Review of Zhang et al. for Atmospheric Chemistry and Physics

General Comments

In “Effect assessment of NO_x and SO_2 control policies on acid species in precipitation from 2005 to 2016 in China based on satellite monitoring”, Zhang et al. describe a metric based on a correlation of OMI observations of NO_2 and SO_2 with wet deposited nitrate and sulfate. The statistical coefficient from each correlation is multiplied by an OMI-derived “atmospheric boundary layer” column concentration, and the ratio of these values is said to represent the ratio of sulfate to nitrate ions in precipitation. They present correlations of this “OMI-derived S/N” metric with sulfate to nitrate ratios measured in precipitation, time (2005-2016), and population density (2010). The authors develop a “potential acidity” metric from the same statistical coefficient that was derived from the observations. The aims of the paper seem to be to define a satellite-based metric to identify the acidic constituents of precipitation and to use it to affirm that emissions control policies have reduced the amount of sulfate in precipitation more than nitrate.

The authors begin with a thorough description of emissions policies in China over the last two decades. The methods rely heavily on assertions from linear correlations. The data the authors analyze is not well documented. Some of the data, including the measured sulfate and nitrate (Section 2.1.3) are referenced to other published papers but without a brief characterization of the nature of the data collection or extent spatially or temporally of the dataset. Other key parameters in the statistical models are not described, such as the atmospheric boundary layer SO_2 term. Evidence of the quality of the models (eq. 5) essential to calculating the OMI-derived S/N metric is not presented. Although the model for nitrogen deposition was recently published in another journal, the model for sulfate deposition, from which the important correlation coefficient arises for the S/N metric, has not yet been peer reviewed. The explanations of data included or excluded in figures (e.g., very small number of observations in Fig 5c) is neglected as are the sources of the emissions. Throughout the manuscript, the quality of the statistical analysis, representations of error, and propensity to neglect outliers without physical reason calls into question the quality of these underlying statistical models, which are not evaluated in this manuscript.

Furthermore, the authors seek to explain an outlier in the SO_2 downward trend by acknowledging that 2011 had the least precipitation on record for the last 50 years. The authors do not take this opportunity to acknowledge the inherent difficulty in using a gas phase satellite-based observation of precipitable species to explain wet deposition nor do they explain how the linear models that are the basis for the S/N metric account for the way that rain depletes the nitrate and sulfate concentrations in the atmosphere. Finally, the authors do not make a case for using a satellite-based metric for estimating the ratio of wet-deposited sulfate to nitrate when measurements of the ions in rain water are already being conducted across China. Because of the poor evaluation of the statistical models underlying the conclusions, the absence of documentation of datasets, the inherent difficulty in the approach attempted, and the lack of purpose for the results, I cannot recommend this manuscript for publication in Atmospheric Chemistry and Physics.