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Interactive comment on "Development of a regional-scale pollen emission and transport modeling framework for investigating the impact of climate change on allergic airway disease" *by* R. Zhang et al.

Anonymous Referee #2

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The manuscript by Zhang et al. describes the development of a regional-scale pollen emission and transport modeling framework that treats allergenic pollens as non-reactive tracers within the WRF/CMAQ air-quality modeling system. This is interesting for two reasons. First, pollen are important allergens and studies such as these are important to improve public health efforts regarding pollen exposure through emission forecasts. Second, recent bioaerosol research has shown that pollen might be an important component of the precipitation cycle in some areas of the globe. Improved understanding of their emissions and transport would thus facilitate further research

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regarding their importance as cloud condensation nuclei.

I can recommend this manuscript for publication in Biogeosciences after the comments below have been addressed.

General comments

The authors mention the keyword *climate change* in the title but don't pick it up later in the manuscript until the summary where they refer to the companion paper by Duhl et al. 2013. I suggest adapting the title if possible to reflect this.

It might be interesting to mention a further motivation for your research in the introduction, namely the fact that biological particles such as pollen can have an impact on atmospheric processes. If you do so, you may want to cite one of the papers in the following special issue of Biogeosciences http://www.biogeosciences.net/special_issue31.html

Specific comments

p. 3980 lines 23-24: You write that the patterns of the pollen sources are based on vegetation distribution maps. However, it's not completely clear from which of the cited sources you take what distribution. Do the different maps differ strongly in species composition and vegetation cover? And if yes, did you for example take the distribution of one plant species from one map and that of a second species from another, or how were those data homogenized? Also, it would be interesting to know how the uncertainties in those maps differ from those investigated in your simulations.

Chapter 2 and equation (1) p. 3982, line 20: You the define the daily pollen emission

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potential as depending on precipitation and temperature. For some species however (e.g. the birch) the amount of pollen produced in one year depends also on the conditions of the previous season ("mast year"). Was this considered in the model somewhere?

p. 3985, line 22ff: it would be helpful to also quickly mention here how the wet deposition process is treated.

p. 3989, line 24: how does this lumping work in the model? You don't have to describe it here but should refer to the companion paper by Duhl et al. so that one can look it up if necessary.

p. 3992, line 2: I find an overestimation of surface wind speeds by 30% quite high! Wouldn't that be a problem when it comes to an accurate calculation of pollen emissions?

p. 3993, line 8: Is the lumping scheme mentioned here the same as in the companion paper by Duhl et al. 2013 or a different one?

p. 3994, line 24: If possible, give values for the simulated lifetime of pollen grains in the model.

p. 3996, line 6: the observed peaks during March might have been missed if the meteorological conditions of the previous flowering season, which determine the current pollen production, haven't been taken into account.

p. 3997, chapter 3.3.2: I guess that another possible reason in the overestimation of pollen might lie in equation 2 which says that the lower a species' canopy height, the higher its escape fraction is. As grass has a very low "canopy", the escape fraction will be high and the emissions might thus get overestimated.

p. 3998, chapter 3.3.3: The problem with the too low emission values for walnut trees might have the same reason as before. Equation 2 states that trees with a high canopy, such as walnut, have a low escape fraction and thus their emission might get underes-

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timated.

p. 3999 and 4000, chapter 3.3.6: After reading the discussion of the pollen concentrations for different species, I'm wondering if equation 2 needs to be adjusted somehow. After all, it seems to predict that plants with a higher canopy will have lower emissions. This is actually counterintuitive, as I would expect pollen emitted for a higher source to travel further and thus have a higher escape fraction. Could you please clarify this?

p. 4010, Table 1: it would be very interesting to see how the settling velocity of the different pollen types differs from model to observation. If such data for comparison are available, it would be good to include them. As the model idealizes pollen grains as smooth spheres while in nature they are irregularly shaped, I would expect different values.

Technical comments

p. 3979 line 16 and 25: correct "Despés" to "Després"

p. 3987 line 11: correct "participant" to "participants"

p. 3988, line 17 (and all following instances throughout the manuscript): write "simulations" instead of "runs"

p. 3988, line 24: to avoid confusion, mention that "YSU scheme" stands for "Yonsei University scheme" as not all readers might be familiar with the abbreviation.

p. 3990, line 25: for a better legibility, rephrase the sentence so it doesn't begin with "10%..."

p. 4001, line 23: correct "maximums" to "maxima"

p. 4004, line 31: change the citation of the Duhl et al. paper from submitted to already

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in discussion (Geosci. Model Dev. Discuss., 6, 2325-2368, 2013).

p. 4009, line 11: As already mentioned by Katrin Zink, the citation of Zink et al., 2011 should be updated to Zink et al., 2012.

p. 4017, Figure 4: The labels of the axes in this figure are very hard to read due to their size, but this might be also a result of the typesetting in the discussion format of the journal. Just make sure that this is corrected for the final version.

p. 4021, Figure 8: Same as above, labels are too small.

p. 4022, Figure 9: Same as above, labels are too small.

Interactive comment on Biogeosciences Discuss., 10, 3977, 2013.