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Reply on CC1

William J. Shaw et al.

Author comment on "Scientific challenges to characterizing the wind resource in the marine atmospheric boundary layer" by William J. Shaw et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-156-AC2, 2022

We are grateful for the substantial and constructive comments that Dr. Banta has provided. We also acknowledge his broad criticisms of the paper. These may be generally summarized as follows:

- Synoptic-scale and mesoscale systems are the primary drivers for inflow into wind plants, and the inflow is then modulated by the processes on which we have focused in out manuscript. He has suggested that the paper would benefit from an expanded discussion of these larger-scale processes.
- He has also suggested that the paper needs to address the primary forcing mechanisms of the synoptic-scale and mesoscale systems and consequently to provide guidance on field measurement strategies that will illuminate NWP errors and their causes so that the models can be improved.
- Dr. Banta has also suggested that the paper prioritize focus on various atmospheric processes based on their importance to wind energy and their levels of uncertainty.

With respect to Point 1 above, the scope of such a discussion can be vast, and the current manuscript is already near the maximum length of what Wind Energy Science can support as one paper in a set of 10 that expand on Veers et al. (2019). We had extensive discussions regarding inclusion of issues associated with the representation of synoptic and mesoscale phenomena in numerical weather prediction models, and we believe that the paper represents a fair balance. We do discuss sea breezes and low-level jets in the paper, but for these mesoscale flows we feel that it is most important to emphasize the lack of validating observations in offshore wind energy areas, especially since most of what is known about sea breezes, low-level jets, and other phenomena of daily meteorology comes from measurements made over land. This is also reflected in the references that Dr. Banta provided. We note the BAMS 2018 article that we originally cited in a narrower context has some broad discussion of the phenomena that Dr. Banta suggested that we discuss. Perhaps the most efficient at least partial solution is to direct readers to that discussion early in the paper 2018 BAMS paper.

We will therefore insert the following at line 82:

"(Strobach et al.2018). From a terrestrial perspective, Banta et al. (2013, 2018) have provided descriptions of these kinds of circulations as they relate to wind energy together

with suggested observational strategies for better observing them. Offshore…"

We will also add the following to the end of Section 1 of the manuscript beginning in line 125:

"While synoptic-scale weather systems are important for driving wind plant inflows in the boundary layer and remain an active area of forecasting challenge and research, the structure and forcing mechanisms of these systems are beyond the scope of this paper."

Points 2 and 3 are related. The general forcing mechanisms of diurnal meteorological flows are well known, but the ability of models to capture details of what modulates that forcing, especially offshore, is still poorly validated. As a result, prioritization will likely be an iterative process as more observations become available to validate more model scales under a broader range of conditions. In the interim, some focus is provided by workshops such as the one held in 2019 with input both from industry and researchers.

Regarding Dr. Banta's comments on h vs Zi as the appropriate variable indicating ABL depth, the authorship team discussed this at some length as we were drafting the manuscript. We decided that Zi was also appropriate because turbulent mixing, even in a stably stratified ABL, will always create a nearer-neutral profile of potential temperature than will be present immediately above the height where the mixing stops. Also, since the temperature profile is often not truly inverted (increasing with height) above a convective ABL (even though potential temperature increases with height), we felt that this choice is acceptable. It was also convenient, since the figures we reproduced for this paper were labeled with Zi as the height of the mixing layer.

Finally, on line 566, we will change "is the refactoring of existing codebases in order to be ported to…" to "is the optimization of the design and the structure of existing numerical model codebases in order to be adapted to…"