Response to the comment from Anonymous referee #2

The manuscript “The impact of sea spray aerosol on photochemical ozone formation over eastern China: heterogeneous reaction of chlorine particles and radiative effect", focuses on investigating the link between sea spray aerosol (SSA) and ozone in the atmosphere by employing the WFR-CMAQ model. To my mind the manuscript is well written and I believe that it is interesting to the scientific community and thus I recommend the paper for publication after the following comments have been addressed:

General comments:

[Comment 1] I find the information on the CMAQ model very short, no introduction is given at the beginning. I could also not find the full name of CMAQ, only the acronym. Please write a short paragraph describing the model and its general use.

Response: Thank you for your valuable suggestion. We have provided a more detailed description about the CMAQ model and its general use in the updated manuscript. We also give the full name of CMAQ.

Revision in the manuscript:

(1) Line 97: “Sarwar and Bhave (2007) utilized the Community Multiscale Air Quality Modeling System (CMAQ) model to explore …”

(2) Line 114: “Here we used the WRF-CMAQ model to perform air quality simulations in this study. The CMAQ (version 5.1) model is a regional chemical transport model developed by the United States Environmental Protection Agency (Appel et al., 2017). It has been widely used to explore the mechanism of multiple air quality issues, including tropospheric ozone, fine particles, acid deposition, and visibility degradation (Zhu et al., 2024; Kitagawa et al., 2021; Onwukwe and Jackson, 2021). The meteorological inputs of CMAQ model (version 5.1) were provided by the Weather Research and Forecasting (WRF) model.”

[Comment 2] Regarding the aspect of humidity for the reactions studied (briefly mentioned on page 5), what kind of deliquescence and efflorescence behavior was used for SSA? Was it chosen size specific? Was the composition of dry SSA chosen to be the same for all sizes?

Response: Thank you for your valuable suggestion. The AERO6i aerosol module in CMAQ employs ISORROPIA (Binkowski and Roselle, 2003; Fountoukis and Nenes, 2007; Kelly et al., 2010) to simulates inorganic aerosol thermodynamics. The ISORROPIA model automatically adjusts the liquid/solid phase state of aerosols based on ambient relative humidity, thereby implicitly accounting for the effects of deliquescence and efflorescence. CMAQ does not explicitly differentiate the phase equilibrium processes between SSA and other soluble aerosols. Instead, they are uniformly handled by the thermodynamic model after accounting for their emissions (including SSA). Regarding heterogeneous chemical reactions involving chloride-containing particles, the uptake coefficients for NO_2 and NO_3 are assumed to be identical across different aerosol modes (Aitken, accumulation, and coarse). Additionally, the model assumes that the composition of emitted dry SSA is consistent across all sizes and does not vary with particle size. We have clarified the description in the manuscript.

Revision in the manuscript:
(1) Line 141: "The AERO6i aerosol module employed ISORROPIA (Binkowski and Roselle, 2003; Fountoukis and Nenes, 2007; Kelly et al., 2010) to uniformly simulates inorganic aerosol (including SSA) thermodynamics."
(2) Line 149: "This parameterization was identical across different aerosol modes (Aitken, accumulation, and coarse)."
(3) Line 179: "The composition of dry SSA in different aerosol modes remains consistent with that of seawater"

[Comment 3] In section 3.1, 3rd paragraph, Cl^- is discussed and it is stated that Cl- emissions are higher compared to those of Na^+. Could you please specify why this is the case?
Response: Thank you for your valuable suggestion. We demonstrated in section 2.2 that the composition of dry SSA remains consistent with that of seawater, containing Cl^- (55.4%), Na^+ (30.8%), SO_4^{2-} (7.7%), Mg^{2+} (3.8%), Ca^{2+} (1.2%), and K^+ (1.1%). As a result, the percentage of particulate Cl^- is higher than those of particulate Na^+, making the emission of particulate Cl^- higher than those of Na^+. We have clarified the description here.
Revision in the updated manuscript:
(1) Line 222: "However, due to higher composition of particulate Cl^- than Na^+ in SSA emissions, regions experiencing >80% change in Cl^- are more extensive, underlining its substantial impact."

Specific comments:

[Comment 4] Page 2, line 42: delete "s" in "investigations"
Response: Corrected.

[Comment 5] Page 3, Eq. R1: please introduce the meaning of "cd"
Response: "cd" means the condensed phase. We have introduced it in Line 64.

[Comment 6] Page 4, line 108: add "s" to "demonstrate"
Response: Corrected.

[Comment 7] Page 7, line 197: delete "s" in "illustrates"
Response: Corrected.

[Comment 8] Page 9, line 260: The start of the sentence needs to be changed. I think you are referring to Fig. 5
Response: Thanks for pointing out this typo. We mistakenly removed some words of this paragraph in the original manuscript. We have corrected this issue.

Revision in the manuscript:
(1) Line 277: “Furthermore, the impact of SSA on Cl radicals is observed not only at the surface but also vertically through the atmosphere. Figure 5 examines the vertical-diurnal variations in SSA-induced Cl radical concentrations in Beijing, Shanghai, and Guangzhou.”

[Comment 9] Page 10, line 290: delete “s” in “illustrates”
Response: Corrected.

[Comment 10] Page 10, line 304: change “present” to “presence”. Delete “s” in “shows”
Response: Corrected.

[Comment 11] Page 12, line 343: please specify what “PRD region” is
Response: Thanks. We have defined PRD (Pearl River Delta) in Line 102.

[Comment 12] Page 13, line 372: add “s” to “illustrate”
Response: Corrected.