

Review for *Wind Energy Science of*

RADAR-Derived Precipitation Climatology for Wind Turbine Blade Leading Edge Erosion

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General Comments

This paper computes the energy of impact to wind turbines by rain and hail, a topic that is seldom discussed, yet very important to operation and maintenance of wind farms. It points out the potential for these hydrometeors to erode the leading edge of wind turbines. They leverage public data for the US regarding dual-pol radar data and estimate the energy for typical turbine parameters. This paper should be of interest to readers of WES. The work is well-justified, interesting, and well presented. The authors justify that the problem is important and review the subject appropriately. The calculations are appropriate, but quite conservative, as the tip speed is used in computing the energy of impact. In fact, the tip itself would be seldom hit. It may be useful to provide a range of impacts as a function of distance from the hub.

Specific Comments

- The literature review is appropriate, but one wonders how much similar research has been done by the insurance industry regarding damage to cars and roofs.
- This paper focuses on the U.S. It would be helpful to discuss how it is expected to apply in other parts of the world.
- P. 3, line 11 – reference to the work of Bech et al. for Denmark on curtailment is interesting. Did they do a cost-benefit analysis? Readers may be interested.
- P. 5, line 5 – It would be interesting to comment on the accuracy of the current classification methods of the dual pol radars – it used to be rather poor, but may have improved with time.
- P. 6, line 7 – Please clarify what you mean by the “largest values”. Do you mean the 75% from the prior page? Later on line 15, you refer to a fitting parameter for D_{75} , which suggests that.
- P. 6, line 29 – “the mean RPM begins to decrease at wind speeds below the cut-out velocity ...” Is this true? Please provide references. The power remains constant at rated capacity until nearly at cut-out, so how does the RPM decrease? Or do you mean as it approaches cut-out speed? Please clarify
- P. 7, line 6 – The rest of the analysis uses the speed of the blade tip for calculations. What if you used the mid-point of the blade instead as a more representative speed? You do mention that this is “conservative”. It would be informative to compare the speed at the mid-point to help show the variability across the blade. Or even to plot impact as a function of distance from the hub.
- P. 15 – lines 19-p. 16, line 10 - -This is a nice list of limitations. Thanks for providing.

Technical corrections

- P. 1, line 26 – please write out “approximately” (not approx..)
- Throughout – please add space between references in parentheses
- Throughout – it is difficult to follow and remember the 4-letter designations for the radar sites, even for an American reviewer. It will likely be even more difficult for international readers. Perhaps using the states where they are located in your references to the sites would enhance readability??
- P. 2, line 30 – WT was already defined
- P. 2, line 35 – please specify U.S. Central Plains – this in an international journal.
- P. 3, line 6 – please define CONUS first time it is used.
- P. 4, line 9 – “nominal wind farm located within the observation areas of six RADARS” is confusing. Are you referring to a wind farm for each of the six RADARS? What do you mean by “nominal” wind farm? Is this “notional”? Have you identified a specific wind farm or are you referring to one within the reach of the radar beam? As written, it implies that you have identified a wind farm that is reached by the beams of all 6 radars, which is surely not what you meant to say.
- P. 5, line 17 – I don’t think you mean to refer to Fig. 3 here.
- P. 6, line 11 – “hailstones” should be plural
- P. 6, line 13 – “sampled IN Alberta”
- P. 6, line 27 – “wind speed AS shown in ...”
- P. 11, line 10 – hail storms are quite frequent in Boulder, Co which is just west of 105°
- P. 12, line 7 – occurring in fewer than ...” (not few). The point you make here is certainly true for damage to roofs and cars.
- P. 15, line 5 – “it is flexible to use with different ...” (not “of”)
- P. 15, line 12 – please indent paragraphs.
- P. 16, lines 5-7 – The word “herein” is used 3 times in 3 lines.