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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Validation of remotely sensed profiles of atmospheric state variables: strategies and terminology" *by* T. von Clarmann

T. von Clarmann

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The reviewer's very careful and thorough reading of the paper is greatly appreciated. For the final ACP version, a clearer distinction will be made between ex ante estimates of errors (based on error propagarion calculation, sensitivity studies etc) and ex post estimates (from statistical samples of real data, using the estimators presented in the paper). A dedicated symbol will be used to distinguish between these in the equations. In the following, the specific points of the review are discussed:

1. Agreed; the Ridolfi at al reference will be included.
2. Agreed; will be restructured accordingly.
3. Agreed; will be reworded accordingly.

4. To introduce d as a vector from the beginning would add additional difficulty to Eqs 14–16, e.g. further indices. Even if d is introduced as a vector and it is switched back the scalar case before discussion of Eqs 14–16, at least the scalars d in these equations would need indices to make clear that d is a component of vector $\vec{d}$. In order to avoid this, I still prefer to discuss the coincidence error for scalar mismatch first, and to present the generalization for multi-dimensional mismatch later.

5. Let instrument 1 measure NO_2 during day only, and instrument 2 during night only. These systematic differences in the sampling will lead to a non-zero expectation of the co-incidenced error. Probably the misunderstanding is caused by the term "systematic sampling errors" This term will be replaced by "errors due to systematic sampling differences in d"

6. No domain needs to be specified here, because all this is a general formalism valid for all domains mentioned at the beginning of the section. Nevertheless I will insert "(...finer structures) in d (than those...)". It should then be clear that the "fine resolved" attribute refers to the same domain. For clarity, in order to avoid ambiguity due to the technical term "distribution" in statistics, I will replace "reference distribution" with "reference data set".

7. Agreed; will be corrected.

8. Agreed for the subscript; this will be corrected. Aren't sensitivity studies just a numerical variant of error propagation studies? Anyway, this statement will be reworded for clarity.

9. Agreed, will be corrected.

10. Agreed, will be corrected.

11. Agreed, will be corrected.

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12. The intermediate step in Eq. 23 makes clear how the error propagation works. The bias is a difference, and the intermediate step shows the error propagation of the variance of the mean value of the validation measurement (first term), of the reference measurement (second term) and the correlation terms (third and fourth term). Without this intermediate step I do not find Eq. 23 very obvious.

13. Agreed, will be corrected.

14. I agree only partly; Eq. 26 will work properly even if all errors are over- or under-estimated by a constant factor, since the precision estimates rule only the relative weight of the measurements. Therefore, even if there is a systematic error in the precision estimates, the use of Eq. 26 still may be advantageous over Eq. 22. The situation is, of course, worse for Eq. 27. I will add a caveat on this.

15. Agreed, will be reworded. This comment brought my attention to another inconsistency: In Eq. 8 b is the systematic difference between a measuremnent and the truth, while from Eq. 22 on, b is the systematic difference between a validation measurement and a reference measurement. As remedy, the quantity b_{diff} will be introduced and used whenever the bias between two measurements is meant.

16. Agreed, will be corrected.

17. Agreed, will be corrected.

18. Agreed and corrected; this comment brought my attention to another inconsistency: While double subscripts are correct for elements of covariance matrices (e.g. $s_{n,n}$), they are meaningless for the standard deviations and variances. These will be changed from $\sigma_{n,n}$ to σ_n.

19. Agreed, will be corrected.

20. Agreed, will be included.

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21. I agree with the different meaning of expectation value and sample mean, also agreed that there is an error in Eqs. 38 and 40. The entire section will be rewritten.

22. Agreed, will be deleted.

23. Agreed, caveat will be added.

24. Agreed, will be corrected.

25. Agreed, will be reworded.

26. Agreed, will be corrected.

27. Agreed that multiplication axiom holds only for independent measurements. This, however, is the reason why this condition has explicitly been stated in line 8.

28. Agreed, will be removed.

All minor suggested corrections will be applied except:

- ”at” seems to me to be the usual preposition after ”estimate”.
- I prefer ”rigorous” over ”conservative”. Conservative is used in the context of ”estimates”, not ”approaches”.
- I prefer not to stick with the 5% threshold in the conclusions, because this number is just an example. I will replace ”small” by ”below a predefined threshold”.

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