

Earth Syst. Sci. Data Discuss., referee comment RC3
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Comment on **essd-2021-221**

Anonymous Referee #3

Referee comment on "Global soil NO emissions for Atmospheric Chemical Transport Modelling: CAMS-GLOB-SOIL v2.2" by David Simpson and Sabine Darras, Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-221-RC3>, 2021

Review of "Global soil NO emissions for Atmospheric Chemical Transport Modelling: CAMS-GLOB-SOIL v2.2 "

This work introduces CAMS-GLOB-SOIL v2.2, a gridded soil NO emissions dataset provided at 0.5 x 0.5 degree spatial resolution and monthly time resolution. The data are produced using the EMEP MSC-W modelling system. The dataset would be a valuable addition to the community, and the discussion surrounding double counting of emissions between this dataset and other inventories is useful. However in its current state, the manuscript lacks a certain level of transparency regarding how these data are produced, particularly regarding the individual terms used within the emissions algorithm. Additional clarification is requested. See below for comments.

Comments:

- Section 2 is a valuable introduction to a variety of soil NO_x models and how those models represent emissions, but only a marginal explanation of the overall "background", or our current understanding, of soil NO_x emissions is provided. I suggest renaming this section to "Previous Soil NO_x Emissions Models", or something along those lines.
- Line 175: How are the minimum and maximum soil water amounts determined?
- Line 179: It is claimed that a grid-averaged SMI is more physically meaningful than a

- grid-averaged volumetric soil moisture, but it's not clear why. Please elaborate.
- Line 185: The reasoning for using air temperature in place of the IFS-provided soil temperature is ambiguous. Why is it difficult to interpret soil temperature from a NWP model? It is implied that the IFS does not capture the complex nature of soil temperature. If that is the case, what evidence is there for air temperature being any more of a reliable metric than the IFS soil temperature? Ideally, a soil temperature product would be used if there is one available within the modelling system being used.
 - Line 205: It is unclear what is meant by allowing emission rates to follow N-inputs.
 - Line 230: While pulses may be the most dramatic short term soil NO events, daily changes in temperature and soil moisture can clearly cause discernable changes in emissions. Given that meteorological data used in this work have a 3-hr time resolution and the strong impact that soil moisture and temperature can have on daily time scales, why not provide daily data? Valuable detail is lost by providing a monthly averaged product.
 - Line 236: I have some questions regarding Equation 3. The soil moisture function used is neither introduced nor explained. Is that function the same as was used in previous studies (e.g. Hudman et al. (2012)), or was a unique scaling function applied? Please add the soil moisture function and an explanation of it for clarity. Additionally, how is Abiome represented? Are the raw values from Table 2 being used alone here, or is this a function of soil nitrogen as was done in Hudman et al. (2012)? Again, please add equations and explanations throughout for individual functions. Otherwise, readers are left to guess how emissions are parameterized.
 - Line 246: It is stated that a vol. SM of 15% "was said so correspond to" SMI of 0.5. Is there a reference to support this, or can this please be explained further? Does this not vary significantly by soil type?
 - Line 250: It is unclear what "Aw rates" refers to.
 - Line 288-289: Please elaborate more on the pulsing criteria. What is meant by "14-day rainfall criteria"? Does this mean that 14 consecutive dry days are required before a pulse can be considered? Further, does "changes in SMI of 0.01" mean both increases and decreases in SMI, or just increases?
 - Line 291: Please rephrase this. Does this mean that annual pulse emissions are always estimated at 15% of annual biome emissions, regardless of how many pulses occur in a grid cell throughout a year? Or is this 15% value only applied to individual days where pulsing criteria are met? It is unclear from the wording.
 - Line 317: Again, the reasoning for using air temperature is confusing, and the explanation in this section (section 4.7) appears to differ from the explanation that was given earlier (section 3.3.2).
 - Lines 330 / 336: For Figures 4 and 5, please specify in the text and captions that these are annually- or monthly-averaged emissions, if that is the case.
 - Line 340 / Figure 6: It is unclear what the factors shown in this figure represent, or how they were derived. Why were these 3 locations chosen (Brazil, Australia, France), and what is the main takeaway from this figure? The value added by including this information is not apparent.

Technical Corrections:

- This work contains numerous instances of short paragraphs which often seem to be

separated arbitrarily, and which would still convey a coherent message if combined into one paragraph (e.g. all of section 3.2, much of section 4.2). There are also numerous paragraphs which are comprised of just one or two sentences, which should really be included with the preceding or following paragraph (e.g. starting on lines 7, 36, 91, 123, 182, 195, 449, 494, ...).

- Line 45: "anthropogenic"
- Line 146: missing open parenthesis
- Line 200: Is this supposed to say "year", or "years"? If multiple years are used, please state which years were used specifically.
- Line 220: Some acronyms (e.g. YL95, SL11) are first formally defined here, after the acronyms are already used earlier on, e.g. line 149, and elsewhere.
- Line 306: "applied" instead of "applies"
- Line 315: "uncertainty" instead of "uncertain"
- Line 318: Undefined acronym "S18"

References:

Hudman, R. C., Moore, N. E., Mebust, A. K., Martin, R. V., Russell, A. R., Valin, L. C., and Cohen, R. C.: Steps towards a mechanistic model of global soil nitric oxide emissions: implementation and space based-constraints, *Atmos. Chem. Physics*, 12, 7779–7795, 2012.