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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An important fingerprint of wildfires on the European aerosol load" *by* F. Barnaba et al.

Anonymous Referee #3

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General comments

This study investigates the dispersion of wildfire smoke across continental Europe and its contribution to the aerosol load. The analyses are performed for a five-year period i.e. 2002-2007. The location of wildfires is determined from MODIS fire counts, and the transport of smoke is estimated using a trajectory model (HYSPLIT). Authors show that wildfires have an impact mainly on Eastern and Central Europe, as well as the Scandinavia, whereas the impact is very limited over Western Europe and Western Mediterranean regions.

The results of the smoke dispersion are also qualitatively compared to the satellite observations of the aerosol optical thickness, with the objective of estimating their contribution to the submicron AOT. Authors conclude that 5 to 35% of submicron AOT in

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Europe is due to wildfires, with however a strong seasonal variability.

The applied approach leads to interesting results although it is based on numerous assumptions and a very crude modeling, in particular the representation of the fires daily cycle is omitted. The methodology is well explained, and the study is relevant to ACP. Therefore, I recommend its publications after the following questions have been fully addressed:

1) The horizontal resolution of trajectory computations was set to 2.5x2.5 degrees, which to my opinion is too coarse. Authors need to show that the results are not significantly impacted by this choice by repeating the calculations for a 0.5x0.5 degrees horizontal resolution. If this calculation is computationally demanding, a 2 months time period could be chosen e.g. summer 2003, and the resulting trajectories compared with the current results. An additional section for instance "3.3 Sensitivity analysis and comparisons to previous studies; 3.31. Effects of the horizontal resolution" need to be added to paper, and the new results described.

2) It is not clear in the paper how the diurnal cycle of the fires has been treated. According to p.2324 l.9-11: "One trajectory per day was computed... starting at 10:30LT. ", it seems that the results are based on a singe calculation per day. If this is true, this is an important shortcoming of the paper that needs to be addressed and fixed. The transport of the fire plume will strongly depend on the time of the day when the fires were injected, as the boundary layer mixing and atmospheric stability considerably change during the day. The end result of trajectory calculations is likely to be very different if the fire plume gets injected at 10:30am LT or e.g. 4:30pm LT due to diurnal changes in the boundary layer mixing.

In addition, fires have also a strong diurnal cycle with more active burning during the mid-day and slower burning (smoldering fires) during night. Injection of the fires at 10:30LT is not representative of this cycle in anycase.

This time dependence needs to be introduced in the Equation 1, and the calculations

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repeated for at least 1 year time period, if not the entire paper. To my opinion including this dependence is CRITICAL to the paper, and its results.

3) Authors assume that the fine fraction AOT should follow a sinusoidal behavior during the year based as found in unperturbed regions. Can Europe be considered as unperturbed region is absence of widlfires? In Europe aerosols are both directly emitted from many anthropogenic sources, but also chemically formed from anthropogenic precursors. This anthropogenic fraction contributes, and one would expect also dominate, the AOT signal in Europe. Therefore, is it reasonable to consider their signal as unperturbed sinusoidal one? This point needs to be further JUSTIFIED and discussed. The inability of this paper to treat the anthropogenic AOT fraction is another weak point of this paper that needs to be explained and highlighted in the conclusion.

4) Authors show that AOT display a clear bimodality, which they attribute to the wildfire emissions. Given their crude modeling approach, it is not clear to me if this bimodality could also be due to meteorology, and changes in e.g. relative humidity, precipitations (AOT are very sensitive to RH). Could authors also plot the corresponding yearly cycles for some of the meteorological parameters, and discuss this dependence?

5) Several parts of the manuscript need to be clarified as suggested below. Authors need to clearly state in the conclusion the uncertainties associated with the results.

Abstract:

-p.2318, l1-8: this general description is too long for the abstract (30%). Here be more specific and just explain that the fires impact over Europe has not been assessed although smoke particles largely contribute to the aerosols load worldwide.

-p.2318, l13: replace: “atmospheric transport model” by “atmospheric trajectory model”.

-p.2318, l.13: replace: “to attempt unraveling the wildfires contribution” by “in the attempt to estimate the wildfires contribution”.

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-p.2318, l25: replace the beginning of the sentence by" Our results suggest that the continent-wide smoke haze is expected to. . . ."

Introduction:

-p2319, l.26-28: Do not use the Chernobyl example here as it is not relevant to the paper. Instead, in this sentence provide the typical location of the anticyclone and low pressure systems during these events.

-p.2320: l.7-12 and p.2321, l.14-19: these two paragraphs describe the results of the paper, which is a bit too soon. Authors should state the goals of the paper instead, and also provide its outline.

-p.2321, l.1: replace "from a regular" by "from a typical".

MISR AOT data

-p. 2322, l.25: convert the radius to the diameter, and specify which type of diameter this is.

MODIS fires data

-p.2323, l3: change this title to "MODIS fire counts"

-p.2323, l22: "rate of aerosols" is misused in this sentence, use "amount of aerosols" instead.

Forward trajectory calculations

-p.2324: indicate what meteorological model is used to drive HYSPLIT calculations.

Results:

-p.2326, l.8: change "The so derived" into "The resulting".

-p.2326, l.25: write s.d. as "standard deviation".

Conclusions:

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p.2333, l.15-20: This sentence is too long and difficult to read.

p.2334, l.1: omit “intricate” from this sentence.

p.2334-2335: some sentences are repeated from the introduction and abstract, please rephrase them.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 2317, 2011.