Geoscientific
Model Development
Discussions

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

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Response to Referee #2

Thank you for the constructive suggestions to improve the manuscript. Line numbers have changed in the manuscript mark-up below; thus, line number references in the author responses are to new line numbers generated because of additional or rearranged content. Referee #2's comments are individually listed below with a corresponding author response.

Comment: Line 28: Wind-borne pollen diameters can range more than 70 μm.

Response: Agreed. We have updated this line to paraphrase pollen size ranges described in the literature: "ranging typically from 15 to 60 μm in diameter, while some-

times exceeding 100 μm (Cecchi 2014; Sofiev et al. 2014)" on Line 30.

Comment: Line 221: BELD is not based only on land surveys. The authors should revise and include version information. Response: Thank you for bringing this to our attention. The description of BELD has been updated for accuracy: "The Biogenic Emissions Landuse Database version 3 (BELD) provides vegetation species distributions at 1 km resolution over the continental United States based on satellite imagery, aerial photography and ground surveys, as well as other land cover classification data such as geographical boundaries (Kinnee et al. 1997; https://www.epa.gov/air-emissions-modeling/biogenic-emissions-landuse-database-version-3-beld3)." (Lines 262-266). Access to the version used in this manuscript is now added as a link to the data access webpage with the citation.

Comment: Section 4.3 needs enhancements to better explain how the production factor was obtained for each modeled taxon due to non-uniform methodology. Furthermore, Table 2 does not exist.

Response: We apologize for the table reference error – the original reference in Section 4.3 was meant to refer to Table 1, which is included in the revised mark-up.

Section 4.3 has been modified to describe the production factor implementation in greater detail. The section now reads as follows: "Annual production factors (grains m-2 year-1; or grains stem-1 year-1 for ragweed) for each modeled taxon are provided in Table 1. The annual pollen production factor (pannual) defines the amount of pollen produced per vegetation biomass per year based on literature values. Tormo Molina et al. (1996) report the annual pollen productivity in grains tree-1 year-1 measured from a number of representative trees from several taxa. Morus has no known reference for production factor and was assumed to be 10x107 grains m-2 year-1, conservatively at the low end of the range for other deciduous broadleaf taxa. Other tree taxa and grasses are reported in grains m-2 year-1, while ragweed is reported in grains stem-1 year-1 (Helbig et al. 2004; Jato, Rodríguez-Rajo, and Aira 2007; Hidalgo, Galán, and

Domínguez 1999; Prieto-Baena et al. 2003; Fumanal, Chauvel, and Bretagnolle 2007). To convert from grains tree-1 year-1 to grains m-2 year-1, the production factors are multiplied by the tree crown area given in Table II of Tormo Molina et al. (1996) After sensitivity experiments of running pollen emissions in RegCM4, we find that the literature value of pannual for Poaceae provides better agreement with observations for C4 grass when reduced by a factor of 10, thus we use this value. To obtain the coefficient of daily pollen production over the duration of the phenological curve, $\delta\dot{I}\dot{Z}_{\dot{c}}$phen, the integral of the daily pollen production is normalized to pannual as demonstrated by Equation 2."

Comment: Section 5. The regional climate model setup needs to be described in more detail (i.e. number of cells, resolution, vertical structure, etc.).

Response: Lines have been added in Section 5 to address this deficit: "The pollen tracer transport scheme is extended from one to four bins in this study to simulate the four PFTs (DBF, ENF, GRA, and RAG), with tracer bin particle effective diameters of 28 μm, 40 μm, 35 μm and 20μm, respectively. Additionally, the temporal emissions input is updated to accommodate daily pollen emissions (grains m-2 day-1)." (Lines 500-503). "The horizontal resolution is 25-km with 144x243 grid cells on a Lambert Conformal Projection centered on 39°N, 100°W with parallels at 30°N and 60°N (Figure 1). The vertical resolution includes 18 vertical sigma levels. Boundary conditions are driven by ERA-Interim Reanalysis while sea surface temperatures are prescribed from NOAA Optimum Interpolation SSTs (Dee et al. 2011; Smith et al. 2008)." (Lines 507-511).

Comment: A taxa-based database comparison providing spatial coverage values for each region would be a useful addition.

Response: To address this concern, we have included a new table to display the total land cover for each tree taxon and PFT in each U.S. subregion (Table 2). This provides a useful comparison of regional land cover when comparing the relative magnitudes of pollen emissions and pollen counts shown in Figures 6-13. This table is now intro-

duced in Section 3.1 on Line 277. An additional reference is made on Line 292 in the sentence, "Overall, the CLM4 land cover fractions for forest PFTs are higher on average than the summed BELD taxa, about 2 to 10 times as much in each region, with the exception of California subregion DBF where CLM4 landcover is about half of that in the BELD dataset (Table 2)."

Comment: References need to be carefully checked - i.e. Zhang, R. et al. (2014)

Response: All references have now been carefully checked against their articles, as is noted in the author response to Referee #1, and corrections were made to any references with errors or missing components. We apologize for inconveniences caused by errors in the referencing.

Comment: Production factors and the units listed in Table 1 must be properly referenced.

Response: References have been added as a column in Table 1 to the source information for creating the model production factors. Units are included in the column titles.

Best,

Matthew Wozniak

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2017-105/gmd-2017-105-AC2-supplement.pdf