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Geoscientific Model Development Discussions

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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General comments

This paper represents an interesting study offering a new parameterization for pollen emission, by using both biological and physical processes. It represents an excellence contribution to modeling science. However, there are some questions that probably could be clarified and some suggestions to take into consideration only if you consider relevant.

Specific comments

As authors have transmitted, airborne pollen has been detected by Hirst type spore trap (Hirst 1957) (you can include this reference in the text). On the other hand, you can also

mention that all EAN members follow the Minimum Requirement in the Methodology for Routinely Performed Monitoring of Airborne Pollen Recommendations (News, 1995. Aerobiologia, 11:69-70).

Some terms are not clear in some subchapters:

In some occasions, appear in the text "pollen emission" as synonymous of "pollen production". When referring to pollen production, it is important to express "pollen production per plant" or "per flower" or "per inflorescence"...

Probably it should be better to use the term "airborne pollen" or "pollen content in the air", instead "pollen concentration", when referring to pollen under different aerobiological process to avoid confusions. This term is not useful when referring to pollen production.

Regarding the two time scales for two sub-models within the emission parameterization: 1. "The seasonal cycle of pollen emission depends on the percentage of ripe pollen grains in the anthers, hence the development of the plants". Pollen per anther is under genetic and physiological control per specie (Subba Reddi and Reddi 1986), however, the number of flowers or inflorescence per plant depend on environmental factors (Stanley and Linskens 1974), and then with annual variations. For this reason, probably it could be expressed as: "The seasonal cycle of pollen emission depends on the number of flowers or inflorescences by plant, depending on different environmental factors". 2. "The diurnal cycle of pollen emission is driven by the current meteorological conditions that lead to a rupture of the anthers... and to the entrainment of the pollen grains into the atmosphere". Yes, but not confuse that pollen emission always refers to pollen release from the anther and usually occur at the same hour of the day. However, the diurnal cycle, or diurnal airborne pollen curve, also depend on local breezes and atmospheric stability. Probably it could be expressed as: "The diurnal cycle of airborne pollen is driven by the current meteorological conditions that lead to a rupture of the anthers for pollen emission... and to the entrainment of the pollen grains into the

atmosphere under different local breezes and atmospheric stability".

Some confirmations are not clears and they should be supported by references or new results:

"Some plants (such as birch trees) produce less pollen when they grow at higher altitudes" (reference).

MeteoSwiss, COSMO-ART use emission parameterization by including temperature, humidity and wind velocity. However, I think that wind velocity is a parameter influencing pollen dispersion and transport, not really for pollen emission. Probably this project is for airborne pollen parameterization.

"For example, grasses need high relative humidity for the opening of their anthers since they have to swell in order to crack" (more recent references).

"Small plants emit more pollen than big plants" (reference?). In my opinion it is not really clear. First of all, indicate that you are referring to anemophylous plants. Second, some studies on pollen production per plant support that in the case of grasses pollen production per inflorescence varies a lot among different annual or perennial species (Prieto-Baena et al 2003). On the other hand, most grasses (smaller plants) produce less pollen per plant than most anemophylous trees (bigger plants). Anemophylous trees are adapted to produce sufficient amount of pollen for pollination under different strategies (Tormo-Molina et al 1996).

"...thresholds are based on allergological studies" (references).

Other specific comments

"...allergenic plants shed their pollen at different times leading to several pollen peaks..." It is important to consider that "the same plant" can emit pollen at different times during the maturation process for different flowers or inflorescences. However, different peaks in the curve, usually, more correspond to "different plants" flowering at different times along the season, depending on the local clime and topography. On the

other hand, this fact occurs in all plants, not only in "allergenic plants".

"...higher wind speeds would yield higher pollen emissions..." Are you referring to higher wind speeds would yield higher pollen dispersion or transport, once pollen has been emitted? For pollen emission it is more important temperature and humidity, i.e. dry and sunny weather. Probably should be expressed: "...higher wind speeds would yield higher airborne pollen...", isn't it?

To define pollen season, it is necessary to take into account a long database and to know the phenological behavior of the plant. Authors refer to the role of temperature to defining the length of pollen season, however, the rainfall and water availability also play an important role: dryer season possible shorter pollen season.

Regarding other features, it is not clear that: "leaf area index (LAI) and the height of the plants that influence the amount of emitted pollen. If leaves keep the pollen grains within the canopy"... Pollen has been really emitted by plant and deposited on the leaf area, are you referring that pollen has not been well transported? Probably it could be expressed as: "leaf area index (LAI) and the height of the plants that influence the amount of airborne pollen. If leaves keep the pollen grains within the canopy". This proposal is based on the "airborne pollen" refers to pollen emission (release) and entrainment (transport). "The maximal amount of pollen that can be released per day on one square meter if the conditions were perfect", in this theoretical case I suppose that it is considered the potential pollen production per plant (it is easy to calculate) and not the pollen emission (it should be predicted). Isn't it?

"ÃŘplant combines the plant-specific variables that define the potential amount of pollen that could be emitted under perfect meteorological conditions". For potential amount of pollen per m3, I also suppose that you use pollen production per plant and land cover.

"Qpollen, day was set to 2.133$\times$109 pollen per square meter and per day. The maximal amount of pollen that can be emitted per time step. It is calculated from the amount of

pollen that can be emitted per day under perfect conditions (Qpollen,day)". My question is if this figure is for only one day and if the same amount is consider for every day of the month?

If you express that you are using bihourly pollen count, and: "The formula takes into account that the flowers can run out of ripe pollen grains before the end of the day. In our implementation, this will happen after 16 h of optimal emission conditions". At what time you consider the maximum pollen emission? The half-life of the reservoir is set to 12 h. Yes, but pollen content is different among the different 12 hours, isn't it?

When testing the new parameterization, the authors define the pollen season as: "the period between the first and last occurrence of 70 pollen per cubic meter in the observations (daily means). They also "exclude days outside the main pollen season from the exercise". This corresponds to a pollen class of "strong". I think that with this pollen season definition, the authors probably avoid pollen from plants booming at the beginning or the end of the season, in favor of Strong class.

Technical corrections (typing errors, etc.)

Legends for figures and tables should present the complete name, no abbreviations. Table 5 with different seasons, it is not necessary due to bird flower during early spring.

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