<u>Responses to the Editor</u>

<u>Comments:</u>

Dear authors,

many thank for your comprehensive revisions and my sincere apologies for the delay in coming to a decision. I am satisfied with your revisions, but would ask you to add the explanation how a flux rate of Ammonia is derived from Eq. 1 in the responses to the main manuscript. The ms is than ready for publication.

Best wishes,
Sönke Zaehle

<u>Reponses:</u>

We thank the editor's constructive feedback.

Per the editor's suggestions, we added the following explanation on how the NH_3 flux rate is calculated in lines 263–277, **Section 2.2**:

"The actual soil NH_3 to be emitted ($F_{soil,act}$; g-N m^{-3}) from each soil layer is then determined **<u>as:</u>**

$$\textbf{\textit{F}}_\textbf{soil,act} = \textbf{min}(\textbf{\textit{F}}_\textbf{soil,pot}, [\textbf{NH}_4^+]_\textbf{available}) \hspace{3cm} \textbf{(1)}$$

<u>where $F_{soil,pot}$ is from Eq. (1) and $[NH_4^+]_{available}$ (g-N m^{-3}) is the concentration of available soil NH_4^+ in the soil layer.</u> The model distributes available soil NH_4^+ to all competing processes**<u>, namely, NH_3 emission, plant uptake, microbial immobilization, and nitrification,</u>** according to their relative demands (individual potential flux to sum of all four potential fluxes) without bias toward any process (Lawrence et al., 2019). The **<u>column-level actual soil NH_3 prone to emission (F_{soil}; g-N m^{-2})</u>** is then computed as the sum of the product of $F_{soil,act}$ and **<u>the soil layer thickness (in meters) across all vertical layers.</u>**

<u>Finally, assuming such NH_3 is released to the atmosphere at a constant rate over a model time step size (Δt = 1800 s in this study), our model estimates the NH_3 emission flux ($\dot{F}_{soil}$; g-N m^{-2} s^{-1}) as:</u>

$$\dot{\textbf{\textit{F}}}_\textbf{soil} = \frac{F_{soil}}{\Delta t} \hspace{5cm} \textbf{(2)}"$$