

Response to Reviewer #2 comments:

The manuscript entitled ‘Fine particle pH and sensitivity to NH₃ and HNO₃ over summertime South Korea during KORUS-AQ’ written by Ifayoyinsola Ibikunle investigated whether the sensitivity of particulate nitrate depends on HNO₃ or NH₃, and extended this estimation for unavailable NH₃ cases. The conclusion of HNO₃ dependence in most cases is informative for the appropriate reduction of nitrate pollution in South Korea. I would like to consider the publication of this manuscript from Atmospheric Chemistry and Physics; however, some points should be addressed with in-depth discussion.

Answer: We thank the reviewer for the enthusiastic response and for the insightful feedback that has improved the manuscript. Below, we include the response to comments and questions raised.

Major points:

Expression of season: As described in L55-56, the KORUS-AQ campaign was conducted from 26 April to 18 June 2016. I have questioned the expression of “summertime” to mention this period through this manuscript (including the manuscript title). This can be late spring for Asian meteorological situation.

Answer: We thank the reviewer for raising this point. The title and revised text will be adjusted accordingly.

Flight altitude: The data used in this study is filtered for the flight altitude below 1 km and the authors stated as “which is often within the boundary layer” in L232. As shown in the flight trajectories in Figure 7, the flight during KORUS-AQ both covered Korean Peninsula including adjacent oceans. I am wondering the simple assumption of 1 km altitude could be free troposphere over the ocean. Please also see the below comment.

Answer: This is a good point! Our analysis could be carried out with data from any altitude; we restricted our analysis to data from below 1km to ensure observations are close to ground (i.e., mostly in the boundary layer and relevant for air quality), and, that the temperature and relative humidity are such to ensure the thermodynamic analysis is valid. In the revision, we will separately consider the points over the ocean to evaluate if they belong to a different regime on the PM sensitivity map.

Nitrate concentration field: As shown in concentration field in Figure 7 and Figure S1, nitrate concentration field below 1 km analyzed in this study posed relatively lower concentration over South Korea (even in over Seoul Metropolitan Area) and higher concentration over oceans. This result could be related to the above mentioned point, and impressed me that the nitrate behavior is different over land and oceans due to the simple 1 km assumption for data analysis.

Answer: This is indeed an interesting point. As mentioned in the previous comment, we will separately consider the points over the ocean to evaluate if they belong to a different regime on the maps.

Implications for policy making: Based on the above comment, the nitrate concentration over oceans will be regarded as free troposphere (not within boundary layer) behavior, and in this case, nitrate could be dominated by the long-range transport from mainland China as introduced in L48.

If so, the conclusion of “NO_x control” means Chinese emission regulation and therefore careful discussion is required. Although the source attribution will be beyond the focus within this study (as stated in L419-422), do the authors put some relevant information in this point?

Answer: Excellent point. We did not consider the aspects associated with long-range transport, as we implicitly assumed the PM was mostly affected by local sources. For cases of aerosol from long-range transport, the acidity & sensitivity regime can change as the air mass is transported away from its source. A combination of policies may therefore be necessary to address PM levels both near-source and for long-range transport. We will discuss this point in the revised manuscript.

Specific comments:

L231: RH is firstly used in L143.

Answer: This is now clear in the text.

Figure 6: Taking into accounts the discussion after Figure 8, the color used in this Figure 6 indicating HNO₃- or NH₃-dominant seems to be confusing.

Answer: Correction included.

Wording: Through this manuscript, the expression of ammonia and NH₃, and nitric acid and HNO₃ seems to be not unified. It will be better to unify these expressions.

Answer: Correction included.