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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global modeling of primary biological particle concentrations with the EMAC chemistry-climate model" *by* Meryem Tanarhte et al.

Anonymous Referee #2

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Summary

This manuscript has developed a global emissions and transport model for primary biological aerosol particles (PBAP). There have been several other prior attempts to do this for all types of PBAP (e.g., Jacobson and Street, 2009) as well as individual types (e.g., fungal spores Heald and Spracklen 2009; bacteria Burrows et al 2009a/b). In this regard, the work is necessary but the manuscript itself does not make new advances in our simulations or understanding of global PBAP. In general, the manuscript has several major omissions of the data and methods driving the model, and this makes it not possible to interpret the results in any meaningful way. This paper requires major

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Discussion paper

revisions to be acceptable in ACP.

Major comments

1. The manuscript states to have simulated the three main types of PBAP, yet there is no detail in the manuscript about the pollen emissions. The authors need to decide if are going to retain the pollen section of the PBAP inventory. If the authors choose to continue to include pollen in their total PBAP assessment, there are several new sections that are absolutely necessary to understand what how the authors are simulating emissions and when and where they might be important. These include the following:

a. Add a section 2.2.3 for pollen. Section 2.2 is titled "PBAP emissions," with one subsection devoted to bacteria (2.2.1) and the other to fungal spores (2.2.2), yet there is no corresponding section on the pollen emissions. A section explaining the pollen emissions parameterization is absolutely required. Similarly, this should include the size distribution implemented in the model (as is for fungal spores and bacteria).

b. Provide some useful discussion on the pollen atmospheric distributions and their realism. For example, there is no discussion about the pollen emissions distributions that they simulate despite including a figure of pollen (Section 3.4). Specifically, their model simulates the highest concentrations of pollen in the tropics, which is inconsistent with the plant distribution of wind-driven pollen. Most plants in the tropics use insects or birds for transmission, so it is not expected that there would be high emissions in these locations. It is impossible to determine why this is without the explanation of the pollen emissions model (see point above).

c. There are ground-based pollen count observations of similar spatial sparsity to fungal spores. Why is a comparison of measured versus modeled not included?

d. In the final discussion, there is hardly any recommendations or future work regarding these emissions and improvements. Again, if the authors choose to keep pollen in there, a more rigorous discussion is required to explain the role of this specific type of

biological particle.

2. There is no information about the LAI distribution used in the model. This is rather important for the fungal spore discussion, as much of the explanation for the three different fungal spores is often tied back to differences in leaf area.

3. Section 3.2: This type of correlation seems rather obvious: modeled LAI is of course going to be lower in urban areas, so then another factor would have to compensate (and it would be a meteorological parameter). I'm not sure how this would not be taken into account already by the existing models. If the authors think that this is important, then they should explore this in greater detail.

4. Section 3.5: For the FBAP comparisons, why not also include the pollen and see if that improves any observations? The caveat of why FBAP may not (page 6, lines 20-21) or may (page 10, lines 10-13) is rather confusing.

Minor comments

1. The title should reflect the full acronym of PBAP (e.g., add the term "aerosol")

2. Abstract Lines 26-27: Needed?

3. Page 2 Line 19: fungal spores reference about being the most abundant and genetically diverse – this is a rather old reference, is there any more modern support for this idea?

4. Page 2 Line 35: Global and regional models are cited here, yet the papers primarily refer to global studies on fungal spores and bacteria. There is a wealth of literature out there on pollen, and this should be included if pollen is kept in the manuscript.

5. Page 5 line 31: Because the model was run without meteorological nudging, some brief reference to prior met evaluation of the model to indicate to readers that biases in the concentrations are not due to meteorological parameters such as temperature. 5. Page 4, section 2.2.1: More detail on the bacteria emissions, specifically the fact that

they are constant and are not simulate with any meteorological dependency should be made very clear in this section. This is discussed later in the manuscript (e.g., Section 3.5) but it would be clearer to provide more detail here such that a reader is not looking up all the references.

6. Page 4, line 29: what does “best estimate number fluxes” mean in this context?

7. Page 6, line 18: What are some examples of “highly fluorescent particles of non-biological origin,” and would these be more likely to be observed in anthropogenically influenced areas?

8. Section 3.1: Note several references to Figure 1 that should be Figure 2, also, the fit metrics are not displayed as stated in the text (lines 12-13).

9. Section 3.1: Please clarify what model layers are used to compare to observed fungal spore counts, as this also may affect the model evaluation

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