

## ***Interactive comment on “Seasonal and diurnal performance of daily forecasts with WRF-NOAHMP V3.8.1 over the United Arab Emirates” by Oliver Branch et al.***

### **Anonymous Referee #1**

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Review of GMD-2020-201 “Seasonal and diurnal performance of daily forecasts with WRF-NOAHMP V3.8.1 over the United Arab Emirates” By Oliver Branch, Thomas Schwitalla, Marouane Temimi, Ricardo Fonseca, Narendra Nelli, Michael Weston, Josipa Milovac, and Volker Wulfmeyer

Summary: This study assessed the performance of a high-resolution ( $dx=2.7$  km) configuration of WRF with the NoahMP land surface model (LSM), over 11 months of daily simulations over the United Arab Emirates (UAE). The variables assessed were 2-m temperature (T2), 2-m dewpoint (TD2), and 10-m wind speed (WS10), with observations from 48 surface weather stations across the UAE, divided into three distinct

C1

climatic zones (mountain, marine, and desert). Analysis of RMSE, bias, and correlation was performed diurnally, seasonally, and annually. Overall, temperatures had a small positive bias in daytime and a stronger negative bias at night and away from the coast. Dewpoint generally had a small bias (especially near the coast) that changed little from day to night. 10-m wind speed had a consistently positive bias, and was largest both inland and during daytime hours. Potential causes for these model biases were identified.

Recommendation: Major Revision.

Major Comments:

1. I think calling this model “WRF-NOAHMP V3.8.1” is misleading. Hyphenating WRF with something else (e.g., WRF-Hydro, WRF-Solar, WRF-Crop, WRF-Urban, WRF-Fire) implies a new set of capabilities based on the WRF modeling system, whereas Noah-MP (and it is Noah-MP, not NOAHMP) is simply one of the physics parameterizations that can be used with WRF. If we use WRF with Thompson microphysics, for instance, we do not refer to it as WRF-Thompson, but simply as WRF. I suggest calling this WRF v3.8.1 with the Noah-MP LSM. I am not sure exactly how best to phrase that in the title, abstract, and elsewhere, but that is something that should be changed throughout.
2. Ensure all tables and figures are numbered according to their order of first mention in the text. What is currently Table 1 clearly should be placed as Table 4, judging from the references in the text that refer to the wrong tables. Several figures are also referenced out of order, and references to incorrect figures are made several times (e.g., lines 311–314). I suggest using the caption/cross-reference macros in Microsoft Word to handle automatic table/figure numbering.
3. Section 3.1/Figs. 2 & 3: I am interested in seeing ERA5 climatologies from El Niño years as a third column in those two figures. How consistent is 2015's geopotential height pattern with the average El Niño pattern in that part of the world?

C2

4. Section 3.3, where you surmise many of the causes that may explain the model biases, are all plausible, but this section still feels a little thin. For instance, when discussing the unclear impact of the PBL scheme on T2, TD2, and WS10 diagnostics, you mention that they are computed either by the PBL scheme using MOST or by Noah-MP. Are those diagnostics always computed by Noah-MP? Or only some of the time? And if only some of the time, then when? There needs to be more clarity and understanding here about what physics scheme is actually controlling the diagnosis of those variables. Also, you mention that Nelli et al. (2020a) found similar wind speed biases within a WRF v3.8 simulation. Was that also in the UAE or a similar environment? That should be pointed out explicitly in the text to further bolster your point that these biases are recurring issues and not unique to your study. Furthermore, when it comes to model spin-up time over UAE for these surface variables, could you test that hypothesis of the benefit of a longer spin-up time over, say, 1 month (or even 2 weeks) of simulations? Or would Nelli's retuned roughness length parameter be able to be applied to these simulations for a similar period of time as a demonstration of benefit here?

Minor Comments and Typos:

1. Indent paragraphs throughout. Without either paragraph indentation or blank lines between paragraphs, the paper is harder to read.
2. In most places where a bold phrase followed by an en dash starts a paragraph, either reword the sentence to make the bold phrase part of the sentence, or make the bold heading a new numbered subsection.
3. Date formats throughout the manuscript should be standardized. GMD may have a required format, but most journals typically use dates formatted as, e.g., 12 January 2015 for the main text, and 12 Jan 2015 in table/figure captions.
4. Ensure all abbreviations are defined (several were not defined), and there is no need to redefine abbreviations multiple times.

C3

5. Please use the Oxford comma in lists (i.e., add a comma before the "and").
6. Most of the dashes (also called hyphens) in the middle of sentences throughout the manuscript are incorrectly used. Some should be changed to commas, some should be changed to semicolons or em dashes (that is often a style preference), and some of the sentences should be reworded to either split them into two sentences or to a single sentence that does not require a clause that is set off by an em dash or semicolon. Please consult an English style guide for the difference between dashes, en dashes, and em dashes, and when it is appropriate to use each one, and when a comma or other punctuation might be more appropriate.
7. There needs to be a comma after every instance of "i.e." and "e.g." throughout the manuscript.
8. Hyphenate compound adjectives, such as "2-m air temperature," "2-m dew point," "10-m wind speed," and "2.7-km grid spacing." By contrast, "grid spacing of 2.7 km" does not require a hyphen.
9. Line 40: Change "general circulation model dataset (GCM)" to "general circulation model (GCM) dataset".
10. Line 44: Add Powers et al. (2017, <https://doi.org/10.1175/BAMS-D-15-00308.1>) as a reference for the WRF model (in addition to the Skamarock et al. (2008) reference for the WRF v3 technical note).
11. Line 48: Add "in" after "WRF".
12. Line 58: "verified configuration of WRF" – What does this mean?
13. Line 85: Change "north east" to "northeast".
14. Line 88 and Fig. 1 caption: When providing latitudes or longitudes, there should be no spaces around the degree symbols (e.g., 14.775°N).
15. Line 90: I suggest changing "weather systems" to "predominant patterns." A

C4

weather system evokes something more transient and singular, whereas a pattern is something larger-scale and longer-lasting.

16. Line 110: Change “north-westerlies” to “northwesterly”.

17. Line 111: Change “direction” to “directions”.

18. Lines 111–113: “The sea surface of the Arabian Gulf. . .” âĀĀ Please rephrase this sentence so as to not imply that the sea surface itself is shallow.

19. Lines 120–121: “This domain was selected. . .” âĀĀ This sentence is awkward. Please revise. Also, what do you mean by “twin experiment”? Additionally, it is customary to describe domain dimensions as “900 x 700” rather than “900(x) by 700(y)”. It is understood by convention that the x-dimension is given first.

20. Section 2.3.1 and Table 2: The microphysics scheme should be referred to as the “Thompson-Eidhammer aerosol-aware microphysics scheme” or, for short, “Thompson-Eidhammer”. And on this note, did you verify that all the options in WPS & WRF were set properly to use the QNWFA/QNIFA monthly aerosol climatology with the Thompson-Eidhammer scheme? If not, then what did you use for aerosols? Did it default to settings in the source code? In my experience, it is really easy for people to think they are using Thompson-Eidhammer, when actually they are essentially using the basic Thompson scheme because of forgetting some namelist settings in WPS and/or WRF.

21. Line 147: Change “Surface Exchange over Land model - HTESSSEL” to “Surface Exchange over Land (HTESSSEL) model”.

22. Line 198: Change “year” to either “yearly” or “annual”, and change “season” to “seasonal”.

23. Line 165: Change “((Danielson, J.J., Gesch, 2011))” to “(Danielson and Gesch, 2011)”.

## C5

24. Line 181: Insert a comma after “strongly”.

25. Line 199: Add “aim” after “Another”.

26. Line 231: Change “In order to get” to “To obtain”.

27. Line 249: Add “the” before “diurnal”.

28. Line 286 and elsewhere: Change “m.a.s.l” to “m ASL” or “m AMSL”. You could also say “station 41229 at elevation 1485 m” and not even mention ASL/AMSL explicitly, because it is implied when giving a station elevation.

29. Line 288: Insert commas around the phrase, “such as differences in mountain and desert cloud cover”, and after the references that follow “for instance”.

30. Line 292: Delete “very”.

31. Line 293: Add a comma after “(Figure 6b)” and change “is” to “are”.

32. Line 299: Add a semicolon before “however” and a comma after it.

33. Line 305: Change “in Section 3” to “below”.

34. Line 309: Delete the comma after “nevertheless”.

35. Line 316: Add “radiation” after “shortwave”.

36. Line 318: Delete “the” before “associated”.

37. Line 326: Change “(5e)” to “(Fig. 5e)”.

38. Line 351: Change “(delta)x 100m” to “(delta)x = 100 m”.

39. Line 352: Change “operation” to “operational”.

40. Line 364: Change “who” to “that”.

41. Line 372: Change “there is a good chance” to “it is likely”.

## C6

42. Line 378: Change “Yonsei YSU scheme” to “Yonsei University (YSU) PBL scheme”.
43. Line 379: Change “Jimenez” to “Jiménez” (add the accent mark, as in the reference).
44. Lines 390–391: The sentence that starts, “Nelli et al., (2020a) found. . .” is confusing and must be reworded. Did you mean that there are positive biases when the wind speed is  $< 4$  m/s? Also, “windspeeds” is not a word. It should be “wind speed”.
45. Line 398: I sincerely doubt that if a center is running a daily WRF run for 30 h operationally (6 h spin-up + 24 h data retained) that it would be unfeasible to run it for 36 h in order to gain an extra 6 h of spin-up. The extra computational cost is only marginal for a once-daily run. Please revise the comment about this issue (there are also some grammatical issues with it as-is).
46. Line 404: Change “information on model in respect to” to “information about the model with respect to”.
47. Line 408: Add a comma before “particularly”.
48. Line 409: Add a comma after “biases”.
49. Line 415: Add a comma after “UV-10m bias”.
50. Fig. 2 caption: Change “ms<sup>-1</sup>” to “m s<sup>-1</sup>”. Without the space, the unit becomes inverse milliseconds.
51. Fig 5 caption: Only use “and” before the last item in a series.
52. Fig. 6: I suggest changing the units from K to °C.
53. Table 1: First, this should be Table 4. Second, consider making this a simple figure?

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-201>, 2020.