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Interactive comment on "Significant multi-decadal variability of German wind energy generation" *by* Jan Wohland et al.

Anonymous Referee #1

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This manuscript addresses an important subject and helps in the "Global Stilling" debate. The analysis of wind trends has to separate between multi-decadal trends such as those forced by the North Atlantic Oscillation and the (expected) reduction in overall wind speeds due to the decrease of the polar-tropical temperature gradient. The reduction of wind speeds in Central Europe has implications on the economic benefits from wind turbines erected during the (necessary) transition process towards a fossil-free energy infrastructure.

Unfortunately, the manuscript is not well balanced. Title, Abstract and Introduction rise the expectation that this paper mainly deals with the separation between multi-decadal variability and Climate Change. But only half of the conclusions reflect findings belonging to this issue. The other half of the Conclusions focusses on economic aspects

of our future energy supply and speaks about transmission lines across Europe and "decadal energy storage systems". How such systems could look like is not detailed (unfortunately).

Another conclusion is that the atmosphere could be used as a carbon storage. What does this mean? Once again, no explanation is given.

The task of a major revision of this manuscript has to be to prepare the discussion in the second half of the Conclusions by additional paragraphs in the Introduction.

Specific Review Points

The "Global Stilling" debate which has been brought up again recently should be addressed in the Introduction and in the Conclusions. This would help to put the results of the present manuscript into the proper perspective.

Page 1, line 20: Comparing an estimated revenue from wind energy devices to the overall value of a car company is a bit strange for a scientific paper.

Page 2, line 30-32: The evaluations in this manuscript are understood to be based on (grided) reanalysis data. Therefore, the reviewer does not understand why there is the necessitiy to extrapolate wind speeds from the 10 m level to hub height. There should be data from heights much closer to hub height. And if this large extrapolation has to be made, then the power law is not helpful. The exponent of the power law depends on height above ground, surface roughness and atmospheric stability. The surface roughness-dependency makes the exponent wind direction-dependent. Especially due to the height dependency of the power law exponent, this law is only suitable for extrapolations over small height intervals. Anyhow, the extrapolation necessity and procedure has to be described in much more detail.

Section 4.2: this Section contains interesting results. According to the title of the manuscript, the reader expects more explanations about how the founded trends are connected to the North Atlantic Oscillation. Why is there an anti-correlation between

the winter trends and the summer trends leading to such strong variations in the seasonality? And why are the frequencies in Fig. 5 varying so much with the season? (major peak at 0.02 for winter and autumn, 0.03 for summer and 0.04 for spring?) If they all relate to NAO, shouldn't they have all the same frequency dependence? Much more discussion is needed on this interesting finding!

Page 16, lines 14 to 15: Is the request for a perpetual redesign of power systems realistic? It sounds well, but how to do it?

A more appropriate title could be: "Multi-decadal atmospheric variability and power system design". Then the reader would expect what is found in the Conclusions. But it then becomes debatable whether this manuscript still fits into the spectrum of this journal.

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