

## ***Interactive comment on* “Observation of horizontal winds in the middle-atmosphere between 30 S and 55 N during the northern winter 2009–2010” by P. Baron et al.**

### **Anonymous Referee #2**

Received and published: 25 February 2013

Review of: Observations of horizontal winds in the middle-atmosphere between 30S and 55N during the northern winter 2009-2010.

Baron et al.

General comments:

This is a very nice paper that does a creditable job of introducing a new middle atmosphere wind dataset, quantifying its precision, accuracy, resolution etc. In addition, the paper shows insightful comparisons with ECMWF analysis wind fields that give information both on the quality of the observed winds, and also comment on the validity of the ECMWF fields themselves.

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I am very happy to recommend this paper for publication in ACP. The authors methodology is very sound and largely well explained. I find no fault with the methodology for generating the wind fields, or the analysis described in the paper. My only comments refer to the manner in which the work is described in the paper. Of these, few will require much work to address and most are only minor corrections.

The paper is very well written and easy to read, with a notably high standard of English. The figures are well thought out and convey useful information in an appropriate manner. However, in many cases the figures could be improved by reducing the amount of white space and by eliminating more cases of duplicative axes.

Specific comments:

— Page 32475

Lines 14 and 16: Is it really "mean" differences you're talking about here (i.e., specifically the arithmetic mean of A-B)? If so, the sign is significant and you should clarify which is greater than the other. Alternatively, is this really the mean of  $|A-B|$  or some kind of rms (or just a "rough" summary). If so? then perhaps use some word other than "mean" to describe it to avoid potential for confusion.

Line 20: Delete "in the stratosphere" (essentially - though not completely I grant - redundant with "stratospheric" two words earlier).

— Page 32477

Line 8: Please clarify "meteor radars" for the uninitiated. Is this some use of radar to somehow directly measure wind, or is this using radar to track incoming meteorites and deduce wind from their velocities? (Apologies if this is a dumb question).

— Page 32478

Line 3: "for deriving trace gas profiles" is awkward in this context - it's not like SMILES would not have been able to make trace gas profile measurements if it had launched

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in different month or year. I'd move the trace gas part earlier in the discussion.

Lines 6-7: I think this issue needs to be made clearer to the uninitiated reader. Unless you know that the ISS orbit is inclined around 50 degrees, and that SMILES looks  $\sim 40$  degrees left of the forward direction (neither of which is described in the paper that I could see) it's far from obvious to those unfamiliar with limb-viewing sensors. In addition to helping the reader understand by making these points, a little sketch diagram would go a long way to making this clearer. It's a really nice feature of the orbit and viewing geometry - I'd make it clearer to the reader.

Line 14: "operational winds" -> "operational wind"?

Line 15: How about "middle stratosphere"? I only suggest this as it sounds better given that you already have "mid latitude"?

Line 16: "...expected to be reliable..." Would be nice to quantify this - better than 5m/s? 10m/s? Any literature one could cite?

Line 18: "...results are uncertain..." Again, it would be nice to be a little more quantitative here.

Line 24/25: Not clear whether mean ECMWF differences are discussed in section 3 or 4 (sorry to be picky).

— Page 32479

Line 20: "induced" -> "induces". Elsewhere you use the present tense.

Line 19-21: You quote the typical Doppler shift and frequency resolution, but I think you should also mention the typical line width (though it probably gets wider lower down). I can imagine shifts are harder to spot in wider lines.

— Page 32480

Lines 1-3: Presumably there is a latitude dependence also? I presume that is consid-

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ered in composition retrievals - might be good to mention that.

Line 4: "Because of the geometry..." As stated above, you haven't actually told us what that geometry is. Again, either here or in the earlier discussion, more details on the orbit and geometry and a figure would be really nice.

Line 13-14: "should have been" -> "are"? "Should have been" makes it sounds like they aren't and you don't understand why.

Line 17: While it's good to have the citation to Merino et al., a few more words on what "measurement sensitivity" means would be good. (I'm guessing it's the sum of the averaging kernel rows).

Line 18: The sentence beginning "Considering altitudes..." is a bit clumsily worded. I suggest changing to "Good sensitivity (defined as where the measurement response ranges from 0.9 to 1.1) is found ..."

Line 23-24: I presume the difference in HCl and O3 reflects their different abundance profiles (with O3 peaking in the lower stratosphere and HCl being maximum in the upper stratosphere and lower mesosphere). It might be nice to add a few words to that effect (or if my guess is wrong, to give whatever the reason is).

— Page 32481

Lines 1-2: This discussion is unclearly described.. Was the non-linearity not considered at all in Baron et al., (2011), or was some different value chosen? If the latter, then why choose 20% here when another value was used before?

Line 8: "lower limit of accurate retrieval" is awkwardly phrased. Also, any way to be more quantitative, what value of accuracy did you consider as being the worst tolerable?

Line 16: Your description of chi-squared is at odds with the typical definition (and probably not what you actually did). Statistically, chi-squared is essentially defined as the

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sum of the squares, as you describe, but importantly it is divided by the estimated error in the radiances. Also, most people in the community typically (but, strictly speaking, incorrectly) divide by the number of measurements (or some similar factor). I'm guessing that's what you actually did here. If so, you should reword the description. If not, then I'd call it something other than chi-squared.

Also, I'm unclear about the "before the retrieval" chi-squared. You need to be clear about what starting guess you're using for the state vector here, as that is what largely determines this value. I expect it's something based on a "dead reckoning" tangent point altitude, but it should be described. I'm not clear what "disturbances in the field of view" are? Is this things like obstructions (I know the ISS solar arrays get in the way from time to time), or is it something else? As to "[disturbances in] the pointing", won't the retrieval take them out, in which case why does the "before" chi-squared matter?

Line 27 (to line 1 of next page): I'd put "from 25km to 16km" in parentheses. Also, why did you not use something like the ERA (or MERRA) dataset that would, presumably, not be subject to the resolution discontinuity that you talk about? If it's just that this is what you had to hand then that's fine, but you should probably say so.

— Page 32482

Line 6-7: Do you do anything about the smearing of the wind measurement along the line of sight (I think you mentioned 500km earlier)? That's a significant number of ECMWF grid points. Some kind of weighted average along that length (though not at a fixed height I guess - tricky) might improve some of your comparisons. Again, if you didn't do this, a quick mention of that, and why it can be neglected is fine by me.

Line 10: Delete the comma after "retrieval"?

Line 16: Delete "with a direction"

Line 19: At first, I was going to ask you to roughly quantify how close to "zero" this is by using ECMWF. However, I see later (lines 15-16 of the next page) that you not only

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do that, but correct for the small remaining wind ECMWF says you have too. Is there anyway to reword this discussion to encompass that point from this early stage?

— Page 32483

Line 20: Delete "data since" and "are"?

— Page 32484

Lines 20-24: Is there anything you can say about why the SMILES standard deviation is so much more than ECMWF? Is this real? It seems that it's more than can be accounted for simply by the SMILES precision? Is that correct? Some discussion would help.

— Page 32485

Line 4: "overestimation" is unclear I'm afraid. Precision, resolution and accuracy are unfortunate words. Qualitatively, English makes it sound like more is better, but quantitatively, more is worse. So "overestimation" is jarring. I tend to use words like "better/worse" or "optimistic/pessimistic". Also I don't understand why the large variability of the mesospheric O3 line intensity would lead to an "overestimation" (i.e., pessimistic estimate?) of the precision. Did you overestimate the O3 intensity variability in your error budget? Sorry to not be following this fully.

Line 23: Having "estimate" and "underestimated" in the same sentence is awkward. Again, using words like better / worse would be clearer, and avoid that near repetition.

— Page 32486

Line 14: "less" -> "fewer"

Line 19: "scaled" - surely you mean "offset" don't you? If not, then I've clearly misunderstood the zero wind issue. Please clarify.

— Page 32487

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Line 14: "< 2ms<sup>-1</sup>" is a little bit confusing. Could we possibly say "> -2ms<sup>-1</sup>"? Sorry, I must sound really fussy. On the other hand, it is more consistent with the way you describe the other biases later in the same paragraph.

— Page 32489

Line 24-28: See the discussion lower down on figure 2. In fact, I'd suggest you make this a separate figure. I'd show N<sub>2</sub>O in a polar projection with combined wind vectors overlaid.

— Page 32490

Line 11: Actually this is quite an important one. You quote this as a 2-sigma error. Have all the errors up to this point been 2-sigma also? If so, you should make that much clearer earlier on. Why 2-sigma? I can perhaps understand for accuracy-related errors, as that gives you a ~95%-confidence range. However, for precision-related errors, most people quote one-sigma. If this is the first time you've used 2-sigma then why?

— Page 32491

Line 14: Add "in" between "variation" and "amplitude"

— Page 32492

Line 9: Please give a citation for the equatorial symmetry of the QBO and SAO? Has that been shown from some kind of observations? Is it a model-based or theory-based assertion? How symmetric is symmetric (i.e., what is a typical wind difference between corresponding north/south latitudes)?

— Page 32494

Line 16: Any citation other than a web page for the SMILES research chain?

— Figure 1

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What does the color of the bar signify (e.g., why is SMILES in red - is it simply because it's what you're talking about). A better way of quantifying the resolution would be nice. Perhaps having more ticks on the x-axis. Alternatively, having thin horizontal lines at selected heights in the "bars" with little legends quoting the precision above/beneath.

— Figure 2

I actually don't like this figure. I don't think splitting the two components of the wind field is good if you're then going to show them with arrows - the arrows are not actually pointing in the direction of the wind (unless you're lucky and the other component is zero)! Also, does the length of the arrow mean the same wind speed at all latitudes? Further, why have N2O here at all, you don't talk about it till way later. I'd make a separate figure (on a polar projection) for the stratospheric sudden warming discussion. In any case, what do the white values for N2O mean? As it is, the arrows are essentially invisible in the low latitudes and then very cluttered and hard to interpret (not least because they are split into two components and thus the direction is really not meaningful) in the higher latitudes.

— Figure 3

There is a lot of wasted white space on this figure. I'd delete the redundant y-axes and make the plots closer. Also it looks like it's been compressed along the x-direction (the fonts are very tall and thin). Why have the "W-" prefixes for each entry in the legend? You've not used this notation elsewhere.

— Figure 4

I'd have an extra color and use it to differentiate the AOS-1 and AOS-2 cases for the O3 band A measurement. Also, what are the error bars? (Your e-bar term?)

— Figure 5

The tall-thin nature of these plots makes them hard to take in. Also, I'd decrease the number of vertical dotted lines if possible. Why is the red line dashed? (Simply for



clarity?)

— Figure 7

A lot of wasted space, delete redundant axes (both x and y) and color bar (one horizontal color bar under each column) and tighten up.

— Figure 8

As figure 7, also include the +/-10 degree caveat in the caption, as in Figure 7.

— Figure 9

Again, a lot of wasted space, getting rid of it would give larger and thus more readable plots. Also is this true zonal wind (i.e. you've done a vector sum of the two components and then taken the zonal projection) or does your +/-10 degree caveat apply.

— Figure 10

Again what do the error bars mean. Also, reduce the number of y-ticks and labels in the lower plot to avoid clutter. It's going to be hard to read in single column format as it is now.

— Figure 11

The font for the color bar is tiny compared to that elsewhere in the figure. Also, the y-axis label has got ever so slightly cut off.

— Figure 12

Again much wasted space that could be used to make bigger plots. Also again, what are the error bars.

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Sorry to be so picky - as I say, it's a very nice piece of work.

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