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Atmospheric Chemistry and Physics Discussions

Interactive comment on "2003 megafires in Australia: impact on tropospheric ozone and aerosols" *by* G. Guerova and N. Jones

Anonymous Referee #2

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The authors present a detailed analysis of the Australian fires in 2003. They compare ground- and space-based observations with model simulations from the GEOS-CHEM model. While the model captures the temporal variations quite well, it tends to overestimate the O3 enhancements. The spatial patterns of the aerosol optical depths are reproduced by the model but their values are underestimated. The presented study is interesting, but some important issues should be resolved before it is suited for publication. The main problem is the coarse resolution of the model, given the large variation in O3 on small scales as measured by the ground-based stations. The authors already state in their conclusion that the coarse model resolution is a limiting factor in their analysis. Models with higher spatial resolution are available, e.g. the TM5 model (e.g. Krol et al. 2005, 'The two-way nested global chemistry-transport zoom model TM5:

algorithm and applications', Atmos. Chem. Phys., 5, 417-432) or even the nested-grid option in the GEOS-CHEM model itself as mentioned by the authors if this option is already available for Australia. If possible, using a higher resolution model would be the best thing to do. At least an assessment of the error in the simulated O3 due to the coarse model resolution in comparison with the ground-based observations should be given.

Major comments:

It is not clear what the message of this paper is and in particular the added value of the model used, given its coarse spatial resolution. In the introduction the authors spend a lot of time discussing the effects of the fires, e.g. number of people killed, area burnt, and health effects. However it is not clear how this relates to the analysis presented in the paper. The only hint is given in the conclusion, namely that if GEOS-CHEM NRT simulations are coupled with the national fire monitoring system it can be used to forecast extreme conditions such as in 2003. If this is the message of the paper, i.e. that the standard GEOS-CHEM model used in this paper shows some potential in simulating O3 and AOD but that a higher spatial resolution would be much better and the NRT version of GEOS-CHEM coupled with the national fire monitoring system would help to enable forecasting so that extreme conditions can be predicted then this should be stated clearly in the abstract and the rest of the paper and not only in the summary section.

Both O3 and AOD are discussed in this paper. Enhancements of both are seen due to the fires but only qualitative comparisons are made. E.g. Edwards et al. (2006, JGR 111, D14312, doi:10.1029/2005JD006655) present a correlation between AOD and CO for some biomass burning plumes. What about adding scatterplots of O3 observations versus MODIS AOD in comparison with GEOS-CHEM O3 versus GEOS-CHEM AOD? How well are O3 and AOD correlated in the measurements and in the GEOS-CHEM model? Do these tell you something about the difference in life time of these species and/or which is a better tracer of long-range transport or are both equally

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suited? These are interesting questions which could be addressed in this paper.

Specific comments:

Abstract:

The first 7 lines of the abstract are general remarks and belong more to the introduction than to the abstract.

A remark about the course resolution of the model should be added as it is an important limiting factor of the analysis presented.

Introduction: Please shorten the introduction, since it is very long and contains a lot of details which seem irrelevant for the analysis presented in the paper. Please add a few sentences why you use the model to simulate the O3 observations. What can the model tell you that the observations cannot?

page 3014:

lines 15-19: are the EPA observations taken every two hours and only in the afternoon? If not, why is the model sampled every two hours and only in the afternoon?

Can you give an estimate of the error in the simulated O3 values due to the different temporal sampling of the GEOS-CHEM model and the EPA observations since O3 concentrations can vary rapidly?

page 3015:

lines 10-15: what is the measurement error of the O3 observations? It is probably much smaller than the spread in the measurements, but if I am not mistaken this is not mentioned. It would be helpful to mention this error and how it compares to the observed range in O3 values. l ine 23: are the Cape Grim measurements representative of the fires in Australia or of the local fires?

page 3016,Section 4.2:

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How many grid cells of the GEOS-CHEM model are used in the averages over Victoria and South Australia? I assume that the spread between the grid cells denotes the simulated range plotted in Fig 4?

The observed range still falls within the simulated range according to Fig. 4. Why do you call it an overestimate of the model? A comparison of the mean of all stations within one GEOS-CHEM grid cell with the GEOS-CHEM value in this grid cell would be helpful to reveal whether it is really an overestimate.

Section 5.3: what about observations of O3 and AOD in New Zealand? Do these confirms the O3 and AOD enhancements?

Technical comments:

Section 2.2: It would be useful to add a figure with the stations used in this analysis indicated. You could add it to figure 1 so that the proximity of each station to the fires is immediately visible. I recommend to show only the South-East part of Australia in Fig. 1 and not all of Australia.

page 3013, line 11: temporal resolution of 3 and 6h : do you mean: 'or' instead of 'and'? Which temporal resolution is used here?

page 3014:

line 8: please add the temporal and spatial resolution of this standard model.

line 22: European Space Agency satellite. I guess you mean the Envisat satellite. Please add a reference to the Envisat website http://envisat.esa.int

page 3015, line 8: This is first study -> This is the first study

Table 1: see comment on figure 4 below.

Table 2: as for Table 1, it would be informative to add the observed ranges. What is the error in the measured AODs?

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Figures:

Since the analysis focusses on the south-east part of Australia it would be helpful to zoom in on this region in figures 1,2,3, and 6-9. The dots indicated in some of these figures indicating the EPA observations are hardly visible.

Figure 2: The spatial resolution in this figure seems much higher than the actual model resolution (compare with Figure 6a). Why not show it at the model resolution?

Figure 4: the figure caption states that the black vertical bars and the black stars both indicate the observed range. While this seems to be true it is confusing. I would like to recommend to remove the stars from the graph and instead add the monthly mean observed range to Table 1. Please explain what AEDT stands for. There are several dashed lines present. I would recommend to change the dashed grey line to a colored line to distinguish it from the horizontal and vertical black dashed lines. Please explain in the caption what the horizontal and vertical black dashed lines are.

Figure 5: I assume the Cape Grim measurements are represented by the black stars, not 'dots'? What are the errors of the Cape Grim measurements? It would be helpful to add error bars. Similar for the MODIS AOD: what is the error and can you add error bars indicating these errors?

Figures 6-9 panels c and d: the spatial resolution of the GEOS-CHEM AOD panels seems much higher than the actual model resolution. I recommend to use the actual model resolution for a proper comparison with the MODIS data which have been re-gridded to the model resolution. Brown dots are visible also in these panels but since GEOS-CHEM is compared to MODIS and not to ground-based observations I suggest to leave them out.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3007, 2009.

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