line 70: The Reynolds shear stress is the center of the energy flux. This is not clear, consider to rephrase it.

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7. lines 78-79: The snapshot method enables reducing POD computational cost when the space dimension of a single snapshot is larger than the total number of snapshots.
8. line 88: The optimal deterministic problem is solved numerically as the eigenvalue problem. Rephrase it.
9. Fig. 3: This is the power measured only for the turbine under examination or from the entire array? Is it possible to report the power in a non-dimensional form?
10. Sect. 4: The power measurements seem to be disconnected from the rest of the manuscript. Try to bridge the power measurements with the wake velocity data.
11. line 161: do you mean upstream and downstream of the turbine under examination?
12. line 186: there is an extra space.
13. Fig. 4: why you do not show the other two velocities as well?
14. Sect. 5B: explain better the rationale in performing averaging in the streamwise direction even though streamwise gradients are significant.
15. line 254: specify if POD was performed by analyzing snapshots of the Reynolds stress or velocity components.

Interactive comment on Wind Energ. Sci. Discuss., doi:10.5194/wes-2016-23, 2016.

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