Atmos. Chem. Phys. Discuss., 9, C658–C661, 2009
www.atmos-chem-phys-discuss.net/9/C658/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysing spatio-temporal patterns of the global NO_2-distribution retrieved from GOME satellite observations using a generalized additive model" *by* M. Hayn et al.

Anonymous Referee #1

Received and published: 8 May 2009

General comments: The article titled "Analysing spatio-temporal patterns of the global NO2-distribution retrieved from GOME satellite observations using a generalized additive model" by Hayn et al. represents an effort towards much needed rigorous quantitative analysis of satellite derived trace gas observations. The idea of finding functional form for components of the observed data is scientifically very interesting, and using a rigorous mathematical model could provide more insight into satellite observations. If published, this will be a valuable contribution to still insufficient literature on satellite data analysis. The authors use a dataset of NO2 observations from GOME span-

ning few years, but this choice is not clearly justified. Description of the data analysis method is generally clear, but very much obscured by vague and confusing notation. The scientific substance is lacking. Most of the results sections state previously reported findings and contain little insight. I also have fundamental objections to many of the conclusions (and I describe them in detail below). In addition, the manuscript lacks proper recent citations, contains many inexcusable typographical errors and figures that are out of order. Before it can be published, the manuscript needs fundamental revision if not rewriting. Only given the potential for scientific contribution considering the method and data used, I would not reject it outright.

Specific comments: Introduction and abstract: 1. Abstract and Introduction: Authors refer to multiple sensors even though they only consider GOME observations. Please delete this misleading text. 2. Introduction: first paragraph has old and outdated references, please update. 3. missing discussion of Boersma et al. 2008 and Boersma et al. 2008 (acpd) for diurnal and weekly cycle. 4. l. 9-13: although it appears to be a crucial point, it is very unclear Section 2 5. While the authors provide (too?) much detail about the GOME instrument, they talk very little about the quality of data, associated error, bias, loss of data due to cloud cover etc. etc. Much more information is needed here. 6. The resolution of ECMWF met fields is very coarse. Also, it is not clear why 24h average is better than, say 6 to 12. Again, more details and justification is needed. Section 3 7. The use of R notation to denote time dimension that varies with each footprint is incorrect or at least unnecessary. 8. The inconsistencies in using Y and X (and bold Y and X, bold y and x, bold italic y and x) need to be fixed. 9. Make equation y = $\eta + \varepsilon$ into equation (1) 10. x and f subscripts (i,j,k) are highly confused and at times incorrect. It is not clear if they correspond to n, m or T ranges. Please clarify 11. Appreciating authors' efforts to be as general as possible, I find description of the functional form unnecessarily vague and unclear. I suggest starting with an example like fann etc. It would also be helpful to say what e.g. frain would correspond to in x space, amount of rain? 12. l. 23-24 but X is not observed (p. 9375) 13. l. 5-15 (p. 9375): it's not clear if this is all in GAM. 14. Equation on l. 3 (p. 9376) has very

unclear dimensionality 15. l. 2 (p. 9377) “qualitative search” is too vague of a term to describe what the model does, please improve the description 16. l. 4 (p. 9377) same as above “irrelevant variable”âĂŤhow is that determined? Small b? 17. l. 18 (p. 9377) again, I thought observations were only of Y, not X 18. l. 11-15 (p. 9378) Please elaborate on how the approximation of considering only surface winds affects the results, how much error does it introduce. Section 4 19. l. 16 (p. 9379) Fig 3. does not show p-values 20. l. 5 (p. 9380) “vary in space on large scales only”: what does that mean? Continental scales? Here and elsewhere please be specific, otherwise the reader learns nothing. 21. Section 4.1: I do not find this section convincing. Why would Indian Ocean region experience stratospheric correction errors, but not other places? We at least need a reference for that. Does your further analysis of wind speed and direction confirm the findings in paragraph 4 of this section? Paragraph 5 describes Tran Siberian railway pattern which is nowhere to be found in Figure 5. Paragraph 6 brings no new science. On l. 2 (p. 9381) it is not clear what differences the authors are referring to. This section needs to be rewritten. 22. Last paragraph of section 4.2: Authors claim agreement where they admit there is no agreement. If there is, please be more specific (region/time/trend etc). Also how about Stavrakou et al. 2008? 23. Section 4.3 does not mention the very obvious swath pattern in Figure 3 in the weekly plot. How is that affecting results? Third paragraph sounds particularly unconvincing in the light of the swath pattern and 3 day global coverage. 24. Section 4.3: Boersma et al. 2008 have showed this already. 25. Section 4.4: Inconsistent and wrong spelling of Hong Kong, please fix. Also not clear what region is “Arabia” referring to, Arabian Peninsula? 26. Section 4.4: Brings no new scientific insight. 27. Figure 7 is never mentioned

Technical comments: Abstract 1. l. 7: delete “in the present work” and “in this task” Section 2 2. l. 8 (p. 9372): delete “in addition” 3. l. 22 (p. 9373): delete “with” Section 3 4. l. 23(p. 9376): “user-interaction” probably should be “user intervention” 5. l. 3 (p. 9377) Fig 3 is out of order Section 4 6. l. 6 (p. 9379) Fig 2 is out of order 7. l. 15 (p. 9379) delete “features”, l. 16, delete “scale” and replace with “domain”, l. 19. insert

“sections” after “following” 8. l. 6 (p. 9380) delete “the”, l. 14, replace “artefact” with “artifact” 9. l. 10 (p. 9381) replace “compliment” with “complement” 10. l. 9 (p. 9382) delete “in Israel the” 11. l. 16 (p. 9382) Fig 8 is out of order 12. Figure 2: use actual date instead of day for x-axis 13. Figure 4: What is the white area? Insignificant p values? 14. Figure 5: Group colors more by seasons, e.g. all green shades = summer (JJA) 15. Figures 1, 3, 4, 10: use fewer colors (e.g. 20) to allow easier identification of features

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 9367, 2009.