Atmos. Chem. Phys. Discuss., 7, S494–S500, 2007
www.atmos-chem-phys-discuss.net/7/S494/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Vertical ozone measurements in the troposphere over the Eastern Mediterranean and comparison with Central Europe" *by* P. D. Kalabokas et al.

Anonymous Referee #1

Received and published: 8 March 2007

1.) General Comments

The paper entitled "Vertical ozone measurements in the troposphere over the Eastern Mediterranean and comparison with Central Europe" presents an analysis of a representative set of vertical ozone profiles derived in the framework of the MOZAIC project between 1996 and 2002. The profiles originating from the Eastern Mediterranean region are classified into "high" and "low" ozone "episodes" and compared with the corresponding profiles from the Central European domain. It is shown that each of these cases corresponds to a specific synoptic pattern with typical directions of the prevailing air flow. Finally, an attempt is made to link the ozone episodes with CO profiles which

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

are considered as a proxy for anthropogenic pollution.

I am afraid I have to say that in my opinion this paper leaves me with a somewhat ambivalent impression. On the one hand, the authors have succeeded to work out the characteristics that distinguish summertime ozone profiles in the Eastern Mediterranean from Central European cases and to connect these differences with the prevailing meteorology. On the other hand, the arguments are presented quite often in a sketchy and perfunctory manner. I think that this paper has good potential but would greatly benefit from additional editing time.

More specifically, I would like the following items to be included/discussed in the paper

(1) A discussion of the common features and unique characteristics of the years under investigation. Specific events such as droughts, exceptionally low or high temperatures (affecting biogenic emissions), wildfires, etc., that would help to put the presented data in a broader perspective.

(2) An attribution of the retrieved sets of ozone profiles to either common meteorological features or unique characteristics of one year. I.e., are the selected profiles spread evenly over the entire period or do they come predominantly from a certain year and can this year then explain the high/low ozone concentrations. Furthermore, in comparing two sets, do both have a similar climatological characteristic, i.e., are both spread evenly or do both of them accumulate in a certain year.

(3) In the second half of the text, several paragraphs need clarification, as I have pointed out in the specific comments.

Finally, I am not sure whether the paper benefits from the discussion of CO profiles. Either the authors need to get into more detail or omit the discussion entirely.

I would, therefore, recommend the paper at hand for publication in ACP only after major revisions of the text as pointed out in the comments.

2.) Specific Comments

ACPD

7, S494–S500, 2007

p. 2252, l. 9-16: I would like to encourage the authors to add at this point a brief characterization of the time period under investigation in terms of meteorological conditions as well as emissions of ozone precursors (biogenic and biomass burning sources). A few sentences summing up the common characteristics but also the possible unique features of individual years would prepare the grounds for the subsequent analysis and put it in a more clear perspective.

p. 2253, l. 11-15: It is not clear to me why the exclusion of the data corresponding to "flights to Antalya" is mentioned in this paragraph. What is the purpose of this statement? Furthermore, the authors set out that the results suggest "that boundary layer processes should be responsible for the enhanced surface ozone levels". What processes? In my opinion Fig.1 and Tab.1 only show that the differences between Eastern Mediterranean and Central European region are most pronounced near the surface. Further investigation would be required to identify these processes and whether they are truly limited to the boundary layer.

p. 2253, l. 15-25: In preparation of the following analysis the data set is divided into four sets on the basis of location of measurement and amount of ozone. It would be interesting to know whether the individual profiles are distributed more or less evenly over the entire period of measurement or accumulate in one of the years. In the latter case the specific set would represent the conditions of one single year more than the "climatological" mean of the period under investigation. The profiles could then be due to a potentially exceptional situation (e.g., the summers of 1997 and 2002 were characterized by exceptionally strong precipitation with severe flooding in several parts of Central and Eastern Europe). If such an accumulation the subsequent analysis would suffer from a certain skewness in the sample.

p. 2254, l. 1-5: It is mentioned that the composite weather maps representing the entire period based on a procedure given in the literature. For a better understanding it would help to add a brief description of the method in one or two key sentences.

ACPD
7, S494–S500, 2007

p. 2254, l. 10: Reference is made to the fact that "high surface air temperature is recorded for this group of days". Could you give maybe a range. Are those temperature records from the same set as the high ozone profiles and averaged in the same way?

p. 2255, l. 9-15: The arguments presented here are difficult to follow. Maybe they would be easier to understand if the authors would extend their discussion. If I understand correctly, the line of argument is as follows: The stable anticyclonic conditions are generally characterized by a pronounced mixing state and aging of boundary layer air. The anticyclone over the Central Mediterranean is acting as a regional conveyor belt that entrains air masses to the Eastern Mediterranean region. During the transport these air masses can be enriched with ozone precursors while passing over polluted areas of the continent. Eventually, this can lead to an accumulation of ozone over the Eastern Mediterranean region.

p. 2255, l. 20-25: The fact that all data in the back-trajectory analysis are taken from a single year seems a bit problematic because the obtained results and conclusions will be representative of the conditions of this year only. Even though the meteorological conditions of this year may be similar to those of the entire data set other important factors, such as, for instance, the chemical reactivity of the atmosphere or biogenic and wildfire emissions, might not. It would be helpful if the authors could, if possible, put the selected data in perspective with the other years and/or the entire period.

p. 2256, l. 1-3: Does that mean that the trajectory starting points are all at the same altitude and do these starting point locations coincide in geographical position and altitude for all back-trajectories but differ in time?

p. 2256, l. 29-30: Primary CO emissions actually are not entirely due to anthropogenic activities. Biomass burning represents another significant source. On the European continental scale in my opinion it appears to be difficult to attribute CO uniquely to anthropogenic sources only. European summers are quite frequently characterized by extended wildfires. Due to the comparatively long chemical lifetime of CO intercon-

ACPD
7, S494–S500, 2007

tinental exchange cannot be excluded either. Therefore, I would not consider CO a tracer uniquely linked to anthropogenic pollution, at least not on its own. Maybe the authors could add a few comments in the text in relation with these issues.

p. 2257, l. 15-18: I am afraid I have to admit that I don't see at all how the shape of the CO profile representative of high ozone conditions can be related in any way to the relative difference between profiles for low and high ozone conditions. I could see some sort of connection if the authors would compare an _increase_ in CO with and _increase_ in ozone. Maybe the authors could explain what they meant to say.

p. 2257, l. 15-30: In addition to the above statement I have to add that the entire paragraph appears not well considered. If I understand correctly the conclusion is as follows: In Summary, the MOZAIC profiles for the Eastern Mediterranean region show that significantly higher ozone levels persistently prevail throughout the entire tropospheric column for the "high ozone" profiles. The high ozone concentration in the upper tropospheric regions in connection with the commonly associated anticyclonic situation are expected to create a downward flux of ozone to the boundary layer which will add to the high ozone burden near the surface. The increase in ozone over the low ozone situation at lower altitudes (700 to 800 hPa) is explained by increased photochemical production due to "the presence of primary pollutants and favorable conditions", the latter partly a consequence of the anticyclonic situation (clear-sky conditions and intense summertime solar irradiation). Finally, the most pronounced difference is seen at the 900 hPa level and is explained by a high concentration of "primary pollutants" entrained to the Eastern Mediterranean boundary layer through the anticyclonic conveyor belt.

The mentioned connection to the CO profiles presented above appears entirely arbitrary and disconnected. It is given without any discussion of causes and consequences: Wherefrom originates the observed CO? What do the observed CO levels implicate? What are possible connections to emissions, i.e., are those "primary pollutants" coming from biomass burning, anthropogenic activities, or maybe are the high CO levels even a consequence of enhanced decomposition of biogenic VOC (the fa-

ACPD
7, S494–S500, 2007

EGU

vorable photochemical conditions would be consistent with such a possibility). The entire paragraph lacks consistency and thoroughness and as such does not help the authors to make their point. Also, what are "primary pollutants"? In connection with ozone are we talking about NOx, VOC, intermediate products, such as PAN etc., that can be transported over a long distance? I am aware of the fact that these questions cannot be answered with the MOZAIC data set. But I think that the discussion of the presented results could benefit from a brief summary of the key contributing factors.

p.2258, l.15-17: I would encourage the authors to describe in more detail what they mean by "leading to regional photochemical activity in the boundary layer". This comment is in fact related to the one in connection with the last paragraph in the discussion of results. What are or could be the key factors?

3.) Technical Comments

p. 2251, l. 22: change to "...due to the surrounding mountains of the Greek peninsula in _the West_ and the the Anatolian plateau in _the East_, ...

p. 2253, l. 7: move the entire sentence "Table 1 summarizes..." up to line 1 of the same page, after "... from the same flights". The reference to both the Figure and the Table makes it easier for the reader to follow the subsequent discussion.

p. 2254, l. 17: change to "... uniform westerly flow over the whole _of_ Europe..."

p. 2254, l. 23: change to "... movement of air masses, _raising_ in fact the boundary layer..."

p. 2254, l. 24-25: change maybe to "... weak pressure gradients _during_ Mediterranean summers..."

p. 2255, l. 6.: change to "... over Central and Eastern Europe (Table 3, _second column_). Update other references to tables accordingly by including the column referenced. It improves readability.

ACPD
7, S494–S500, 2007

EGU

p. 2255, l. 13: change to "... fresh emissions added during the _transition_ of air masses..."

p. 2256, l. 18: change to "... and Central Europe is _visible_." You are talking about a model.

p. 2257, l. 14: change to "... entering the boundary layer reaching 250 ppb close..."

p. 2257, l. 19: change to "... which is associated _with_ the presence..."

p. 2268, Fig. 2: In the caption change to "... of geopotential heights at 925 hPa: (a) _for_ the group... (b) _for_ the group..."

p. 2269, Fig. 3: In the caption change as above.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 2249, 2007.