This paper combines multiple satellite retrievals of tropospheric NO2, multiyear simulations with a relatively high resolution model, and an updated emission inventory to analyze the trends and variability of NOx over East Asia. It also tries to invert NOx emissions for 2009-2010 when the bottom-up inventory is not available. Overall I find the paper is within the scope of ACP. There are some issues to be addressed before the paper can be published in ACP.

Some results on emission trends and variability have been found in previous studies (e.g., Schneider and Van der A., 2012, JGR; Lin and McElroy, 2011, ACP; Lamsal et al., 2011, GRL; Stavrako et al., 2008, GRL). I suggest the authors to make it clearer (especially in the introduction) how the current study improves upon the previous ones, in addition to the use of different models and emission inventories. Quantitative analysis should be included in the introduction.

I find the multiyear simulations on a relatively high resolution to be an important aspect that could be addressed in the introduction.

Model uncertainties could be discussed more thoroughly and quantitatively (if possible). Such discussions should be placed when introducing model simulations in Sect. 2.1. While this paper focuses on emission trends, an improved discussion of model settings and model uncertainty would be very beneficial.

Lightning emissions are not included, so what are the implications for model VCDs and comparisons with satellite retrieval? Adding lightning emissions would lead to more VCDs particularly in summer.

Model schemes should be clarified and citations provided. The sentence ‘CMAQ was configured to use mass-conserving scheme for advection, multiscale horizontal diffusion and eddy vertical diffusion.’ does not tell much.

Month variation in emissions should be presented. How about the diurnal variation of emissions in the model? This may affect the comparison results for morning time and afternoon time.

A table listing anthropogenic and natural emissions in the model will be very useful.

Are model results sampled at time and places with valid satellite retrievals? Sampling bias is important. Please also give detailed info on how the satellite pixels are gridded to 0.5 degree.

Errors in satellite retrievals should be addressed more consistently. In Sect. 2.2, satellite retrieval errors are assumed to be relatively small, which are in contrast with later sections suggesting satellite biases to be larger. Estimate of satellite errors should be made consistent, placed in Sect. 2.2, and referred to in later sections.

Results for Japan and Korea may be affected by the small domain such that the effect of model and retrieval errors may be larger (because fewer data can be used to do spatial averaging, as compared to CEC). Please discuss.

Specific comments

Abstract:

Quantitative analyses will be useful.

Introduction:

P11249, L20: transportation and power plants belong to 'fossil fuel combustion'

P11250, L7: If cloud cover is considered, more days are needed for global coverage

P11251, 2nd paragraph: the paragraph is complicated. I suggest to split it. Also, 'fully utilizing' is just 'utilizing'

Sect. 2.2

Use of averaging kernel will affect the trend analysis (e.g., Lin and McElroy, 2011).

P11254, L2: unclear. Is '30-35%' found in the present study or quoted from other papers?

Sect. 3.1

P11254, L14-18: Lin and McElroy (2011) first analyzed the downturn, and should be cited here.

P11254, L25: the differences may also be caused by larger biases in the morning time for both modeling (due to model errors at night) and satellite (due to less valid data from SCIAMACHY, etc.).

P11256, L4: the satellite errors suggested here are inconsistent with Sect. 2.2.

P11256, 1st paragraph: the discussions on model and retrieval errors should be placed in Sect.2.

P11257, L1: 5.1%/yr is smaller than Lin and McElroy (2011) (8-9%/yr). Please discuss.

Sect. 3.2

P11257, L20: The sentence is an overstatement, particularly for Japan and Korea.

P11258, L1: SCIAMACHY is subject to much less valid data, and the comparison in the morning time is subject to model errors in the nighttime. Please comment.

P11258, L11: the sentence ‘because of …’ is unclear

P11258, L18: ‘the results in…’ is unclear

P11258, L18-21: the estimate should be presented with caution. The fraction of CEC to China may be changed from one year to another due to the different growth rates of NOx emissions in different regions. Also, what is the source of ‘46%’?

P11258, L22: source of ’14.3Tg’?

Sect. 3.2

P11259, 2nd paragraph: the general discussion on China should cite other studies.

P11259, L16: ‘it is considered…variability’ is unclear

Sect. 4

P11259, L23-26: please cite previous studies on NOx trends and economic downturn.

Table 1:

Pixel sizes and periods are presented incorrect/incomplete.

Lamsal, L. N., Martin, R. V., Padmanabhan, A., van Donkelaar, A., Zhang, Q., Sioris, C. E., Chance, K., Kurosu, T. P., and Newchurch, M. J.: Application of satellite observations for timely updates to global anthropogenic NO(x) emission inventories, Geophysical Research Letters, 38, L05810, 10.1029/2010gl046476, 2011.

Lin, J.-T., and McElroy, M. B.: Detection from space of a reduction in anthropogenic emissions of nitrogen oxides during the Chinese economic downturn, Atmos. Chem. Phys., 11, 8171-8188, 10.5194/acp-11-8171-2011, 2011.

Schneider, P., and van der A, R. J.: A global single-sensor analysis of 2002-2011 tropospheric nitrogen dioxide trends observed from space, J. Geophys. Res.-Atmos., 117, D16309, 10.1029/2012jd017571, 2012.

Stavrakou, T., Muller, J. F., Boersma, K. F., De Smedt, I., and van der A, R. J.: Assessing the distribution and growth rates of NOx emission sources by inverting a 10-year record of NO2 satellite columns, Geophysical Research Letters, 35, L10801, 10.1029/2008gl033521, 2008.