Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-661-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatial and temporal changes of SO_2 regimes over China in recent decade and the driving mechanism" *by* Ting Wang et al.

Anonymous Referee #2

Received and published: 27 August 2018

General comments: In this paper, Ting Wang et al. analyzed the spatial distribution and temporal variation trends of SO2 VCD and emissions in different regions of China in the last decade based on the OMI observation and emission inventory. Further they discussed effects of meteorological conditions on the SO2 variations based on the differences of emissions and SO2 VCDs in South China. In general the scientific topic is meaningful, and the perspective of understanding effects of meteorology on SO2 depositions and dispersions is novel. However I have two major concerns below: 1) A credible emission inventory is quite a foundation of the study. However the authors do not give a peer-reviewed publication of the emission inventory in Section 2. The authors should cite some papers to introduce the methodology and validation of the

inventory. Meanwhile it could be more convincing if the authors do the same analysis based on another available peer-reviewed emission inventory. 2) The author did not consider any effects of regional transports in the discussion of the discrepancy of SO2 VCD and emissions. SO2 life time could be long and has a big variability. SO2 could be transported by on an order of 100 km, especially during night.

Specific Comments: 1) Line 116-117: how significant is the improvement of the new product on the study of variation trends? Do the authors compare the variation trends based on the new product with those based on the previous product? 2) Line 120-121: What kind of background correction is applied? Can the correction cause artifacts of some weak signals of SO2 in some regions which are dominated by the natural sources as discussed in Line 151-155? 3) Fig. 3a: The author should explain the line around 40 N latitude with high values in winter. 4) Line 161 and Fig. 2a: snow could cover the surface in the western and northern part of China in the seasons, except summer. The snow covered surface could impact the retrievals of SO2 VCD. This could be the reason of the missing values of satellite SO2 VCDs in the two regions, especially in winter. Do the authors consider the point in the discussion? Meanwhile in the lines of 161-163, the authors attribute the higher SO2 amounts in summer than other seasons to the natural emissions. However the snow coverage effect could also play a role. 5) Line 159: The authors conclude that "nearly half of the annual totals is released in winter" because of the significant higher SO2 VCD in winter than in other seasons. However SO2 lifetime could be also longer in winter. The larger SO2 VCD values could be also related to longer lifetime of SO2 due to its easy accumulations in winter.

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