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Biogeosciences Discussions

Interactive comment on "Soil biogenic emissions of nitric oxide from a semi-arid savanna in South Africa" *by* G. T. Feig et al.

G. T. Feig et al.

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We would like to thank the three anonymous referees for their useful and considered comments on this paper. We will reply to the comments, according to the referees.

Referee #1:

Comment 1:
The referee suggests that our use of literature on the subject is not fully complete

Reply:
We have attempted to utilize all of the appropriate literature, although certain papers may have been inadvertently overlooked or we have become aware of the publication of a number of useful articles since our paper was submitted these include [e.g. Galbally et al., 2008; Kutsch et al., 2008; McCalley and Sparks, 2008], mention of these papers

will be included in the final version, where appropriate (a complete list of these papers is given below)

Comment 2:
The reviewer suggested that more statistical analysis should be conducted in the results section, however which type of analysis has not been mentioned.

Reply:
Statistical analysis of annual differences in up-scaled NO emission will be conducted.

Comment 3:
The referee suggested that the non linear influence of soil moisture content, soil moisture and soil temperature on the NO emission from soil is not fully addressed and that more work should be done on available literature.

Reply:
A non-linear effect of the soil moisture content on NO emissions was observed in this study. In two of the three soils where the Q_{10} could be calculated (Footslope and Midslope soils), the Q_{10} was higher in the region of optimal soil moisture that at high and low soil WFPS. Since this effect was not consistent across all three soils the Q_{10} values were calculated from around the optimum soil moisture. Subsequent to the submission of this paper to BGD, an article by Kutsch et al [2008] has shown that there is a non linear influence of soil moisture on the temperature dependence of the emission of CO_2 from this site: "*data showed that the temperature response was modified by soil moisture: at low soil moisture the Q_{10}-value of the temperature function was reduced in comparison to high soil moisture*"; To respond to these new findings we will be more specific in the methods and materials section about the calculation of the Q_{10} temperature amplification factor. On page 2806, line 9 we will insert "*In the midslope soils soil WFPS had a marked effect on the Q_{10} function of NO emission from the soil. However this effect was not consistent across all the soils and therefore the Q_{10} values used for this study were calculated from NO fluxes near the optimum soil moisture content*". In

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the discussion section (on page 2815) we will include "*In recent studies looking at the soil respiration that have been conducted at this site, it has been noted that the soil WFPS affects the Q_{10} value in a non-linear fashion, where the temperature response is greater in wet soil than in dry soil [Kutsch et al., 2008]. On closer examination, a similar effect can be seen on the Q_{10} temperature amplification factor of NO from this site (data not shown), however this effect was not consistent across all the soils sampled. In light of the recent paper by Kutsch et al [2008] it may be worth while examining this effect more closely in subňsequent studies*"

Referee 2:

Comment 1:
The referee suggests that the use of a simple model that uses only two parameters (soil moisture and soil temperature) to estimate regional NO emissions looks simplistic and suggests the use of a biogeochemistry model (such as the DNDC model) that considers more environmental factors including the soil chemical and physical characteristics should be considered.

Reply:
The authors entirely agree with this recommendation by Referee #2. The use of a biogeochemistry model would give us far more insight into the processes that are occurring in the soil. The reasons that we have not used such a model are as follows:
(1) Previous flux studies eg [Kesik et al., 2005] which have used models such as DNDC and GIS for up-scaling of biogeochemical fluxes, suggest that these models are better suited for use at a large scale and are not suitable for a small scale regional study such as the one we have conducted
(2) A large number of climate and soil parameters are required for runňning a model such as DNDC/CENTURY/CASA. While some of the paraňmeters might be obtained from previously published data, the majority of the needed parameters are entirely lacking and will still need to be estimated for the site and for the up-scaled region. In addition, many of the important soil parameters (soil texture, soil pH, microbial com-

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munity composition ext) are implicitly included in the estimates of the soil emission of NO, since the production of NO occurs in soils that have been sampled in the field. We therefore believe that it is more valuable to up-scale to a regional scale from actual soil measurements from the major ecosystem components (while bearing in mind that spatial variation in soil chemical and physical properties will have and effect on the calculated emissions) than to perform the entire analysis in models where only roughly estimated parameters are used.

Comment 2:
The referee suggests that we should describe the climatic conditions of the experimental area, including the mean annual precipitation, variations in precipitation, and monthly highest and lowest temperatures.

Reply:
All these values have been previously published in [Venter et al., 2003] and in [Scholes et al., 2001], we therefore believe it is redundant to republish this data.

Referee 3

Comment 1:
The referee has mentioned the choice of unit that we have used for k m^3 kg^{-1} s^{-1}) and suggests that instead we use a unit that is more comparable to the net NO flux (ng kg^{-1} s^{-1} ppb^{-1})

Reply:
If one looks at equation 3 the unit proposed by the reviewer (ng kg^{-1} s^{-1} ppb^{-1}) is equivalent to the units that we have used (m^3 kg^{-1} s^{-1}), however we have decided to continue using m^3 kg^{-1} s^{-1} since this is in agreement with the correct SI units. Nevertheless, to avoid any further confusion we will rename *k* "*the volumetric consumption rate*"; and it has been changed in pg 2802 line 24.

Comment 2:

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the referee mentions that the units of k are wrong on pg 2803 line 8.

Reply:
this has been corrected

Reference List

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Kutsch, W.L., N. Hanan, R.J. Scholes, I. McHugh, W. Kubheka, H. Eckhardt, and C. Williams, Response of carbon fluxes to water relations in a savanna ecosystem in South Africa, Biogeosciences Discuss. J1 - BGD, 5 (3), 2197-2235, 2008.

McCalley, C.K., and J.P. Sparks, Controls over nitric oxide and ammonia emissions from Mojave Desert soils, Oecologia, 156 (4), 871-881, 2008.

Scholes, R.J., N.G. Gureja, M. Giannecchinni, D. Dovie, B. Wilson, N. Davidson, K.C. McLoughlin, K. Van der Velde, A. Freeman, S. Bradley, R. Smart, and S. Ndala, The environment and vegetation of the flux measurement site near Skukuza, Kruger National Park, Koedoe, 44 (1), 73-83, 2001.

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