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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The influence of European pollution on ozone in the Near East and northern Africa" *by* B. N. Duncan et al.

Anonymous Referee #1

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General comments

This is a well written, very interesting and important paper. I think it really clearly shows the importance of European ozone pollution on the surrounding regions, a topic that has been largely overlooked when long-range transport issues have been considered. Policymakers, such as those involved with the UNECE Convention on Long Range Transboundary Air Pollution (CLRTAP) should be alerted to the results.

I have only a few, relatively minor comments, suggestions and requests for clarification.

Specific comments

p1914, l7-10. 'We estimate that 19 000 additional mortalities occur annually in these regions from exposure to European ozone pollution and 50 000 additional deaths glob-

ally; the majority of the additional deaths occurs outside of Europe.'

This sentence is not entirely clear. It says that there are 31000 deaths not in the Near East/N. Africa, and >25000 outside Europe, and <25000 inside Europe, but it takes a bit of thinking about. I suggest it could be made more obvious exactly what your findings on additional mortalities are; I guess by listing the key numbers from Table 2.

p1917, l14. By 'augmented', do you mean that the regional emissions inventories overwrote the global EDGAR data, or that they were somehow merged? If they overwrote, were there any problems with discontinuities at the boundaries? Clarify exactly what was done.

p1918, l14. We need to know the units of ENOx - is it in N or NO2, as this will obviously affect the EO3 value.

p1918, l19. What is done with ship emissions at >60 degrees latitude? Presumably they are not pre-processed at all?

p1918, l23/24. 'Boxes without other emissions sources.' Does this include natural oceanic emissions, such as DMS or hydrocarbons? (Possibly the model does not include these; if it does, perhaps this should be 'Boxes without other anthropogenic emissions'.)

p1918, l25. Add 'open sea': Our approximation gives an annual production of ozone from open sea shipping of 4.4 Tg ozone... This begs the question: what fraction of ship NOx is emitted in coastal regions? I.e. what fraction is not subject to this pre-processing calculation, and is therefore presumably not accounted for in the value of 4.4 Tg O3? This value could be compared to the results from a recent multi-model assessment of ship emissions (Eyring et al., 2007: ACP 7, 1995-2035, 2007) - their Figure 9 shows a similar value for tropospheric ozone burden due to ships, from a similar total ship NOx emission - even though none of the models in that work applied pre-processing.

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p1919, l1-8. Maybe comment that Eyring et al. (2007) (see previous comment), which applied no plume processing, but used similar emissions, found roughly double this contribution of ships to surface ozone (e.g., their Fig. 7f).

This discrepancy between the two studies (i.e. that the change in ozone burden due to ships is similar, but that the change in surface ozone concentrations is only half that in Eyring et al. (2007)) suggests that transport from the marine boundary layer to the free troposphere is rather different between the GMI model and the Eyring et al. models (stronger in GMI). I think this is a point worth making concerning the uncertainties associated with the impacts of ship emissions, in addition to the potential importance of plume processing.

p1923, l14. '(2K/km)' - perhaps slightly expand on this tropopause definition. Is it if the local vertical temperature gradient across a model layer (or between layers?) is >= 2K/km, then you assume you are in the stratosphere?

p1924, l8. Delete first 'and'.

p1924, l25 and Figure 4: Is it worth extending the domain plotted in Figure 4 up to 90N, so that the extension of the yellow/orange (5/10 ppbv) ozone difference contours further into the Arctic can be seen? I appreciate the main emphasis of the paper is on the Near East and northern Africa, but it would also be interesting to see the European impact on the Arctic.

p1925, l19 and Figure 6: Is it worth adding a spring (April) panel to Figure 6? This would mean all 4 seasons are shown, and spring is particularly interesting, given that most remote northern mid-latitude regions show a spring peak. I also think the switch from ozone decreases to increases is probably not symmetric either side of the summer, and it would be interesting to see and discuss this.

p1928, l1-3. Presumably the definition of 'Western Europe' (used for the mortality rates) is a little different to 'Mediterranean Europe' (used for the population density). It

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is probably worth clarifying these - in particular what are the relevant fourteen world regions used for mortality? (p1927, l9)

p1928, l26. '...uncertainty in ozone-related mortality calculations...is fairly substantial' - Can this be better quantified? I appreciate this is difficult (and that you follow this with some discussion on the topic), but I wonder if terminology along the lines of IPCC's 'likely' (>66% chance) and 'very likely' (>90% chance) etc., could be applied? Phrases like 'fairly substantial' are not that useful.

Technical corrections

p1917, l16. 'Verstrengetal.,2005'. Add spaces and check: this is Versteng et al. in the reference list.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 1913, 2008.