ACPD 15, C2837-C2839, 2015

I am very grateful to the anonymous referee #1 and give a response as follows.

Page here points to the page of the manuscript published in ACPD.

1. The paper presents an evaluation of the NIES TM, but it is not sufficiently thorough and the results lack context. The agreement between HIPPO data and model results is described qualitatively without presenting the results in the context of the spatial or temporal variability of CO_2. This is equivalent to describing "noise" and bias without any information about the magnitude of the critical signals. Global mean maps of the model XCO_2 corresponding to each period of the HIPPO flights would provide some important context.

Response: The original Page 12, line 6, I add Figure 3 and corresponding description as follows (see Page 14, line 304-314 in revised manuscript), and change the original Figure 3 to Figure 4.

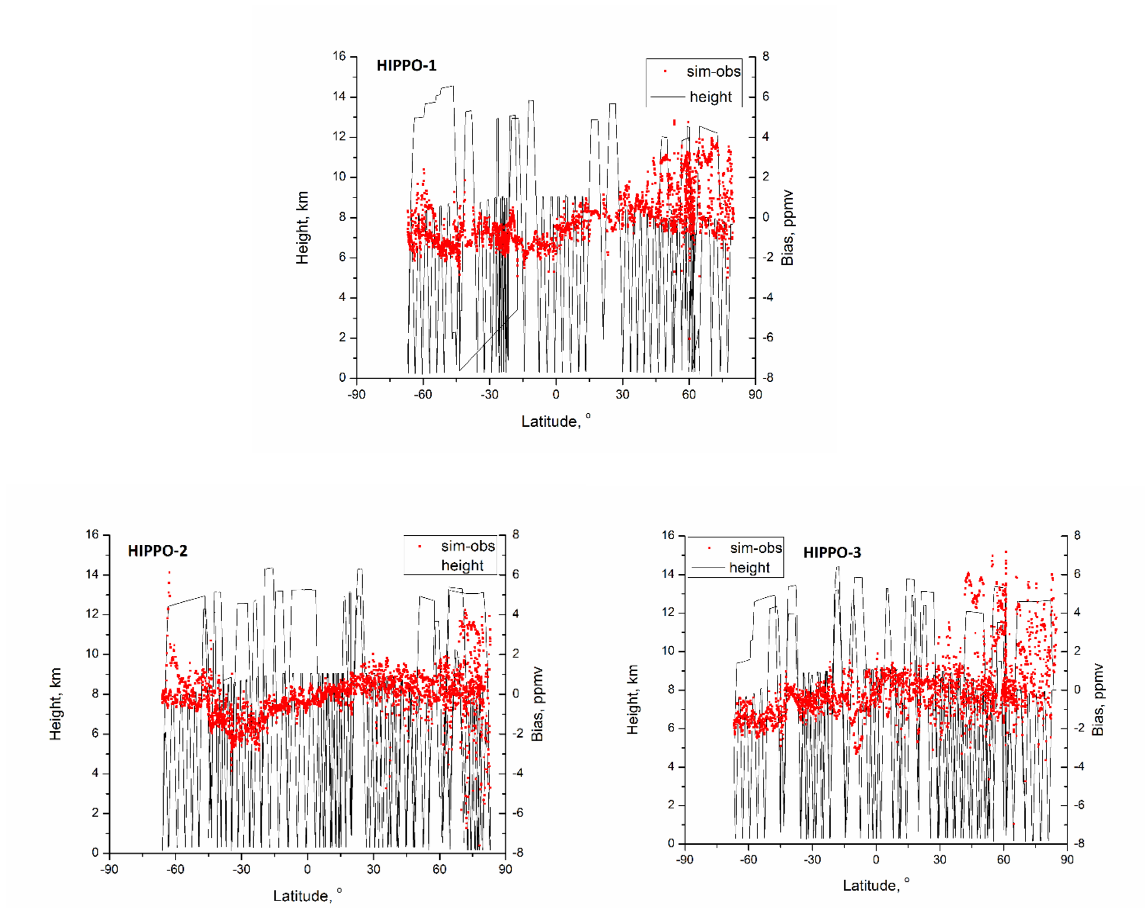


Figure 3. Change of flight height and difference between simulation and observation of HIPPO-1, 2, 3 with latitude.

The above Figure 3 presents us the change of flight altitude and bias by subtracting observation by simulation of HIPPO-1, 2, 3 with latitude. The observations' number of these three missions is 17621, 23451, 22372 respectively, and the plenty of observations provide basis for model validation. Based on the change of flight height with latitude in the Figure 3, we only select CO_2 profiles that their height is from near surface to lower stratosphere. According to the rule, 24, 34, 35 profiles are chosen respectively for the HIPPO-1, 2, 3. Then we separately choose one profile in the low, middle and high latitude of Northern and Southern hemisphere from the selected profiles for each mission because of the similarity of the profile shape in every latitude zone. Seen from the Figure 3, the relatively larger biases always occur in the higher latitude of Northern hemisphere.

2. The scatter around the 1:1 line in Figure 1 seems rather large compared to regional scale flux signatures in XCO_2. For example, the entire range of XCO_2 for HIPPO3 is only 12 ppm according to Figure 1, while the 1-sigma variability looks to be approximately 2 ppm. Regional scale flux signatures in the column CO_2 are typically just a few ppm or even smaller.

Response: Because Figure 1 describes the correlation of total 63444 simulations and observations, including 17621, 23451, 22372 observations for HIPPO-1, 2, 3 respectively. However, we only select CO_2 profiles that their height is from near surface to lower stratosphere. According to the rule, 24, 34, 35 profiles are chosen respectively for the HIPPO-1, 2, 3. Then we separately choose one profile in the low, middle and high latitude of Northern and Southern hemisphere from the selected profiles for each mission because of the similarity of the profile shape in every latitude zone. So there is only a few observations for the selected profiles with regional scale, and it may be no big biases for the selected profiles.

3. One possibility for increasing the significance of this manuscript would be to use the model to investigate the extent to which HIPPO data are representative of the regional/seasonal mean behavior over the remote Pacific. What spatial and temporal scales are represented by the dataset? One could also examine what

model physical parameterizations give best agreement with the data, although much longer model simulations would likely be needed. Although HIPPO included 787 vertical profiles, only twelve are actually used. A much more thorough comparison could be done showing statistics of simulated minus observed for e.g. 0-2 km, 2-4 km versus latitude for each season.

Response: The idea of analysis suggested by the referee is rather attractive, however it looks more suitable as a task for a separate study due to large volume of tests required for studying separate contributions to CO_2 transport, especially in southern hemisphere.

There are 787 profiles and we only select CO_2 profiles that their altitude is from near surface to lower stratosphere. According to the above rule, 24, 34, 35 profiles are chosen respectively for the HIPPO-1, 2, 3. Due to the similarity of all these profile shape presented to us in every latitude zone, so we separately choose one profile in the low, middle and high latitude of Northern and Southern hemisphere from the selected profiles for each mission.

Seen from Figure 3, it presents the biases of all simulation minus observation from 0-16 km. And I add 3 graphs (Figure 5, 7, 9) which show the biases of simulation minus observation corresponding to profiles of HIPPO-1, 2, 3 respectively, and change the original Figure 4 to Figure 6, Figure 5 to Figure 8. The corresponding descriptions are as follows.

The original Page 12, line 20, at the end of line 20, I add “For details, Figure 5 presents the biases of simulation minus observation corresponding to Figure 4(a) – 4(f) respectively.” (see Page 15, line 330-332 in the revised manuscript).

The original Page 13, line 4, at the end of line 4, I add “Moreover, Figure 7 further displays the biases of simulation minus observation corresponding to Figure 6(a) – 6(f) respectively.” (see Page 16, line 346-348 in the revised manuscript).

The original Page 13, line 14, I add “Furthermore, Figure 9 shows the biases of simulation minus observation corresponding to Figure 8(a) – 8(f) respectively.” before “Larger bias” (see Page 17, line 359-360 in the revised manuscript).

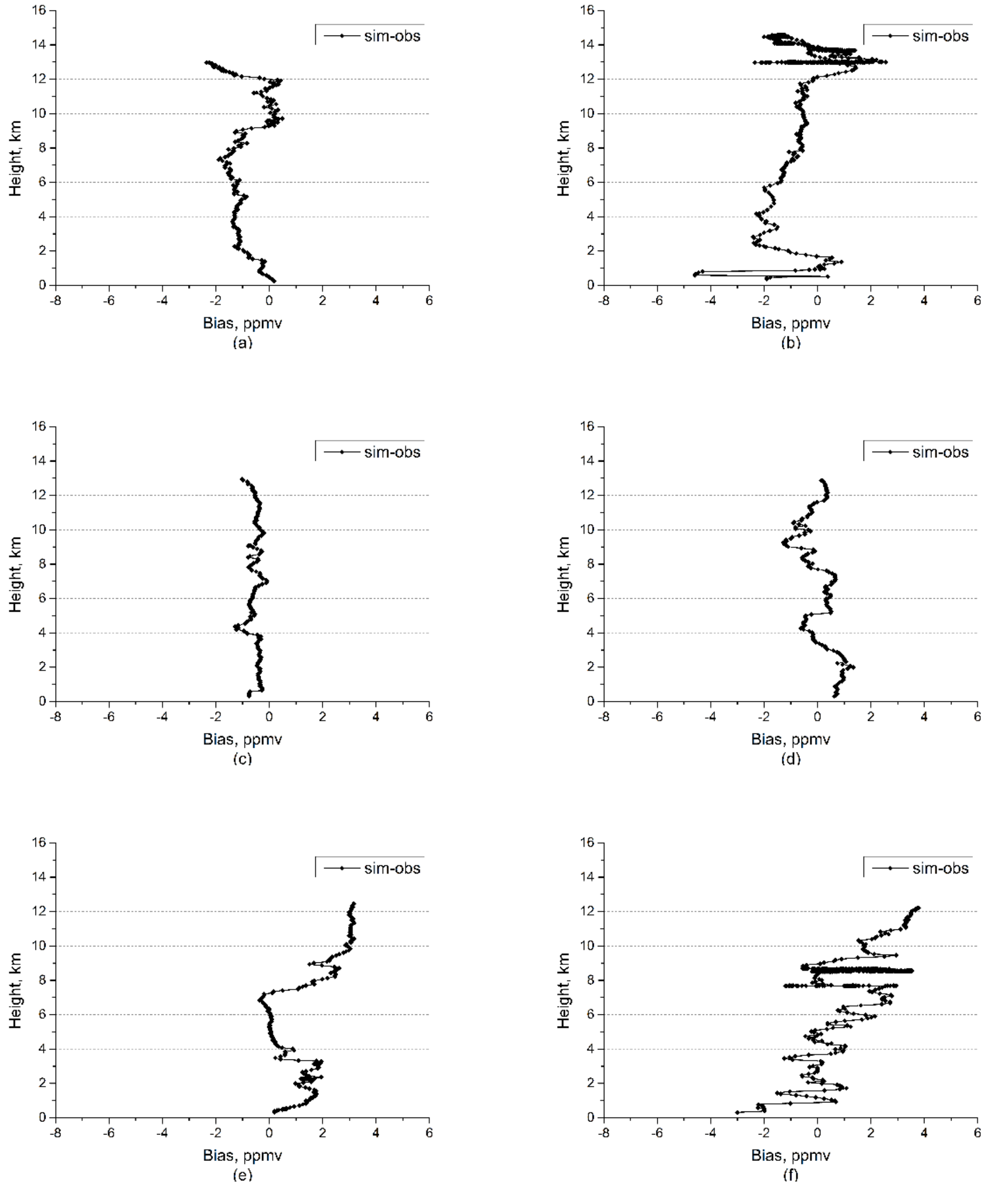
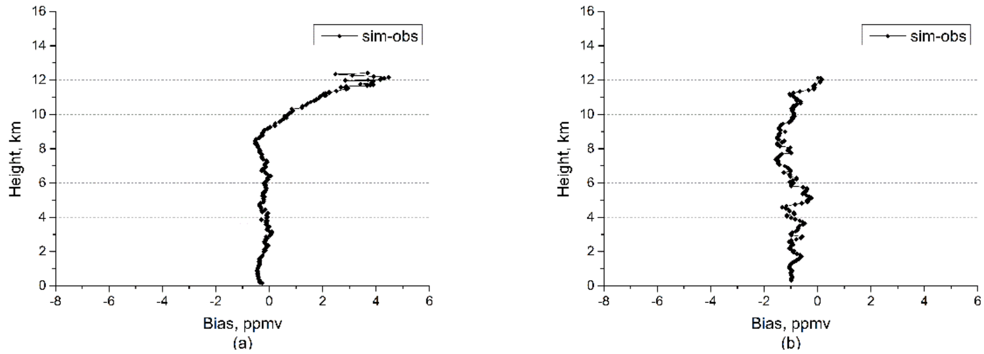


Figure 5. Biases of simulation minus observation from near-surface to the LS for HIPPO-1, panels are corresponding to Figure 4(a)-4(f) respectively.



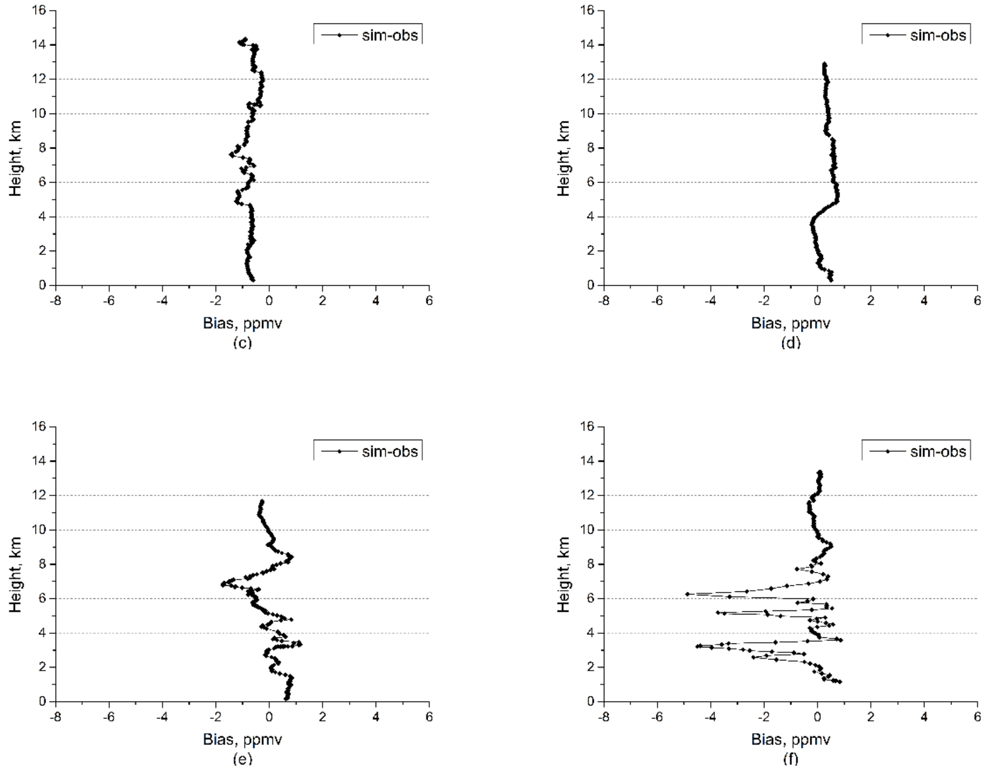
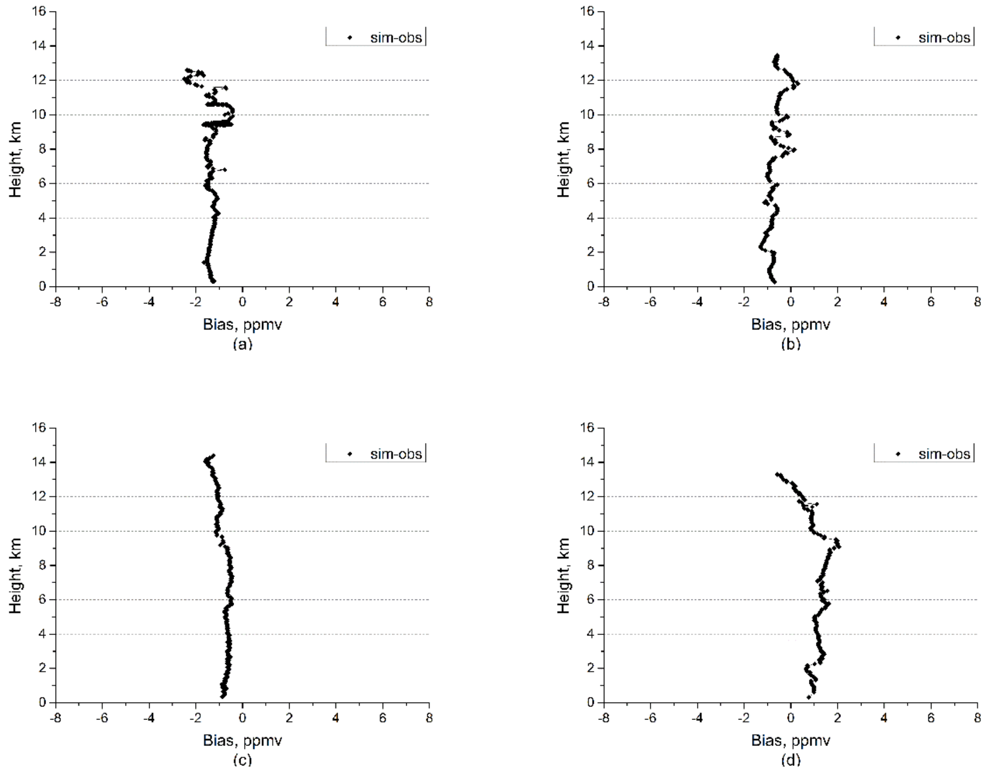


Figure 7. Biases of simulation minus observation from near-surface to the LS for HIPPO-2, panels are corresponding to Figure 6(a)-6(f) respectively.



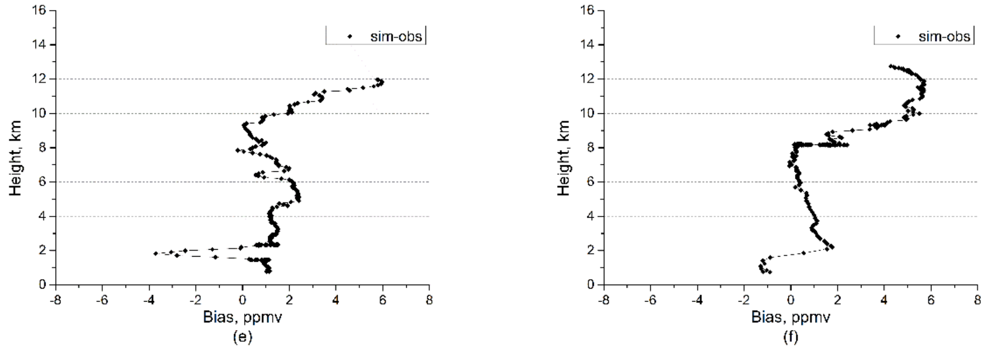


Figure 9. Biases of simulation minus observation from near-surface to the LS for HIPPO-3, panels are corresponding to Figure 8(a)-8(f) respectively.

4. How is XCO_2 being computed from HIPPO data? What is being used to fill in the stratosphere above the maximum altitude of the profiles? Is XCO_2 from the HIPPO profiles being computed according to the GOSAT retrieval algorithm (i.e. applying averaging kernels and a prior) or some simpler pressure-weighted aggregation?

Response: Through the manuscript, I did not use XCO_2, the HIPPO observation and simulation are all CO_2. I used the term column from carelessness (the original Page 6753 line 22 in original manuscript). I have updated the sentences with red color. (Page 11, line 235-236 and Page 14, line 295-296 in the revised manuscript)

5. More details are needed in Section 2.3. There should be some more description of the “Level 4A global fluxes” used to drive the model. I think perhaps a reference to this paper is needed: S. Maksyutov et al.: Regional CO_2 flux estimates for 2009–2010, Atmos. Chem. Phys., 13, 9351–9373, 2013. Also, how was the model initialized? Is it initialized with the corresponding GOSAT LEVEL 4B product? The HIPPO-1 and HIPPO-2 runs were initialized only one day before the start of the flights, while the HIPPO-3 was initialized on 1 March and flights did not start until 24 March. Is this an important difference? What does it mean to have a 1-degree space step and a 2.5×2.5 degree spatial resolution?

Response: The original Page 9, line 10, after “respectively”, I changed the sentence to “with individual initial 3D tracer distributions using the global prior fluxes of biosphere-atmosphere and air-ocean exchange, fossil fuel emissions, biomass burning, and GOSAT Level 4A inverse model correction (Maksyutov et al., 2013), provided by climatological mean of monthly global CO_2 fluxes estimated with GLOBALVIEW and GOSAT SWIR Level 2 XCO_2 data. As we use same set of fluxes and same version of transport model as GOSAT Level 4 product, the flux corrections provided by GOSAT Level 4 product provide optimal fit to available observations.” (see Page 10-11, line 219-226 in the revised manuscript)

The original Page 17, I added the reference you mentioned after line 14 as follows.

“Maksyutov, S., Takagi, H., Valsala, V. K., Saito, M., Oda, T., Saeki, T., Belikov, D. A., Saito, R., Ito, A., Yoshida, Y., Morino, L., Uchino, O., Andres, R. J., and Yokota, T., Regional CO_2 flux estimates for 2009-2010 based on GOSAT and ground-based CO_2 observations, Atmos. Chem. Phys., 13, 93519373, doi: 10.5194/acp-13-9351-2013, 2013.” (see Page 24-25, line 528-532 in the revised manuscript)

The initial condition was produced with short one year spin-up run starting with realistic two-dimensional field given in latitude-pressure coordinates. As model is known to maintain realistic stratospheric air age (Belikov et al, 2013), a longer spin up was considered unnecessary.

The HIPPO-1 and HIPPO-2 runs were initialized only one day before the start of the flights, while the HIPPO-3 was initialized on 1 March and flights did not start until 24 March. It is a very small difference which can be negligible.

For the last question, I made a mistake, so in the original page 9, line 6, I changed the sentence to “The model was run at a horizontal resolution of 2.5°×2.5° and 32 vertical levels from the surface to 3 hPa.” (see Page 10, line 216-217 in the revised manuscript)

6. Regarding data attribution, were the HIPPO data providers contacted about the use of this dataset and offered co-authorship and a chance to review the manuscript? The acknowledgement only mentions CDIAC. Although the data have been made freely available, the HIPPO data providers should be consulted about appropriate

attribution for use of this data.

Response: I change the acknowledgements according to the use recommendations of HIPPO Data Policy.

The original Page 14, line 18, I change the first sentence to “The authors acknowledge NSF, NCAR/EOL and NOAA and related scientists which supported the collection of the original HIPPO data.” (see Page 19, line 403-404 in the revised manuscript).

The original Page 19, line 15, add reference “Wofsy, S. C., Daube, B. C., Jimenez, R., Kort, E., Pittman, J. V., Park, S., Commane, R., Xiang, B., Santoni, G., Jacob, D., Fisher, J., Pickett-Heaps, C., Wang, H., Wecht, K., Wang, Q.-Q., Stephens, B. B., Shertz, S., Watt, A. S., Romashkin, P., Campos, T., Haggerty, J., Cooper, W. A., Rogers, D., Beaton, S., Hendershot, R., Elkins, J. W., Fahey, D. W., Gao, R. S., Moore, F., Montzka, S. A., Schwarz, J. P., Perring, A. E., Hurst, D., Miller, B. R., Sweeney, C., Oltmans, S., Nance, D., Hintsa, E., Dutton, G., Watts, L. A., Spackman, J. R., Rosenlof, K. H., Ray, E. A., Hall, B., Zondlo, M. A., Diao, M., Keeling, R., Bent, J., Atlas, E. L., Lueb, R., Mahoney M. J., 2012. HIPPO Merged 10-second Meteorology, Atmospheric Chemistry, Aerosol Data (R_20121129). Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A. http://dx.doi.org/10.3334/CDIAC/hippo_010, (Release 20121129) (HIPPO_all_missions_merge_10s_20121129.tbl).” (see Page 29, line 628-640 in the revised manuscript).