Review of “Potential Influences of Neglecting Aerosol Effects on the NCEP GFS Precipitation Forecast” by Jiang et al. submitted for a publication in ACP

This study evaluated the potential impact of neglecting ACI on the operational rainfall forecast using ground-based and satellite observations, and NCEP GFS simulations. The main conclusion is that the ACI, which is not accounted by the forecast model, may contribute to the overestimation of light rain and underestimation of heavier rain. Since the forecast is the worst in China, the authors choose a place in China to conduct more insightful investigation using a suite of variables from gauge-based observations of precipitation, visibility, water vapor, convective available potential energy (CAPE), and satellite datasets. This is the first study to look at the potential contribution of ACI to forecast problems. The idea is new and interesting. In addition, the analysis is comprehensive. The paper is well-written and I enjoyed reading it. It is definitely worth publishing such a high-quality paper for ACP. My comments are minor generally since they would not impact the conclusions of the paper.

Major comments,

1. About using cloud mixing ratio at 850 hpa for indicating different large-scale conditions, first, cloud water mixing ratio at such a low level would be close to zero except for boundary layer clouds (even it is not, it would not be representative of any clouds with a cloud base above 850 hpa. So, it could be problematic to use this quantify at 850 hpa. A better quantity for indicating different large-scale conditions is LWP, which can be easily obtained for both observations and model, and is typically used in many literature study.
2. Page 23 and Figure 13, the decrease of cloud top temperature does not necessarily mean the convective invigoration as suggested by Rosenfeld et al. 2018 and then the precipitation enhancement. This is illustrated in Fan et al. 2013 (PNAS). If the CTT analyzed is for convective core only (i.e., excluding stratiform/anvil areas), this analysis may be ok. Otherwise, you can not use the increase of CTT as a proxy of convective invigoration.
3. Discuss the data uncertainty and the implication to your results, such as satellite-retrieved AOD, the proxy of aerosols with visibility, and the rain gauge rain data. Particularly rain gauge data, it can not measure light rain with smaller rain rate such as less than 0.25 mm/h, which might contribute to the model overestimation of the light rain. Also, rain gauges might miss heavy rain spots and usually underestimate very heavy rain rate.
4. Discuss the sampling size or sampling strategy differences between model and simulations for your analysis and the implications to your results. The observations and model data could differ in time frequency, spatial resolution, and many other things.
5. MERRA aerosol data are not coupled with GFS simulations, discuss this caveat in the model analysis.

Specific comments,

Ln 75-79, ARI can increase precipitation at the download of the polluted places as shown in many studies (such as Carrió et al., 2010, Atmos. Res., 96, 560–574; Fan et al. 2015, GRL, 42)

Ln 95-95, I am not clear about "ARI are only considered offline and are not coupled with the dynamic system", is the temperature change by ARI considered in physics? You mentioned that aerosols are considered in the radiation scheme, which means ARI should impact radiation and temperature, and then impact dynamics. Why do you say it is not coupled with the dynamic system?

Ln 144-145, what are the major aerosol components that are chosen for both longwave and shortwave
radiative transfer calculations? It is not enough to say "one or two components".

Ln 183-184, what is the time frequency of the sounding data? If it is standard 00/12 UTC, it might not be useful.

Ln189-192, this sentence does not seem to be important unless you are specific about what new data types are included and how important they are to your analysis.

Ln229-230, 850 hPa is pretty close to the surface. Cloud mixing ratio would not exist except for boundary clouds. Do you mean total condensate mixing ratio?

Ln372-374, this is probably only true for summer time when convective clouds are dominant.

Ln 382, contradicting with a previous statement saying that AOD>0.6 is excluded from the analysis.

Page 19 and Figure 6: First, the text and Figure should be clarified about the threshold. The unit is a rain rate in text but it is a rain amount in Figure. Second, do you mean for (a) and (b), you only analyzed the data below 5 mm/hr while for (c) and (d), the data analyzed with a rate less than 20 mm/hr? Third, the ranges of low, middle, high, and very high AOD and those of low, middle, and high cloud mixing ratios should be given. Also, needs justification why only the results in U.S. are shown. Lastly, I do not understand why cloud mixing ratio is used. As mentioned above, cloud mixing ratio at 850 hpa does not mean much. A better quantity for indicating different conditions is LWP, which can be easily obtained from both observations and model.

Figure 12: Need to explain why cloud effective radius increases as AOD increases for LWP < 50.

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Line 495-497, I think this effect may only be true for summer and under the conditions that ARE is not dominant.