Response to Reviewer #2

The authors of the present manuscript acknowledge the reviewer for carefully reading and providing constructive comments that have led to an improved paper. Responses are written in blue text.

Page 1. Line 26-29, please modify the sentence to correct the grammar.

Response: The sentence has been changed to "Under low aerosol loading conditions, the liquid water path (LWP) and droplet effective radius (DER) significantly increased with increasing LTS, but under high aerosol loading conditions, LWP and DER changed little, indicating that aerosols significantly weakened the dependence of cloud development on LTS."

Page 1, Line 30, either "a stable condition" or "stable conditions"

Response: Fixed.

Page 2. line 2, you may remove "with increasing LWP"

Response: We have removed "with increasing LWP".

Page 2, Line 3-5, grammar error for "can significantly made", also "narrowed"

Response: The sentence has been changed to "Under both continental and marine air-mass conditions, high aerosol loading can significantly shift COD towards larger values and LWP and DER towards smaller values, narrowing the distributions of LWP and DER."

Page 2, Line 15-28, many references should be cited here. For example, the aerosol direct effect (Yang et al. 2016, 2018; doi:10.1002/2016JD024938, doi: 10.1016/j.atmosres.2018.04.029), the aerosol indirect effect (Feingold et al., 2003; Garrett et al., 2004; Zhao et al., 2018, 2019), lifetime effect (Albrecht 1989), thermal emissivity effect (Zhao and Garrett, 2006; Garrett and Zhao, 2015); semi- direct effect (Koren et al.). Feingold, et al., First measurements of the Twomey indi- rect effect using ground-based remote sensors, Geophys. Res. Lett., 30(6), 1287, doi:10.1029/2002GL016633, 2003. Garrett, et al., 2004: Effects of varying aerosol regimes on low-level Arctic stratus. Geophys. Res. Lett., 31, L17105. Zhao, et al. (2018). Negative Aerosol-Cloud re Relationship from Aircraft Observations over Hebei, China. Earth and Space Science, 5, 19-29. Zhao, et al. (2019), A case study of stratus cloud properties using in situ aircraft observations over Huanghua, China, Atmosphere, 10, 19. Albrecht, B.A., 1989: Aerosols, cloud microphysics, and fractional cloudiness, Science, 245(4923), 1227-1230. Garrett, T. J. and C. Zhao, 2006: In- creased Arctic cloud longwave emissivity associated with pollution from mid-latitudes. Nature, 440, nature04636, 787-789. Zhao, C., and T. Garrett, 2015: Effects of Arctic haze on surface cloud radiative forcing, Geophys. Res. Lett., 42, 557-564, doi:10.1002/2014GL062015.

Response: The suggested references have been added to the revised manuscript.

Page 2, Line 32, for surface remote sensing, Garrett et al. (2004) and Qiu et al. (2017, 8-Year ground-based observational analysis about the seasonal variation of the aerosol-cloud droplet effective radius relationship at SGP site) should be cited.

Response: They have now been cited.

Page 3, Line 2, for aircraft measurement-based studies, Yang et al. (2019, Toward understanding the process-level impacts of aerosols on microphysical properties of shallow cumulus cloud using aircraft observations) and Zhao et al. (2018, 2019) should be cited, which are for North China region.

Response: They have now been cited.

Page 3. Line 17-20, The effect is also dependent on the availability of water vapor, or the amount of water vapor, and meteorology (such as vertical velocity), as indicated by Qiu et al. (2017) and Yang et al. (2019).

Response: Yes, we agree. The suggested references have now been cited.

Page 3, Line 22-23, Garrett et al. (2004) also examined the sensitivity of FIE to aerosol size and number, which shows weak sensitivity of FIE to aerosol number concentration for those small sizes, but good sensitivity for aerosols with relatively large size (such as CCN or accumulation mode aerosol).

Response: We added the sentence "Garrett et al. (2004) indicated a weak sensitivity of FIE to aerosols with small particle sizes but a stronger sensitivity to aerosols with relatively large sizes." to the revised manuscript.

Page 4. Line 13-14, What is the maximum size for Na? You might also give this information.

Response: We have added this information and changed the sentence to "with diameters larger than 10 nm and smaller than 3 μm".

Page 5 Line 10-21, The uncertainty information for cloud boundaries should be provided. As indicated by Zhao et al. (2012, Toward Understanding of Differences in Current Cloud Retrievals of ARM Ground-based Measurements) and Zhao et al. (2013, Ground-based remote sensing of thin clouds in the Arctic), the uncertainties in cloud bases and tops measured by ARM are generally 7.5 m and 45 m, respectively.

Response: We have added the sentence "The cloud-base and cloud-top height uncertainties are ~7.5 m and ~45 m, respectively (Zhao et al., 2012a; Garrett and Zhao, 2013)." to the revised manuscript.

Page 5. Line 28, "density of liquid water", and COD is cloud optical depth at visible wavelength.

Response: Done.

Page 8, Line 12-15, please check and correct the grammar here.

Response: The sentence has been changed to "When the continental air-mass influenced the site, fine particles dominated aerosol scattering and were responsible for ~65% of the total particle scattering, indicating that more anthropogenic aerosols with small particle sizes were transported to the site from continental regions to the west."

Page 10, Line 1-5, Other studies as mentioned earlier have also indicated this likely evaporation and entrainment effect near cloud tops, which could be cited.

Response: Done.

Page 10, Line 7, “can possible” -> “can be possible”

Response: The sentence has been changed to “The changes in DER with LTS possibly reflect the changes in LWP with LTS due to the high positive correlation between LWP and DER (Zhang et al., 2011; Sporre et al., 2014).”

Page 10, Line 10-14, Yang et al. (2019), Zhao et al. (2018, 2019) have also made similar descriptions.

Response: These references are now cited.

Page 12, Line 20-21, Zhao et al. (2012) have indicated that using different aerosol variables to represent the aerosol loading amount, the quantified FIE values could vary, which is worthy to be mentioned here.

Response: It has already been mentioned in section 3.3.2.

Page 13, Line 11, also Zhao et al. (2012); Lin 12-13, Yang et al. (2019) too.

Response: These references are now cited.

Page 13, Line 24, I would suggest “the question how sensitive the cloud properties are sensitive to ...”

Response: The sentence has been changed to “Examined next is the sensitivity of cloud properties to aerosol chemical composition represented by the mass fraction of organics.”

Page 13, Line 26, what is the size range for the aerosol concentration?

Response: The size range for the aerosol concentration is 10 nm to 3 μm in diameter. This is mentioned in section 2.1.1.

Page 14, Line 13, “larger”?

Response: Done.