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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Two-years of $NO_3$ radical observations in the boundary layer over the Eastern Mediterranean" *by* M. Vrekoussis et al.

**M. Vrekoussis et al.**

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We would like to thank the referee for the time he/she has spent on the manuscript and for his/her useful comments that help improving the quality of the manuscript. All the comments of the referee have been taken into account; some of them have been already addressed in the replies to the referee 1:

Reply to the general comments: We agree with the referee that both production and destruction affect NO3 levels. Indeed the lower NO3 levels in winter are due to both the lower production as and higher destruction. All information is already available in the manuscript but some rephrasing has been performed for clarity. - In figure 6b (figure 7 in the revised manuscript), P(NO3), the production and f(NO3), the loss rate of NO3 radicals; the caption of this figure has been modified to facilitate the reader. - The NO3 lifetime deduced from the observations for the various studied periods is given in Table

2. Thus, in page 9523, line 4, the discussion of the seasonal pattern of NO3 levels has been improved to direct the reader to this table and to the discussion on NO3 losses: 'NO3 radical levels are high in spring (seasonal average 3.7+-0.9 pptv) and summer (5.6+-1.2 pptv) and low during winter (1.2+-1.2 pptv), and follow those of its precursors, NO2 and O3 and of NO3 lifetime depicted in Table 2 (see discussion in section 3.3.2).' Further improvements were done as listed in the reply to reviewer #1 comments 4, 7, and 8.

The study by Heintz et al. (1996) was already cited in the manuscript (page 9520, line 24; page 9522, line 24 and in Table 1), however we added the following acknowledgement at the end of section 3.3: 'the methodology applied by Heintz et al. (1996) has been followed.'

The background of this analysis is already provided in the introduction of section 3.3. The discussion in section 3.3.2 has been enriched as suggested by both referees. In particular see replies to referee #1 comments 7 and 8

In page 9524, line 15-18, it was clearly stated that 'Each of the 32 high NO3 episodes observed during this study can be classified within one of these two categories (12 in case one and 20 in case two shown below).' We have added a paragraph break in page 9524, line 13 to attract the attention of the reader to this sentence.

Section 3 has not been restructured. However, section 3 and its subsections have been renamed for clarity: section 3 as 'Results and discussion', sub-section 3.1.1 as 'Case 1: Intrusion into the boundary layer' and section 3.1.2 as 'Case 2: Transport from pollution sources', Sub-section 3.2. as 'Correlations between NO3 radicals and related species-statistical analysis.' Section 3 has been enriched for clarity to address the specific comments of both referees (see further replies).

Specific comments: 1. Abstract, This sentence has been rephrased to: 'NO3 radicals follow a distinct seasonal dependency with the highest seasonally average mixing ratios in summer (5.6+-1.2 pptv) and the lowest in winter (1.2+-1.2 pptv).'



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2. line 10: the sentence has been modified as suggested : 'used to reveal possible relationship with the observed NO3 variability.'

3. line 13: This part of discussion has changed as discussed in the replies to reviewer #1

4. Abstract, last sentence has been modified: 'These observations support a significant contribution of NO3 nighttime chemistry to the oxidizing capacity of the troposphere.'

5. page 9518, last line: 'NO3 radicals are formed in the lower troposphere mainly via reaction (R1)'

6. page 9519, line 3: we now mention 'measurable levels (c.a. 1 pptv)'. The expected steady-state daytime NO3 levels for typical conditions in the studied area are calculated to be about 0.1 pptv (page 9528, line 17).

7. text has been moved as suggested.

8. line 4: 'transient' has been added

9. To our knowledge there is no clear evidence that N2O5 reacts with water dimmers. Text in parenthesis has been removed.

10. page 9520, line 14: done

11. page 9521, 'the following changes have been made 'corresponding reference spectra', 'integration time'; 'and by periodically shifting' has been removed. Detection limit is now given without variation.

12. page 9522,line 10: The sentence has been rephrased: 'The meteorological parameters (temperature, relative humidity, wind speed and direction and solar irradiance) have been measured by an automated meteorological station and then averaged over 5 minute intervals.'

13. page 9522,line 19: The variation of the average nighttime NO3 refers to the stan-



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dard deviation as stated.

14. page 9522, lines 24-ff: This part has been modified to address also of referee 1 comment 1; see in reply to referee 1

15. page 9523, line 3: see reply to the first general comment; (line 9): 'The annual mean NO2 mixing ratio based on observations above the detection limit is 0.31+-0.13 ppbv.' This information was indeed missing and is added in the revised manuscript.

16. page 9527: fA and fB are defined in line 12, for clarity equation 2b is added: f(NO3)=fA+fB=P(NO3)/[NO3] [eq. 3]

17. P(NO3) is now given also in molecules per cm3 per second (p. 9528, line 13). Units of R8 (now equation 9) were given in the caption of Table 2 (page 9537); they are now also given in the main text after equation 9.

18. section 3.4: The calculated NO3 lifetime is given in the Table 2, reference to this table is added at the end of the first sentence of section 3.4: 'and presents large temporal variability (up to a factor of 5) shown in Table 2.' Discussion on O3 loss has been removed.

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9517, 2006.