

## ***Interactive comment on “The changing role of organic nitrates in the removal and transport of NO<sub>x</sub>” by P. S. Romer Present et al.***

**Anonymous Referee #2**

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This paper evaluated the relative importance of two NO<sub>x</sub> removal pathways, forming HNO<sub>3</sub> and RONO<sub>2</sub>. The fraction of NO<sub>x</sub> loss via RONO<sub>2</sub> chemistry was approximated the contribution of VOC to the total OH reactivity with additional consideration of RONO<sub>2</sub> yield. The comparison of such simple calculation and 13 field campaigns results show consistent trend, which give confidence to conduct long-term prediction. The impact on the ozone production is discussed based on the growing importance of RONO<sub>2</sub> chemistry to NO<sub>x</sub> loss. Finally, the spatial distribution of NO<sub>x</sub> lifetime is evaluated using WRF-Chem model for the 2013 summer United States. This paper presents an interesting result on the fate of NO<sub>x</sub> using a simplified but insightful approach. The paper is well written and the method to evaluate the fate the NO<sub>x</sub> is helpful to diagnose the non-linearity of the atmospheric chemistry. I recommend publication after

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the following comments are addressed. Comments: (1) The uncertainty in the radical budget calculation. In the appendix, the production of OH, HO<sub>2</sub> and RO<sub>2</sub> are not complete. The HONO photolysis, alkene ozonolysis are missing. How much does the result rely on this budget analysis? Some results showed that HONO photolysis, as an OH source, is more important than ozone photolysis in polluted environments (Mao et al., 2010; Tan et al., 2019). Ozonolysis of alkenes, isoprene, and monoterpenes could be important radical source in forest areas (Griffith et al., 2013). A discussion on this missing radical source and its impact would be helpful. Also, I assume these radical concentrations are used to calculate the P(HNO<sub>3</sub>) and P(RONO<sub>2</sub>) separately for each 13 campaigns but it's not clear in the context. The authors should make this point clearer. (2) The detail description of alpha. The organic nitrate yield is determined for different VOCs and explained in the appendix. However, I would suggest adding a table to describe the range of organic nitrate yield. As I found in Figure 2, the least-squares fit is  $y = (1 + 125x^{1.06})^{-1}$  and 125 should be equal to  $1/(\alpha \cdot f_{NO} \cdot Y_{RO_2})$ , the alpha would be 0.008 if  $f_{NO}$  and  $Y_{RO_2}$  are unity. In this case, a comparison with least-squares fit to Eq. 4 and discussion on the parameters would be helpful to the reader to understand what the meaning of such fit function is. (3) Some argumentation are too general or without explanation. Page 4 Line 23, please define low-NO<sub>x</sub> Page 9 Line 1-2, according to Fig. 3, this statement relies on an assumption that many regions are located in the transition regime (e.g. NO<sub>2</sub>R/VOCR ranges from 2e-2 to 1e-3). The authors should provide relevant information to support this argument. Page 9 Line 12, please define comprehensive metric. Technical corrections: Page 5 Line 1, 'NO<sub>2</sub>R' 2 should be subscripted. Page 5 Line 2, please provide the reaction rate constant for OH+NO<sub>2</sub> reaction and the literature. Page 9 Line 10, 'P(O<sub>3</sub>)' 3 should be subscripted. Page 13 Line 14, (A3)  $2j\text{HCHO}^*[\text{HCHO}]$  Page 13 Line 19, (A8)  $L(\text{OH})$  should be  $(\text{VOCR} + \text{NO}_2\text{R})^*[\text{OH}]$

References: Griffith, S. M., Hansen, R. F., Dusanter, S., Stevens, P. S., Alaghmand, M., Bertman, S. B., Carroll, M. A., Erickson, M., Galloway, M., Grossberg, N., Hottle, J., Hou, J., Jobson, B. T., Kammrath, A., Keutsch, F. N., Lefer, B. L., Mielke,

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