

Interactive  
Comment

## ***Interactive comment on “Sensitivity of simulated CO<sub>2</sub> concentration to sub-annual variations in fossil fuel CO<sub>2</sub> emissions” by X. Zhang et al.***

**Anonymous Referee #2**

Received and published: 26 August 2015

This paper uses an atmospheric chemistry transport model for simulating CO<sub>2</sub> concentrations due to fossil fuel CO<sub>2</sub> emissions at varying time resolution, namely, hourly to annual intervals. The simulation method chosen here is well established and the topic of research is quite relevant for the present day CO<sub>2</sub> research. However, this work did not make any effort to analyse the model simulations in comparison with measurements. Thus I am still wandering which fossil fuel CO<sub>2</sub> emission is more close to real world situation? Yes, I agree that we should use the time resolved CO<sub>2</sub> emissions, but only when we are told that the diurnally varying emission is correctly modelled. Anyways, the paper is clearly written and may be considered for publication after a revision or sufficient clarifications provided in reply to my comments below.

Major concern:

C6239

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I do not think the experiments are well thought out. For a fair comparison, you need to first make the DCE FF emissions by including the weakly, daily and diurnal cycle first. Then apply time aggregation to make daily, weekly, and monthly emissions

Here are the steps to follow in my opinion:

1. make monthly-mean FF emissions (if you are starting with annual mean emissions)
2. redistribute monthly-mean FF to daily - by linear interpolation or cubic-spline filter. This will be your (1st guess) MCE.
3. DCE: insert diurnal cycle to WCE (now at daily time intervals)
4. WCE: redistribute daily emissions by introducing weekly effect.

Now, the DCE emission become your 'control' emission scenario. But by introducing the WCE, your daily emissions should have been somewhat perturbed, and monthly-total may not exactly match with that produced in Step #1 (above). Please check.

I got confused because if you started with a daily time interval field, after applying the MCE, you did not need this cubic spline and conservation of mass issue would not arise.

I do not understand why you have to apply these divisions. Normally the models take fluxes in  $\text{g}/\text{m}^2/\text{s}$  or equivalent units.

p 20691, line 8 : these are all nice discussoins. But please clarify the above to exactly prove these are correct. Secondly, the regionally aggregated seasonal cycles should be shown in main paper, e.g., for china, usa, and west europe also you will learn more if these plots are made for summer (JJA) and winter (DJF) seasons separately.

Minor comments:

p 20683, line 21 : do you need a reference to Kaya identity here?

p 20684, line 6 : is 'TIMES' is an acronym?

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p 20686, line 24 : do you mean Peylin et al., 2013? Then I think Law et al. (2008) is a better reference here.

p 20687, line 22 : is this constant or variable (7.5 being the shortest/longest limit) ?

p 20688, line 10 : I think globalview-co2 is not an appropriate choice for this analysis. since your model o/p are at 3-hr intervals and your analysis did not require interpolated data, I would recommend you to sample the model results at the observation time using the real data from WDCGG.

p 20692, line 5 : aren't the tall tower measurements made continuously, shouldn't they be using data at all times?

p 20692, line 21 : The widespread negative values may arise from something not properly set in terms of emission as mentioned earlier (experimental design).

p 20694, line 17 : which means the DCE in FF emis leads to deeper seasonal amp in summer? this may imply that we need less biospheric uptake in the summer by inversion. or if the peak is higher in the winter than we need weaker source by inversion - resulting in stronger biospheric sink regionally.

p 20695, line 11 : but what about the city hotspots? why aren't those start to appear? or the -ve values are due to how time is defined. Monday of UTC (model) time is mostly sunday in California. Is leap-year is accounted for properly?

p 20695, line 18 : sited → situated

p 20697, line 5 : straight → simple

p 20697, para 2 : How will then people claim that they can track megacity fossil emission from space. Can you show the mean column averaged CO2 map for one of your simulation - I am curious how elevated the column-CO2 appear due to FF CO2 emissions alone.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 20679, 2015.

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