

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-799

Anonymous Referee #1

Referee comment on "Formation, radiative forcing, and climatic effects of severe regional haze" by Yun Lin et al., Atmos. Chem. Phys. Discuss.,
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General comments:

Using in situ measurements, satellite observations and the WRF model, the authors investigated the contributions of chemical and physical processes to the evolution of haze extremes. Findings show that chemical process that plays a leading role in PM production varies with the development stage of the haze event. And the haze-PBL interactions accelerate the accumulation of aerosol particles and water vapor at the ground level, amplifying the haze severity. The findings help to demonstrate the potential for achieving co-benefits for air quality and climate via black carbon mitigation. I recommend it to be accepted after minor revision.

- 3 show the concurrent increases in OOA, PM_{2.5} and Ox concentrations during the transition period. Is that also the case for the clean days? Why or why not?
- Generally, the PBLH increases from morning to afternoon, and then decreases to the midnight. While it seems that the rate of growth in PM during the polluted period (from afternoon to midnight) is comparable to that during the transition period (from morning to afternoon) in Figs. 3a-b. Does it mean that photochemistry produced more PM? I suggest the authors to provide additional information on the diurnal evolution of the PBL for the two selected cases, and further explore the role of boundary layer evolution and chemical processes in the development of pollution.
- In my opinion, the relative humidity calculated by the Nozaki's equation (Lines 402-407 and 501-503) may suffer from large uncertainties that originated from 1). errors in PBL height, especially for the clean cases (Line 257), 2). inappropriate selection of Pasquill stability level (Line 255) due to the lack of cloud fraction measurements. 3) the uncertainty of the empirical formula itself. Since the model simulations agree well with the observations (Fig. s2), why not use the modelled results to show the changes in RH from the ground to the free troposphere?

Technical comments:

- Line 300, the '(Li et al. (2015))' should be '(Li et al., 2015)'
- I cannot find tables. 1-3 in the manuscript.