

***Interactive comment on “
A model study of the Eastern Mediterranean ozone
levels during the hot summer of 2007” by
Ø. Hodnebrog et al.***

Anonymous Referee #4

Received and published: 22 June 2012

This is a very interesting paper focusing on a hot summer in the Eastern Mediterranean and investigating the impact of regional emissions from various sources including those from forest fires in Greece and other locations surrounding the Eastern Mediterranean basin on ozone levels using two different mesoscale models.

It represents a significant amount of modeling and analysis work. The conclusion drawn on the need for re-assessment of the CO/NO_x ratios from forest fire emissions is a major contribution of this work. However, several clarifications are needed to make this paper appropriate for publication in Atmospheric Chemistry and Physics.

My major concern is about the potential double-counting of emissions from vegetation:

C3936

To my understanding MEGAN (WRF/CHEM) and EMEP biogenic emissions are calculated based on land-use/vegetation maps that do not account (or do they?) for the forested areas burnt in 2007. Then the biomass burning emissions are added at the top of the biogenic VOC emissions? The authors need to clarify this aspect.

Clarifications are also needed on the consistency between the two applied parameterizations in the biogenic emissions (MEGAN) and the dry deposition scheme. If increasing temperature causes the plants stomata to close and thus reduces deposition, would it be that it also affects BVOC emissions? Are these two effects consistently taken into account or are they treated totally decoupled?

Another point of concern is the accuracy of the plume chemistry as simulated by the mesoscale models. Due to high non linear behavior of O₃ (and OH) to NO_x levels, I doubt that models with resolution of a few tens of km are able to capture the low oxidant levels in the center of a fresh plume. How such model limitation can affect the presented results and conclusions?

Further specific comments:

Page 7619, lines 10-15: this part fits better before the discussion of the CO levels.

Page 7619, line 25: add a reference

Page 7620, lines 23-25 there is some repetition with page 7619 lines 20-25.

Page 7620, line 11: indicate that Poupkou et al. 2009 concerns summertime.

Page 7621, line 19-22: Can you be more specific on the share between increasing BVOC emissions and decreasing dry deposition in the ozone increase in these earlier works? and compare your results to these earlier studies in the discussion session.

Page 7622, section 2: the coordinates of the 4 corners of the two model domains and the Eastern Mediterranean area can be provided here or in the Figure 1 caption.

Page 7622, line 21: the full model name (WRF-CHEM) should be given where it has

C3937

been first mentioned.

Page 7622, line 19: Table 1 should be updated to provide the first model layer heights and if possible, PBL layer heights (or how many layers are within the PBL roughly). The model calculation of temperatures, biogenic emissions and deposition can vary largely based on the first layer heights.

Page 7622, section 2.1: since WRF-CHEM can simulate chemistry feedbacks on meteorology and considering that the periods that are studied in this paper concern forest fire, the aerosol scheme should also be mentioned (if used).

Page 7623, line 11: the configuration of the Oslo CTM2 model should also be briefly described in the supplementary material as in Table 1 for the mesoscale models.

Page 7624, line 28: provide a reference for lumping to RADM2 species.

Page 7625: lines 1-4: How the NMVOC are speciated in the EMEP model?

Page 7626: lines 17-20: Information on NMVOC speciated fire emissions as derived from this study would be useful. It can be provided in the supplement.

Page 7627, line 8: impact of total cloud fraction on PAR: Is this taken into account in both MEGAN and EMEP BVOC emissions calculations? If not, how much of the difference in the computed emissions can be attributed to that?

Page 7627, line 12: ... are ...

Page 7628: line 14: rephrase

Page 7628, line 23: are given

Page 7628, section 3.1. comparisons between modeled and observed surface temperatures in some representative stations can be presented (in supplement) in order to show how good the model was able to simulate the transport.

Page 7629, end of 1st paragraph: explain better the impact of emissions from fires on

C3938

ozone production.

Page 7629, lines 16-17: ozone SURFACE measurements ... in the EXTENDED region of interest. ... (Most of these stations are located upwind the fire events areas. This has to be mentioned).

Page 7629, section 3.2. Reference to Table 4 (in which geographic coordinates of the stations are missing) is needed here.

Page 7630, line 24: EMEP has also a relatively 'low' top at 100 hPa as given in Table 1.

Page 7630, line 25: WAS to be made. ...

Page 7631, lines 2-4: As written it is not clear if the difference in the retrieved CO columns is real or a measuring artifact. This sentence needs rephrasing for clarity.

Page 7631, line 8: fires in Algeria are not seen in Figure 2

Page 7631, last line: contributes

Page 7632: line 2: dilution in the model grid

Page 7633, line 17: Could this discrepancy be due to the strength of the anthropogenic sources in Ukraine? Does this difference persist when the fire emissions impact is separated from the other sources?

Page 7634, line 19: reactivity of NO_x to NO_y: please rephrase.

Page 7634, figure 7: A scatter plot comparison between model and satellite observations would be more informative.

Page 7635: lines 9-11: To my understanding Eastern Mediterranean stations are those in countries surrounding the East Mediterranean Basin, i.e. located roughly south of 45N. Thus some of the stations used for the model evaluation are in East Europe and not South East Europe. Please rephrase.

C3939

Page 7636, line 10: The strength of the emissions is also very different between the two models.

Page 7636, lines 14-20: besides the uncertainties in the emissions, overestimations at coastal sites such as Finokalia can be due to underestimated dry deposition due to the grid resolution that provides more water fraction in the particular grids cell, leading to accumulated O₃ levels.

Page 7637, line 22: indicate which sensitivity study.

Page 7638, line 3: two orders of magnitude

Page 7639, line 16: Table 2 shows that NMVOC emissions in FINN are lower than in GFED, whereas those of CO and NO_x are the other way around. Is there a reason for that?

Page 7639, lines 23-24: Rephrase to discuss NO titration of O₃, HNO₃ formation, NMVOC oxidation.

Page 7639, line 21: GFED emissions are spread EQUALLY (?) over the 16 grid cells?

Page 7639, line 26: impact on ozone

Page 7639 last paragraph: This is interesting – Is there a difference in pollutant lifetimes between the two models driven by chemistry that is making this difference?

Page 7640, line 9: It is difficult to compare the BVOC emissions impact on O₃ calculated by the two models, since the BVOC emissions are very different. A kind of normalization of impact on O₃ to the BVOC emissions might be useful.

Page 7641, line 9: These are areas that are experiencing very high temperatures in the Eastern Mediterranean.

Page 7642, line 16: This agrees with. . .

Page 7642, line 18-19: 'export of ozone': a fraction of ozone is exported but significant

C3940

amounts should be formed by exported precursors.

Page 7643, line 24- 7644, line 1. When boundary conditions are kept the same and regional emissions are changing, the importance of long range transport of pollutants (e.g. O₃/NO_x/PAN/HNO₃/CO) for the regional chemistry is also changing. Some rephrasing is needed to make this clear.

Page 7643, lines 4-7: As shown in Table 2 the largest source of VOC in the region during summer is vegetation. Therefore, ship emissions downwind of biogenic VOC emissions can also produce ozone.

Page 7645, line 5: the largest STUDIED contributor.

Page 7645, line 14: over land.

Page 7654, line 18: in the core of the plume : do not forget that model resolution is 25 km.

Page 7654, line 25: The point here is that all chemistry is faster both the O₃ production and the O₃ destruction reactions.

Table 2: Please add the surface of the studied region in the caption.

Table 5: For EMEP the 'percentile' titles have to be shifted to the right

Figure 6- caption: The data are . . . The model data have . . .

Figure 13 –caption: due to

Finally there are many references to “not shown” material in the results that I consider are important and would be useful to be presented in a supplementary material.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 7617, 2012.

C3941