Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-86

Anonymous Referee #1

Referee comment on "Reversible and irreversible gas–particle partitioning of dicarbonyl compounds observed in the real atmosphere" by Jingcheng Hu et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-86-RC1, 2022

Review of "Reversible and irreversible gas-particle partitioning of dicarbonyl compounds observed in the real atmosphere"

Hu and coauthors describe a set of field experiments designed to investigate the gas/particle partitioning of glyoxal and methylglyoxal in Beijing as a function of season. Gas phase dicarbonyls were collected using DNPH-doped cartridges and particle phase dicarbonyls were collected using a filter assembly. Both reversible and irreversible uptake pathways are considered using supporting measurement data and irreversible pathways are found to be dominant for both dicarbonyls in all seasons, although reversible uptake (self-reaction, oligomerization) becomes more relevant in the winter. As expected, the field data demonstrate particle phase concentrations that are orders of magnitude higher than those expected based solely on absorptive partitioning theory. This study, however, is particularly useful in demonstrating the estimated dominance of the irreversible pathway in all seasons, and in presenting real-world SOA contributions for these dicarbonyls at this urban location (approximately 25% of Beijing SOA is assigned to glyoxal/methylglyoxal uptake processes). Overall, I find the manuscript to be well written with comprehensive consideration of the relative importance of reversible and irreversible uptake pathways and their impact on SOA production. These data should be useful for optimizing dicarbonyl uptake in SOA modeling efforts.

Comments

Line 86: How were positive artefacts from direct deposition of gas phase glyoxal/methylglyoxal on the filter surfaces accounted for? This could bias the partitioning result from Equations 1 and 3 and should be discussed in the text.

I think the manuscript would benefit from an expanded discussion of assumptions used to calculate the reversible and irreversible pathways. Calculations of the irreversible pathway

involve the particle phase and gas phase monomer dicarbonyl concentrations to be known and these data are derived from analysis of the extracts. But the particle phase monomer extract concentration will also include the contributions from the reversibly formed products present in the extract. Expanding the discussion of deriving the cp term in the formulas and what exactly it represents would be useful for readers.

Figure 2c: Change the color of one of the grey traces

Figure 3: Define SNA in caption

Figures throughout: Colorscales should go from lower values in blue to higher values in red to be consistent with general uses in the literature. It is counterintuitive for the reader for these to be the other way around. Also the axis scale in the colorscale legends has numbers increasing from right to left which is also confusing.

Abstract, change last line to present tense. eg "To our knowledge, this article is the first to…"

Line 33: reorder the two references

Line 36: consider rephrasing to "lost in the gas phase by photolysis, oxidation by OH radicals, and dry deposition" as OH oxidation is a photochemical reaction

Line 40: "Although they have relatively high…"

Line 41: How relevant is adsorption to surfaces vs absorption into the bulk particle phase material? Worth discussing here

Line 90: "common"

Line 94: "time resolution"

Line 167: "soluble"

Line 170: “close to”

Line 180: “real atmosphere”

Table 4: “Particulate matter”

Line 206: Worth noting that the observed RH dependence for the reversible pathway is consistent with the Healy et al 2009 chamber study reference

Line 270: “close to”

Line 284: Define SNA

Line 285: rephrase

Line 339: rephrase