Reviewer Comments – A quantitative analysis of the impact of wind turbines on operational Doppler weather radar data

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General Comments

The author examines a large data set comprised of the three meteorological radar variables for a Swedish radar site located near a wind farm. The data exist both before and after the construction of the wind farm, allowing for a comparison between the two time periods. The impact of the wind farm is apparent and analyses are performed. Spatial and temporal impacts are explored through a variety of figures and statistics.

While the methodologies are not extremely novel, the data itself and the capability to perform such an analysis is quite unique and contributes to the understanding of the impacts of wind turbines on weather radar systems. Significant consideration for prior work was apparent. Methodologies were simple, but scientifically sound, with assumptions clearly defined and convincingly explained. The discussion of ground clutter filtering is brief, and the impact of the filter will need some further explanation in the final revision; however, the overall quality of the paper is good. Some of the language regarding the potential mitigation/recovery technique should be softened. Overall, the figures and charts were well presented and relevant to the analysis.

Specific Comments

Abstract

1. Line 17
   The author should soften the language regarding the impact of the wind turbines. The data do not show definitively that the impact 'disappears', but it is greatly reduced.

Section 1

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Section 2

1. Paragraphs at lines 81 and 85
   The minimum detectable signal is -30 dBZ: what is the equivalent SNR? Please include the SNR censoring level during the dBZ censoring discussion. Minimum SNR information gives the reader more details about the level of censoring, as well as the expected performance of the estimators used in the analysis.
2. Line 96
   Please give some examples of what constitutes invalid data for each variable.
3. Paragraph at line 97

More information about the clutter filter is needed. The implications of the filter on the evaluation presented later in the paper are substantial. The discrepancies between the lower elevation grouping and the higher grouping are attributed to the change in range gate size, but the clutter filter is also omitted in the higher scans and should be accounted for in the discussion.

4. Section 2
   Please provide some information/details about the radar sidelobes in this section. The analysis performed later (line 211) should reflect the locations of the radar sidelobes. A plot/image of the antenna pattern would be useful in this section.

Section 3

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Section 4.1

1. Figure 2
   Suggestion: It would be useful to include a difference plot (Z-Z0) as in Figures 4 and 5, and would make comparisons with said figures easier.
2. Paragraph at line 147
   Here, and as the discussion of the impact of the wind farm progresses through the meteorological variables, an acknowledgement of the impact of the clutter filter is necessary. Please include a discussion addressing the impact that the clutter filter may have on the presented results, i.e., is the contribution solely due to the blades, or does the clutter residue play a role?
3. Paragraph at line 162
   Similarly, the absolute velocity bias toward zero could be due to the clutter residue, or to the blades imposing both positive and negative velocity values (aliasing) on the spectrum. Please discuss what might cause the velocity to be biased toward zero.
4. Paragraph at line 171
   Similar to the previous two comments, please include a discussion addressing the reasons for the decrease in spectrum width in the wake of the wind farm.

Section 4.2

1. Line 217, 228, 236
   The fifth elevation tilt is also where the clutter filter is no longer applied. Please include this fact in the discussion for each of the variables.
2. Line 236
   The decrease in range resolution at the higher elevation tilts is cited as a possible cause for discrepancies. Please expand and explain the reasoning.
3. Line 283
   It would be useful at this location in the paper to evaluate a potential inversion situation, and show the effect on the beam propagation. For instance, calculate the height of the beam at the standard tilt angles for normal propagation, and compare that to the heights of the beams during a

moderate to extreme ducting scenario. A brief presentation would validate the author's argument.

Section 4.3

1. Line 356
   Suggestion: It would be useful to show some climate data, such as a wind rose, for the time period in question to show the dominate wind direction relative to the radar radial. Such a presentation would validate the observed velocities.
2. Line 376
   The author should soften the language from 'recover' to 'approach' or 'resemble' the values before the construction of the wind farm.

Section 4.4

1. Section 4.4
   Throughout this section, the author should soften the language regarding the recovery of estimates. The impact of the wind farm approaches that of the clean reference gate, but the data do not show that the impact is completely eliminated.
2. Correlation Coefficient, Figure 9, and Figure 10
   It is not apparent what the correlation coefficient values are intended to provide. The high degree of variability between the parameters and the elevation tilts makes it difficult to draw meaningful conclusions, i.e., a conditional threshold as mentioned in the conclusion. Please include a discussion of how the data presented in Figures 9 and 10 could be used/combined to determine a valid threshold for meteorological data recovery.

Section 5

1. Line 472
   The mitigation scheme presented here seems premature as a definitive threshold determination is not presented in the paper. The author should refrain from suggesting a threshold, i.e., larger than the average wind turbine value, without a more detailed analysis and justification.

Technical Corrections

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