Geoscientific
Model Development
Discussions

Interactive comment on "A prognostic pollen emissions model for climate models (PECM1.0)" *by* Matthew C. Wozniak and Allison Steiner

Matthew C. Wozniak and Allison Steiner

mcwoz@umich.edu

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Response to Referee #1

Thank you for your compliments and constructive suggestions to improve the manuscript. Referee #1's comments are individually listed below with a corresponding author response. Line numbers in author responses correspond to the revised manuscript.

Comment: General: Throughout the manuscript the word "climatological" or "climatology" is used instead of the word "average" or "mean" with regard to pollen. For example, lines 161- 162 state that: "For deciduous broadleaf forest (DBF) taxa, the Southeast has the highest climatological pollen maximum reaching up to about 700-

1200 grains m-3 around day 100." This is confusing because it is applied to a non climatic/meteorological variable, and because it is used in a manuscript which also focusses on climate. It would be much better to simply state: "For deciduous broadleaf forest (DBF) taxa, the Southeast has the highest average pollen maximum reaching up to about 700-1200 grains m-3 around day 100." Similarly, lines 159-160 could be modified from: "Figure 2 shows the observed clima- tological PFT daily pollen counts averaged over all stations within the defined subre- gions." to: "Figure 2 shows the observed average daily PFT pollen counts averaged over all stations within the defined subregions.". And so on.

Response: All instances of "climatological" or "climatology" with regards to pollen emission fluxes and counts have been changed to "average", sometimes with added specificity (e.g, "8-year average pollen time series", Line 164).

Comment: Line 17, Abstract: "PFT" is used without being given in full earlier in the Abstract, so please provide both the full and abbreviated form here. Response: PFT defined as "plant functional type" at first use in the in abstract (Line 17).

Comment: Line 40, Introduction: The authors may wish to refer to two recently published works that relate to the introductory material here and/or elsewhere in the Introduction: Sofiev M, Prank M. Impacts of climate change on aeroallergen dispersion, transport, and deposition. In: Beggs PJ (Editor). Impacts of Climate Change on Allergens and Allergic Diseases. Cambridge University Press, Cambridge, 2016. pp 50-73. Beggs PJ, Šikoparija B, Smith M. Aerobiology in the International Journal of Biometeorology, 1957–2017. International Journal of Biometeorology 2017. DOI: 10.1007/s00484-017-1374-5 [see section on "Aerobiological modelling and forecasting"]

Response: Beggs et al. 2017 is now cited on a new line that reads, "The interest and growing wealth of knowledge of allergenic pollen is reviewed by Beggs et al. (2017)." (Lines 40-41). Sofiev & Prank 2016 was found useful for the discussion of climate-scale

pollen dispersion models, thus it cited in a new line of the introduction, "Only recently have regional-scale modeling studies of pollen dispersion been conducted for Europe, and they have been used to assess the impacts of climate change on airborne pollen distributions." (Lines 45-47).

Comment: Line 98: This sentence makes reference to "the Finnish emergency modeling system (SILAM)". It would be better to change this to "the Finnish System for Integrated modeLling of Atmospheric coMposition (SILAM)" as given in the Introduction section of Sofiev et al. (2013).

Response: This correction to the acronym "SILAM" has been made on Lines 110-111.

Comment: Line 130, paragraph 1 of section 2.1: Table 1 does not relate to "NAB pollen count data ranging from 2003-2010 at all stations in the continental United States", so delete reference to it and just refer to Figure 1.

Response: The reference to Table 1 was intended to be a reference to Table S1; Table S1 is now referenced at the end of paragraph 1 of section 2.1, and any reference to Table 1 has been deleted.

Comment: Line 139: This line includes a reference to Table 2. There is no Table 2 in the manuscript. Should it be Table S2?

Response: The reference to Table 2 was intended to be toward Table S2. It has been corrected on Line 152.

Comment: Line 140: Change "Cupresseceae" to "Cupressaceae".

Response: This spelling correction was made on Line 150.

Comment: Lines 155-159, paragraph 1 of section 2.2: Currently just two of the four boundaries of each of the five subregions are provided. Please provide upper and lower limits of both latitude and longitude for each subregion.

Response: We have revised the subregion boundaries to include full boundaries as

displayed in Figure 1. (Lines 167-173).

Comment: Lines 161-170: The paragraph in these lines seems to contain several values that do not match what is shown in Figure 2. Specifically, deciduous broadleaf forest (DBF) taxa in the Southeast does not have an average pollen maximum reaching up to about 700-1200 grains m-3. Figure 2b shows that it only reaches up to about 500 grains m-3. In the Northeast, DBF does not reach up to an average of 400 grains m-3. It peaks just above 240 grains m-3. And finally, a sharp maximum of 775 grains m-3 does not appear in the Mountain subregion. The sharp maximum is only about 360 grains m-3. The paragraph should be carefully checked. Line 173: As above, please check the numbers 400 and 200 in this line.

Response: We thank the reviewer for drawing this to our attention. Figure 2 data was found to have errors, and as a result does not match the text as noted by the reviewer. We have revised Figure 2 with the correct data and now the figure is consistent with the manuscript text.

Comment: Lines 184-186: The discussion regarding C3 and C4 grasses here and/or elsewhere in the manuscript may be enhanced through reference to the following article: Medek DE, Beggs PJ, Erbas B, Jaggard AK, Campbell BC, Vicendese D, Johnston FH, Godwin I, Huete AR, Green BJ, Burton PK, Bowman DMJS, Newnham RM, Katelaris CH, Haberle SG, Newbigin E, Davies JM. Regional and seasonal variation in airborne grass pollen levels between cities of Australia and New Zealand. Aerobiologia 2016;32(2):289-302. DOI: 10.1007/s10453-015-9399-x

Response: Thank you for the suggestion. Medek et al. 2016 has been cited in the main discussion of C3 and C4 grass phenology in Section 2.2. New lines of text are as follows: "Similarly, Medek et al. (2016) observed two grass pollen peaks in Australia, with a stronger, late-summer peak at lower Southern latitudes where there is higher incidence of C4 grass. However, the authors note that sometimes this may be due to a second flowering of some C3 grass species." (Lines 211-213). This paper was also

used in the discussion of phenological trends in Section 4.2 with new text as follow: "Trends for grass in Australasia show that the correlation of the end date of the pollen season with average spring temperature is positive, while the same relationship for the start date is negative, suggesting also that season start dates are earlier and season duration increases with warmer climates (Medek et al. 2016)." (Lines 408-410).

Comment: Line 278: Change "met" to "meteorological".

Response: Correction made from "met" to "meteorological". (Line 339). Comment: Line 343: With respect to the Parry et al. 2007 citation, it should be Confalonieri et al. 2007 because the former are the book editors and the latter are the chapter authors. Change also in the References list (i.e., chapter authors first, book editors later in the reference). Further, here and/or elsewhere in this paragraph (lines 342-352) could benefit from reference to the following: Ziska LH. Impacts of climate change on allergen seasonality. In: Beggs PJ (Editor). Impacts of Climate Change on Allergens and Allergic Diseases. Cambridge University Press, Cambridge, 2016. pp 92-112. Ziska L, Knowlton K, Rogers C, Dalan D, Tierney N, Elder MA, Filley W, Shropshire J, Ford LB, Hedberg C, Fleetwood P, Hovanky KT, Kavanaugh T, Fulford G, Vrtis RF, Patz JA, Portnoy J, Coates F, Bielory L, Frenz D. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. Proceedings of the National Academy of Sciences of the United States of America 2011;108(10):4248–4251. DOI: 10.1073/pnas.1014107108

Response: The reference to Parry et al. 2007 has been changed to Confalonieri et al. 2007 as suggested. The additional references are excellent examples of general and advanced discussions on pollen phenology. Ziska 2016 is cited several times throughout the manuscript : "The spatiotemporal heterogeneity of climate change may affect which regions and seasons will be most influenced by climate change (Ziska 2016)." (Line 415-416), with a second citation on Line 419-420 and a third citation in the introduction: "Climatic changes in large-scale pollen distributions are mostly absent from scientific literature, though multiple studies on phenological changes in the pollen

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season have been published" (Lines 43-44). Ziska et al. 2011 has been cited in the discussion of ragweed phenology in Section 4.2: "The apparent trend in the season end date for Ambrosia with PYAAT could be due to the increased number of frost-free days, consistent with global warming, and a strong relationship between frost-free days and changes of ragweed season length" (Lines 410-413).

Comment: Line 359: This line includes a reference to Table 2. There is no Table 2 in the manuscript. Should the reference be to Table 1?

Reponse: We apologize for this mistake. The table reference in section 4.3 should be to Table 1. This has been corrected.

Comment: Lines 505-507, section 5.2.4: This sentence, and this section, seems to neglect any mention that the first of the two observed ragweed peaks in the Mountain subregion (from about day 100 to day 140) is entirely missed by the model.

Response: We have added a note about the spring ragweed peak in the Mountain sub-region in the discussion ("There is a yet unidentified observed spring peak of ragweed pollen at about day 125 in the Mountain subregion, possibly due to an identification error." lines 641-642), though no known source can yet be identified for these somewhat unusual ragweed pollen counts.

Comment: Note also that the lower row of plots in Figure 12 is mislabelled (except for the first in the row). What are currently r-u should really be q-t. q was missed somehow.

Response: Thank you for pointing out this error. Figure 12 has been updated with corrected panel labels, now including q and excluding u.

Comment: Line 532: See earlier comment regarding Parry et al. 2007. Also, a couple of additional references that would be strong support for this sentence are: Lake IR, Jones NR, Agnew M, Goodess CM, Giorgi F, Hamaoui-Laguel L, Semenov MA, Solomon F, Storkey J, Vautard R, Epstein MM. Climate change and future pollen allergy in Europe. Environmental Health Perspectives 2017;125(3):385–391. DOI:

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10.1289/EHP173 Ziello C, Sparks TH, Estrella N, Belmonte J, Bergmann KC, Bucher E, et al. Changes to airborne pollen counts across Europe. PLoS One 2012;7(4):e34076. DOI: 10.1371/journal.pone.0034076

Response: Additional references Ziello et al. 2012 and Lake et al. 2017 have been added to the citation in Line 664 as they support this discussion point. In addition, Lake et al. 2017 was cited in Lines 45-47 in the discussion of recent pollen dispersion modeling efforts.

Comments: Line 570: Change "estimating" to "estimation".

Response: Change made on Line 703.

Comment: Line 584: Change "Association for" to "Academy of".

Response: Change made on Line 718.

Comment: References: These should be carefully checked to ensure the details and format are correct. Details should be carefully checked against the PDF of each article.

Response: All references have been checked against their articles, and the details have been corrected for any references that were missing components or incorrectly formatted.

Comment: Line 731, Figure 1 caption: Instead of using the word "black" to describe the shading of the Pacific Northwest subregion, perhaps the term "dark grey" would be better.

Response: "black" updated to "dark grey" in Figure 1 caption as suggested.

Comment: Figure 2: The RAG and GRA lines are too similar. They are fine when enlarged on screen but when printed they are difficult to tell apart. Perhaps one could be red and the other black (meaning the four lines would be black, red, green, and blue).

Response: The line colors in Figure 2 have been updated such that the previously red ragweed line is now magenta. This appears to provide good contrast for all lines in this plot.

Comment: Line 733, Figure 2 caption: As stated earlier in the comments with respect to the manuscript as a whole, remove the word "climatological" and replace it with "average", such as: Average daily observed time series of pollen count data . . .

Response: This language has been updated from "climatological" to "average".

Comment: Line 740, Figure 3 caption: BELD is defined as "Biogenic Emissions Landuse Database" in Section 3.1 paragraph 2, not "Biogenic Emissions Land cover Database" as it is here in the figure caption. Which is correct?

Response: We apologize for this confusion. The correct name is "Biogenic Emissions Landuse Database". The Figure 3 caption has been updated to reflect this.

Comment: Line 748, Figure 4 caption: Indicate that ragweed is "(g)".

Response: Figure 4 caption has been updated accordingly.

Comment: Line 757, Figure 6 caption: Change the start of the caption to: Monthly average pollen emissions potential . . .

Response: This correction has been made to the Figure 6 caption.

Comment: Lines 777-782, Figure 12 caption: Change the three occurrences of climatologi- cal/climatology. The caption can start: Average daily (2003-2010) time series of pollen counts . . .

Response: The Figure 12 caption has been updated accordingly.

Comment: Line 778: Change RAG from "p-u" to "p-t".

Response: The Figure 12 caption has been updated to reflect the changes to the panel labels in the figure.

Comment: Line 782: Add to the end of the very last sentence "by region and PFT", i.e.: Note: scale of y-axes varies by region and PFT.

Response: This addition has been made to the Figure 12 caption.

Comment: Table 1: The numbers in the production factor (P) column should include the same number of numbers after the decimal point (I suggest 1, e.g., 89.1, 210.0, etc.), and the numbers should be aligned right in the column, not aligned left.

Response: All values right aligned. Decimal places are left unchanged for production factors as those are formatted to reflect the correct number of significant digits in that data. Linear regression values are also updated so that all numbers are rounded to two decimal places.

Best,

Matthew Wozniak

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2017-105/gmd-2017-105-AC1-supplement.pdf