

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-41

Anonymous Referee #1

Referee comment on "Extension of a gaseous dry deposition algorithm to oxidized volatile organic compounds and hydrogen cyanide for application in chemistry transport models" by Zhiyong Wu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-41-RC1>, 2021

Summary:

In "Extension of a gaseous dry deposition algorithm to oxidized volatile organic compounds and hydrogen cyanide for application in chemistry transport models", Wu et al. describe an extension of an existing dry deposition algorithm to 12 additional oxidized VOCs and evaluation of the model against field data. The effort shows that some oVOCs are well-represented by this formulation, but others severely underestimate the observed deposition rates, suggesting a second sink is also important that the authors suggest is chemical reactivity. Overall, the important content is included, but the manuscript would be improved with a reorganization to introduce important background information earlier on. Specific comments aim to improve this and other areas of the work.

Major comments:

As an overall comment, the manuscript would benefit from reorganization in ways that present relevant background information earlier in the introduction and methods, and not waiting in some cases to present this information in the results and discussion. An additional section heading after 3.2 could help indicate that the discussion has shifted from evaluation of modeled deposition velocities to the role of other loss mechanisms, namely chemical reactions. The comments below give more specific examples for this organization along with other notes.

(1) I suggest defining dry deposition early on in the abstract and introduction. Which processes are considered dry deposition? Are they all dependent on concentration to first order (L24 states how it is calculated, could you state what it represents)? Why is it 'dry' vs 'wet', and how relevant is the distinction for different gases/processes? For many gases with uptake fluxes into the biosphere, the term 'deposition' is a bit misleading, because rather than depositing like a dust particle or aerosol, gases are often taken up by gradient-driven biochemical reactions that vary in time and space in ways that are not consistent with the idea of simple deposition on a surface. I understand the historical use of this term, and my suggestions here is just to add more description of the involved processes that are referred to collectively as dry deposition earlier in the manuscript.

abstract: Instead of relying on the citation of Zhang et al. (2003) to describe the nature

and extent of the dry deposition scheme, please be more descriptive in this second sentence of the abstract and describe in simple terms what dry deposition processes are, what the Zhang version includes, and was anything in the scheme fundamentally changed except adding new gas species?

Methods: Is dry deposition to canopy/vegetation only or does it also include soil? This information should be given in introduction, instead of only being first mentioned in L119.

L90 give the model equations/formulation in this paper earlier in the methods, instead of relying on the reader accessing Zhang et al. 2002 or waiting to L134. Does H^* enter into the model formulation directly, or just inform the parameterization of alpha and beta? The 'scaling parameter' terminology is helpful for understanding these factors in Table 1, and could be used in the text to make their meaning clearer. Give a formula for how you scaled alpha for oVOCs relative to that of SO₂.

L196-201: this is really helpful background information for the model that might be more useful in the introduction or methods section, rather than only being presented in the results. Same comment regarding the introduction material on stomatal conductance and transpiration fluxes.

L230: give some examples of what other processes can affect deposition earlier in this paragraph, rather than leaving it to the end as "leaf cuticle and ground (more specifically soil/litter) or reactions within and near canopy".

(2) Appropriate context for the current state of understanding is lacking. Give examples of the oVOCs relevant to this paper and their properties before L31, so we can understand how suitable it may be to use SO₂ or O₃ as references. For example, you state that the O₃ reaction with oVOCs should depend on chemical structure—please describe this in more detail and list the oVOCs you will consider beforehand so we have context. L50-53 on HCN feels like an orphan sentence—suggest to make a different paragraph where oVOC and HCN properties are discussed together. Define IEPOX in Table 1 or text referring to it the first time.

I would suggest re-writing L32-L50 to make more general statements that are illustrated by the discrepancy between Zhang and Karl studies, rather than being so specific about these papers. Otherwise, the introduction reads more like a discussion and feels very narrow, and the expectation (L43) is written more like a conjecture. Give a range of ratios for oVOCs and O₃ V_d so we can more clearly compare how they differ.

(3) L64: what specifically do you mean by 'this approach'? The last sentence ends with the inability of the model to match high daytime values... making it unclear what approach you are referring to because the last description of the approach was a negative one. Give model context. L65, consideration 1: the introduction did not give sufficient context for what you mean here, please describe this more clearly. It is unclear how your approach addresses these considerations.

(4) End of introduction. L71-74: very general, long sentence. Reads more like a conclusion/future outlook. As does most of this paragraph. Much of this final paragraph does not appear to be relevant to the specific approach taken in this study, so it belongs earlier in the introduction or maybe in the conclusions. Be specific about what the contribution of your effort here is.

(5) Since the measurement of VOCs is highly dependent on the instruments used, state the instrumentation used to measure the 13 VOCs, HCN, H₂O₂, and HNO₃ in this paper instead of relying on the Nguyen et al., 2015 paper alone.

(6) Were there ever net emissions of these compounds from the ecosystem, and how did that factor into V_d calculations? Please comment on what role soil uptake might or might not play in the large observed residual uptake of oVOCs during daytime dry conditions.

(7) How is G_{ns} calculated, and how does that differ from $G_{residual}$? An equation is only given for the latter (L231). The difference between the two, and why we must assume that G_{ns} terms are correctly estimated is not clear. Please elaborate and justify.

Minor comments:

L33: cite the existing schemes or describe how they are different from what you do here.

L54: be more specific, what does 'community demands' mean?

L263: had instead of have

L270: discussion starts?

L110: specify if you mean formic acid is the only species available in the original Model.