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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Ozone profiles above Kiruna from two ground-based radiometers" *by* Niall J. Ryan et al.

**Anonymous Referee #1**

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This is a nice validation paper which focuses primarily on the 2013 period when MIRA and KIMRA were both deployed at Kiruna. The validation information is encompassed primarily in two sets of figures. Figures 3, 7, and 8 show comparisons between average profiles from the instruments, and point-by-point coincident comparisons are presented in Figures 4, 5, 9, and 10. It is therefore important that these figures are as informative as possible in order to provide for the basis for interpretation of the validation.

For Figures 3, 7, and 8, it is unclear what the blue "measurement error" refers to. Is this systematic error? This is unclear in the associated text as well. If the point of these figures plot is to discuss systematic biases, and I think it is, then the appropriate error bars here should be sigma/sqrt(n), not sigma as is shown. Given the number of data points here (e.g. 177 in Figure 3) error bars should then be much smaller. In fact, if the error bars are retained at their current large form, some of the statements made in the



conclusions cannot be drawn. The variability and random error comparison for which the larger error bars would be appropriate is best left to Figures 4, 5, 9, and 10.

For Figures 4, 5, 9, and 10 it is important to clearly define how exactly the x and y errors are determined. To what extent are the slopes sensitive to reasonable variations in the error estimates? A similar study was conducted by Nedoluha et al. [1997], where it was found that different error estimates gave significantly different slopes, but because of the smaller geophysical variations in that study the sensitivity of the slopes to the error estimates may have been much higher. In any case, an estimate of the uncertainty in the slopes based upon an uncertainty in the error estimates should be given. If the slopes are not, within the uncertainty of these estimates, equal to 1, then there is a significant difference in the variations observed by the instruments and this should be discussed. If not, then the appropriate conclusion is that they agree within reasonable uncertainties.

Page 2 - "With a likely upcoming gap in observations from profiling satellite instruments, ground-based instruments will represent the predominant source of atmospheric measurements needed to maintain a long-term O3 profile record." While I don't dispute the importance of ground-based instruments, it seems unlikely that there will be a true gap in profiling satellite instruments in the near future. Admittedly MLS may stop operating in the next few years, but OMPS-LP and SAGE III are both likely to be operating for some time, and the OMPS nadir instrument certainly does provide some profile information. Perhaps it would be best to just rephrase this as "With the decrease in observations from profiling satellite instruments, ground-based instruments will represent an increasingly important source . . ."

Page 3 - "as well as two Fast-Fourier-Transform spectrometers (FFTS)." There's only discussion of what is done with the narrowband FFTS. What about the other one?

Page 5 - "Attenuation of the signal due to the troposphere is accounted for by including the Millimeter wave Propagation Model MPM93 H2O continuum (Liebe et al., 1993) in

the inversion." Does this mean that ARTS is not run in the troposphere (i.e. it is run only in the middle atmosphere)? Or does it mean that something is added to ARTS in the tropospheric levels?

Figure 2 - Please put a dashed or thin line at 0.5 ppmv/ppmv (=100% measurement response) to make it easier to estimate the measurement response.

Page 8 - "Either way, the choice of time criterion did not have a substantial effect on the presented results (there was a slight increase in standard deviation)." So there was an increase in standard deviation both for tighter and loser coincidence criteria?

Page 9 – "Both the ozonesonde and MLS profiles were smoothed using the averaging kernels." How were the ozonesonde profiles smoothed with averaging kernels given that their highest altitude is in the middle of the KIMRA/MIRA2 vertical range? It seems surprising that KIMRA shows so much less variation than the sondes in Figure 5, but in other figures that show 16-26km data KIMRA shows more variation the MIRA2 . Any comments on this?

Figure 10: The caption says "same as Figure 10". Presumably it should say "same as Figure 9".

Page 12 – The only reasonable explanation for the double peak structure is the last one given, beginning with "A possible explanation for the observed shape is the combination of downward motion of air within polar vortex, and transport of extra-vortex air into the middle to upper stratosphere". A lot of the discussion leading up to this (chemical ozone depletion, mini-holes, . . .) should be eliminated since it clearly isn't relevant.

Page 12 – "An oscillatory bias was identified in the KIMRA data, present in the comparison with all three instruments." According to Figure 3, 7, and 8 in their current form with their very large error bars, this bias would appear to be insignificant, so it is not clear that this conclusion can be drawn. If the error bars were changed to sigma/sqrt(n) then this conclusion would probably be appropriate.



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