Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-1054-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid reduction of black carbon emissions from China: evidence from 2009–2019 observations on Fukue Island, Japan" *by* Yugo Kanaya et al.

Anonymous Referee #1

Received and published: 19 January 2020

The authors presented black carbon (BC) observations from 2009 to 2019 at the Fukue island located downwind of China and inferred China's BC emission trends from these observations. They used the chemical transport model WRF-CMAQ to estimate the meteorological effects on BC concentrations, used the backward trajectory model HYSPLIT to attribute observed BC trends to emission source regions, and finally identified rapidly decreasing BC emissions from China, which are broadly consistent with the up-to-date bottom-up emission inventories. The comprehensive analysis that integrates several models and datasets gives a strong, convincing conclusion. This paper is well written and deserves publication after several issues addressed.

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Discussion paper

Major comments:

1) The key to this method is estimating emission correction factors, assuming that all of the differences between observed and modeled BC are attributed to the errors in surface BC emissions. This assumption has some problems since both models and observations have their own uncertainties. Without considering these uncertainties in the estimation of the emission correction factors, the authors tend to overestimate the uncertainties in BC emission inventories and thus tend to overestimate the correction factors. Although I believe that China's BC emissions have been declining since 2010, the authors need to justify the methodology they used and to acknowledge that the method still has large uncertainties in the emission correction factors. And if I understand correctly, the WRF-CMAQ model used here has no modules simulating BC wet deposition, which can cause <10% of BC loss even under an APT less than 1 mm. The current manuscript lacks a detailed discussion on the deficiencies of the model as well as the uncertainties in the observations.

2) In order to compare with bottom-up emission inventories, the authors scaled China's emissions from REAS2.1 with the emission correction factors for several large regions (Fig. S3). The footprint map of BC observations mainly covers central and eastern China (Fig. 5), while the emission correction factors are applied over the whole of China. I am wondering how many China's provinces and their BC emissions can be well observed by the station at Fukue Island. And the uncertainty range of the red curve in Fig. 7a should be larger than the current estimates after considering the representation errors of emission correction factors for the whole of China.

Minor comments:

1) Line 3 on Page 4. "minimize the gaps related to failure of individual instruments" Please clarify how many data points are missing from individual instruments. Are the BC trend estimates affected by the missing observation data?

2) Line 7 on Page 4. Please clarify why the uncertainty of the BC observations is

estimated at 12%.

3) Line 3 on Page 5. “representation of wet deposition in the model was not important in this study” I do not think so, because air masses without significant influence from wet deposition can still cause <10% of BC loss (Line 24 on Page 4).

4) Line 9 on Page 5. “Hourly outputs at the nearest grid were used for analysis” The nearest grid is the grid cell where the Fukue Island is located, right?

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