

Interactive comment on “Spatial distribution and seasonal variations of atmospheric sulfur deposition over Northern China” by Y. P. Pan et al.

Anonymous Referee #1

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The paper presents measured and estimated total sulfur atmospheric deposition at 10 sites in northern china. Such a data set is needed for this region for ecosystem studies and for making emission control policies. The methodology is scientifically sound and the results are valid. The presentation of the results could be improved as listed below. Most materials presented in Section 2 are the same as those presented in another paper by the same authors and should be significantly simplified by referring to the previous publication (Pan et al., ACP, 2012). The estimated SO₂ dry deposition from using the inferential method contributed to nearly half of the total deposition budget. A brief discussion on the concentrations and dry deposition velocities is first needed before discussing dry deposition amounts. This will allow the readers to find out if the deposition velocities used here are in reasonable range. Presentation of SO₂ and sulfate concentrations will also help to explain the spatial and annual variations in their

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dry and wet deposition patterns, instead of simply attributing the variations to emission sources (as frequently done in many places in this paper).

It is the total annual deposition that is of concern to ecosystem study. Discussions on annual average of dry and wet deposition and their spatial patterns and the causes of these patterns should be the focus of the paper. Discussions of monthly and seasonal variations should be brief. Too many detailed information makes the paper difficult to read.

Page 23657. line 3: using “local emissions” was not accurate here. Wet deposition amount includes contributions from in-cloud scavenging (most of which might be from long range transport) and below-cloud scavenging (part of which might also be from long-range transport). You could simply state that “part of the differences was caused by differences in ambient concentrations). Again, as suggested above, if ambient concentrations of SO₂ and sulfate were first briefly discussed, it would be easier to discuss spatial variations in wet deposition. Such information is also needed for discussions on page 23662, line 15 (and discussion in Section 4). There is no evidence to conclude that the differences were caused by scavenging ratios. Differences in ambient concentrations are likely the main causes.

Page 23662. The first paragraph: You simply use emission inventory to explain everything in this paper including this paragraph. A brief explain of the following theory is needed somewhere: “Dry deposition is mostly decided by surface concentration which has a close link with local emission. Wet deposition has less dependence on local emission because it depends on column concentration and in-cloud scavenging.”

Page 23666. First paragraph of “Conclusions”: Introductory materials should be removed from the Conclusion section. Also avoid repetitive materials through the text.

In summary, the paper presents too many detailed information on less important issues, but lack of in-depth analysis on some important issues.

Minor comments Page 23646. Line 18: scavenging ratio was never investigated in the paper. The statement is just a speculation. Line 21: "constant" is confusing, from year over year or from site over site? Same issue on page 23667, line 18. Consider rewriting the sentences in both places. Page 23648. Lines 22-23, you meant 20% for the territory, not for the extent of the exceedance of critical loads, this is not consistent with the subject. Consider rewriting the sentence. Page 23649. line 7: change "few" to "a few". Lines 19-20: use either "although" or "however", not both. Line 21: "fewer"-compared to what? Consider change it to a different word such as "limited". Page 23652. Line 5: "30min x 30min"? Do you mean "30 km x 30km"? Also check figure 1 caption. Page 23654. Line 1: change "measurements" to "estimation" since SO₂ deposition was not measured. Page 23657. Lines 16: Consider changing "less" to "low". Page 23660. the first several lines should be in "Introduction". Section 4.1 fits better in Section 3 (as section 3.4) than in Section 4. Page 23661. Line 24-27: split the sentence into two separate sentences. This sentence and the previous one discussed three cases: sites with high deposition and emission; sites with low deposition and emission; and sites that did not have consistent deposition and emission. Use three separate sentences to discuss the three cases; do not put the latter two together. Page 23662. line 27: consider changing "fluctuations" to "differences". Page 23633. First sentence: was the low SO₂ % at BJ caused by the low deposition velocities over urban land use categories, or by low concentrations?

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