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Interactive comment on "Inverse modeling of black carbon emissions over China using ensemble data assimilation" *by* P. Wang et al.

Anonymous Referee #3

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In this study, the assimilation technique is used to investigate the possibility of optimally recovering the spatially resolved emissions bias of black carbon (BC). An inverse modeling system for emissions is established for an atmospheric chemistry aerosol model and two key problems related to ensemble data assimilation in the top-down emissions estimation are discussed. In general, I found the paper appropriate for ACP audience. However, it need to be major revised before accepted this paper for publication in ACP with addressing those comments listed below:

Major Comments:

1.My primary criticism is that the authors spend too little time discussing the uncertainty in the results. 2. Author need to conduct at least more than 12 months simulation for

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comparison and validation. One month is not reliable to simulate the black carbon emissions over China. 3. The purpose of this manuscript is unclear. When first quickly look through the title, I think this paper will discuss about the black carbon emissions over China, which is compared with the previous studies. After I read it very carefully, the theme just discuss the comparison of the two simulation methods with the observations. 4. What I concerned is about the author illustrated that the inversed emission over China in January is over 1.8 times of bottom-up emission inventory. But how much for the other months and seasons. Is it possible that the bottom-up emission inventory is larger than inverse model ?

Minor Comments:

1. Line 2 in page: Author need to provide the reference for why " BC aerosols have been shown to act as cloud condensation nuclei when they become hydrophilic, affecting cloud micro- physical properties and rainfall processes." 2. Line 26 in page 11: Authors need to provide some discussions about model fails to capture the spatiotemporal variability in the BC observations and underestimates the BC concentrations at almost all assimilated sites except site SD. 3. Line 6 in page 13: Author should give the reason why the Most of them feature a positive bias. 4. Line 10 in page 13: Figure 7 is too small to see. 5. Line 14 in page 13: Authors need to provide some discussions about why "Even though we only employ the monthly mean BC measurements to inverse the emissions, the accuracy of the daily model simulation is also improved."

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 20851, 2015.