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Interactive comment on "Estimates of lightning NO_x production from GOME satellite observations" *by* K. F. Boersma et al.

Anonymous Referee #1

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General comments:

This is a well written paper, with a new analysis of the contribution of lightning to the nitrogen oxide production in the troposphere. Data from the GOME satellite are used to infer the significance of lightning to NOx production. Although there are many uncertainties in the final calucalation of the NOx production, these uncertainties are addressed in the paper, and even though there are many steps taken from the satellite data collection of NO2 at 10:30am to the final NOx estimate, the results provide additional independent scientific estimates of this uncertain source of tropospheric NOx. My one concern was actually the depth the authors went to analysing all the different possible error. I think section 6 is much too long considering all the other possible

uncertainties before this stage of the research (that are addressed by the authors). I would recommend greatly shortening this section 6 to a very brief discussion on all the error analysis. There are some minor comments below that need correction and addressing before publication. However, if dealt with I think this paper should be published after the minor revisions.

Specific comments:

Abstract: third line NO2 is written twice. This should be NO + NO2 Pag4, paragraph 1: "kernels also allow a meaningful" Page 5, last line of section 2: This implies a 50% error! Page 6: Please explain what are "ghost column difficulties" PAge 6, middle: How do you define ocean? Majority of gridbox having ocean? Total gridbox with ocean? Page 6, bottom: "as a validation of the power-law parameterisation" All through the paper the word "parameterization" is mis-spelled. Please check. Page 6, last sentence: There are very large changes in cloud properties withe altitude around 10km. Up until -40C you can have mixed phase clouds (ice and supercooled drops) while at temperatures below -40C you have ONLY ice. This is exactly the altitude (10km) where these changes can occur in the tropics. Page 7, first paragraph: "a 24 hour-average ratio of 5" Figure 5: There are many more clouds over the oceans at 10:30. How did this influence your statistics in Figure 4? Page 8: The CP parameterization is only good over continents and not over the oceans. You have to be careful using continental relationships over the oceans, and vice-versa. Page 8, section 4.1.1: How sensitive are your results to the assumption that "deep convection over oceans is 10 times less efficient in generating lightning". If this was 5 times less, would the final results be twice as large? Page 10, sectino 4.3: The correlations imply a good connection between the variability of the two estimates. What about the absolute values? GOME shows twice the amount of NO2 compared with the model. Page 11: why were only 14 data points used in the correlation? It would be more convincing if this number could be increased. PAge 12: middle: What about the influence of the stratosphere-troposphere exchange, aircraft, etc. ? Page 14, second paragraph: a CG:IC ration of 1 would reduce the overestimation

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over the oceans, but would this not increase the error over the continents? Page 14, middle: Why was the TRMM data not used to investigate the diurnal cycle. In fact, the LIS/OTD website give the mean diurnal plot for oceans and land which could be used in this study (http://thunder.nsstc.nasa.gov/bookshelf/docs/white_paper_driscoll.html) Page 16, Figure 10: I would not say that the agreement is very good. Africa in GOME analysis is very strong source, and in the model quite weak. Page 21, last paragraph: "The upper plot" Figure 4: caption states "left" and "right" when this should be top and bottom. Also there is a "35" floating around for no reason. Figure 6: Why only 14 data points when you have measurements every day at 10:30am. Figure 8: caption - left, right should be top,bottom

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 3047, 2005.