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Atmospheric Chemistry and Physics Discussions

Interactive comment on "CO_2 and its correlation with CO at a rural site near Beijing: implications for combustion efficiency in China" *by* Y. Wang et al.

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This is a very good paper that presents an important new dataset from China. The paper is clearly written and represents thoughtful analysis.

I have the benefit of having read Reviewer #1's comments. I agree that it would be useful to see the CO timeseries from Miyun. Specifically, I recommend expanding Figure 3 to include the corresponding CO data. CO data is also available for the NOAA/Globalview sites presented in that figure, and it would be useful to see how the background CO values estimated as the 5th percentile from the Miyun observations compare.

One especially relevant recent study that should be referenced is by S. Han and coauthors: JGR, Vol. 114, D23202, doi:10.1029/2009JD012027, 2009

My other major comment has to do with interpreting the dCO2/dCO ratio without accounting for biological fluxes of CO2. Positive biological fluxes of CO2 in winter can be comparable in magnitude to fossil fuel fluxes and compact correlations between CO2 and CO can exist in winter even when fossil and biological sources are comingled only over large spatial scales. This assertion is based on analysis of continental data from the US (manuscript in preparation), where R^2 for CO2/CO correlations can be > 0.9, but biological fluxes are thought to be of the same approximate magnitude as fossil fuel fluxes (based on CarbonTracker fluxes convolved with lagrangian particle dispersion footprints). At a minimum, I think the authors should include a discussion of the likely magnitude of biological fluxes integrated over the landscape and how consideration of biological fluxes would impact the interpretation of CO2-CO correlation slopes.

In the absences of ocean and fire sources:

CO2(obs) $\sim$ ΔCO2(fossil) + ΔCO2(bio) + CO2 (bg)

CO(obs) $\sim$ ΔCO(fossil)

where Δ denotes a change in CO2 or CO resulting from upwind sources.

And: CO2(obs-bg)/CO(obs-bg) = (ΔCO2(fossil) + ΔCO2(bio))/ ΔCO(fossil)

Set α = fraction of total flux from fossil fuels such that:

CO2(obs-bg) $\sim$ α ΔCO2(fossil) + (1- α) ΔCO2(bio)

and: ΔCO2bio = (1- α)*CO2(obs-bg)

So: CO2(obs-bg)/CO(obs-bg) = (ΔCO2(fossil) + (1- α)*CO2(obs-bg))/ΔCO(fossil)

Rearranging gives: ΔCO2(fossil)/ ΔCO(fossil) = α CO2(obs-bg)/CO(obs-bg)

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So, if an estimate of α is available, then it is possible to estimate the quantity: ΔCO2(fossil)/ ΔCO(fossil)

I'm not sure accurate seasonally resolved estimates of α are available for China. I did look at CarbonTracker fluxes corresponding to the "NCN" region (100-120 degrees longitude and 40-50 degrees latitude). The fluxes are available online: ftp://ftp.cmdl.noaa.gov/ccg/co2/carbontracker/fluxes/

CarbonTracker's median values of α for January 2004-2008 range from 0.45 – 0.95, but may not be realistic. The fluxes available online are from CarbonTracker-North America, which is not optimized to solve for Asian fluxes. Data to constrain Asian fluxes in CarbonTracker-NA is very sparse. It may be possible to get more reliable estimates of α from CarbonTracker-Asia or from another source such as flux tower data or an ecosystem model.

This paper makes good use of data from NOAA's Earth System Research Laboratory and the Globalview-CO2 dataset, which has many contributors. I hope that data from Miyun will also be made freely available.

I would be happy to discuss any of these comments via email.

Other specific comments:

Pg 12667 lines 10-15 and pg 12668 line 1-5: NOAA "baseline stations" has a specific meaning within NOAA. It refers to the fully staffed observatories (e.g., Mauna Loa, Barrow, South Pole, Samoa). The sites used here are part of NOAA ESRL's Global Cooperative Flask Sampling Network.

Pg 12671: Please describe how standards are traceable to NOAA.

Pg 12672: It should be mentioned that diurnal variations of CO2 are strongly dependent on intake height (see e.g., P Bakwin et al., Tellus B, 50(5): 401-415, 1998). Also, the absence of a strong diurnal cycle does not require that biological fluxes are neglible, only that the fluxes do not have a strong diurnal cycle.

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Pg 12673: Given that nighttime data is strongly dependent upon boundary layer height, it might be better to use afternoon only data for the trends/seasonal cycle analysis.

Pg 12674: It would be interesting to include some discussion of how the seasonal cycle is likely affected by the monsoonal circulation.

Pg 12675: Respiration from large-area vegetation sources is likely to be larger than the human component even in Winter. I think this would be especially true for the North China region analyzed in section 4.3.

Footprints for continental boundary layer observations are of order 100kmˆ2 (see e.g., Folini, D. et al., JGR-D, 114(D8), 27 April 2009; Gloor, M., et al. (2001). "What is the concentration footprint of a tall tower?" Journal of Geophysical Research-Atmospheres 106(D16): 17831-17840.) So, sources far upwind can contribute to observed CO2-CO ratios and even coarsely co-located sources can produce compact correlations.

Pg 12677: I recommend adding CO and background CO to figure 3, as suggested above.

Pg 12679: I don't agree with the assertion that vegetation does not affect CO2-CO correlations in winter. If some reasonable estimates of the wintertime biological fluxes for North China can be acquired and taken into account, then I think this section would be much improved.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 12665, 2010.