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Interactive comment on "Atmospheric boundary layer modeling based on mesoscale tendencies and data assimilation at microscale" *by* J. Sanz Rodrigo et al.

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Thanks for the review. Here is our answer to each of the points:

P2 L6 What "larger scales" are meant here temporal or spatial? Here "large-scale" is anything larger than microscale in a broad sense

P2 L5 MOST is not the theory for neutral conditions, it is the theory that extends from neutral to non-neutral conditions. Yes, you are right. I meant MOST applied in neutral conditions.

P2 L10 At this stage it is unclear what "micro-scale models" are. "Microscale" is simply defined in the first paragraph as the flow around and within a wind farm. We believe

this is how the wind energy community understand microscale models.

P2L15 Do the authors mean "ABL models" or "microscale models"? We'd rather use ABL models as the backbone of microscale models dealing with atmospheric boundary-layer turbulence. The paper is about development of ABL models in flat terrain, not microscale models that would include other complexities (terrain, wind farms, etc).

P4L3" Hence, contrary to the original GABLS3 set-up, we allow the mesoscale forcing to retain its uncertainties, for the sake of a more generalized mesoscale-to microscale methodology, and then relax the microscale model simulation towards the profile observations to correct the hour-to-hour bias." I think this needs some more wording to become clear to the general reader. How about: "Hence, contrary to the original GABLS3 set-up, for the sake of a more generalized mesoscale-to microscale methodology, we propose using the large-scale tendencies computed by a mesoscale model as driving forces at microscale without introducing any correction based on measurements. Then, at microscale, the simulation can be dynamically relaxed to the profile observations to correct the hour-to-hour bias."

P4 L26 How is this coordinate system oriented? Yes, we should say "natural Cartesian coordinates (x –> East, y–> North, z –> vertical)

P4 L23 "This meso-micro methodology" Do the authors mean a "one –way coupling" ? Please reformulate. Yes, it is one-way coupling. We will add this distinction.

P5 L 8-9. Why the subscript "pbl" for the turbulent diffusion tendency "pbl" for planetary-boundary layer. We use this term here following the same term in the WRF community to relate to boundary-layer parameterizations or "PBL schemes". We'll add this explanation as follows: "...U_pbl and V_pbl are the turbulent diffusion wind components (equivalent to the so-called planetary-boundary layer (PBL) scheme in mesoscale models)".

P5 L17 are these terms height dependent? Unclear how the height information of the observations is incorporated. Yes, they are all height and time dependent. Observations are nudged according to (4) by using a height-dependent weight function w_z as described in the text. P6 L1 or is it just the diurnal time scale itself? The time-scale tau_nud simply determines how gradual is the bias-correction introduced

P9 Conclusion for GABLS1 not much difference Fig 3 needs some more explanation. Stability is plotted with a color code I'll add a colorbar to the plot although the limits between stability classes can be seen in the contour labels. Fig.3 contour plots summarize the profile characteristics, using a range of surface cooling rates and geostrophic wind magnitudes, after 9-hr of GABLS1-like simulations to a quasi-steady state.

P10L L4 humidity is not relevant as long as clouds are absent. Yes, this is true, although wind energy "microscale" models typically do not include the humidity equation.

P10 L9-12: This is unclear formulated. Are the 5 cycles 5 times the 48 hour periods? How then can consecutive days have almost the same temperature and wind? Also look at the formulation of the caption of fig 4 Yes, the "cycle" here corresponds to the 48 hour long period of Fig.4, which is repeated 5 times to obtain equilibrium (difference between cycle 5 and cycle 4 is small). Fig. 4 dashed line shows two of these cycles. We will remove the time labels 25-Oct-1999 and 26-Oct-1999 since the simulation time after the first cycle does not correspond to real time.

P10 L17-20. A higher k can be a sign of the model being less dissipative, as it is unable to get rid of the turbulent kinetic energy. Yes, you could say that. We'll simply say: "As the closure order is increased, higher turbulent kinetic energy is observed. Higher mixing..."

P11L6 Is 19 m/s correct? Typo, it should say 5 to 10 m/s

P11 L10-13 Is there anything to say about the quality of the advective terms in the meso-scale simulation? The assessment of WRF from Kleczek et al (2014) doesn't

include advective terms.

P12 L3 Fig 7. If I add the individual components I would expect the signature of U_cor to stand out more clearly in U_tend. In the text, we mention "curvature" tendencies not being significant. These are not the Coriolis forces but terms that appear in WRF due to having a curvilinear coordinate system. To avoid confusion we will say: "Curvature (due to curvilinear coordinate system in WRF) and horizontal..."

P12 L3 Fig 7. Bosveld et al. (2014) attributed the strong tendency after midnight to U_adv. Please comment. Yes, there is a clear signature of U_adv in the momentum tendencies during the night. While the timing and magnitude of advection tendencies is difficult to predict, the results of the sensitivity analysis showed that not including this forcing resulted in worse results than including it. This was also mentioned by Bosveld et al. (2104)

P12 L3 Fig 7. The strong peak at midnight in U-adv is after 60 minute filtering only 60 minute wide. This means that in the original data it is even narrower in time, and may indicate a very sharp front. Much sharper then is found in the RACMO run of Bosveld et al. (2014) and much sharper then observed. Yes, the advection tendencies in Bosveld et al. (2014) show a broader peak at midnight. It is difficult to say where the differences come from since RACMO simulations in Bosveld et al. and our simulations with WRF were done at different resolutions and with different input data. We'll mention these differences in the text.

Textual comments: P1L11 insert " cases" P1L15 " from the Cabauw meteorological tower" P2 L5 "site measurements at standard height" P2 L5 "relying" P3 L13 Bass -> Baas (see also P4 L18 and P4 L22) P4 L1 unclear sentence P9 L3 long -> high P9 L9 than -> as P12 L21 "even though the filtering process, .." incorrect formulation P12 L25 "a" should be "at", "than" should be "as". In general please check carefully throughout the manuscript for misspelling! P12 L30 add "This results in an imbalance of forces . . ..." P15 L1 the term "footprint" is confusing, you may want to use " structure" P15 L1

change to " . . . even though more simplified physics is used." Thanks for the editorial changes. We'll include them in the revised version.

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