

## Reviewers Comments and **Author Responses:**

First of all we would like to thank the reviewers for their comments and suggestions.

Comments from the Reviewer are in black and are referred to as RFC. Authors' responses are in red and are indicated by AR.

### **Reviewer 1 Comment:**

The manuscript is well structured and written. It provides a valuable comparison for modeled deposition of nitrogen and sulfur by fourteen air quality models over Europe. There is a lot of information provided from the evaluation results in the manuscript and the supplementary material. I think the article deserves publication. I have only a few minor comments to be considered by the authors.

**RFC.1: In Section 2.1.1 the emissions used are only briefly described. Although there are references provided I would suggest to provide a little more information for Copernicus, HTAP\_v2.2 and ECLIPSE\_V5 emissions (eg. spatial resolution, temporal resolution).**

**AR.1: Yes, it's true. We have now added some more information in the text, specifically the spatial and temporal resolution. We have also included this information in Table 2.**

**RFC.2: In Section 2.2 please describe briefly how the statistical measures for each individual station are implemented in smile plots where we see the entire set of stations.**

**AR.2: Each point in smile plots corresponds to the statistics calculated using the data from all sites combined. We have modified the sentence to clarify this this in lines 152-153:**

“For each model simulation and set of sites with observations, the following statistics were calculated (Table 4) for each variable (considering all the values in time and space): “

**RFC.3: it is stated that there is a tendency for the models to underestimate WSO4\_S and simultaneously overestimate the gaseous pollutant SO2\_S on and annual and monthly basis. Please discuss some possible reasons for this. Is there a possibility for less efficient heterogeneous oxidation of SO2?**

**AR.3: Yes, this happens for some models. We included in the text some allusions to an potential underestimation of the aqueous chemistry (559-561):**

“The fact that sulfate concentration is also low for several models in Jan and Feb and SO2 somewhat high could be due to an underestimate of the conversion to aerosol (sulfate) via aqueous chemistry, which could be another cause of the excess NH3.”

The relation of this to wet deposition would be clear if the efficiency of wet scavenging for SO2 (if overestimated) was lower than that for the sulfates, which in fact is the case for the parameterization used in EMEP model parameterization. But although it's out of the scope of this paper to look into detail the parameterization of all the models, due to the complexity of the variables involved, chemical and meteorological, we have included in the conclusion

section the potential occurrence of a low heterogeneous SO<sub>2</sub> oxidation efficiency, suggested by the results in this study.

**RFC.4:** In Section 3 it is written that “As can be inferred from AM 2.3, AQ\_DK1\_HTAP estimate the main contribution from the gas phase, . . .”. To my understanding this holds for AQ\_F11\_HTAP according to AM2.3 while for AQ\_DK1\_HTAP the highest contribution comes from the particle phase.

AR.4: It’s true that this figure in AM 2.3 has not been sufficiently explained, as left (dry deposition from NO<sub>2</sub>) and middle (dry deposition for HNO<sub>3</sub>) maps correspond both to gases, and only the one in the right correspond to the particle phase. This could have led to a wrong interpretation, but the statement was correct; for AQ\_DK1\_HTAP the main contribution to dry deposition comes from the gas phase (in particular from HNO<sub>3</sub>). This is also valid for AQ\_F11\_HTAP. We have modified the text slightly to avoid confusion (lines 332-337)

Before:

Significant differences can be found when looking at the gas and particle deposition for the AQMEI13 participants. Two gases, NO<sub>2</sub> and HNO<sub>3</sub> can contribute to OND. **As can be inferred from AM 2.3, AQ\_DK1\_HTAP estimate the main contribution from the gas phase, whereas in the case of AQ\_TR1\_MACC, highest contributions to OND come from the particle phase.** This highlights the importance of making measurements that can shed more light on these processes, providing modelers with data that can be used to parameterize and evaluate the different processes.

Now:

“Significant differences can be found when looking at the gas and particle deposition for the AQMEI13 participants. Two gases, NO<sub>2</sub> and HNO<sub>3</sub> can contribute to ONDD. **As can be inferred from AM 2.3, in the case of AQ\_DK1\_HTAP and AQ\_F11\_HTAP the gas components (NO<sub>2</sub> and HNO<sub>3</sub>) contribute more to ONDD than the particle phase, whereas in the case of AQ\_TR1\_MACC the largest contributions to ONDD come from the particle phase.** This highlights the importance of making measurements that can shed more light on these processes, providing modelers with data that can be used to parameterize and evaluate the different processes.”

Final comments:

We have updated the maps with sites, as we noticed some missing sites in the original maps.