

Review of SCIAMACHY nominal mode NO

The paper “Retrieval of nitric oxide in the mesosphere from SCIAMACHY nominal limb spectra” by Stefan Bender et al. describes a new mesospheric SCIAMACHY NO data product, the retrieval algorithm of which is largely based on the MLT mode NO retrievals. Preliminary results, along with the effects of a priori information, are also discussed. The paper is well written, flows logically, and is on a subject matter that would be of interest to an AMT reader. As well, the new NO data product will be of great interest to the mesospheric community as there are very few mesospheric NO data sets currently available (especially in the middle mesosphere where this data set yields the best results). I would recommend the paper for publication after one major issue and a number of more minor issues (listed below) are properly addressed.

Major issue

It is highly unlikely that using a constant correction factor (0.5) to the a priori values will be a solution to the overcorrection for all SCIAMACHY retrievals. Especially when considering the reason given—that the SNOE mission was during an epoch of high solar activity, since the SCIAMACHY mission spans almost an entire solar cycle. Also, NO peak densities are known to vary by much more than a factor of 2 throughout an 11-year solar cycle. I would highly recommend varying this scale factor based on known NO variation throughout a solar cycle and make it dependent on either Ap or AE index values.

Minor and/or technical issues

Title: Title has “nitric oxide”, whereas P1L1 and P1L16 have “nitric monoxide”. Suggest only using nitric oxide.

Abstract: Try to reduce the number of times you begin a sentence with “we”.

P1L7: what does NOEM stand for?

P1L8: Would “realistic” be more accurate than “meaningful”?

P1L10: What is meant by “misidentification”?

P2LL2-3: I would suggest something like “...to about 91 km, they do not sample the lower thermosphere where peak NO densities are typically located, above ~100 km (...”

P2L4: “the whole” should be “all”

P2L14: Although there is no paper dedicated solely to SMR NO retrievals, it might be good to also cite Pérot et al., AMT, 2013 which also describes the SMR NO data.

P2L15: I recommend mentioning that the ACE-FTS NO was validated by Kerzenmacher et al., 2008, as the study doesn't greatly discuss the retrieval algorithm. Also, the way the paragraph is structured could lead people to think that ACE observes emissions, when it is solar occultation.

P2L20: Conclusions are given in Section 5.

P3L1: It would be beneficial to mention that NO gamma band emission is fluorescent scattering, hence only dayside. (It could also be mentioned at line 11 of this page)

P3LL8-9: “we fit the measured NO gamma bands spectra to modelled spectra (...”

P3LL30-31: It seems like you're describing solar occultation measurements. I would assume that the forward model would calculate emissivity along the line of sight (not extinction, as you just mentioned that for these transitions the atmosphere is optically thin), and from the top of the atmosphere to the tangent point (not from the sun)?

P4L19: remove “again”.

Eq. 2: Sorry, I've never seen this notation before. I assume that, $\|Kx - y\|_{S_y^{-1}}^2$ is the same as $(Kx - y)^T S_y^{-1} (Kx - y)$?

P5LL8-9: The NO peak height is *typically* between 100-110 km. The Odin measurements show that it can be lower in mid-winter.

P5LL14-15: Please define NOEM and SNOE.

P6LL11-12: It would be better as “...fitted NO slant column densities from the (0, 2) band...” the way it's currently worded seems to imply that you're showing NO $\gamma(0, 2)$ slant column densities, which is not the same as NO.

Figure 1: Is there a reason why only slant column densities from (0, 2) are being shown? If it's because it has the greatest S/N, maybe that should be mentioned in the text. Also, in the titles for the number density plots, “NO02+14+15” is a bit distracting. It could just be “NO”, or something like, “NO all bands average”.

P7LL7-10: This point doesn't seem important, consider removing.

P8L1: "...number densities without a priori..."

P8LL17-18: Even though it only gives a rough qualitative look, please briefly describe the results in a sentence or two.

Figure 6: I'm not sure what the values "(490, 1680, 509)" are referring to, but they don't appear to be necessary (especially in the legends).

P10L3: should be "(dark orange and dark purple)".

P11L3: "dark purple"

Section 4.4: Please discuss how the values for the sample orbits compare to typical retrievals. Are they average, are they better or worse?

P13LL13-12: ACE-FTS measures NO in the same altitude range. Even though it's solar occultation, there should still be hundreds, if not thousands, of coincident measurements between SCIAMACHY and ACE NO. It is not necessarily recommended that you do the comparisons here, but it should be done in the future (and at least mentioned here).

P14L1: "The ten years of daily measurements allow for the study of NO..."