

Reviewer 1:

This is a comprehensive analysis of emission trend and mitigation options. I focused on section 4.2 on the comparison of the emissions with the satellite observations, for which I have more expertise.

The comparison of satellite observations presented in sec 4.2 is qualitative, but seems reasonable for the scope of this study. The comparison of NO₂ columns and NO_x emissions is subject to time-dependent chemical feedbacks of NO_x on its own lifetime. A more rigorous comparison would involve incorporating the emission inventory into a chemical transport model and comparing the simulated NO₂ versus satellite NO₂; however that may be beyond the scope of this manuscript.

Response: We agree with the reviewer that it is more rigorous to calculate NO₂ vertical column density with a chemical transport model and then compare with satellite observations. This manuscript focuses on the emission trends and mitigation options of air pollutants, the calculation of NO₂ column with chemical transport model is beyond the scope of this study. However, in our previous study (Zhao et al., 2013), we once compared the NO₂ column simulated by the Community Multi-scale Air Quality (CMAQ) model with the satellite observations in 2005 and 2010, and demonstrated good agreement with each other. In the revised manuscript, we have added the importance of comparing the simulated NO₂ column trends with satellite observations in the future. (Page 39 Line 13-16 in the revised manuscript)

Reference:

Zhao, B., Wang, S. X., Dong, X. Y., Wang, J. D., Duan, L., Fu, X., Hao, J. M., and Fu, J.: Environmental effects of the recent emission changes in China: implications for particulate matter pollution and soil acidification, Environ. Res. Lett., 8, doi:10.1088/1748-9326/8/2/024031, 2013.

The SO₂ comparison is subject to uncertainty in the retrieval algorithms. The authors may be able to easily strengthen the confidence in Fig 5b by adding GOME-2 from Fioletov et al. (2013), but I suggest this only for consideration.

Response: We appreciate the reviewer's valuable comment. We have added the SO₂ column retrieved by Fioletov et al. (2013) from GOME-2 DLR and GOME-2 SAO products, as shown in Figure R1 below, or Figure 5(b) in the revised manuscript. It can be seen that the temporal trends of SO₂ vertical column density retrieved from all four data sources (OMI,

SCIAMACHY, GOME-2 DLR, and GOME-2 SAO) agree fairly well with each other. The addition of GOME-2 strengthens the confidence but does not change our previous conclusions.

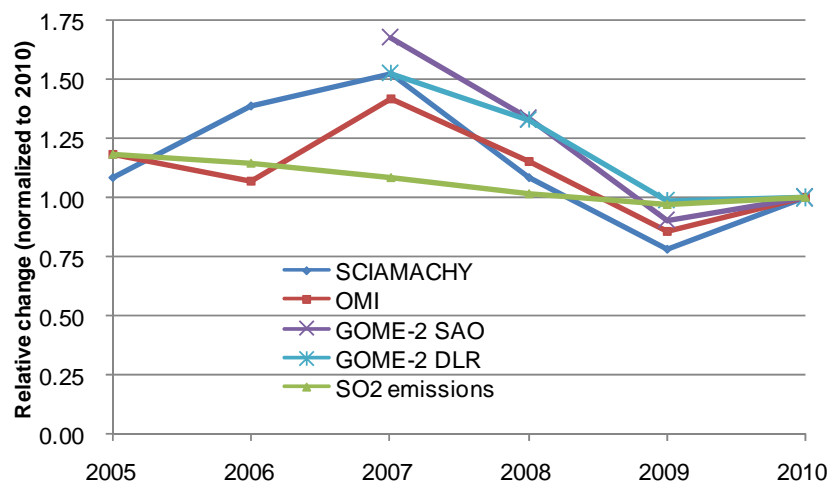


Figure R1 Inter-annual relative changes of SO₂ vertical column density and total SO₂ emissions over an area of Eastern China (34°N–38°N, 112°E–118°E). SO₂ vertical column density was derived by Fioletov et al. (2013), in which a filtering procedure was applied to remove local biases. All data are normalized to 2010. This figure is consistent with Figure 5(b) in the revised manuscript.

References:

Fioletov, V. E., McLinden, C. A., Krotkov, N., Yang, K., Loyola, D. G., Valks, P., Theys, N., Van Roozendael, M., Nowlan, C. R., Chance, K., Liu, X., Lee, C., and Martin, R. V.: Application of OMI, SCIAMACHY, and GOME-2 satellite SO₂ retrievals for detection of large emission sources, *J. Geophys. Res-Atmos.*, 118, 11399-11418, doi:10.1002/jgrd.50826, 2013.

Spelling and grammar do need some attention throughout the manuscript.

Response: We thank the reviewer for this comment. While revising the manuscript, we took special care to assure correct spelling and grammar. In addition, we have invited Dr. Michael B. McElroy and Dr. Chris P. Nielsen, co-authors of the manuscript, to help us edit the language of the whole manuscript.

Specific:

I could not find in Fioletov et al. (2013) where they attributed the pronounced between in

2009 and 2010 to transient volcanic signals. It may be more accurate to say that the difference arises from time-dependent bias in the retrieval algorithms.

Response: We appreciate the reviewer's valuable comment. We double checked the relative literature (Fioletov et al., 2013). The author did not explicitly attribute the pronounced increase between in 2009 and 2010 to transient volcanic signals. Instead, we concluded that the transient volcanic signals resulted in the pronounced increase by discussing with the author of Lu et al. (2011). Lu et al. applied a filtering procedure quite similar to Fioletov et al. (2013), except that they did not eliminate transient volcanic signals. Therefore, we believe the volcanic signals should be the major contributor to the pronounced increase. To be more accurate, we accepted the reviewer's suggestion and revised the original text as follows:

Lu et al. (2011) shows a significant increase in SO₂ vertical column density (VCD) between 2009 and 2010 (especially that retrieved from SCIAMACHY), while Fioletov et al. (2013) shows a slight increase. Fioletov et al. (2013) implies that the pronounced increase between 2009 and 2010 arises from time-dependent bias in the retrieval algorithms. When the filtering procedure developed in Fioletov et al. (2013) was applied, the pronounced increase turned into only a slight increase. Therefore, we exclude the SO₂ VCD in 2010 in Lu et al. (2011) in the following discussion. (Page 40, Line 1-7 in the revised manuscript)

References:

- Fioletov, V. E., McLinden, C. A., Krotkov, N., Yang, K., Loyola, D. G., Valks, P., Theys, N., Van Roozendael, M., Nowlan, C. R., Chance, K., Liu, X., Lee, C., and Martin, R. V.: Application of OMI, SCIAMACHY, and GOME-2 satellite SO₂ retrievals for detection of large emission sources, *J. Geophys. Res-Atmos.*, 118, 11399-11418, doi:10.1002/jgrd.50826, 2013.
- Lu, Z., Zhang, Q., and Streets, D. G.: Sulfur dioxide and primary carbonaceous aerosol emissions in China and India, 1996-2010, *Atmos. Chem. Phys.*, 11, 9839-9864, doi:10.5194/acp-11-9839-2011, 2011.