Authors' Responses to Referee #1 Comments

We thank the anonymous referee #1 thoughtful comments, which are very helpful to improve our manuscript. Based on the reviewer's comments, we revise the manuscript.

Anonymous Referee #1

In this manuscript, the authors measured concentrations and d-15N of TN and WSTN at Sapporo, Japan for one year. The authors examined seasonal variations of WSON and WION in relation with organic tracers and analyzed sources of these species. This manuscript is well written, clearly organized and gives useful information about atmospheric behaviors of WSON and WION. This reviewer recommends for publication after the following modification.

Response: We consider all the comments and revise the manuscript accordingly.

p.12622, line 8-10: "The analytical uncertainties": Can you change this term more specific? (1 or 3 standard deviations?)

Response: We modify the phrase "analytical uncertainities in duplicate analyses of filter samples" to "analytical uncertainities (i.e., RSD) in a single set of duplicate analyses of filter samples" in the revised MS.

p.12624, line 14-16: In the midlatitude regions, transient cyclone/anticyclone often occurs and changes wind direction within a timescale of several days. This reviewer doubts this description and considers that this line is unnecessary.

Response: Following the reviewer's suggestion, we delete the description: "Further, the air masses ---- long interval of sampling.", in section 3.1 in the revised MS.

p.12625, line 11-12: It seems there are clear seasonal patterns. (also for TN/TSP ratio, WSON, and WION).

Response: Although the temporal trends of TN and WSTN (as well as other components) did follow a seasonal pattern, except for few samples, their increasing and decreasing trends are not quite distinct from season to season. For example, TN and WSTN continued to increase from late autumn until to mid winter and to decrease from the mid winter to early spring (please see Fig. 2a in the MS). We clarify this point in the revised MS.

p.12626, line 13-14: In this section, rationale that chemical aging had influence on ON loadings is not provided. Do the authors mean that the chemical aging reduce ON/TN ratio during the chemical aging? Even so, how chemical aging affect ON loadings? Methodical explanation is necessary.

Response: No, we do not agree with the referee's view; chemical aging promotes the production of ON and thus increases the ON/TN ratio. Since we discussed the possible impact of chemical aging on ON loading in detail in section 3.4 of the MS, where it is more appropriate, we exclude the description on ON/TN in section 3.2 in the revised MS in order to avoid any misleading as well as repetetion.

p.12628, line 13-25: Are there any literatures about WION in urban areas? The authors suggested that biogenic sources had important contributions to WION. This suggestion would be partly validated from comparison with WION in other urban areas.

Response: No, unfortunately, there is no literature available on WION in urban aerosols to the best of our knowledge. Therefore, the assessment and quantification of biogenic contributions to the atmospheric WION is a subject of future research. We briefly note this point in the revised MS.

p.12635, line 6-10: This description should be more modest considering that the discussion about sources of aerosol N in Section 3.5.2 is not quantitative.

Response: Following the comment, we modify the phrase in the revised MS.

Table 3: The authors only applied simple linear regression analyses. Apparently, WSON and WION are influenced by multiple emissions sources, and thus, this reviewer recommends the authors to conduct multiple regression analyses.

Response: We agree with the reviewer's opinion that WSON and WION should have been influenced by multiple emission sources. However, the focus of the current study is limited to just understand the potential influence of biological sources and secondary formation rather than quantitative assessment of different sources. Moreover, most of the parameters are not normally distributed. Therefore, following the referee #2 suggestion, we choose to conduct the Spearman's rank correlation analysis instead of multiple linear regression analysis for the revised MS.