Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-15

Anonymous Referee #2

Referee comment on "Comparison and evaluation of updates to WRF-Chem (v3.9) biogenic emissions using MEGAN" by Mauro Morichetti et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-15-RC2, 2022

Main comment:

The authors made an effort to update and test the MEGAN biogenic model coupled to the WRF-Chem model. The major problem is that the results are slightly worse than the previous version and the question upon what should be done to improve the model remains unanswered. Also, this poses a question, why to use a new version instead of the older one? In addition, the US case lacks the proper statistical verification and should be done. However the paper provides the information on the new version and can be valuable mid-step towards the further improvement of the model.

Except for this problem, the paper is well written and organized. However I provide a list of minor comments below.

Minor comments:

CA.1) Abstract is too long and includes too many details, particularly part after line 21. Try to point out the main results and make the abstract shorter and/or remove part after line 21 in introductions.

CA.2) Line 24. Sentence The updated MEGAN model… is not clear, what does the estimated BVOC emissions refer to? Please rephrase the sentence

CA.3) Line 27. Is the bias obtained from comparison of measurements and modeled values of ozone? The sentence is not clear, rephrase

C1.1) In Introduction, the 'discussion' regarding the different modeling approach is missing the information about the capability of the models to simulate the BVOC emissions and O3 concentrations. Can you find the information about it and explain in general what is the success of modeling BVOC emissions and O3 concentrations and what are the uncertainties (both in modeling and measurements). Add this part between lines 65 and 80.

C1.2) Line 50. What are the other meteorological parameters used in the MEGAN model?

C1.3) Lines 50-60 should be moved in the model description chapter

C1.4) Line 61-65. Sentence beginning with Zao et al. (2016)... is confusing, particularly after , "namely the Community Land Model,..", what is the relation between Noah, CLM4 and MEGAN? Explain and separate this sentence into 2 sentences

C1.5) Line 65. Which authors, there are several authors cited?

C1.6) Line 67. What do you mean by "**consistent variations** in BVOC emissions predicted with MEGAN v2.1. " ? Paraphrase this sentence

C1.8) Line 71. What do you mean by different meteorological drivers? Aren't the meteorological drivers the same for the BVOC emissions?

C1.9) Line 78. What do you mean by five species?

C1.10) Line 82. Can you be more specific about the evolution of MEGAN versions, why do you use version 2.04, while version 2.1 is the latest version in WRF 4.3.

C1.11) Line 85. Put G12 instead Guenther et al. (2012). Also check this issue in other places in text for consistency

C1.12) Line 85. Again issue with versions of Megan, it is not clear if you use version 2.1 or 2.04 in this study, later you suggest that the comparison was made between versions 2.0 and 2.1…

C1.13) Line 91. Add a link to the AirBase database.

C1.14) Line 100. Add a link to the SAS.

C2.1) As I understand, you made an update of version 2.04 and the updated version is 2.10. Add sentence in the beginning of chapter 2.1.

C2.2) Line 114. To follow the explanation of the emission activity factors, set them in order as in eq. 1, and use brackets i.e., ð□□¾LAI (leaf area index)...etc. Apply this approach further in text if needed.

C2.3) Line 117. No need for typing plant functional type (PFT), use only PFT if abbreviation is already introduced in text before

C2.4) Line 117-118. Explain how the deviation from standard conditions is taken into account.

C2.5) Line 128. Replace influencing with decreasing.

C2.6) Line 129. What is the meaning of the sentence “The integration of MEGAN in CTMs (e.g., temperature, solar radiation and soil moisture)....”? Rephrase

C2.7) Line 133. What is the meaning of the local state “climate”? Rephrase in more precise manner.

C2.8) Line 139. What is the meaning of the sentence after “ included it in the light,..”? Rephrase.

C2.9) Line 140. So you used version 2.04 and updated it to version 2.10? Rephrase and move to section 2.1

C2.10) Line 146. Delete “are comprised”.

C2.11) Line 147. Response emission activity should be mentioned after eq 1., line 115 … here use symbol only. Also, refer to the Tab. 1, since the equation with sine can be found there.

C2.12) Line 148. Class compound or compound class ? Also check line 169.

C2.13) Eq 2, index “i” stands for each compound class? Specify.

C2.14) Line 150. Correct the part “...the Ps the…”.

C2.15) Line 152. The sentence “This new version…” is confusing. Instead of “new version” and “updated version” use the v2.04, or v2.1. Which version uses swdown and which mwdown?

C2.16) Line 158. Are all equations from Guenther et al.(2006), also use G06 instead of citation, also in line 171.

C2.17) Eq 9. Use 0.05 instead of 0,05

C2.18) Line 164. How is the T determined/calculated in the model? Add explanation

C2.19) Line 175. Perhaps write "..values of T24 and T240 are estimated.." instead of "..value of T24 and T240 is estimated..."?

C2.20) Lines 179-180. How is this in agreement with the statement in line 126: "with young leaves emitting no isoprene and mature leaves emitting isoprene maximally"?

C2.21) Line 195, (Error! Reference source not found.Table 1)? Also replace citation with G12.

C2.22) Equations below line 203, eq. numbers 13,14,... instead 1,2,3? Change.

C2.23) Line 211. Explain Cce and canopy environmental model.

C2.24) line 221, use G12…Table 2 is from G12 or from this paper, or both?

C3.1) Figure 3 has some issues; the colorbar has no units, the x value is not explained in the caption and has no units. Also it is unclear how the maps of the isoprene emission factors are obtained in regard to the previously mentioned options (prescribed and eq 1), explain…

C3.2) Chapter 3.1.2. What is the period of simulation and spin up time? Why did you not use

nested domains as in the US case?

C3.3) Line 280. How did you infer the conclusion regarding the mixing ratios inside the PBL versus the free troposphere from Figure 3?

C3.4) Line 291. How did you determine the 2 days is appropriate for the spin up time?

C4.1) Line 310. Why averaging the geopotential field over 6 days? How is this representing the evolution of the synoptic situation?

C4.2) Figure 5. I suggest plotting all the fields on the same map, i.e., plot the temperature as it is, but use contours with ticks for geopotential. Also, the surface pressure would be good to show on the same map also using contours.

C4.4) Line 329. What does the expression "more staggered trend" mean?

C4.5) Line 337. In section 4.1 there is stated that BVOC observations are not available, so how do you analyze the "isoprene and alfa-pinene emissions"? Are the time series from the model?

C4.6) Line 343-344. Why the MG and MGPFT gave the exact same emissions?

C4.7) Lines 350-351. How did you determine the temperature range, is it the diurnal cycle. Is it from the model 995 hPa and if so, why choosing this level? What is the temperature used by MEGAN model, at which level and why?

C4.8) Line 351. What this sentence means: "Kiev look like they may have experienced cloudiness based on the shape of the diurnal profile". Diurnal profile of which parameter? Measured or modeled? How it affects the emissions, is the cause the change in temperature or radiation?

C4.9) Line 361. What is the meaning of the sentence "As with isoprene, the differences

in the isoprene emission magnitudes are caused by the plant functional types, temperature and cloudiness for each city." ?

C4.10) Figure 11, add y and x labels on the figure.

C4.11) Line 386, attitude?

C4.12) Line 397. What do you mean by "Regardless of the location of the monitoring stations, the M2.10, MG, MGPFT runs show similar statistics for ozone….", How did you estimate the effect of the station location if you have one number for each station?

C4.13) I see the general problem in the Chapter 4.1.3. regarding the evaluation of the model: i) the new version 2.10 and all the experiments show the worst results regarding the bias in O3, ii) the correlation coefficient is extremely low for the NO2 and especially for CO, but is it significant? What is the benefit of the new version if the results are worse? iii) How do you explain that there is a fairly good correlation between O3 measurements and modeled values, while CO and NO2 correlation is low?

C4.14) What do you mean by “nitrogen dioxide coefficient correlation has no modifications”?

C4.15) Line 417-419, in the part of the sentence “; the highest biases in O3 tend to occur at locations where there are substantial discrepancies (up to 90 ugm-3)”, the conclusion is inferred from where?

C4.16) Lines 423-428, this part is confusing, how are the results in contrast with those of Jiang et al. (2019), I see no discussion upon low versus high mixing ratios overestimation/underestimation in your results?

C4.17) Lines 428-429, what do you mean by “The NO2 (Figure 14-b) spatial

resolution is not well represented in WRF-Chem, especially in north Europe…”

C4.18) There are two main issues in chapter 4.2.1: i) there is no statistics calculated as r, RMSD, BIAS,... ii) As in European case, the version v2.10 is shown to be worse than the older one, v2.4 (for isoprene and MACR).

C4.19) Lines 461-463, how are the M2.04 isoprene values overpredicted by factor 5 (Fig. 5)?

C4.20) Lines after 482. The discussion is not very clear, what is the conclusion in the end, is the problem in the Megan or the PBL schemes? If the PBL scheme is consistent with meteorological observations, and you use the same meteo setup in all experiments, isn't there a problem in v2.10?

C4.21) Lines 488-490. What is the meaning of the sentence "However, differences between modelled and aircraft data likely do not depend on boundary layer meteorological variables as measurements flights generally take place under weather conditions and boundary layer heights scarcely affected by boundary layer mixing phenomena (Travis et al., 2016)."?

C5.1) Lines 500-505. The conclusion is missing, why is v2.10 having higher bias?

C5.2) Lines 505-510. Statistical evaluation is not performed, only comparison of the diagrams

C5.3) Lines 519-530. What do you mean by stating the new model has more flexibility?The idea of verification the results with satellite observation is valuable, but will this improve the model? Can you be more specific on what should be improved in the model based on the results from this paper.