Review of Solar FTIR measurements of NOx vertical distributions: Part I) First observational evidence for a seasonal variation in the diurnal increasing rates of stratospheric NO2 and NO

This study examines stratospheric columns of NO2 and NO from FTIR measurements at two sites (Zugspitze and Garmisch). The retrieval process is discussed for each dataset. The results are then used to calculate the rate of change in both NO2 and NO as a function of local solar time for each month of the year. Overall, this paper is good. I look forward to part 2, which will be particularly helpful for validating model based diurnal scaling factors.

Questions & Comments

Line 45: Chu et al reference is for SAGE III/Meteor-3M, not SAGE III/ISS. The typical reference is

Cisewski, M., Zawodny, J., Gasbarre, J., Eckman, R., Topiwala, N., Rodriguez-Alvarez, O., ... & Hall, S. (2014, November). The stratospheric aerosol and gas experiment (SAGE III) on the International Space Station (ISS) Mission. In Sensors, Systems, and Next-Generation Satellites XVIII (Vol. 9241, pp. 59-65). SPIE.

Line 77: Which years does this trend correspond to?

Line 87: Clearly define what you mean by 'diurnal increase'

Line 155: Is it still possible to retrieve at SZA > 80? I understand that these values are not helpful for your diurnal increase calculation, but they would be very valuable for validating modelled NO2 and NO at sunrise and sunset. The photochemical model output at these times in highly uncertain, but necessary to use when considering measurements from occultation instruments.

Figures S3 and S4: red and green lines together will not pass the journal's colorblind test. I suggest changing the green line to black or blue.

Line 268: "The NO 2 concentration in summer (greenish symbols) is ~3.5 times higher than in winter time (blueish and yellowish symbols)"

- This is not very clear from the figure. I assume that the green and yellow symbols are on top of the blue and purple symbols, in which case it looks like the blue and green points have similar values. Perhaps it would be easier to see if you just chose a single colour for each season. Or else you could just refer to figure 3 instead as it more clearly shows the difference between the months.

Line 271: It is likely that your results do not show the non-linear behaviour because you are using a column measurement. Figure 1 of Dube et al 2021 shows that the slope and linearity of the NO2 diurnal cycle (from a model) varies considerably with altitude. This is probably worth mentioning.

Dubé, K., Bourassa, A., Zawada, D., Degenstein, D., Damadeo, R., Flittner, D., & Randel, W. (2021). Accounting for the photochemical variation in stratospheric NO2 in the SAGE III/ISS solar occultation retrieval. Atmospheric Measurement Techniques, 14(1), 557-566.

Some questions about Figure 4:

- Why does Zugspitze have a smaller slope in the first part of the year?
- Why do both stations show a steady increase in slope up to september and then a more rapid drop?
- Why does Garmisch have larger error in the winter?

Line 325: What are the other reasons?

Line 340: Are the changes in NO and NO2 consistent with one another? I think they should change in proportion to each other while in equilibrium (slope of scatter plot should follow 1:1 line)

Minor Edits

- In general, some of the wording and comma usage is strange. I suggest reading the manuscript through carefully.

Line 35: 'building' should be 'build-up'

Line 38: add a comma between 'cycle' and 'NOx'

Line 78: remove comma

Line 103: remove 'thereafter', change 'over' to 'of'

Line 107: change 'consecutive ' to 'continuous' Same on line 113.

Line 118: remove 'very fast'

Line 127: change 'daytime' to 'daylight'

Line 128: NO2 continues to increase at the same rate?

Line 241: change 'highly smoothened' to 'smooth'

Line 306: change 'This analyzation is motivated by the question whether' to 'This analysis is motivated by the question of whether'

Line 307, 327: change 'is originated in the' to 'originates in'

Line 310: change 'on the' to 'as a function of'

Line 314: change 'abundancy' to 'abundance'

Line 321: remove comma

Line 334: remove comma

Line 349: I do not understand this statement. The following line is also unclear: what is meant by the slope of the NO rise?