Anonymous Referee #2

The authors conducted long-term observations of ship-related SO_2 concentrations in the Shanghai shipping channel from 2018 to 2023 by the DOAS technique. Meteorological effects and urban background emissions were removed by machine learning techniques. The paper focuses on evaluation the effectiveness of low-sulfur policies in mitigating the SO_2 emissions from maritime activities, since during the time period marine fuel sulfur content (FSC) was restricted twice. The authors suggest that this DOAS-based approach is cost-efective tool for monitoring ship emissions and can be easily applied to other coastal regions. The paper is scientifically sound and well organized. It is very important not only for scientists but also for policy makers. However, I have some issues that should be addressed before recommending the paper to be accepted for publication in ACP.

Main comments

1. In Introduction, lines 40-50 considering the restrictions in FSC is somewhat confused and should be elaborated. Please, give explicitly the years when China designated and implemented ECA, DECA and CDECA (the abbreviation is mentioned in Fig.4 but not explained anywhere) areas, and the maximum sulfur content percents in the regions. Regarding Fig. 4 you should clarify the red bars. What happened in Jan 2020 (IMO regulation, FSC from 3.5% to 0.5%) in the Yantze River Delta since if I understood correctly that region implemented the FSC of 0.1% already in Jan 2019.

2. The experimental setup is poorly described. In section 2, it is mentioned that over a thousand vessels pass daily the confluence of the two rivers. However, more information about the ships are needed such as the used engine (main or auxiliary), speed and age as they all affect the SO_2 emissions in addition of FSC and meteorological effects. It is important to know the stack heights and how well the DOAS system could capture the smoke plumes. At which heights the light emitter and the retroreflector located? More discussion is needed of these topics.

3. The Deweathered models used seven meteorological factors and time-related variables to capture the SO_2 pattern. Which was the most important variable for SO_2 explanation in WSW and in FDU. I suggest that you produce figures depicting the variable name as a function of variable importance similar as in Fig. 2 of Grange and Carslaw, 2019.

4. Is this the first time when the ETR learning model have been applied in deweathering ship SO_2 data. If not, add the references found in literature.

5. I suggest to present residual error plots between the actual and predicted SO_2 concentrations in both regions. Please include a discussion about the limitations of your study and about the uncertainties.

6. Not clear why the authors say that "After normalizing the meteorological influences, the (Deweathered) SO_2 concentrations in WSW and FDU showed an overall decrease during the observation period, while Table 1 shows that in WSW the SO_2 concentrations increased in 2021-2023 (lines 198-199).

7. The time development of monthly (or annual) number of vessels or ship types in WSW would help to interpret the results in Figs. 3 and 4.

8. Figure 6 shows that low SO_2 emission plume [4,6) ppbv started to increase from 2018 and to decrease just after 2020 while the lower SO_2 emission plume [2,4) started to increase (Fig. S6). The

authors suppose that this reflects the transitional effect of policy implementation, and some ships have started to use lower sulfur fuels during the restriction period. Do you have any empirical evidence of this assumption? What about the alternative fuels such as liquid natural gas (LNG) and biofuels? Another reason might be the use of better scrubbers that efficiently clean the exhaust gas, particularly sulfur oxides. Numerous cargo ships are moving in the channel. I would like to see the annual development of the number of different ship types regarding Fig. 6a. More discussion is needed about this topic.

Minor comments

9. Which value did you use for the absorption cross section of SO_2, I could not find any value in the references given in Supple.

10. line 250: check the year, should be 2021 instead of 2023

11. Abbreviations should be defined when they appear for the first time, at least XGBR (line 98), ERA5 (line 148) and BEAD (line 228).

12. Give reference for ERA5.

13. Explain the error bars Fig. S3.

14. The use of dots and commas should be checked in the main text as well as in supple.

15. lines 104-105: a subject is missing after comma

16. line 108: "(Including…" should start with a small letter.

17. line 165: remove the dot after the word Figure

18. line 37: a space is missing between the words "from" and "shipping"