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Interactive comment on “Simulating CO₂ profiles using NIES TM and comparison with HIAPER Pole-to-Pole Observations” by C. Song et al.

Anonymous Referee #1

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This manuscript aims to document the performance of the NIES TM against data from the HIPPO experiment. Unfortunately, the model evaluation fails to meet the standards of ACP in my opinion. Of course it is useful to document model performance against a high quality dataset like HIPPO, but for publication in ACP there should be some interesting scientific aspect.

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 CO₂. This is equivalent to describing "noise" and bias without

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any information about the magnitude of the critical signals. Global mean maps of the model XCO₂ corresponding to each period of the HIPPO flights would provide some important context.

The scatter around the 1:1 line in Figure 1 seems rather large compared to regional-scale flux signatures in XCO₂. For example, the entire range of XCO₂ 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 CO₂ are typically just a few ppm or even smaller. Errors of only 10

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.

How is XCO₂ being computed from HIPPO data? What is being used to fill in the stratosphere above the maximum altitude of the profiles. Is XCO₂ 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?

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 CO₂ 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

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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 2.5x2.5 degree spatial resolution?

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.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6745, 2015.

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