

Anonymous Referee #2

This paper describes an improved method for estimating emissions from NO₂ columns. The method is applied to model results so that it can be evaluated thoroughly, with a view to application to satellite data in the future.

The paper is interesting and well written, and the subject is significant. I am happy to recommend publication.

Response: We thank Referee #2 for the encouraging comments. We addressed all the comments carefully as below.

My main comment is that the method is presented as being “new” but is really an evolution of prior work. This is not a problem, but I think the presentation would be greatly helped by describing more clearly what the method was before, and what the change is. I know that the details are already in the manuscript, but at the moment it is a little difficult to follow and to figure out what the significant changes are.

Given that the paper is a methods paper, it would help if the figures and description were more pedagogical in nature. They could show more clearly what the method does and how. This would help the reader follow the explanation.

Response: In order to make it more clearly what the method does and how,

We have updated the schematic of the work in Figure 1 based on the comments from reviewer #1, as follows:

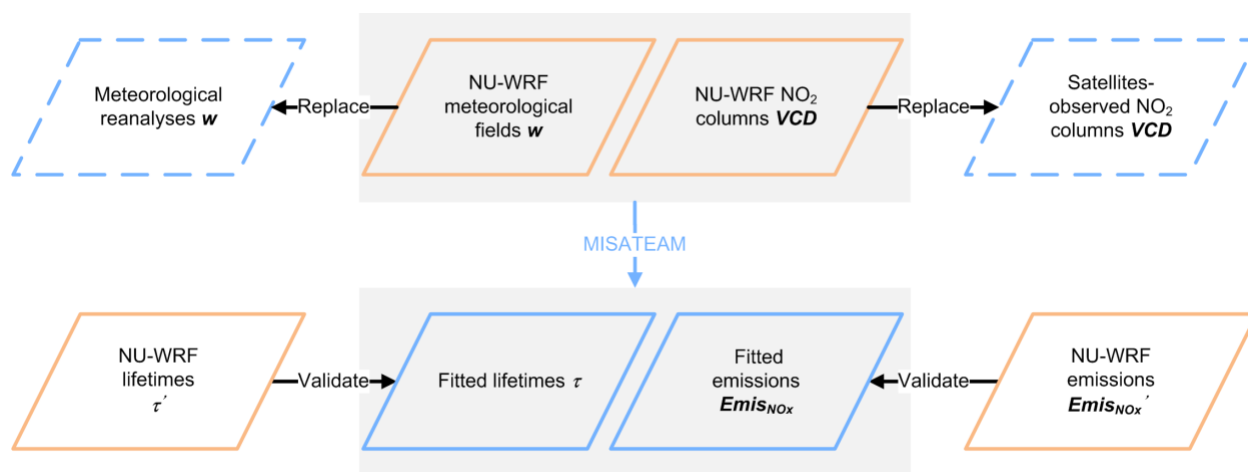


Figure 1 Schematic of our evaluation system to assess the accuracy of the inferring NO_x lifetimes and emissions derived from MISATEAM. The blue symbols represent the inputs (dash line) and outputs (solid line) of MISATEAM. The orange symbols represent the information derived from NU-WRF.

We have also added a flow chart to clarify the changes of this study compared to previous work in Figure S5 of the revised supplementary, as follows:

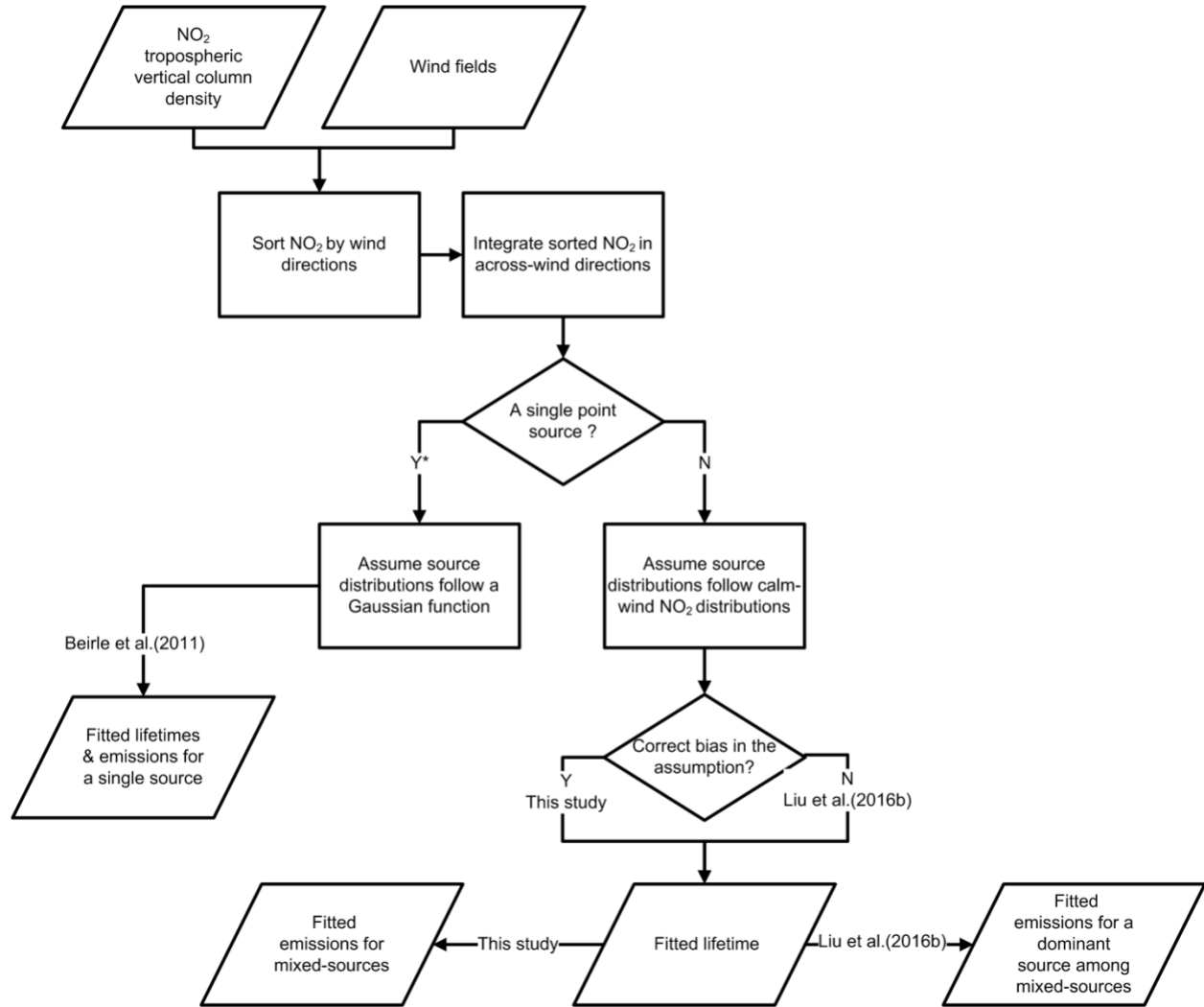


Figure S5 Comparison of methodology between this study (MISATEAM) and Beirle et al. (2011) and Liu et al. (2016b). *MISATEAM and the approach of Liu et al. (2016b) are also applicable to a single point source.

The study uses 26 cities but does not show much about the difference between them – we barely see where these cities are. Some more details should be presented, at least in the SI if not in the main text.

Response: We have listed the details of the cities in the table S1 of the revised supplementary.

I think it would be informative to say what percentage of the days are in each wind direction sector. It would also be interesting to see some of the rejected sectors – for someone wanting to replicate the study, it would be helpful to see what was kept and what was rejected. The text could briefly explain the rationale for the decision.

Response: We added the number of days used for each wind direction sector in the revised Figure 4, as follows:

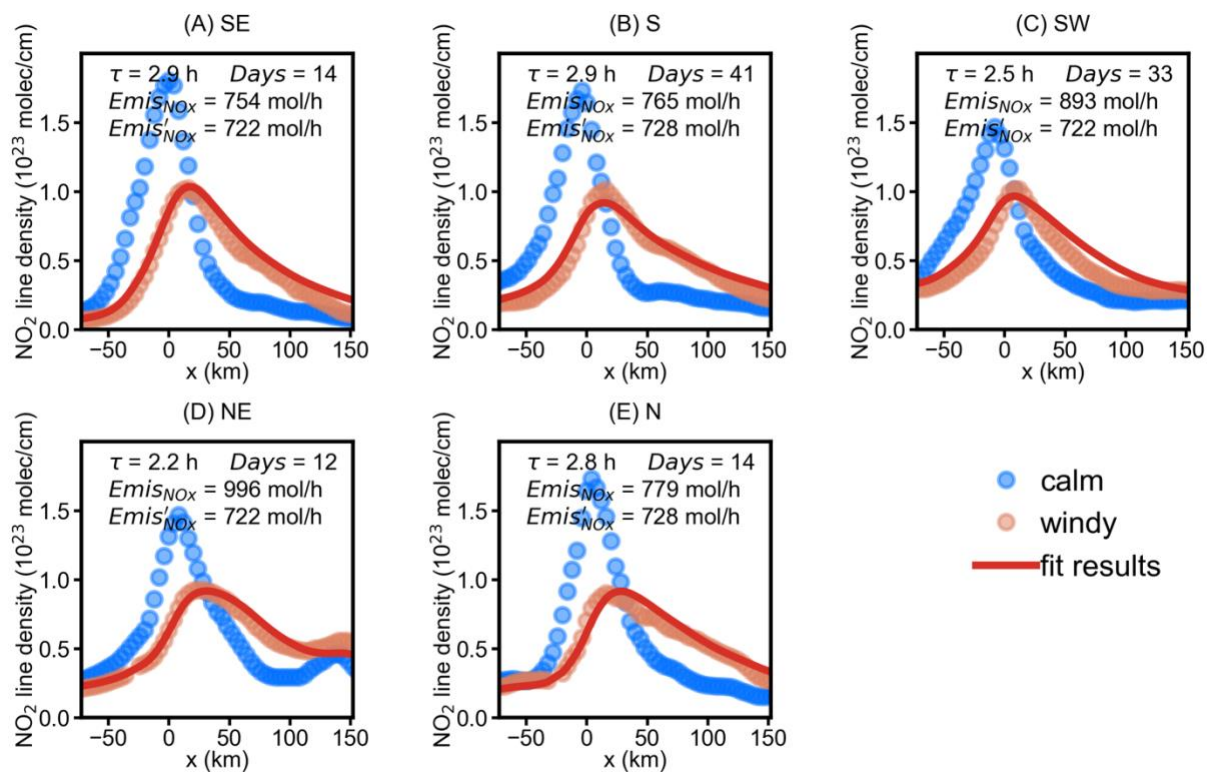


Figure 4 NO₂ line densities around New York for different wind direction sectors. Circles: NO₂ line densities for calm (blue circles) and (A) southeasterly, (B) southerly, (C) southwesterly, (D) northeasterly, and (E) northerly winds (red circles) as a function of the distance x to New York center. Red line: the fit result $f(x)$. The numbers indicate the fitted NO_x lifetime (τ), average days of data used for calculating NO₂ line densities ($Days$), derived emissions ($Emis_{NO_x}$) and given emissions ($Emis'_{NO_x}$). NO₂ line densities are derived from NO₂ VCDs averaged from April through September, 2016. NO₂ line densities for the remaining wind direction sectors are discarded due to the fitting results being of insufficient quality.

We have also added the figures for rejected directions in the Figure S4 of the revised supplementary, as follows:

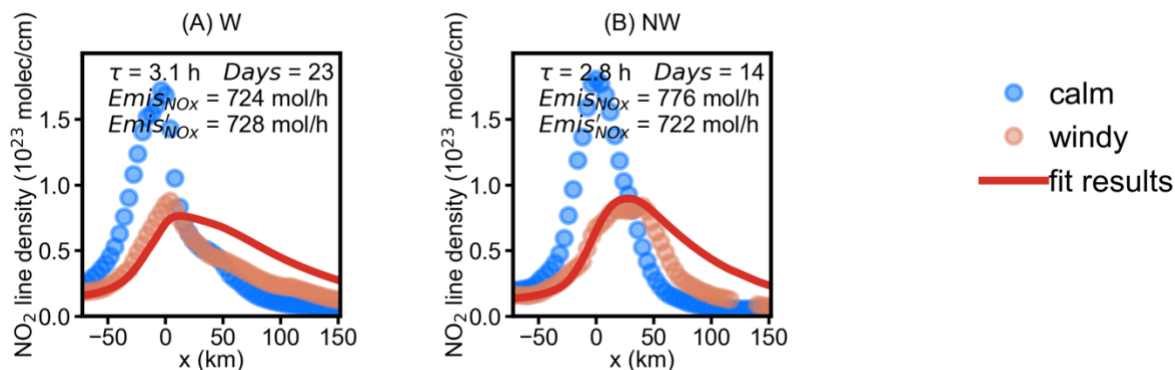


Figure S4 Similar to Figure 4, but for wind direction sectors with fitting results of insufficient quality: (A) westerly and (B) northwesterly wind.

We have explained the reason for the rejection in the manuscript, as follows:

“Fitting results of insufficient quality (i.e., the correlation coefficient R between the fitted and observed NO₂ LD < 0.9 , and one standard deviation error of $\tau > 10\%$) are discarded.”

I thought Fig 5 was an odd choice to include in the manuscript. It seems like typical SI stuff (if that even). Maybe moving it would free up some space to include more figures describing the method and the results themselves.

Response: We thank you for the suggestions and fully understand the concerns here. However, since Reviewer 1 indicated that they considered this an important figure, we decided to keep it.

Nomenclature was sometimes a bit clumsy. “ratio” and “emis’ ” could have better names for clarity and legibility.

Response: We have changed *ratio* to $R_{NO_x:NO_2}$ and *emis* to $Emis_{NO_x}$ in the revised manuscript.