

## ***Interactive comment on “The observation of nitric acid-containing particles in the tropical lower stratosphere” by P. J. Popp et al.***

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Review of ms by P. J. Popp et al.

I would like to state at the outset that this is a very nice paper about an important discovery. There have been suggestions over the years that nitric acid particles could form at the tropical tropopause. It is cold enough there, but there was always considerable doubt whether particles would actually form because the amount of nitric acid is about ten times less than in the polar regions. Furthermore, the region where the temperature is cold enough for nitric acid deposition to occur is very narrow (vertically). Occasionally, investigators have reported that no nitric acid particles are found at the tropical tropopause; some have even insisted that there is no way they could form.

Now, it seems that the controversy has been put to rest by the observation of rather large nitric acid particles measured during several flights of a NASA research aircraft. The technique used is the same as was used to find the very large nitric acid particle ("rocks") in the Arctic stratosphere.

Although I have made some suggestions below, they are relatively minor. The paper is well written. It is complete. The authors have done an excellent job of considering all possibilities.

Now for a few minor criticisms.

First of all, let me mention some typographical errors.

In section 2 on line 20 of page 10101 the period after the abbreviation "min" should be removed.

In section 2 on lines 24 and 25 of page 10101 we read "...for short a period later..." instead of "...for a short period later..."

In section 3 on lines 22 and 23 of page 10103 we read "...are only slightly large than..." instead of "...are only slightly larger than..."

In Section 7 on line 15 of page 10109 we read, "...process is likely further..." instead of "...process is likely to further..."

A few more substantive criticisms now follow.

Page 10100 line 7 we read, "By induction, in situ observations can be used..." I do not know why the words "By induction" are in this sentence. I suggest they be removed.

At bottom of same page (around lines 25 or so) various differences between PSCs and tropical NAT particles are listed. Another difference that is not listed is the fact that polar particles grow much more rapidly than tropical particles. This is implied in the paper, but it might be worth mentioning at this point.

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Page 10102 lines 13/14. "Peaks were not observed in this gap (not shown)..." Sentence is confusing. If peaks were not observed, then obviously they are not shown. I thought perhaps the authors meant the gap was not shown, but since it is visible in the figure, I guess they did not mean that either. So I really do not know what the author's mean by the sentence.

Section 3, page 10102 lines 25/26, "...under observed conditions." Under observed conditions of what? Perhaps of HNO<sub>3</sub> concentration? Unclear.

Page 10103 lines 18/19, "Weinstock et al., 1994, Appendix B" The authors mean to refer to both Weinstocks 1994 paper and the second appendix of the present manuscript. However, it sounds like they are referring to an appendix in the paper by Weinstock. I suggest changing to "Weinstock et al., 1994 and Appendix B."

Page 10106. Figure 4 is mentioned here. I just thought I'd say that this is a very nice corroborative figure.

Caption of Figure 2. "...the integrated HNO<sub>3</sub> mixing ratio for an individual particle in ppv.s." I think this should be ppbv because the integration has been over time. Also, in the same caption, it is not clear if the integration is over a single (thin) peak or over the entire 3 seconds during which the HNO<sub>3</sub> ion is monitored. If it is the whole 3 seconds, then the integration would make the particles appear to be significantly larger than they actually are.

Caption of Figure 5. "...using the model of Appendix B." This should read Appendix A.

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