Geosci. Model Dev. Discuss., 6, C867–C872, 2013
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Geoscientific Model Development Discussions
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6, C867–C872, 2013

Interactive Comment

Interactive comment on "EMPOL 1.0: a new parameterization of pollen emission in numerical weather prediction models" *by* K. Zink et al.

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Received and published: 25 June 2013

General Comments:

Parameterization of pollen release is an essential input for numerical weather prediction models. The paper presents a novel approach for developing a parameterization of airborne pollen release. The authors used the COSMO-ART numerical weather prediction model that contains a module to simulate the emission and dispersion of pollen grains and evaluate the performance of the developed parameterization. Performance was compared to the parameterization operationally used by COSMO-ART for modelling airborne birch and ragweed pollen, and validated using airborne pollen concentrations observed at a number of pollen monitoring stations over Central Europe.

The authors clearly comprehensively described major disadvantages of known parameterizations for pollen release (as mentioned in the text Horig, Hopt, S13). These disadvantages were the driving force for developing the presented emission parameterization, in particular the need for simplifications that will allow experimental determination of meteorological influences. The paper contributes to the mechanistic description of the pollen release and it is of particular interest since it addresses the importance of the biological component of the pollen emission process. I strongly believe that the suggested simplifications in required inputs will foster experimental studies that will gather data required for parameterization of pollen release. The authors stressed the plasticity of EMPOL parameterisation with the respect to application in other plant producing species (e.g. grasses, ragweed). However, the EMPOL parameterization is evaluated only for birch and therefore application for other species needs to be tested and therefore remains speculation.

The manuscript was clearly written and well structured. The results were also well discussed. The components of the developed pollen release parameterization are described precisely and thoroughly interpreted.

Specific Comments:

It is difficult to discern exact differences between EMPOL and other known parameterizations for pollen release (as mentioned in the text Horig, Hopt, S13), or at least Hopt which is used in evaluation process. I would suggest including a table (as supplementary material) that will present the exact differences which are described in sections 3.2 and 3.3.

I would also recommend presenting the section 4.1 in the form of a flow chart (maybe provided as supplementary material). This way, the reader could easily follow which factors influence particular steps in the pollen release process. The presented parameterization should serve as a basis for mechanistic description of pollen release in a number of pollen sources (e.g. grasses, ragweed, hazel, alder and ash, as numbered

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in the conclusions) and such a flow chart could serve as a guideline both for modellers and biologists that are going to work on subsequent versions of EMPOL. In addition, the authors should stress critical points where adjustment might be required if the EMPOL parameterization is used for other trees, grasses or ragweed.

There are several comments about the basic concept of the EMPOL elaborated in the section 4.1 that need to be addressed.

1. Environmental influences on Qpollen,day

It was shown that in herbaceous annuals (e.g. ragweed) the production (including pollen production) positively correlates to the amount of available CO2 in the atmosphere (Rogers et al., 2006; Ziska et al., 2000). As a result, the given function would have different outcomes for plants living in urban and those living in rural areas. Similarly, atmospheric CO2 would have different effects at increased distances from roads.

2. Environmental influences on pollen emission

It should be stressed here that opening of the flowers does not necessarily mean that the pollen will be released. Therefore after the pollen is ripe the emission will happen after flowers and anthers are opened. This is illustrative in anemophilous plants (e.g. birch, hazel) in which inflorescences are extended and the flowers are opened (making anthers exposed to environmental conditions) before the anthesis and the release of pollen grains. This means that the opening of flowers is a step before pollen release. In some species flower opening and anthesis are simultaneous, or anthesis can even precede the opening of flowers (e.g. Vitis vinifera) (Staudt, 1999). For other species, particularly anemophilous plants, the flowers have to be opened before pollen is released from the anthers. Since the paper tends to present parameterization concept applicable to a wide spectra of species, the authors should indicate all steps at which modifications could improve the quality of the emission model. Bearing this in mind, besides two given questions (page 3139, line 16), the emission parametrization should also adress how the emission takes place (i.e. the mechanism).

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3. The entrainment of the pollen from the reservoir into the atmosphere

The mean of pollen presentation is different among plant species. The authors mentioned ragweed that presents part of its pollen on surface of the leaves under the flowers. However, there are also plant taxa such as Urticaceae (Dahl et al., 2013) and Moraceae (Rohwer, 1993) that tend to release pollen in an explosive manner. In such species, pollen enters the atmosphere as small puffs. Bearing in mind that the proposed concept is designed to be the basis for the parameterization of pollen release in different plants, it is necessary for the authors to indicate to what extent the type of pollen presentation alters the influence of proposed environmental factors to the entrainment of pollen grains in the atmosphere.

Before the evaluation of the performance of the EMPOL, the authors need to give a short evaluation of the pollen dataset used in the development and validation process (2010-2012). Are there any irregularities in the birch pollen seasons from different locations? As mentioned in the paper, birch shows bi-annual cycle in pollen season intensity (Dahl et al., 2013). Although taking two years (2010-2011) for tuning the parameterization could resolve the problem, I wonder, whether a mast year (more pollen in the pollen season) in 2012 in some stations, would affect the model performance with the respect to predicting concentrations.

Finally, there is an impression that there are not enough references to support some of the statements given in the paper. For example, on page 3142, line 15 the authors say: “Following measured pollen data, the shape of the pollen curve is chosen to be positively skewed”. Does this refer only to measured data from Swiss stations or it is expected throughout Europe? Recent publication by Grewling et al. (2012) confirmed positive skewness of the birch pollen curve in an area of Central Europe. Also on the page 3152, line 24 the statement “These thresholds are based on allergological studies” requires references, especially as the reader is not know the proportion of hay fever sufferers this relates to (e.g. is it the majority of sensitised patients?).

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Technical Corrections:

Page 3146 line 9 The construction "fill up a pollen reservoir“ has a botanical synonym "pollen presentation“ and as such should be defined.

Page 3154 line 10 "forecast" should be "forecasted".

I do not think that the design of figure 7 is appropriate for presentation of correlation coefficients and corresponding p-values because it is really difficult to link them. In addition, it is difficult to link some of the columns in the upper panel to corresponding station code. I understand the intention to emphasize that higher coefficients tend to have lower p-values but I believe table would be better option.

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Interactive comment on Geosci. Model Dev. Discuss., 6, 3137, 2013.