

Review:

This work presented the “NOyBOx”, a new instrumental framework combining measurements of NO, NO₂ and NO_y from commercial analyzers with a custom-built incoherent broadband cavity-enhanced absorption spectrometer (IBBCEAS) that measures NO₃ and N₂O₅. The design of the IBB-CEAS subsystem, characterize the TDI, cavity optics, transmission losses, were described. Furthermore, a synthetic spectra simulation approach was used to correct the bias of ambient NO₂ and water vapor on concentration retrieval procedure. The first field deployment during the Atmospheric ChemistRy of the Suburban foreSt (ACROSS) campaign was presented.

This work has certain research significance and value. However, there are some problems in the article, please give a supplement. I suggest that the article be published after revision.

Major comments:

1. The authors presented the “NOyBOx”, a new instrumental framework combining measurements of NO, NO₂ and NO_y from commercial analyzers with a custom-built incoherent broadband cavity-enhanced absorption spectrometer (IBBCEAS) for NO₃/N₂O₅ detection. However, the introduction does not draw a sufficiently clear distinction from previously published multi-channel IBBCEAS and TD-CRDS works that simultaneously measure NO₃/N₂O₅ together with NO_y. Please explicitly state in the manuscript the innovations or optimizations of NOyBOx relative to prior comparable instruments.

2. In Section 2.2.2, the authors state that two high-reflectivity mirrors used have a reflectivity of 99.98 ± 0.01 % at 630–690 nm, and separated by 61.5 cm. In previous studies, high-reflectivity mirrors for this spectral band can achieve reflectivity above 99.998 %, or the effective optical path length can be increased by extending the mirror-to-mirror distance to improve the technique's sensitivity. Please elaborate how the detection limits of 1.5 and 2.2 pptv (1 σ , 15 s) are achieved under the given experimental conditions.

3. In Section 3.3, Model 2 introduces an empirical temperature-dependent wall-loss term in the form of a Hill type, $k_9 = k_{\text{Hill}}(T)$, to reproduce the decrease in the NO_3 signal at high temperatures. An arbitrarily chosen constant background loss (0.1 s^{-1}) between 300 and 373 K, followed by a sigmoidal increase in k_9 to 0.4 s^{-1} between 373 and 473 K to empirically reproduce the observations. It is suggested to add supporting information: literature-reported NO_3 wall loss on PFA tubing under high-temperature conditions, to justify the choice of these empirical parameters.

4. In Section 3.5.1, to investigate the effects of NO_2 and H_2O , a synthetic-spectrum approach used to characterize fitting bias in other spectroscopic retrievals were inspired. The effective limit-of-detection LOD_{eff} is obtained based on Monte-Carlo simulations to correct $\text{LOD}_{\text{noise}}$ derived from Allan deviation. It is recommended to quantitatively evaluate the potential bias in LOD_{eff} caused by mirror-reflectivity drift.

5. In Section 3.4, by repeatedly switching between sampling NO_3 from CESAM through PFA tubing and through the filter, a transmission efficiency ($\pm 2\sigma$) was found to be $(90 \pm 1) \%$. Please supplement whether this transmission efficiency was obtained using a clean filter or a contaminated filter. Türk et al. (2026), published in AMT, reported that filter exposed to NO_3/O_3 can increase the transmission efficiency from 70–80 % to approximately 98 %. Please refer to this paper (DOI: 10.5194/amt-19-4815-2026) for details.

6. Section 4 stated that “where the observed NO_z increase accounted for only a fraction of the concurrent $\text{NO}_3/\text{N}_2\text{O}_5$ signal, pointing to additional, yet-unquantified oxidation pathways”. It is suggested to briefly list these potential pathways.

7. Section 3.2 noted that the reflectivity at 662 nm varied between 99.983 % and 99.988 % for the NO_3 channel, corresponding to changes in L by a factor of 0.7. In the field deployment, R and I_0 were determined every 24 h and 1–1.5 h, respectively. It is suggested to add an assessment of the systematic biases for NO_3 and N_2O_5 introduced by the slow drift of R between two successive R -determination events.

8. In Section 2.2.1, precise thermal regulation of the LED light source is mentioned to suppress wavelength drift and intensity instability. It is suggested to supplement information regarding the long-term stability of the central wavelength.