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Interactive comment on "Minute-Scale Wind Speed Forecasting Using Scanning Lidar Inflow Measurements" *by* Elliot Simon et al.

Anonymous Referee #2

Received and published: 16 January 2019

The authors have provided field testing results from a campaign in Denmark, where a scanning Lidar has been used for ultra-short term forecasting. Although this is not novel and has been previously studied by a few people, it's a relatively new topic in the field and of high importance to the wind energy community.

The authors need to improve their explanations, figures, captions, tables considerably and provide clarity to the topics they discuss. It feels too spread out and not coherent. So I would not recommend publication as it is. It's definitely relevant to Wind Energy Science journal objectives but only after they address the below comments and make considerable improvements.

Unfortunately, there are too many grammatical errors, incorrect or abrupt sentences in the paper which I feel the authors have to review once again and provide additional

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clarity. Looks like this was written in a hurry! I would recommend to carefully rewrite the paper and resubmit. There is a lot of useful information and I would recommend a few below to carefully be considered:

1. The current paper is also too long and needs to be shortened (25 Figures!). I couldn't get to the results section during my second careful read, as there were too many inconsistencies in the article. So I would really like to see a lot of the information provided in the Supplemental section or maybe split it into two shorter papers? 2. In General, I know we all don't like to do it, but the article needs to be formatted as per Journal specifications. Currently, the text format and figure format is not up to standards and is not acceptable for publication. So please look into this carefully. 3. The subheadings are like a sentence, please shorten them (Ex: 5.7 Model changes which did not improve the overall result). 4. And I would recommend not to include the word Novel, as this is not a novel field study. There have been field studies that have looked into wind farm control using Lidars in the past. See my comments below.

Comments: L26: "However for very-short time scales (< 1 hour) these methods are generally not applicable due to their coarse temporal and spatial resolutions, and long initialization times" The authors mention about coarse temporal and spatial resolutions, what are the resolutions used by current generation models? HRRR Model from NOAA provides accurate forecasts with resolutions to about 1 km and the temporal resolution can be anything! So this statement needs to be reconsidered looking at the modern forecast capabilities.

L28: "Site measurements offer a promising approach to generating forecasts for these lead times" This is a very vague conclusion/statement. Site measurements don't generate forecasts, they are observations, measurements in tandem with a model can provide forecasts. So please be clear in your explanations or conclusions on this topic. As modelers would not be happy with this statement!

Table 1: Please check and make sure you have consistent definitions with the research

community. Is it Very Short Term or Ultra Short Term?

Line 39: The idea of wind farm control has been reviewed in the past for several years and in the recent past also the idea of using Lidar-based measurements for wind farm control has been studied (see what I could find on Google Scholar, there are several more, so please do a thorough review) a) Valldecabres, L., Nygaard, N., Vera-Tudela, L., von Bremen, L., & Kühn, M. (2018). On the Use of Dual-Doppler Radar Measurements for Very Short-Term Wind Power Forecasts. Remote Sensing, 10(11), 1701. b) Annoni, J., Taylor, T., Bay, C., Johnson, K., Pao, L., Fleming, P., & Dykes, K. (2018, June). Sparse-Sensor Placement for Wind Farm Control. In Journal of Physics: Conference Series (Vol. 1037, No. 3, p. 032019). IOP Publishing. c) Kanev, S. K., Boorsma, K., & Boquet, M. (2016). On the application of LiDARs in wind farm control. ECN. d) Magerman, B. (2014). Short-Term Wind Power Forecasts using Doppler Lidar. Arizona State University. e) Krishnamurthy, R. (2013). Wind farm characterization and control using coherent Doppler lidar (Doctoral dissertation, Arizona State University). Also, AWS TruePower had conducted Wind Farm Control trials a while ago (http://apogeospatial.com/measuring-distant-winds/) for their wind farm in Hawaii using a scanning Lidar. ECN, NREL, Sandia National Labs, Lockheed Martin, and Dong Energy have also conducted several trials of wind farm control (presented during AWEA & EWEA conferences, https://www.windpoweroffshore.com/article/1409717/dong-sheds-light-weather-monitoring-radar-station), Universities in Arizona, Texas, Auburn (France) have also looked into wind farm control using Remote Sensing. In general, the reviewer feels the comment about a distinct gap in knowledge is not true. Researchers and companies are aware of the benefits of wind farm control using very short-term forecasting and are still exploring it (as every other field in forecasting). See some other material on wind farm control for you and others: https://www.ieawindtask32.org/wp-content/uploads/2018/06/Minutes-of-IEA-Task-32_36-Forecasting-Workshop.pdf https://www.osti.gov/servlets/purl/1364776 Please revise the statement and place in the above-mentioned references for the reader.

Section 2.2 - You have missed the concept of wind farm control by wake management using scanning Lidars. There is very short term forecasting involved in that as well. Please refer to a recent large body of work done by NREL (Esp. Dr. Paul Fleming) and Sandia Labs etc. . .

L95: Again, please be specific on space and time scales you think is needed for wind farm control? The spatial scales a mesoscale model can resolve are now about $\sim$1 km, which are sufficient. And this may be what you get from a sectorVAD type approach from a scanning Doppler Lidar depending on the range from the Lidar.

Figure 6: What do red or blue color indicate? Please provide details about the plot in the caption and also a color bar!

Figure 9: What is the Figure scale? Is red/maroon 100% data availability? Please use Parula color bar in Matlab as a standard for all your color plots.

L29: change to “intra-hour”

L320 - But the computational expense is nothing while running a VVP or a sectorVAD for a given scan compared to a 2D VAR or 3D-VAR. The trade-off is the accuracy, and the method authors have chosen provides the maximum error. So the uncertainty of your initial data itself would be very high if there is wind veering or wind shear. Since for those special cases, you deemed model output was not relevant to the wind farm control. So how do you justify this simple method to be better than an advanced model?

The comparison between a sectorVAD if the wind directions are uniform does better than 97% correlations, please carefully see the literature.

Why was the Lidar not scanning both clockwise and anti-clockwise (Table 3: “Reversing” - that’s not a technical term)?

The Flowcharts are too confusing and the text does not make it easy to understand. Please redraw and clarify.

Section 5.3 on Gust tracking should be removed from the paper.

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