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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sources of variations in total column carbon dioxide" *by* G. Keppel-Aleks et al.

G. Keppel-Aleks et al.

gka@gps.caltech.edu

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We thank Dr. Rayner for his review of our manuscript.

We have run simulations with local fluxes at Park Falls labeled and confirm the small influence of local fluxes on $\langle CO_2 \rangle$. On diurnal timescales, local fluxes contribute only 0.5-0.7 ppm to the peak-to-trough diurnal amplitude, and, as expected, there is no synoptic scale variability. When diurnal variations in $\langle CO_2 \rangle$ are regressed against the local flux, there is slightly more explanatory power (R^2 = 0.2 instead of R^2=0.12).

We will include a reference to the Chevallier et al. (2010) paper in the revised manuscript, and will expand the final Results section on vertical mixing to include model transport error. We expect that the discussion in this paper of the footprint of $\langle CO_2 \rangle$ will

help to inform the design of spatial covariance structures used in inversions of $\langle CO_2 \rangle$. The extent to which transport errors are aliased into errors in the optimized fluxes are likely quite sensitive to the spatial covariance specified in the inversion setup. The good agreement between the $\langle CO_2 \rangle$ gradients in TM5 and AM2 estimated from covariations with theta suggests that using a dynamical coordinate may provide a means to account partially for model transport error.

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Interactive Comment