We are thankful for the comments of Dr. Anna Fitch. Below we address all comments (italic and bold) and specify the position of the proposed updated text.

1. Page 3482 lines 21-22: citations regarding high resolution simulations of the impact of wind turbines on boundary layer flow are missing, including Calaf et al. (2010), Porté-Agel et al. (2011), Lu and Porte-Agel (2011), Fitch et al. (2012, 2013a). Further observational studies include Smith et al. (2013) and Rajewski et al. (2013). Also of relevance are wind tunnel studies e.g. Zhang et al. (2013).

Thank you for the suggested literature. We would add Calaf et al. 2010, Lu and Porté-Agel (2011), and Fitch at. al (2013)a to the literature. However, the study of Porté-Agel et al. (2011) is similar to that of Wu and Porté-Agel (2013), which we already use as a reference. Smith et al. (2013) and Zhang et al. (2013), study mostly the changed heat-fluxes due to wind farms, whereas we have simulated neutral conditions without heat-fluxes in our simulations.

2. Page 3483 lines 27-28: here you might like to mention Fitch et al. (2013b) who compare the roughness and elevated drag approaches.

Thank you for suggesting this interesting work. We would add this reference.

3. Page 3484 lines 12-13: the name WRF-WF has not been used in prior work, this should be re-worded e.g. "here denoted as WRF-WF". Similarly with page 3496 lines 1-3. Also, Fitch et al. (2012) describe the parameterization and model formulation whereas Jimenez et al. (2014) compare the parameterization with observations.

Following the comment from Anna Fitch, we would update on p. 3484 l. 12–13:

> . . . The WRF model already includes a wind farm parametrisation option, WRF-WF (Fitch et al., 2012; Jiménez et al., 2014) . . .

to:

> . . . The WRF model already includes a wind farm parametrisation option (Fitch et al., 2012; Jiménez et al., 2014), which we will denote as WRF-WF . . .

4. Page 3496 line 2: it was introduced in WRF version 3.3.

Thank you for bringing this to our attention. This would be corrected in the manuscript.

5. Page 3496 lines 20-23: Fitch et al. (2012, 2013a,b) use both turbine thrust

and power coefficients from a real wind turbine, and it is stated in the WRF model instructions that the idealized data included in the model should be replaced with actual coefficients for the particular turbine of interest (obtained from the turbine manufacturer). The formulation of the parameterization is not based on an empirical relationship. The reason real data was not included in the model was due to legal considerations with turbine manufacturers who do not release this data into the public domain. Idealized thrust and power coefficients are included in the model instead as an example, with the caveat that they are for testing purposes only, not for scientific work. A note regarding this issue in more detail will appear in the journal Wind Energy.

Thank you for this comment. We, however, did not intend to state that the formulation of the parametrisation is based on an empirical relationship. On p. 3496, we described that in WRFV3.4 the thrust coefficient was determined in the WRF-WF module from the power coefficient. Later, in WRFV3.6 both coefficients could be provided via an ASCII file per default. To accommodate also the second major comment of the first reviewer, we would update the final paragraph on p. 3496 l. 19–24 from:

> In WRFV3.4, the WRF-WF parametrisation the power coefficient has been obtained from the power curve information. The thrust coefficient was then determined by an empirical relationship with the power coefficient. Jiménez et al. (2014) improved the performance of the WRF-WF scheme in a comparison against turbine measurements of the Horns Rev I wind farm by using both a turbine thrust and power coefficient. This approach is used in the experiments performed in Sect. 5.

to:

> In Sect. 5, we use the up-dated WRF-WF parametrisation from WRFV3.6, which has no free parameters. The power and thrust coefficients come from the Vestas V80 turbine.

6. Page 3502 lines 10-13: wind acceleration at low levels has been observed by Rajewski et al. (2013).

Thank you for the link to this interesting work. This study, shows velocity profiles in front of and behind a wind turbine for one night in Mid-Summer in the Great Plains. The simulation of this particular case study, would require detailed information about the atmospheric conditions during that night. Therefore, we would prefer to compare the wake profiles from our study (neutral conditions) to profiles that were obtained under similar conditions.

References:

Barrie, D. B. and Kirk-Davidoff, D. B. Weather response to a large wind turbine array. Atmos. Chem. Phys., 10:769775, 2010.

Calaf, M., C. Meneveau, and J. Meyers, 2010: Large eddy simulation study of fully developed wind-turbine array boundary layers. Phys. Fluids, 22, 015110, doi:10.1063/1.3291077

Fitch, A. C., J. K. Lundquist, and J. B. Olson, 2013a: Mesoscale influences of wind farms throughout a diurnal cycle. Mon. Wea. Rev., 141, 21732198.

Fitch, A. C., J. B. Olson, and J. K. Lundquist, 2013b: Parameterization of Wind Farms in Climate Models. J. Climate, 26, 64396458. doi: http://dx.doi.org/10.1175/JCLI-D-12-00376.1.

Jiménez, P. A., Navarro, J., Palomares, A. M., and Dudhia, J.: Mesoscale modeling of offshore wind turbine wakes at the wind farm resolving scale: a composite-based analysis with the Weather Research and Forecasting model over Horns Rev, Wind Energy, 18, 559566, 2014.

Kirk-Davidoff, D. B. and Keith, D. W. On the climate impact of surface roughness anomalies. J. Atmos. Sci., 65:2215-2234, 2008.

Lu, H., and F. Porté-Agel, 2011: Large-eddy simulation of a very large wind farm in a stable atmospheric boundary layer. Phys. Fluids, 23, 065101, doi:10.1063/1.3589857.

Porté-Agel, F., Y.-T. Wu, H. Lu, and R. J. Conzemius, 2011: Large-eddy simulation of atmospheric boundary layer flow through wind turbines and wind farms. J. Wind Eng. Ind. Aerodyn., 99, 154168, doi:10.1016/j.jweia.2011.01.011.

Rajewski, D., and Coauthors, 2013: Crop Wind Energy Experiment (CWEX): Observations of surface-layer, boundary layer, and mesoscale interactions with a wind farm. Bull. Amer. Meteor. Soc., 94, 655672.

Smith, C. M., R. J. Barthelmie, and S. C. Pryor, 2013: In situ observations of the influence of a large onshore wind farm on near-surface temperature, turbulence intensity and wind speed profiles. Environ. Res. Lett, 8, 034006.

Wang, C. and Prinn, R. G. Potential climatic impacts and reliability of very large-scale wind farms. Atmos. Chem. Phys., 10, 2053:2061, 2010.

Wu, Y.-T. and Porté-Agel, F.: Simulation of turbulent flow inside and above wind farms: model validation and layout effects, Bound.-Lay. Meteorol., 146, 181–205, 2013.

Zhang, W., C. D. Markfort, and F. Port-Agel, 2013: Experimental study of the impact of large-scale wind farms on land-atmosphere exchanges. Environ. Res. Lett, 8, 015002.