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Interactive comment on "Soil-atmosphere exchange of ammonia in a non-fertilized grassland: measured emission potentials and inferred fluxes" *by* G. R. Wentworth et al.

Anonymous Referee #1

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Overall this is a well written manuscript that describes AIM-IC measurements of gas phase NH3, SO2, HNO3, and aerosol NH4, NO3 and SO4 and soil NH4 and pH measurements in a semi-natural unfertilized grassland. The authors use a simple resistance model to estimate NH3 fluxes and a back trajectory model to assess the impact that nearby sources may have on the measurements. The air-soil compensation point for this type of land use is well documented here. I believe that the most interesting finding in this paper are that they could not identify regional NH3 sources due to modulation of ambient NH3 concentrations by bidirectional exchange. This work is important and is suitable for publication in Biogeosciences. However there are a couple of areas that should be addressed first. Comments

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1. Page 7549 line 26 to 7550 line 2: Can you quantify what more stable and variable metrological conditions mean? It would also be nice to give an idea about how this variability may impact the flux estimates.

2. Page 7550 lines 23-27: "The inherent assumptions is . . ." How does this assumption impact the results presented here? A sensitivity calculation to bound the uncertainty in this assumption should be done. For example, how would a 50% reduction in the available NH4 for exchange with the atmosphere alter the conclusions of this study?

3. Page 7553 first paragraph in section 3.1: Are there environmental variables that correlate with the observed variability in Γsoil?

4. Page 7553 lines 13-20: This section is a nice justification for the need of these types of measurements.

5. Page 7554 line 24: At what depth was the soil temperature measured?

6. Page 7554 line 28 – page 7555 line 4: The diurnal trends could be related to the soil moisture content. Soil moisture could also impact the soil compensation point because it determines the volume of soil NH4 that is available for air-surface exchange and impacts the diffusion of air through the soil media.

7. Page 7555 lines 9-10: Why would the peak be larger than in September, if this peak originates from NH4 in the dew? Was there more dew or higher morning time humidity values in August?

8. Page 7555 lines 28-29: The autumn deposition flux estimated by Wichink-Kruit et al. (2007) appear to be much larger, nearly a factor of 5, than the deposition fluxes estimated in this study. Perhaps this can be explained by differences in the ambient concentrations in the fall between the two studies.

9. Page 7557 lines 2-4: Another explication that is often made, typically outside the atmospheric measurement community, is that NH3 deposits near its source. However, I think that the relatively high background concentrations measured here argues in favor

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of a local and relatively heterogeneous sources, likely bidirectional exchange.

10. Page 7557 first full paragraph: This paragraph could be made more concise. The authors are making an order of magnitude estimate here and there really is no need to discuss the 3m equilibria calculations. The system never reaches equilibria any ways as evident from the differences between the ambient concentration and compensation points. I think that a general statement that the soil NH4 pool is large and modulates the ambient NH3 concentration would be more reasonable.

11. Page 7558 line 27: Figures 3b and 3c indicates that the observed increase in the mixing ratio in the morning was greater than 0.5ppb.

12. Page 7560 Line 10: Again, I do not think that the deposition fluxes are that similar but this may be due to higher ambient NH3 concentrations measured by Wickink Kruit et al (2007).

Interactive comment on Biogeosciences Discuss., 11, 7541, 2014.