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Interactive comment on "How can mountaintop CO_2 observations be used to constrain regional carbon fluxes?" *by* John C. Lin et al.

Anonymous Referee #3

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Comments on "How can mountaintop CO2 observations be used to constrain regional carbon fluxes?" by Lin et al.

Overall comments: This study intends to investigate the mountaintop CO2 observations being used to constrain the carbon fluxes in regional scales. The authors compared the CO2 simulations and trajectories with CO2 observations at 3 sites in the mountains of the Western U.S. in summer from June to August of 2012. The authors also have adopted multiple approaches to discuss and address possible contributors of the results from STILT coupled with individual meteorological model outputs or dataset. They indicated that a fine grid spacing of ∼4 km or less may be needed to simulate a realistic diurnal cycle of CO2 for sites on top of the steep mountains for avoiding erroneous atmospheric flows as a result of terrain that is misrepresented in the model.

The major concern is that how different the CO2 simulations and observations are compared from day to day, particularly when finer scale models are used as suggested? Averaged results might miss some crucial information hidden in the discrepancies between model simulations and site observations in present study.

The related studies focusing on mountaintop such as this one are important and rarely explored. I would recommend this manuscript for publication after above concern is addressed.

Specific comments: Line 146: How is the vegetation covered at these mountain stations? Are these monitoring sites far above the tree line? Local influences on CO2 due to the surrounding plant cover at these sites may need to be considered.

Lines 296-297: How much percent is contributed to the wildfires during the study period?

Lines 301-302 and Fig. 3: Fig. 3 illustrates the 3-month averaged diurnal cycles of the results from individual models and observations. Do they show similar diurnal cycles every day during these months? Consider addressing the variabilities of the diurnal cycles (e.g. error bars) in the supplement.

Fig. 4: Has the GDAS_1-deg_ASL in Fig. 4 been adjusted with the biospheric fluxes? If not, I would recommend drawing it as gray line and dot as presented in Fig. 3.

Fig. S5: Two CT Level 1 (dark blue) and two CT Level 2 (blue)?

Fig. S5 and Table 1: The differences between the site and model altitude (Table 1) seem to be generally associated with the CO2 biases. For instance, larger differences such as WRF-12km, GDAS, and Carbon Tracker showed larger discrepancies in diurnal cycles of CO2 at HDP. What if the model altitude fixed as same as the mountain site? Could it be better correlated to the observational CO2 data?

Lines 336-380: Are these trajectories in a good agreement for each day during the study period both in nighttime and afternoon hours?

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2016-762/acp-2016-762-RC2-supplement.pdf

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