

The authors have significantly modified their paper, and have taken my comments and suggestions into account. They have generalized their ‘triangular’ approach to estimation in the form of an interesting ‘polygonal’ approach (none of my suggestions). I think the paper is now acceptable for publication. I nevertheless suggest a number of modifications of mostly editing character which should not require substantial work.

1. From a purely scientific point of view, I have only one request for correction which, without being critical for the paper, must be made.

The authors write, concerning positive definiteness (ll. 406-407) ... *the generalization to covariances matrices is expected to increase the occurrence of negative values in off-diagonal elements*. Positive definiteness is not a question of the signs of off-diagonal elements. It is that a covariance matrix, in addition to being symmetric (and to have as such real eigenvalues) must have only positive eigenvalues (or nonnegative ones, depending on the precise definition one takes). For instance, the 2-2 matrix

$$\begin{array}{|c|c|} \hline 1 & a \\ \hline a & 1 \\ \hline \end{array}$$

is definite positive if  $a^2 < 1$ , and is not if  $a^2 > 1$ , independently of the sign of  $a$ .

Along the same line of ideas, I make the following remarks

1a. L. 727, I think the need for positive definiteness will always be there, independently of the purpose or use (using a ‘covariance matrix’ that is not positive definite can lead to absurd results, for instance in data assimilation)

1b. And I suggest to change the words *positive definiteness might not be fulfilled* (ll. 785-786) to *there remains the risk that positive definiteness might not be fulfilled*

2. L. 685, ... *not every possible combination of error statistics to be estimated provides a solution*. This statement, which is fundamental for the paper, is mentioned explicitly only in the conclusion. It should be mentioned in the introduction (for instance between ll. 47 and 48 of the present version, or after l. 67), with appropriate references (possibly Vogelzang and Stoffelen, 2001, or Gruber *et al.*, 2016).

In addition, from I understand, a better formulation would be ... *not every possible a priori choice of error statistics to be estimated provides a solution*.

On the number of occasions, the wording is improper, imprecise or awkward

3. Ll. 71-72, ... *the exact formulations of error statistics in Sect. 3.3 remain underdetermined* ... to be changed to ... *the **complete estimation** of error statistics in Sect. 3.3*  
*remains underdetermined* ...  
 (it is the estimation as a whole that is underdetermined in a real situation, not the exact estimation)

4. Ll. 323-324, sentence starting *It includes* ... seems awkward to me. From what I understand, I suggest *In order to achieve a complete estimation of error statistics, the Section includes the estimation, either direct or sequential, of additional error covariances, as well as of some error cross-statistics* (although it seems to me that the words *additional* and *some* are not here necessary, since it is the whole of error statistics that are in the end to be estimated. But I may be mistaken)

5. L. 326, *the analysis of differences from residual covariance- and cross-covariance estimates*, ... The formulation may be confusing. I think it would be preferable to restrict the word *estimate* to estimates of the error statistics, not of the residual statistics, which are directly computed from the data and which (contrary to the estimation of the error statistics) do not require *a priori* hypotheses. I suggest to write simply *the analysis of differences from residual covariances and cross-covariances*.

A similar change may have to be made elsewhere. Please check.

6. L. 337, ... *the assumption of zero **error** cross-covariance* ...

7. Ll. 384-385, ... *non $\epsilon$  of the estimates ensures positive definiteness of the **estimated** error covariances*.

8. Ll. 415-416, I suggest *As described in Sect. 2, for  $I > 3$  datasets,  $A_I > 0$  gives the number of error cross-statistics which can potentially be a priori assumed in addition to all error covariances*

9. L. 437, ... *pairwise-independent datasets* ..., do you mean two successive datasets in the series are independent, or more than that ?

10. L. 437 again, ... *where the referring error covariances* ... What do you mean here by *referring* ?

11. L. 464, ... ***polygonal** error covariance* ...

12. L. 523-524, sentence starting *The sequential estimation* ... makes no real sense to me. In any case, there is a useless repetition of the words *error covariance*, and the proper wording is *similar ... to* (not *similar ... as*)

13. L. 546, ... *the true error statistics* ... Ambiguous. The *a priori* assumed error statistics, or the empirical statistics obtained from the 20,000-sample ? The difference may be

small in the present case, but I presume you mean the latter, which would be the only ones available in a real situation. And they would not be *error statistics*, but *residual statistics*.

14. Ll. 565-566, ... *the independent assumption in the basic triangle(1;2;3) is an accurate approximation of the true error dependencies*. Well, have not the true error dependencies assumed to be zero by construction ?

15. L. 579, ... *true error dependencies are occurring ... → ... true error dependencies are used ...*

16. L. 591, ... *This neglected positive error dependency ...* In what is that neglected error dependency positive ?

17. L. 594-595, ... *these three matrices are underestimated w.r.t. the true statistics by the half of the neglected error dependency matrix ...* That these matrices are underestimated by half of the neglected error dependency matrix is not visible from the figure. Say it clearly, and say how you know it. Is it consistent with error estimates that have been given in Section 4 ? If yes, say it clearly and make reference to the relevant equations. If not, explain.

A similar comment applies to the text ll. 615-617.

18. L. 597-598, Sentence starting *This experiment demonstrates ...* Move the word *accurately* to ... *to estimate accurately*.

19. L. 598, ... *accurate reproduction → accurate estimation*

20. L. 606 ... *a true dependency ... → ... a non-zero dependency ...*

21. Similarly, l. 607, ... *three true error dependencies ... → ... three non-zero error dependencies ...*

22. L. 830, ... *the need for estimating **possible** asymmetric error cross-covariances ...* (cross-covariance matrices, if they are square in the first place, will in general be asymmetric, but there is no need for them to be so).

The English, although perfectly understandable in most places, is occasionally incorrect

23. In many places (starting on l. 272) the word *uneven* is used to qualify an integer that is not even. The proper word is *odd*

24. L. 30, *This method **has been** widely used ...*

25. L. 48, ... *the estimation [...] **has been** well-established for decades, ...*

26. L. 54, ... *were the first **to propose** the additional estimation ...*

27. L. 338, *thereafter → hereafter*

- 28. L. 498, *partly* → *partially*
- 29. L. 534, ... *the capabilities for estimating* ...
- 30. L. 651, *If the other two error covariances 1 and 2 had also been estimated*

Additional corrections to be made

- 31. L. 2, ... *is an underdetermined problem* ...
- 32. L. 70, word *respectively* seems here useless
- 33. L. 96, l. 189, ... *as functionS of* ...
- 34. L. 461, ... *each subsequent datasetS  $j > i$*  ... (singular)
- 35. L. 477, ... *and the  $m_{G-1}$  the reference of* ...
- 36. L. 546, suppress the word *be*
- 37. L. 556, ... *to estimate~~d~~ the error covariance* ...
- 38. L. 626, ... *the uncertainties in the two estimated error dependencies* ...
- 39. L. 526, ... *of the other two error dependencies* ...
- 40. L. 724, *dat**a**sets*
- 41. Ll. 767-768, ... *a flexible setup* ...
- 42. L. 807, Title of Appendix *Algorithms* (plural)
- 43. L. 201, ... *or unbiased datasets* .... It has already been said (l. 148) that unbiasedness would be assumed in the paper. Unless the authors want to stress particularly that point (and, if so, they must do it explicitly), this kind of repetition is useless, and may even be confusing.