

## ***Interactive comment on “Potential of multispectral synergism for observing ozone pollution by combining IASI-NG and UVNS measurements from EPS-SG satellite” by Lorenzo Costantino et al.***

### **Anonymous Referee #2**

Received and published: 24 January 2017

#### General Comments:

This paper demonstrates the potential of combining future thermal infrared (IASI-NG) and UV (UVNS) measurements from the EPS-SG satellite to significantly improve retrievals of lowermost tropospheric ozone over existing capability of combining IASI and GOME-2. It uses a pseudo-observation simulator, generating synthetic data based on instrument specifications and then performing inversions from these synthetic data. To clearly show the improvement, the IASI-NG + UVNS retrievals are contrasted with IASI+GOME-2 retrievals in terms of surface-3 km DOF, height of maximum sensitivity to surface-3 km ozone as well as retrieval biases. This study is suitable for publication in AMT. It is very well logically organized. It is also generally well written although the

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English usage can be improved and the abstract can be more concise. Some of the figures or tables can be improved and more explanations can be added. Overall, I recommend it to be published after addressing the following comments.

Specific Comments:

1. The abstract seems to be too long with a long introduction. Please make it concise and only highlight the important points.
2. The abstract typically should not have citations.
3. Also, please define acronyms at their first occurrences such as IASI, IASI-NG, GOME-2, EPS-NG, UVNS, a.s.l., in the abstract, and also separately at their first occurrences in the text.
4. L40, L43 and in the text, suggest adding “for signal” after “degree of freedom” as it could be used for signal or for noise.
5. L51, it seems to me that ADEOS is not currently working.
6. L53, this also applies to global CTMs
7. L63, suggest adding “with adequate vertical sensitivity” after “observed” as UV retrievals can be sensitive to ozone down to below 2-3 km although with reduced sensitivity and retrieved at a much broader altitude range as shown in Liu et al. (2010)
8. L65, add “to enhance sensitivity to LMT ozone” after “spectral domains”
9. L74, I would not call this “for the first time” as the study of Fu et al. (2013), published almost at the same time (slightly earlier), also showed similar capabilities (e.g., surface-700 hPa ozone)
10. L120, suggest rephrasing to “For practical consideration of computation, OSSEs typically approximate the pseudo-observations, . . .”
11. L159, the vertical resolution is not a property of radiation transfer models, but the

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radiative transfer calculations. I suggest rephrasing it to “All the profiles are sampled to 1-km layers in the radiative transfer calculations”

12. L168-169 and in Table 1, what is the SNR between 306-325 nm?

13. L216-217, the sentence “At given altitude (defined by the matrix column), each row shows ” is confusing and should be rephrased, as both column and row refer to a given altitude and the sentence reads like, “For the given column, each row . . .”

14. In section 4, it would be very useful to mention other retrieval variables (some of them are interfering) in addition to ozone even it is mentioned in Cuesta et al. (2013).

15. L263, the sentence is not accurate as the cloud can enhance ozone sensitivity above clouds, suggest rephrasing to “IASI+GOME-2 retrieval sensitivity to LMT ozone is significantly reduced when CLF > 0.3”

16. L279-282, I don't see the need to understand the small mean IASI+GOME-2 and MOCAGE differences as one is based on retrievals (not real data), and the other is based on assimilation of different ozone products, and too many important factors in retrievals, model simulations/assimilations can cause their differences.

17. L363, it is not clear about what you mean by “with a similar gap of 0.8 . . .”

18. Table 1 & 2: captions typically are put above tables. Please check the requirements. Table 2 caption, it is good to describe what is R,  $\sigma$ -bias, and RMS in a few extra words. The gains for different columns are likely calculated inconsistently, please consistently use the IASI-GOME-2 as the reference point. The gain for the last one should be  $(1.55-1.77)/1.77=-12.4\%$

19. In the 3rd row of Figure 5, there are no significant differences in the linear regression slope between black and red. Typically, you want to show how well your pseudo observations can capture the pseudo-reality or pseudo-reality with AVK (typically in validation). I think that it is better to show the PO (y-axis) vs (PR or PR\*AVK). The slope for PO vs PR\*AVK should be much closer to 1. This is also the case for Figure 12.

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Also in the 4th row, the standard deviation between PO and PO\*AVK is much larger for the IASI-NG+UVNS (1.47 DU) than that of IASI+GOME2 (0.74), suggesting that the retrieval precision is worse for IASI-NG+UVNS. It is good to mention this and give an explanation.

20. In Figure 6 bottom and L475-479. Can you please explain why sigma-bias for IASI-NG+GOME2 becomes larger than that for IASI-NG alone while the sigma-bias for IASI-NG alone is smaller than for IASI alone?

21. Figure 9, I would like to suggest the same thing as the first reviewer, i.e., plotting the data in more conventional units of ppbv.

22. The synthetic retrievals show the potential of synergism of combining IASI-NG and GOME-2 for enhancing LMT retrievals. However, real retrievals might not be able to realize all the potentials due to mismatch of IASI-NG and UVNS and the retrieval challenges in TIR or in UV or the combination. Take the UV for example, the signal to noise ratio is assumed to be 1000. In practice, it might be difficult to fit the data well enough to this level. Also there can be strong correlation between surface albedo parameters and ozone in the lower troposphere, reducing the potential such enhancement to LMT ozone retrievals. It might be useful to discuss/mention some of the implementation challenges or future work in the conclusion.

#### Technical comments

1. L21, change “at the lowermost” to “in the lowermost”
2. L23, In abstract, change “spatial missions” to “spaceborne mission”
3. L28, use subscript in O<sub>3</sub>. It also occurs several times in the text or figure captions
4. L56, change to “the Metop satellites” due to multiple satellites
5. L57, change to “ground resolutions are”
6. L65, change to “Worden”

7. L70, change “at” to “in”, or change to “real TIR and UV satellite measurements”
8. L84, L91 and several other occurrences, add “of” after “generation”
9. L88, change to “similar”
10. L167, change to “Nowlan”
11. L182, “LEO-“ are not needed before “UV-1” and “UV-2”
12. L185, change “the half” to “half”
13. L187, change “polar-orbit” to “polar orbit”
14. L189, change “IASING” to “IASI-NG”
15. L229, change to “unavailability of satellite data or invalid retrievals”
16. L240, 290, change to “8 July 2010”
17. L262, change to “minimize the differences in . . .”
18. L264, remove “results”
19. L290, add “(blue)” after by “real AVK”
20. L314, change to “tackled”
21. L332, change to “, respectively” and “We then”
22. L391, change “Values of total DOF (0-60 km) . . .”
23. L511, change to “screens out”
24. L548-549, this sentence “is captured by IASI-NG+UVNS that is . . .” does not read well and needs to be rephrased.
25. L556-557, change to “is analysed”, otherwise it is not a complete sentence
26. L584, change to “Same data as”

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27. L602, change to “be considered”
28. L617, change to “constraint” as “constrain” is a verb
29. L618, change “relies a on” to “relies on the” or “relates to the”

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-374, 2016.

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