Anonymous Referee #1

The authors have thoughtfully responded to each of my comments. The paper should be accepted as is or subject to minor corrections. I ask that the authors consider the following minor changes: clarification that de Foy et al. (2014) accurately retrieves synthetic tracer emission, but does not necessarily accurately retrieve the specified lifetime of the tracer (1 h, 12 h, see comment 5) and the addition of a citation tp Fioletov et al. (2015) in regards to using satellite-based measurements to quantify SO_2 emissions and lifetime (see response to comment 6 - $\tau(SO_2)$ = 4 - 12 hours).

Response: We thank Referee #1 for the comments. We have clarified the work of de Foy et al. (2014) in the introduction of the revised manuscript, as follows:

"de Foy et al. (2014) further analyzed the performance of the method using model simulations with fixed a-priori lifetimes and realistic wind data, which proved that the model accurately estimated the synthetic emission, but did not necessarily accurately retrieve the lifetime, and showed best performance for strong wind cases."

We have added the citation of Fioletov et al. (2015) to the end of Sect. 3.2.

Anonymous Referee #2

I recommend publication of the manuscript after minor revisions.

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

Abstract

Please specify the period that is used to define the lifetimes such as ozone season (May-September).

Response: We added the information of ozone season in the abstract of the revised manuscript, as follows:

"The derived lifetimes for ozone season (May-September) are 3.8 ± 1.0 hours (mean ± standard deviation) with ranges of 1.8 to 7.5 hours."

Introduction

Lines 18 and 19 in first page of the introduction section

data is -> data are

Response: Thanks. We have rephrased this in the revised manuscript.

2.3 Uncertainties

Lines 28-29

the uncertainty of tropospheric NO_2 TVCDs (30%)

->Provide the reference for this estimation in the main text. Do you suggest that users of the satellite NO_2 retrieval refer to this number in your manuscript for their study?

Response:

Concerning the uncertainty of NO_2 from satellite, users should refer to the respective

Algorithm Theoretical Basis Document (ATBD) or paper, and we thank the reviewer for pointing out that our choice of 30% uncertainty for TVCDs misses some explanation and appropriate reference in the manuscript.
Thus, we have modified the supplement (first sentence in 3 (e)) to:
"The uncertainty of TVCDs consists of additive (biases due to the spectral retrieval and the stratospheric correction) and multiplicative terms (tropospheric AMFs). For our study, any additive bias is eliminated by the fitted background, while the uncertainty of the tropospheric AMF of about 30% (Boersma et al., 2007, table 2 therein) directly propagates to the uncertainty of the estimated emissions."
In the main text, we modified lines 28-29 to "*the uncertainty of tropospheric NO_2 TVCDs (30%, see Boersma et al., 2007 and Sect.3 (e) in the supplement)*" .

3.3 Uncertainties
Lines 24-28
Information here is useful. I do not think this estimation is conservative.
My experience with regional scale model using MEIC for year 2010 clearly shows a factor of 1.5 to 2 overestimation compared to the ground-based observations as well as satellite and MAX-DOAS NO_2 data collected for the same period. This also affects substantially the biases in the model-simulated ozone to the observations.
Response: We have quantified the uncertainty of emissions resulting from our method at best knowledge in section 3.3 of the main paper and section 3 of the supplement. We do not see that our final uncertainty would be contradicted by 50%–100% deviations between (MAX-DOAS and satellite) observations and regional scale model runs found by the reviewer, given the fact that bottom up inventories and chemical models have considerable uncertainties as well.