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Interactive comment on "Carbon Monitoring System Flux Net Biosphere Exchange 2020 (CMS-Flux NBE 2020)" *by* Junjie Liu et al.

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General comments.

The authors present a brief description and evaluation results for the inverse model estimated CO2 fluxes for 2010-2018, based on observations by GOSAT and OCO-2 satellites. The data presented in the dataset are produced with the same model that was applied in several research papers and have mostly been used for estimating the variability and anomalies in the global carbon cycle at the regional and global scale. The satellite-based flux inversions proved to be useful in constraining large regional scale response of the natural carbon cycle to climate anomalies, droughts, heatwaves, such as those driven by the El-Nino cycle. In this context, the presented data can become a useful asset for those studying the carbon cycle variability at regional scale and its connection to the climate anomalies. On the negative side, there are desir-

able components in the evaluation, such as analysis of the CO2 flux seasonal cycle, its comparison with inverse model estimates made with ground-based observations, or other independent estimates, such as based on flux tower data. The same can be said on comparison with observed CO2 concentration at background monitoring sites, such as the NOAA flask sampling network. In case there are identified biases in such comparison, it would be possible to advise the users to restrict the use of the data to studying the flux anomalies rather than using the fluxes for forward simulations, comparing with surface fluxes and using in ecosystem model optimization, where seasonal cycle performance is important. The authors should clearly state such limitations so that the users can have enough information on how to make best use of the provided data. The paper is well written and can be accepted after minor revision addressing the comments and suggestions.

Detailed comments.

Notable deficiency: NBE flux evaluation looks somewhat qualitative. Based on data presented in the paper, and data provided on the data distribution site it is difficult to compare the NBE fluxes to alternative estimates. The 28-region data is provided, but it doesn't look directly mappable to widely used Transcom-3 22 region map. Recommend adding comparison figure (similar to Figure 8) of the seasonal flux climatology on Transcom3 22 regions or the authors-proposed 28 regions to other available estimates such as CAMS inversion fluxes (based on Chevallier et al. 2010) or FLUXCOM fluxes (Jung et al. 2020)

Line 208 It looks like presented bias figures (below 0.1 ppm) are related to global mean bias, are the bias values available as seasonal mean values by latitude or TCCON site? Are retrieved and bias-corrected concentrations consistent with model simulations optimized with ground-based observations?

Line 1031 Figure 8. Although the seasonally varying fluxes look to be in a reasonable range it is very much advisable to compare/plot along with observed or observation-

based fluxes, such as FLUXCOM NEE product (Jung et al. 2020).

Technical corrections.

Line 191 Looks anomalous, to have 2000 good quality retrievals available on a single day in the ACOS-GOSAT dataset (appears significantly larger than average).

Line 193 Need to state how good quality is defined (what value of the quality flag is used)?

Line 199 Is 'super observations' a good term to name 100 km ($\sim$12 sec) average data?

Line 228 The statement "For large-order systems, the posterior errors cannot be explicitly calculated" can be argued. Posterior flux uncertainty projected to regions can be estimated analytically using recipes provided by (Fisher and Courtier, 1995) or (Meirink et al, 2008), using either flux singular vectors or flux increments obtained on course of the iterative optimization (eg Niwa and Fujii, 2020). Using random perturbations is simpler and is used widely, but that doesn't mean that the more accurate method is impossible to apply.

Line 240 Common perception is that tower footprint size is less than 1 km, based on estimates by Baldocchi, (1997) and others. The citation by Running et al (1999) of 'several km2' may refer to the upper range. They (Running et al 1999) also consider 1–3 km2 and 1 km2 as typical values throughout their paper.

References

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