

Interactive comment on “

The impact of temperature changes on summer time ozone and its’ precursors in the Eastern Mediterranean” by U. Im et al.

Anonymous Referee #2

Received and published: 17 February 2011

General

There are interesting results in this paper, although some revisions should be done before publication in ACP. In general, the language of needs to be revised, and I have suggestions below. There are scientific points/discussions that should be clarified/improved.

The vertical resolution of WRF and CMAQ is a bit unclear and should be improved.

As I comment below, it seems to me that S6 has different meteorology, since it is not

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the WRF meteorology that has been changed, but the input to WRF. If I’m mistaken, this could be made clearer, and if the meteorology differs from the other scenarios, this should be added to discussions on differences between S6 and the others (see specific comments).

In the whole paper the wording “station groups” should be revised. Two stations are no group. I see no problem in looking at the 8 stations independently, why not do that? It would also be nice to see the stations on a map.

Also, some comments on the daily variation should be included. The daily mean is somewhat interesting, but how is the daily variation or even the daily maximum/minimum?

A meteorological discussion should be included to explain the expected outcome of transport vs chemistry. Vertical transport in summer (e.g. convection) will mix surface air up and upper air down, e.g. surface emissions will be transported upwards, and if O₃ increase with height, O₃ will be transported downwards. Horizontal winds usually increase with height, so it is to be expected that horizontal winds will have a larger impact above. However, if I understand the IPR correctly, it diagnoses net transport, so if the horizontal gradient of species is zero, there would be no effect of HTRA.

References need doi-numbers.

Figures need to be updated as explained after my specific comments below.

Specific

P4356, L22: Remove comma after thus.

P4356, L25: A comment on why aerosols (SOA, dust, sea salt) are important would be good. Other dust and sea salt related papers:

Bian, H., and C. S. Zender (2003), Mineral dust and global tropospheric chemistry: Relative roles of photolysis and heterogeneous uptake, *J. Geophys. Res.*, 108(D21), 4672, doi:10.1029/2002JD003143

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Grini, A., G. Myhre, J. Sundet, and I. S. A. Isaksen (2002), Modeling the annual cycle of sea salt in the global 3D model Oslo CTM2: Concentrations, fluxes and radiative impact, *J. Clim.*, 15, 1717– 1730, doi:10.1175/1520-0442(2002)015<1717:MTACOS>2.0.CO;2.

P4358, L27: Change “is a very sensitive region” to “region is very sensitive”.

P4359, L3: Reference for CMAQ needed.

P4359, L4: After (WRF-ARW), add “described in section 2”

P4359, L19: Please clarify if you mean that the thickness of layers range from 8m to 16km, or is it the model top which is at 16km?

P4360, L20: “the city” -> “this city”

P4361, L19: “nitrogen oxide”. I assume you mean “nitrous oxide (N₂O)”. If you really mean nitrogen oxide, please specify “(NO)” also.

P4362, L6: It seems to me that there is no proper reference for the TM4-ECPL.

P4362, L8-9: “all major . . .” -> “the major aerosol components sulfate, nitrate and secondary organic aerosols.” (Perhaps you also model primary organic aerosols?)

P4362, L10: “in to” -> “into”

P4362, L12: “The” before “AERO5 module”, and move the AERO5 reference to after “module”.

P4362, L17: “for the” -> “for in the”

P4362, L21: Is the vertical resolution the same as for WRF? If not, please explain the vertical resolution.

P4363, L4: Space before “%”.

P4363, L5-8: This could be made clearer. There is no difference between PC_i and

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PC_j, except for the summation. E.g. “PC_i is the contribution from each process *i*, and %PC_i is the relative contribution of the process to the sum of the contributions from all processes.” No need for the sentence “and PC_j is the . . .”, that should be clear from the text already.

P4363, L13: “response of” -> “response in”

P4363, L17: Is the spin-up done for all scenarios?

P4363, L18: Perhaps draw sentences together: “2004, however, the model results”

P4363, L19: Add “The scenarios are:”

P4364, L10: As I understand scenario 7 (S6), this changes the meteorology. Does it? Have this been investigated? Does it impact the circulation much? How about the soil properties? Does it change the deposition velocities or even the biogenic emissions? If meteorology differ, this should be stated.

P4364, L21: “comparison of” -> “comparing”

P4364, L22: “from various locations in” -> “within”

P4364, L24: “the quantification of the model success in simulating the” -> “how well the model reproduce”

P4365, L2: Not necessary to capitalize “mean normalized bias” and “index of agreement”.

P4365, L11-13: In the whole paper the wording “station groups” should be revised. Two stations are no group. E.g. “These stations have been grouped . . .” could be revised to “Six stations have been paired due to their close locations, and the comparisons between model and observations for these have been done using the averages of rural stations that fall into the same pair.” I suggest to change all “station groups” and “groups” according to this. In addition, I don’t see why you should need to treat them as an average, please explain. Why not look at the 8 stations independently? Do the

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averages produce better results? If so, an explanation for that would be welcome as well.

P4365, L14: "not fine enough" -> "not able"

P4365, L15: "5 station groups are generated" -> "5 stations are compared, for which 3 are pairs of stations".

P4365, L26: Comma before and after "however".

P4366, L27-28: I don't see why temperature agreement should imply comparable isoprene concentrations. Even if isoprene emissions are only dependent on temperature, you still have chemistry and meteorology which can change.

P4367, L4: Why daily mean? How is the diurnal variation and the maximum values?

P4367, L22: "in the region" -> "in this region"

P4367, L23: Remove "in the region"

P4368, L5: "intensive photochemical activity": I'm still not sure if this is the correct term if the photodissociation rates are unchanged, but where more species to dissociate are produced by e.g. temperature dependent chemistry/emissions. I would use something like "more NMVOCs will then be processed by photodissociation".

P4368, L8: "masses" -> "mass"

P4368, L8: "surface-mean" -> "surface daily-mean"

P4368, L9: "are computed" -> "is computed" and "are depicted" -> "is depicted" (singular distribution)

P4368, L10: "able to capture the pattern within the stations": compared to measurements?

P4368, L10-11: "as CO/NOx . . .": Does this sentence explain the previous sentence? I think line 10-11 should be rephrased.

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P4368, L12: "smallest" -> "low"

P4368, L28: Remove "to the total".

P4369, L2: PBL, is that defined by WRF? What is the definition of PBL used?

P4369, L12: "overall results for each station group" -> "IPR station results"

P4369, L13: I think a meteorological explanation should be included. VTRA mixes air from the surface and above through turbulence or convection, hence bringing high O3 from above down, while surface species are transported upwards (as seen later for e.g. NOx).

P4369, L14: ". At the rest of the station groups, VTRA contributes by" -> ", otherwise"

P4369, L19: "becomes a sink": As I understand, it would be better to add "with height".

P4369, L22: "area": What area? I suppose you mean to the station site.

P4370, L4: "carried away above": Either upward or downwards.

P4370, L4: Sentences as "at the IST station group" could be shortened to "at IST"

P4370, L6: "towards higher altitudes": May also have transport to lower altitudes

P4370, L13: "at all stations" could be moved to: "and NMVOCs at all stations"

P4370, L13: That VTRA is a sink is expected, as explained in comment for P4369, L13

P4370, L21: "that is plotted . . ." this sentence should be removed. Plotting program is irrelevant.

P4370, L21-23: Better rephrasing would perhaps be: "in Fig. 7, showing the circulation vectors along with potential temperatures." (remove "in the two cross sections")

P4370, L25: "As exhibited, in both cross-section" This should be removed. (Exhibit is not the best word to use.)

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P4370, L27: "axis of Etesians"; perhaps make this clearer by adding "winds"?

P4371, L3: Move comma after "Although" to after "Athens"

P4371, L4: "cities" -> "city"

P4371, L7: "towards south" -> "southwards"

P4371, L9: "These results" -> "Our results"

P4371, L10: change "done in the area" to ":"

P4371, L12: Comma after "levels", and perhaps change "during summer in particular" to "especially in summer"?

P4371, L20: "1-to-5" -> "1 to 5" or "1-5", and space before degrees.

P4371, L26: Perhaps add "per Kelvins" after "response"

P4371, L1: (Does meteorology differ? Drydep?)

P4372, L7: "enhanced photochemistry": Does the photochemical dissociation rates change? If not, the photochemistry is not enhanced. If meteorology is different for S6, this could be the case, but otherwise I would doubt that. However, more is processed by photochemistry.

P4372, L8: remove "domain wide"

P4372, L9: remove "O3 level", it is implicit

P4372, L19-20: remove "and increase the O3 concentrations" (it is implicit from the sentence)

P4372, L21: remove "wide" and "concentrations"

P4372, L23: remove "concentrations", it is implicit from units

P4372, L25: Is it domain mean VOC divided by domain mean NOx or domain mean

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(VOC/NOx)? Do they differ? What is the purpose of this domain mean?

P4372, L27: "The PAN" -> "PAN"

P4372, L28: remove "concentrations", it is implicit from units

P4373, L1: "in changes of" -> "of changes in"

P4373, L1: add "the resulting" before "O3"

P4373, L2: remove "layer"

P4373, L4: "O" -> "On"

P4373, L5: If meteorology differ, comment on that also.

P4373, L6: remove "extended"; already said by "around"

P4373, L9-10: "in emission hot spots of" -> "in the emission hot spots"

P4373, L14: "close to the surface over" -> "in"

P4373, L16: "increased free-tropospheric O3 background": What is the normal value?

P4373, L29: Increased O3 transported to or from stations seems to be due to increased production of O3.

P4374, L6-7: Perhaps move sentence "The largest change in DDEP ..." to line 9 before "Less O3 ...".

P4374, L7: "the S5" -> "S5"

P4375, L3: Add "O3": "The O3 production"

P4375, L5: remove "in the area"

P4375, L21: "predictions" -> "model"

P4375, L23: Could also overestimation can be possible?

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P4376, L5: "at downwind" -> "at further downwind"

P4376, L6: remove "while transported"

P4376, L11: The almost linear increase in isoprene emissions from temperature could probably be found from MEGAN. Perhaps temperature is the main driver, certainly if all other parameters stay unchanged between scenarios. If meteorology (soil, humidity) change in S6, does this affect the isoprene emissions?

References Need doi's.

P4380, L20: "crossoads" -> "crossroads"

P4382, L17: "oz" -> "of"

Tables and figures

Table 4

Text: Change "Concentration" to "Mixing ratio"

Table header: change "Species" to "Species (units)"

Figure 1a

I suggest plotting the line AA' and BB' in red. It is difficult to see the black lines.

Figure 2

Titles are almost unreadable

Figure 4

Station name should be included in the plot.

Figure 5

Titles are almost unreadable

Text: Add "daily": "distributions of daily mean surface"

Figure 6

Must have vertical axis

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Figure 8

"mean ozone" -> daily mean? For which day? Day 15?

"mean molar" -> daily mean? For which day? Day 15?

Figure 9

Is this for day 15?

Differences in daily means?

Titles are almost unreadable

Figure 10

Is it the change from day 1 to day 15?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 4355, 2011.

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