Response to RC2 (9.9.2025): Deposition velocity concept does not apply to fluxes of ambient aerosols

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The authors have done a good job formulating, demonstrating and discussing the issue, but unfortunately there is rather little practical outcome and recommendations on how to deal with the identified problems (given the paper estimates quite an abundance of ammonium nitrate in Europe and indicates its potentially frequent presence in PM2.5?

Could the authors suggest better solutions for the application of Vd in the case of semi-volatile (ammonium nitrate) aerosols i.e. whether and how the "apparent Vd" from field measurements could be used in a sound way? Alternatively, could a model representation of the apparent Vd be proposed? Actually the paper anticipates that the authors would (L. 105) "..suggest an approach to bridge the gap between observed apparent deposition velocities and deposition parametrisations based on Eq. (1)".

In practice, we recommend using deposition schemes designed for passive particles only for passive particles. For semi-volatile particles, the particle deposition scheme should be applied in combination with gas–particle partitioning. This approach reproduces observed fluxes without invoking apparent Vd. The Apparent Vd should therefore be treated as a diagnostic quantity only, not as a tunable parameter of the model. We will make this recommendation more explicit in the revised paper.

It would also be advisable to show the effect of accounting for gas-aerosol partitioning during aerosol deposition on model results on a regional (European) scale. What is the seasonality of this effect? Does it help to improve the model performance.

The gas–aerosol partitioning plays a major role for semi-volatile species, but it is hardly possible to isolate the effect of partitioning during deposition from other processes occurring throughout the aerosols/precursors life cycle (emissions, chemical transformation, and transport). A simulation with partitioning entirely turned off can be done with moderate effort. However, the results will have no meaning because the formation of ammonium nitrate is the result of the very same partitioning process that is responsible for its disintegration near the surface. So, in the simulation with partitioning off, there will be no ammonium nitrate in aerosols at all.

My recommendation would be that the paper can be published after the authors complete the manuscript in line with the suggestions in the evaluation above and also attend to the following comments.

Thank you! The specific comments will be addressed in the revised manuscript.