

We have addressed the questions and suggestions as outlined below.

We have indicated a handful of points (underlined in bold) that the editor may want to double check with one point we would like to keep as is and a modification we made that was not requested but we nevertheless thought useful:

- With regard to discussing the two 20-year old exploratory papers on this topic and discussing what was and was not done in those papers [point 13 below] we kindly ask to keep it as is. The statement about what was not done was not meant as criticism but merely factual and something we believe certain readers may want to know.
- We modified Appendix Fig. A3 which originally had the same layout as Fig. 5 but we realized that except for Fig. 5a all differences were marginal (which was the point of A3 anyway), hence just showing two versions of that panel (a) of Figure 5 suffices.

We hope that we have therewith addressed all issues raised.

Response to editor comments

[0] Title was changed as suggested

[1] We merged figures 1A and 1B with two panels (A+B) and one figure caption.

[2] P1, L8: added “Sedimentation of large nitric acid trihydrate polar stratospheric cloud particles within the Antarctic polar stratospheric vortex that form during winter deplete the inner vortex from nitrogen oxides”

[3] P1, L14: modified the sentence to “Connecting both main regimes is a third regime of coherent patterns in the total nitrogen dioxide column - total ozone column phase space – defined here as “mixing lines”.”

[4] P1, L12: changed to “and long term monitoring of Antarctic Ozone Hole conditions.”

[5] P1, L26-27: changed “after formation of” to “and the development of” (Extremely low stratospheric temperatures during Antarctic winter and the development of the stratospheric polar vortex results in ...)

[6] P1, L27: modified as suggested

[7] P1, L28: modified as suggested

[8] P1, L23ff: we changed the description from “Antarctic” to “polar” although we still have to make the switch to the Antarctic as that is where we analyze data in this paper. We hope this meets the request but please do check.

[9] P2, L30: changed to “Strong zonal winds at the stratospheric polar vortex edge prevent ...”

[10] P2, L35: changed to “... and unfavorable for PSCs while favorable again for stable halogen reservoir species like HCl ...” → please check, we found it not easy to come up with a satisfactory sentence.

[11] P2, L37: This was not meant as a reference to the vortex breakup but rather the association with increase planetary wave activity. We changed it now to “but sometimes also by increased

planetary wave activity (de Laat and van Weele, 2011; Wargan et al., 2020; Smale et al., 2021)".
Note that we wanted to keep the explanation short, hence why we only refer to papers already in the reference list (because there are plenty more possible references).

[12] P2, L50: we alternatively deleted "mostly Antarctic". The sentence originally read "(mostly Antarctic) polar ...". Polar already indicates that it can be either Arctic or Antarctic, hence there is no reason to add "(Arctic and Antarctic) polar". Even though most studies into the Noxon cliff have focused on the Antarctic.

[13] P3, L66: if the editor allows us we would rather keep this in this particular case because we think it is important: looking in hindsight we found it very surprising that no one had looked into this for the past 20 years. Especially after the two initial explorative papers we discuss here. Although we have our ideas about why this has been left. The description here is not (meant as) an accusation but a factual brief summary of what was shown and discussed (and not). We expect that is of interest to some readers (we thought it interesting to note this as it clearly puzzled us).

[14] P3, L68: full instrument names of GOME, OMI and IASI are added

[15] P3, L70: SNO₂ abbreviation was already introduced in L63 (and yes = stratospheric NO₂)

[16] P3, L71: changed

[17] P3, L77: deleted

[18] P3, L81: changed to "is the main denitrification process"

[19] P3, L91: m

[20] P4, L103: changed to "This makes TROPOMI TNO₂ or SNO₂ – in particular combined with the much higher spatial resolution of TROPOMI compared to OMI, GOME-2 and the Ozone Mapping and Profiler Suite (OMPS) - particularly suitable for exploring the Noxon Cliff."

[21] P4, L117: added a reference to "(WMO 2022)"

[22] P5, L22: we do indeed think "from" is better here

[23] P5, L138: change to "width"

[24] P5, L144: changed to "(for TROPOMI: TM5-MP - Transport Model version 5 – Massive Parallel; Williams et al., 2017)", note the added reference

[25] P5, L149: changed to "nearly all Antarctic"

[26] P6, L161: correct, should read "qa_value"

[27] P6, L163: changed

[28] P6, L166: changed

[29] : changed Figure and section to Fig. and Sec. in the entire document

[30] P6, L179: changed

[31] P7, L193: changed

[31] P7, L198: changed

[32] P7, L212: changed

[33] P8, L241: "Tropospheric Emission Monitoring Internet Service"

[34] P8, L250: changed

[35] P9, L267: changed to "springtime advection of SNO2 enhanced stratospheric air into the Antarctic stratospheric vortex is limited during ..."

[36] P9, L270: "found for" change to "from"

[37] P9, L274: changed

[38] P10, L285: changed

[39] P10, L289: changed

[40] P12, L350: changed

[41] P12, L355: changed

[42] P13, L386: changed

[43] P13, L395: changed: QA4ECV = Quality Assurance for Essential Climate Variables

[44] P13, L397: changed

[45] P13, L410: changed

[45] P13, L417: changed

[46] P14, L435: changed

[47] P14, L444: changed

[48] P15, L460-471: checked

[49] P17-P18: figures A1 and 1B are now combined in one figure with two panels (1A + 1B)

[50] P18, L493: changed

[51] Figure 4: changed to using parenthesis instead of brackets for all relevant figures and switched from upper case to lower case letters. Checked the document for referencing to panels (lower case instead of upper case). Modified Appendix Fig. A3 which was similar to Fig 5. but now only showing and comparing Fig. 5a rather than all panels of Fig. 5. Appendix Fig. A3 showed the results of Fig 5. But for TROPOMI SNO2 data at pixel level rather than averaged at 40x80 km. As differences are marginal, we thought there was no added value of showing all Fig 5. panels in Appendix Fig. A3. The comparison with Fig. 5a – 2D histogram – should be sufficient to convince the reader that for the results presented in this paper there is no real material difference in using TROPOMI SNO2 at 40x80 or at the TROPOMI pixel level.

[52] Figure 4: added stations to Figs. 3 and 5 (note that it is not needed for Fig. A3 due to the modification as described in the answer to [51])

[53] Figure 5: see answer [51]

[54] P29, L529: changed

[55] P30, L541: changed

[56] P31ff: checked to the best of my abilities

[57] P44, P55: changed

Response to Referee #1

1) In the RC1 1), change of the action is suggested. However, in the revised manuscript, the following sentence is somehow missing. I would recommend to add it to the manuscript. "The amplitude of the adjustment depends strongly on the effective SZA assigned to the ZSL-DOAS measurement: it is taken here to be 89.5.

Correct and well spotted, the sentence "it is taken here to be 89.5" has been added.

2) Section 2.3, the authors added a references [van der a et at, 2010, 2015], which are not found in the reference list.

In both submitted revision versions (with/without track changes, on the COPERNICUS webportal, submitted files from 26 January) both "van der A et al. [2010, 2015]" papers are in the reference list. The 2015 paper has always been in the reference list, the 2010 paper was added after the revision.

Probably what has happened is that the referee looked under the "V" whereas we listed both papers under "A" (always a problem with Dutch last names).

3) Figure 1A. The last sentence ends somewhat strange: "Note that for ...". Please add correct caption.

Turns out that the rest of the sentence is on the next page. We fixed that in the draft paper but for the eventual edited document that does not matter.