Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-77-RC1, 2020


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# *Interactive comment on* "Mountain waves impact wind power generation" *by* Caroline Draxl et al.

**Anonymous Referee #1**

Received and published: 4 June 2020

Review of the manuscript WES-2020-77

Mountain waves impact wind power generation

by C. Draxl et al

Summary This paper puts together WRF model simulations and field campaign data from the WFIP2 campaign and satellite observations to illustrate the role of mountain waves in stably stratified conditions on wind oscillations in wind parks and consequences for wind energy production and its forecasting. I find the paper addresses a relevant and relatively new topic and the authors have a unique set of data (model and observations) available to study this topic. At the same time I think the paper has to become more mature before it can be published. Overall I have the feeling the model results and observations offers much more opportunity for discussion and that there is more to be learnt from the data offered.



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Discussion paper

Recommendations: major revisions

Major remarks:

1. Abstract should be rewritten. The sentence “This paper aims at understanding how mountain waves form in the complex terrain of the Columbia Basin, subsequently affect wind energy production, and impact aspects of operational forecasting, wind power plant layout, and integration of power into the electrical grid.” is more like an announcement of the goal of the study, but in the abstract the reader expects concretely what has been learnt about from the study.

2. Title: I recommend to revise the title. The current title kind of gives the reader the expectation that a general and new theory is presented. However, the paper itself report mainly about a WRF study for a single case study for a specific region where the campaign was held. So these aspects should be included/reflected in the manuscript title. Otherwise it puts the reader on the wrong track.

3. I have the feeling that papers was put together somewhat hastily in the sense that there are many figures, while many of those figures are not discussed in depth and only touched superficially or briefly. E.g. figure 8 is discussed on only 5 lines, figure 9 in 5 lines and figure 10 in 7 lines, Figure 11 in 4 lines, fig 12 in 8 lines, Figure 13 in 5 lines ... So overall I have the impression that not all graphs are necessary or their discussions should be deepened.

4. The paper can be strengthened to include more information about the upscaling of the result. The authors elaborate on one case out of two they know when the mountain waves are relevant. It would be interesting whether the authors can say something about how often this occurs based on e.g. ERA5 data (so in a climatological sense) and how much forecast error is expected also in power forecast. Or how often the error is in a certain range (contingency table). This helps to put the paper in a broader perspective than the case study it is now.

Minor remarks:

Ln 18: Large mountains: perhaps it is good to add some scale that you mean with “large”. You only mean Rockies or would the Alps or Pyrenees also be considered? Where is the cut off?

Ln 136: Mellow -> Mellor

Ln 140: please add a few sentences why Allaerts et al was so positive about this setup that you used it here as well.

Ln 169: perhaps good to add the formula for the Scorer parameter, since I can image that it is not common for the complete readership you want to serve.

Figure 6: it would be helpful to have line in panel a that shows where cross sections b) and c) are taken.

Figure 6a: it would be helpful to have the terrain height in contours plotted in this panel as well.

Figure 8: could the panels b and c be merged? Simply two lines in one panel is much more easy to compare the evolution of the profile.

Section 3.2.2: I find that section be written much more in a quantitative way, with more information about the wavelengths involved and how much WRF overestimated the wind speed in m/s at which particular height. Also how do I see the waves in these plots? I do see alternating wind speeds at some levels, but are these waves or

Ln 260: large: please add the scale you mean with large wavelengths.

Ln 268: From the spatial pattern of mountain waves in the 100 m wind speeds: why 100 m? Is the picture consistent with the behaviour at 50 and at 200 m? Also I miss a discussion here how the model resolution may have limited the wave behaviour scale. If these are horizontally propagating waves one could also use the WRF tslist tool to include multiple receptors point on the line where the FFT was performed. The

advantage of this is the higher time resolution that is obtained so one is less restricted to the model resolution.

Ln 273: “Figure 12 (a) and 12 (b) show the Hovmoller diagram of the original and reconstructed hub-height wind speed at the targeted latitude, respectively.” This sentence is technically a caption and should not be part of the main text.

Ln 283: a wave period of 1.5 h: this is inconsistent with Fig 12 c where I do not see a peak in the spectrum at 1.5 h, neither in the model nor the observations.

Ln 284: The results seem to be sensitive to the chosen grid point and the period of interest (not shown). This is a critical sentence that one should elaborate on. If the result is sensitive to the location, then it is also important for the forecasting. So the reader should get a better insight here how much this sensitivity is.

Ln 366: typo in teshold

Figure 10: in panel b the horizontal white lines are dotted lines where in the others they are full lines.

Figure 11+12: s in ms-1 should not be italic along the color bar.

Figure 12: Panel c: please add the time period over which the spectrum was taken in the caption

Figure 12c: I am concerned with this plot, it is dominated by the energy at the diurnal cycle, (wave period of 24 h) but this is not the focus of the paper. As such the high energy peaks due to the wave are not easily identifiable. So I suggest to reshape this plot such that it better serves the aim of the paper.

Figure 13b: I do not see the use of this panel. Lots of info is redundant w.r.t. to panel a. If you want to show the shifted line, then just plot it in panel a, in dashed or dotted blue line.

Figure 15: The caption gives very limited information. Please add the time period or

model initialization time and precise location of the three sites. Otherwise this work is not reproducible.

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