Review of the paper “Methods for validation of random uncertainty estimates and their applications to ozone profiles from limb-viewing satellite instruments” by V. Sofieva et al.

General comments

This paper provides an overview of methods for validating the random-error components of uncertainties in remote-sensing products. While these methods have been described previously in the literature, the authors bring them together here, apply them to various limb-sounding observations, and compare their performance for ozone profiles. The topic is relevant for data providers and data users, and the manuscript is generally well written. Some harmonisation of terminology would be beneficial, however, and the effect of retrieval constraints on the validation of the random error could be better addressed (see specific comments below).

Overall, I believe the manuscript can be published in *AMT* after the authors address the minor issues raised in this review.

Specific comments

1. **Consistency of terminology**
   - for measurement noise error
     The propagation of instrument noise into the retrieval is referred to by several different names throughout the manuscript—for example, *measurement noise error* (pag. 3, line 29), *ex-ante estimate for instrumental noise* (pag. 9, line 12), and *propagation of instrumental noise* (pag. 1, line 38), while *measurement noise* at pag.4 (lines 9 and 10) is the error in the measurement domain. I recommend reviewing the entire manuscript and adopting a single, consistent term.
   - in the description of all instrument and in particular in Section 2.5.
     The presentation of the different cases would benefit from improved harmonisation. Please highlight clearly which aspects are common among the cases and which aspects differ.
2. **Clarity regarding the handling of a priori information**
   Statements related to the use of a priori constraints could be better explained.
   - Page 6, lines 23–25: “If the retrieval is performed with the Bayesian maximum a posteriori estimates, a data correlation can also arise due to the usage of a priori information. These aspects should be taken into account when validating uncertainties.”
     It is not evident whether these aspects *have* been taken into account in the analyses presented, apart from the MLS case, for which it is said that “it overestimates the scatter in the geophysical products in cases where the a priori information and other regularisation constraints contribute significantly to the results,” which implies that smoothing error *is* included in the random error. In the OMPS-LP USask case it is specified that smoothing error is not included in the random error; does this mean that smoothing error is included for all other instruments/dataset?
     A clearer and more systematic description of how a priori information and smoothing error are treated for each instrument, also reporting the equation for the random error, would help.
   - Page 7, lines 27–29: The manuscript states that it is important for this type of analysis that all profiles have similar vertical resolution. Could you better clarify the

rationale?
Is the requirement related to the relative strengths of the constraints used in each retrieval? While vertical resolution certainly depends on the constraint strength, it also depends on the measurement vertical sensitivity and the chosen retrieval grid.

- In general a short description of what the validation of random error has to consider in presence of constraints in the inversion procedure and with the inclusion of the smoothing error in the random error would be valuable, also because it would help readers understand how the presented validation techniques could be extended, for example, to nadir observations

Minor corrections

- Pag. 6, line 10: an estimate OF THE
- Pag.5, line 25: please remove ‘is provided’
- Caption of Fig. 3:
    1. vurves -> curves
    2. uncertainty estimate AND its standard deviation
- Eq. 15: First c2 -> c1