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Interactive comment on "Downscaling surface wind predictions from numerical weather prediction models in complex terrain with WindNinja" *by* N. S. Wagenbrenner et al.

N. S. Wagenbrenner et al.

nwagenbrenner@fs.fed.us

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Reply to Referee #1

Thanks for the comments and suggestions. These will strengthen the paper. Here are our detailed responses:

1. Figures 1 and 6-8 will be updated to show a zoomed in version of the butte.

2. R2 and R26 will be added to Figure 1.

3. The diagnostic model evaluated in this paper, WindNinja, is only designed to downscale the flow. WindNinja includes physics for modeling the mechanical and thermal

effects of the terrain on the flow field. WindNinja is capable of interpolating other parameters (e.g., temperature and relative humidity) to a finer grid, but does not provide any additional physics (e.g., conservation of energy) or parameterizations to simulate terrain effects on these parameters. For these reasons, WindNinja does not output additional downscaled weather parameters. Additionally, wind varies more spatially than temperature and RH, so is more important to predict at a high resolution. Wind is known to often be the driving environmental variable for wildfire spread and behavior. We will clarify these points in the paper.

4. Yes, it is correct that high winds are often the most important factor for wildfire spread. This point will be incorporated into the paper.

5. HRRR-initialized 1.33 km WRF runs were not considered in this study, but could be considered in the future.

6. The discussion will be adjusted accordingly to more clearly separate the externally-forced flow and locally-forced flow discussion.

7. LES was not considered for a couple of reasons. Most importantly, LES is too computationally intensive to be used in an operational context in an emergency response situtation such as wildland fire. Additionally, there appear to still be many issues regarding LES in complex terrain. For example, as we understand it, WRF-LES cannot be run in complex terrain with the typical meshing algorithm employed by WRF; instead some other method, such as IBM must be used. Becasue of these issues, LES was not considered. However, we are working with colleagues who have substantial experience with LES that are investigating LES simulations at Big Southern Butte. We plan to make comparisons between WindNinja, the next generation WindNinja with a RANS-based solver added, and these LES simulations in the future.

8. The discussion of the slope flow parameterization will be re-worked. We will also include some background information in the introduction to set the stage for this discussion.

9. Yes, the weakness in simulating lee-side recirculation occurs under high wind speeds as well. We will re-work this discussion to clarify the lee-side flow behavior and difficulty in simulating that behavior.

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