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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Potential Influences of Neglecting Aerosol Effects on the NCEP GFS Precipitation Forecast" *by* Mengjiao Jiang et al.

Anonymous Referee #2

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This study evaluated the National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) forecast bias in different precipitation (light rain, moderate rain, heavy rain and very heavy rain) by comparing the ground-based observations in three countries. Then the correlations between GFS precipitation forecast errors and the aerosol loading are investigated extensively to examine the potential impact of neglecting aerosol-cloud-interaction (ACI) on the operational rainfall forecast. The main result is that the GFS overestimates light rain, and underestimates moderate rain, heavy rain, and very heavy rain, which is partly due to neglecting the ACI process in the GFS. The study fits within the scope of the journal, and the information and arguments are generally clear enough to be followed. Although the current study does not fully establish the causal relationship between the ACI and the bias of precipitation forecast of GFS

due partially to a lack of sufficient information, it should still be commended for confronting a highly-challenging task to make this first attempt to evaluate the numerical weather prediction forecast errors in terms of the potential effects of aerosols. Therefore, I'd recommend accepting this manuscript if the following comments are properly addressed. Major Comments: As shown in figure 3, the magnitude of underestimation in light rain and overestimation in heavy rain by GFS are all similar over three counties, but the aerosol loading in China is significantly higher than in other two countries. If the aerosol is one of the major factors causing the bias in the GFS precipitation simulation, why there is no obvious difference in the magnitudes of the bias among the three countries? For the study of the aerosol invigoration effect on the warm and cold based mixed clouds, please clarify the cloud top temperature is for convective core area or for whole convective clouds (including anvil areas). As those studies by Rosenfeld et al. [2008] and Fan et al. [2013], only the decrease of cloud top temperature for convective core with increasing of aerosol loading can be attributed to the aerosol invigoration effect. Some of descriptions are too detailed and may not be necessary. Minor Comments: Line 95: The description of "ARI are only considered offline and are not coupled with the dynamic system" is confused. Part 2.1: Since this study only used the simulation results and the details of GFS has been widely described, thus I'd suggest cutting the description in section 2.1 and paying more attention to the potential error of GFS precipitation forecast. Section 2.2.1: Such a detailed description on MERRRA-2 aerosol reanalysis is not necessary. What is the spatial resolution? Same with the CPC data? Line 251-255: Please give the observed time of the sounding data. Section 3.1.1: From figure 2, the systematic bias is found in three counties, such as the overestimations are found in north, west of China, and underestimations are found in east China. Could you explain this? Line 340: Clarify the meaning of Z. Line 385: in figure 6, please clarify the definition of the low, middle and high cloud mixing ratio, and the definition of the low, middle, high and very high AOD conditions. And why the thresholds of 5 and 20 are selected. Line 394-396: how to draw the conclusion of "the underestimation for heavy rainfall increases as AOS increases for low and middle

cloud mixing ratio conditions" from figure 6d. Line 457: Although the long-term data are used, the seasonal variations in aerosol loading, cloud properties and meteorological parameters may result in the nominal relationship as shown in figure 12. Line 479-485 and figure 13: Is the relationship statistical significant? Please give P values in figure 13. Line 485: It is either significant or not significant, based on the confidence level the authors choose. Therefore, I advise the authors to use stronger or weaker correlations, or higher or lower slopes, but not the more or less significant. Figure 8a: change the "Total" to "All"

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