Aerosol processes relevant to the indoor environment simulated in a detailed chemistry and aerosol microphysics model

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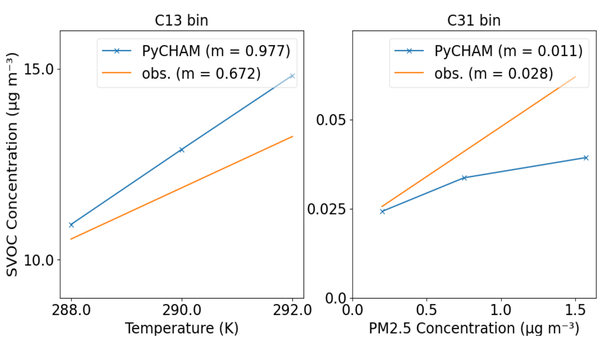
Introduction

The updated and open-source CHemistry with Aerosol Microphysics in Python (PyCHAM (2023)) box model is here verified against indoor observations and used to test the role of Highly Oxygenated Molecules (HOMs).

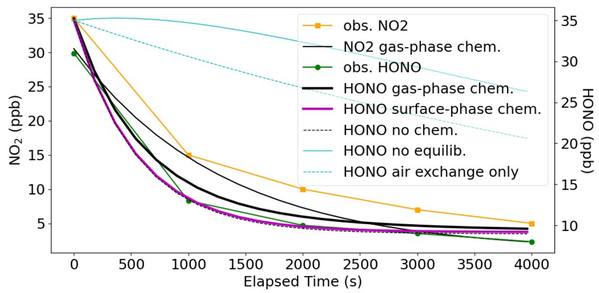
Surface-Gas-Particle Partitioning

Lunderberg *et al.* (2020) show that organics on indoor surfaces modulate gas-phase and particle-phase concentrations. Below we reproduce their gas-plus-particle observations for organics with vapour pressures equivalent to alkanes with carbon numbers (C) 13 and 31 in response to varying indoor temperature and particulate loading, respectively.



Surface Reactions

Collins et al. (2018), show that the gas-phase concentration of nitrous acid (HONO) is driven by surface chemistry of nitrogen dioxide (NO2) and modulated by the resulting surface reservoir. Below we reproduce their observations of HONO decay following combustion.

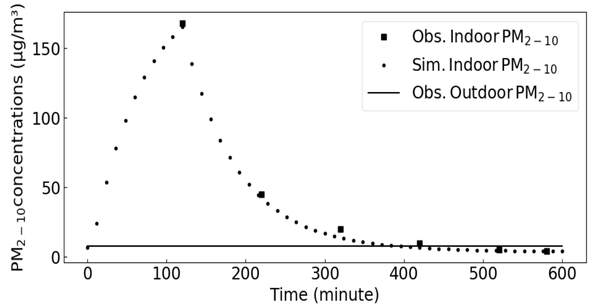


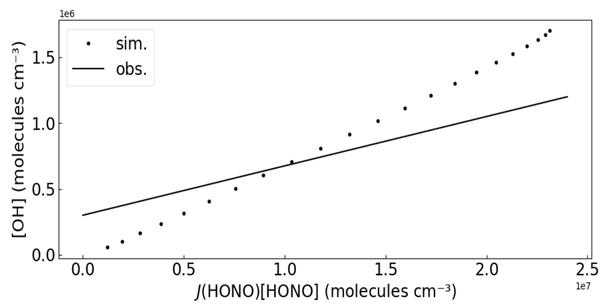
Light Transmission Through Windows, Indoor Emission of Gases, Indoor-Outdoor Exchange of Gases

Using the observed light transmission factor, right we reproduce the measured hydroxyl radical (OH) concentrations as a function of photolysis rate from Alvarez *et al*. (2013). NO2 from outdoors, and volatile organic compounds (VOCs) from indoor and outdoor sources affect results.

Particle Deposition to Surfaces, Indoor Emission of Particles, Indoor-Outdoor Exchange of Particles

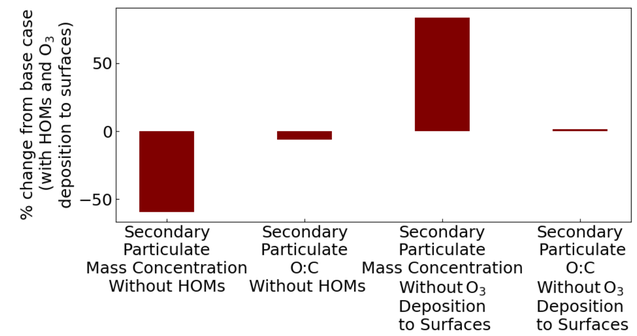
Following indoor activity, simulating outdoor particle ingress, and using the observed particle loss rate to surface, below we reproduce the observed decay of particles from Tran *et al*. (2017).





Role of HOMs

Highly oxygenated organic molecules (HOMs) were simulated in combination with all processes evaluated here.



References

Lunderberg *et al.* 2020, doi: 10.1021/acs.est.0c00966
Collins *et al.* 2018, doi: 10.1021/acs.est.8b04512
Alvarez *et al*. 2013, doi: 10.1073/pnas.1308310110
Tran *et al*. 2017, doi: 10.1177/1420326X15610798
PyCHAM 2023, github.com/simonom/PyCHAM (/ind_AQ_ex for poster input)

Acknowledgements

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PyCHAM
CHemistry with Aerosol Microphysics in Python

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