

## **Answer to referee comments for the final version of the manuscript**

Again we would like to thank the referees for their fruitful comments that have improved the quality of the manuscript.

### **Answer to Annika Vogel (referee #1)**

Thank you very much for your final review of the manuscript.

- L.33 & l.606: “cross correlation” -> “cross-correlation”

This has been corrected.

- L.317: The spelling of “auto covariance” is inconsistent with the spelling of “autocorrelation” which was introduced in l.33.

This has been corrected.

- L.292 structure of sentence: remove 1st “of”. I.e., “The numerical experiment studies of the time propagation...”

This has been corrected

- L.272-275: Generally ok, but maybe you could formulate more clearly that the PKF is performing better here? I.e., This difference is due to errors in the enKF, rather than errors in the PKF.

The sentence you proposed has been included in the final version of the manuscript (see L673).

- Maybe you want to add a referent to the Algorithm for the multivariate PKF (Alg.1) in the conclusions? This would increase the visibility of the Alg. although being in the Appendix.

This has been introduced by rewording L646-648 (in the final manuscript version) of the conclusion as follows “Moreover, a multivariate formulation of the PKF analysis step has been introduced, given by Algorithm 1, and several assimilation cycles..”

### **Answer to Anonymous Referee #3**

*The authors responded to reviewers' comments. They shortened the manuscript and clarified limitations of the assimilation approach. It appears that this approach would be most suitable to a box chemical model rather than to real-world air quality prediction. I am supporting publication of the manuscript in the current form.*

Thank you very much for your final review of the manuscript. We do not understand your comment concerning the “box model” terminology that refers to 0D domain for us ( i.e. the dynamics of chemical species in a parcel of fluid) while our contribution concerns a 1D domain with a transport plus a set of chemical reactions, which is a step forward from box models, and intermediate to operational models of air quality in the real world. We agree that assuming the dynamics of the anisotropy independent of the chemistry can make think to a box model where grid-points would be independent from one to the other ; but this is not strictly the case here since we considered non-trivial spatial correlation that implies a spatial dependency of the forecast and of the analysis error along the grid, where the forecast error anisotropy changes because of the heterogeneity of the wind that has been considered. Note however that this simplification of the anisotropy dynamics has been supported by the 1D simulations but it has to be re-evaluated for real systems, as it is mentioned in the conclusion of the manuscript (see l653-654 “To go further, it will be interesting to see if the advection terms remain dominant under different conditions like weaker wind or accelerated chemistry from an ensemble of forecasts of operational CTMs”.)