We would like to thank the anonymous referee 2# for his/her comprehensive review and detailed suggestions. These suggestions help us to present our results more clearly.

Referee 2#:

General comments:

This paper studies the terrestrial carbon fluxes in China using a previously established model setup and different data constraints, which lead to two different inversion products, i.e. GLOBALVIEV-CO2 data based (GV) vs. GLOBALVIEV-CO2 and CONTRAIL data based (GVCT). In addition, CO2 measurements at three observational sites in China are used to evaluate the posterior carbon fluxes in a forward model framework. The authors also try to correlate integrated carbon fluxes in large regions with climate factors such as radiation and temperature in an effort to validate their inversion results. It appears that the inversion results are qualitatively correlated with the climate factors, but is less convincing without a thorough quantitative analysis. On the other hand, the inversion method and the data used in this paper are sound in general, however, critical screening of the data and discussions of their limitations are clearly missing. Furthermore, the reduction in the posterior uncertainty with the added CONTRAIL data is only 2.2%, which does not support the authors' conclusion that "CONTRAIL data have helped improve the inversion results for China". The manuscript needs a major revision before it can be considered publication.

1) Details on the use of the CONTRAIL data are needed. For example, what are the criteria for screening out polluted profiles near airports? The authors' statement on page 7688, "In view of high pollution near the ground around airports by aircraft emissions, only data measured above 2000m are used" does not give sufficient information for a judgment. Furthermore, how did the authors deal with potential stratospheric influences? Note that stratospheric influences were characterized and filtered out in Sawa et al. 2008 and Niwa et al. 2012.

Response: Thank you for these suggestions. For the use of the CONTRAIL data, we will give details in the revised paper. And for the potential stratospheric influences, i.e., the seasonal variation of CO_2 in stratosphere is quite different from that in troposphere, we have considered it and found that it is not necessary to distinguish whether the CO_2 recodes are in stratosphere or in troposphere. In our study, level flight is considered as flights at heights

greater than 8 km. For level flight sites, first, we define 19 regions with ranges of 10 deg x 10 deg according to the airlines (Figure 1a). Then, all the observation records with heights greater than 8 km located in one region are clustered, so that for one site, the concentration is the average of all observation records located in its region, and the 3-D location is the mean of all observation records as well. We have checked the monthly concentrations of level flight sites processed using this method, and found that there are still obvious seasonal variations. Fig. 1 shows the comparisons of observations and simulations for 4 selected level flight sites. It can be seen that the observations could fit well with the simulations.

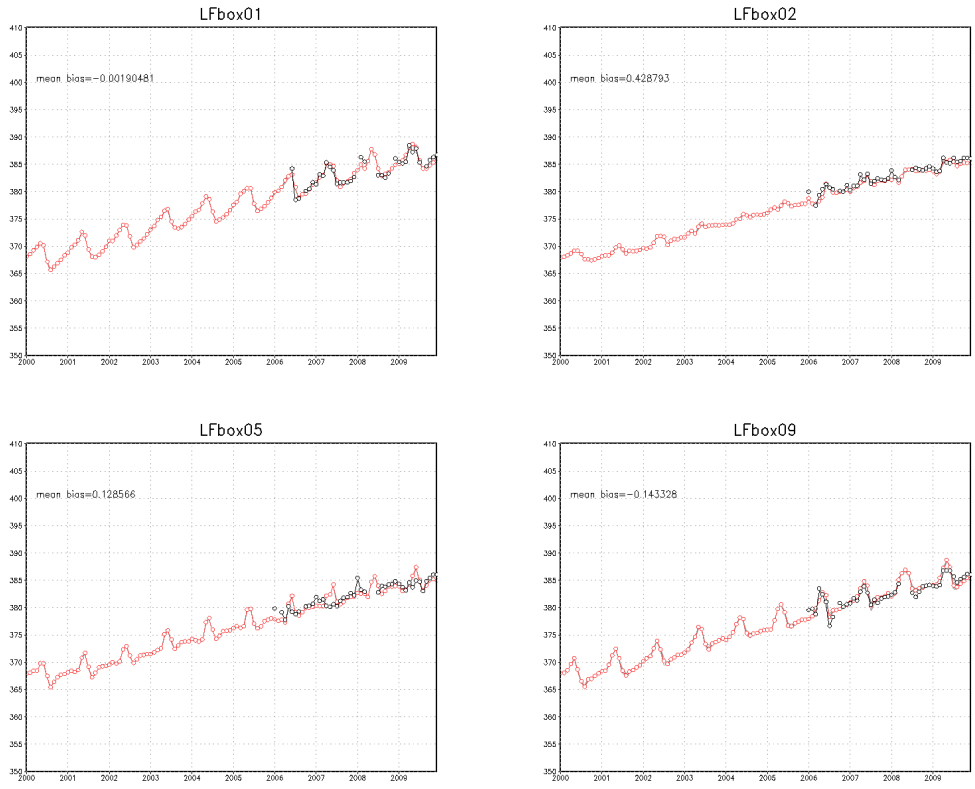

Fig 1. Comparison of observations and simulations for CONTRAIL sites

2) Regarding the CO2 measurements at three stations in China, why were they not assimilated directly in the inversions? The authors discussed the seasonal and spatial variations of the priors and posterior fluxes, and compared them with Niwa et al. 2012. However, there are clear mismatch between the simulations and the observations for all three stations, which seem to point to late ecosystem carbon sinks.

Response: Thank you for these comments. Yes, we don't assimilate the three Chinese sites in these inversions. There are two reasons: the first is that these sites have been assimilated in the

inversion in one of our previous studies (Jiang et al., 2013), and the second is that we need some independent sites in China to evaluate the changes caused by the use of CONTRAIL data. There are still indeed differences between simulations and observations at these sites because the observations at these sites were not used in the inversion and there are uncertainties in the inverted flux. However, the comparison with the CO2 data at these three sites indicates that the use of CONTRAIL data improves the carbon flux inversion over China.

Reference:

Jiang, F., Wang, H. W., Chen, J. M., Zhou, L. X., Ju, W. M., Ding, A. J., Liu, L. X., and Peters, W.: Nested atmospheric inversion for the terrestrial carbon sources and sinks in China, Biogeosciences, 10, 5311-5324, doi:10.5194/bg-10-5311-2013, 2013.

3) How were the data uncertainties prescribed? Especially in the context of surface (GLOBALVIEW) vs. free troposphere (CONTRAIL).

Response: The data uncertainties are defined using the following function, which is similar to Peters et al. (2005) and Deng and Chen (2011).

$$R = \sigma_{const}^2 + GVsd^2 \qquad (4)$$

where *GVsd* reflects the observation error, for GLOBALVIEW data, it is the standard deviation of the residual distribution in the average monthly variability (var) file of GLOBALVIEW-CO_2 2010, and for CONTRAIL data, it is the standard deviation of the residual item which is output during the smoothing of daily CO_2 concentrations using the ccgcrv processing package (Masarie and Tans, 1995). The constant portion σ_{const} reflects the simulation error. For GLOBALVIEW data, this portion varies with station type because transport models generally have different performances at different observation stations. Except for some difficult stations, the observation sites are divided into 5 categories. The categories and respective error values are: Antarctic sites/oceanic flask and continuous sites (0.30), ship and tower sites (1.0), mountain sites (1.5), aircraft samples (0.5), and land flask/continuous sites (0.75). The value of 3.5 is used for the difficult sites (e.g., abp_01D0, bkt_01D0). For CONTRAIL data, we use a constant of 0.75.

We will add this information in the revised paper.

A few details:

1) The unit of CO2 concentrations should be ppm, not ppmv

Response: Thank you for this correction. We will use ppm in the revised paper.

2) Page 7684, line 17: the magnitude of the uncertainty reductions needs to be clarified

Response: Thank you for this suggestion. We will add the magnitude of the uncertainty reductions in the revised paper.

3) Page 7688, what periods are the CO2 measurements at the three sites available

Response: The CO_2 measurements at the three sites are from Jul 2006 – Dec 2009. We will add this information in the revised paper.