Reponses to referee(s) comments

Dear Editor,

Thank you for your efforts for handling our manuscript. We appreciate to receive the useful comments from reviewer. These comments are very constructive, and we have now further revised our manuscript in light of referee's comments. Based on the helpful suggestions from reviewer, we believe that we should have addressed questions and concerns from referee appropriately, and adequately. Please find our point-by-point responses below.

Suggestions for revision or reasons for rejection (will be published if the paper is accepted for final publication)

The authors have addressed most of my concerns. The manuscript can be accepted after minor revision.

RESPONSE: Thanks for your constructive comments. We have revised all your problems carefully. Please find our point-by-point responses below.

(1) How many sounding profiles (the exact number) at 08:00, 14:00, and 20:00 BJT were used in this study?

RESPONSE: Thanks for your suggestion. Sorry for missing the number of sounding profiles. 368,367, and 368 sounding profiles at 0800, 1400, and 2000 BJT were used in this study. We have clarified this issue at lines 164-165 on page 7 as "along with 367 sounding profiles at 1400 Beijing time (BJT) from 64 stations and 368/368 sounding profiles at 0800/2000 BJT from 77 stations, respectively".

(2) In Fig. 11, clear differences can be observed in the same type. Were the clean samples relevant to the precipitation processes? The variations of clean and pollution days may be primarily caused by the precipitation, not the PBL structure. Please clarify.

RESPONSE: Many thanks for your constructive suggestion. We have clarified it at lines 428-429 on page 16. Please see also as follow: "It can be clearly seen that various precipitation primarily caused differences in concentrations of both O_3 and $PM_{2.5}$ between clean and pollution days under Type 1/Type 2 (See Figs. 12–13).".

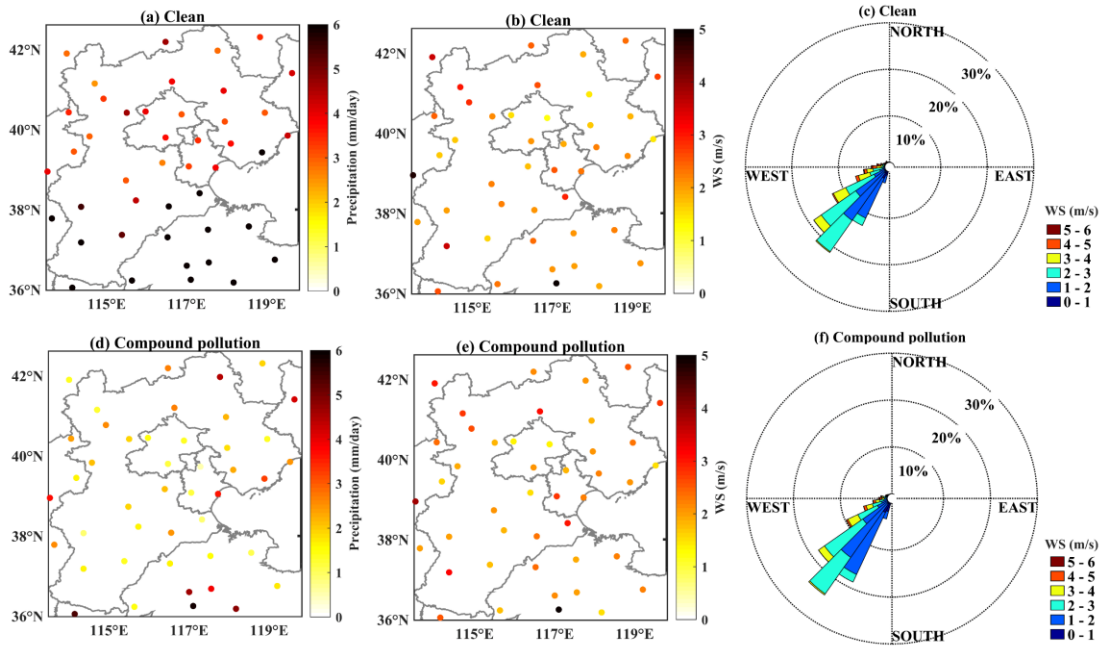

Fig. 12. Precipitation, WS, and WD during clean and compound pollution periods under Type 1 over BTH.

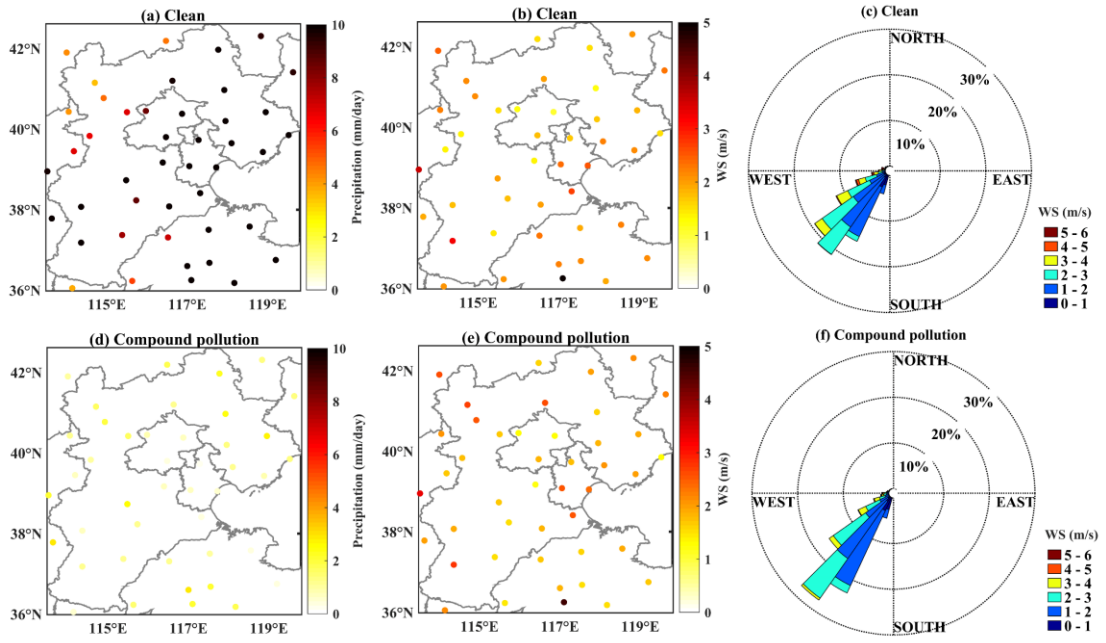

Fig. 13. As in Fig. 12 but for Type 2.

(3) Line 438, "The prevailing southerly winds during the compound pollution period may have driven the transportation of air pollutants from the southern plains, resulting in more serious pollution (Fig. 11; see also." The sentence is incomplete, please check.

RESPONSE: Thanks for your suggestion. We have completed this sentence as "The prevailing southerly winds during the compound pollution period may have driven the transportation of air pollutants from the southern NCP, resulting in more serious pollution (Fig. 11), which is consistent with the results of Miao et al. (2017, 2019).".

(4) Line 443-446, “In comparison, although there was a southerly prevailing wind in the BTH region (Figs. 11 and S14), the rain belt also being located in the southern area of the BTH might have led to the potential removal of PM2.5 (Fig. 9j). Therefore, compound pollution across the BTH region might mainly have been due to local emissions of air pollutants.” The rain belt is not always fixed in the southern area of BTH, which cannot support the conclusion “pollution across the BTH region might mainly have been due to local emissions of air pollutants”.

RESPONSE: Many Thank you for your valuable comments. We have restated our points as following: “In comparison, although there was a southerly prevailing wind in the BTH region under Type 2 (Figs. 11 and 13), the rain belt being located in the southern area of the BTH might have led to the potential removal of $PM_{2.5}$ over there (Fig. 9j), so the pollutants transported from the southern NCP would be partially reduced. Therefore, it can be concluded that the emissions of local pollutants accompanied with unfavorable meteorological conditions will continuously accumulate pollutants (Figs. 8–9 and 12–13; Gui et al., 2019; Zhang et al., 2020), which should be main cause of the BTH compound pollution.”