Sensitivity of simulated CO₂ concentration to sub-annual variations in fossil fuel CO₂

emissions

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Figure SI.1. Normalized diurnal cycle of $FFCO_2$ emissions over three large source regions (US: solid gray, Western Europe: solid blue; China: solid orange) and the normalized diurnal cycle of biospheric fluxes for the tropics and northern middle latitude ($20^{\circ}S \sim 50^{\circ}N$) (solid green). Also plotted are the normalized diurnal cycle of planetary boundary layer height for the three LSRs (US: dashed gray; Western Europe: dashed blue; China: dashed orange) and that for the region of biospheric fluxes (dashed green).



Figure SI.2. Daily $FFCO_2$ emissions for each day of the week: a) for Monday, b) for Tuesday, c) for Wednesday, d) for Thursday, e) for Friday, f) for Saturday and g) for Sunday.



Figure SI.3. Normalized monthly FFCO₂ emissions for three large source regions (US: solid gray, Western Europe: solid blue and China: solid orange) and normalized monthly biospheric fluxes for the tropics and northern middle latitude (20° S~ 50° N) (solid green).



Figure SI.4. Annual mean surface *FFCO*₂ concentration difference between the WCE and *FE FFCO*₂ emission fields.



Figure SI.5. Annual mean surface CO_2 concentration difference between the biospheric fluxes and the 350 ppmv initial condition.



Figure SI.6. Difference in diurnal peak-to-peak amplitude of surface $FFCO_2$ concentration between diurnal $FFCO_2$ simulation and biospheric simulation ($FFCO_2$ minus biospheric CO_2). In the figure, a) for January and b) for July.



*Figure SI.7. Maximum and minimum of seasonal surface FFCO*₂ *concentration difference between monthly cycle emissions (MCE) and flat emissions (FE) (MCE minus FE). a) seasonal maximum; b) seasonal minimum.*



*Figure SI.8. Timing of seasonal maximum and minimum of surface FFCO*₂ *concentration difference between monthly FFCO*₂ *emissions (MCE) and flat FFCO*₂ *emissions (FE). In the figure, a) maximum; b) minimum.*



Figure SI.9. Column-averaged annual mean FFCO₂ concentration difference between cyclic FFCO₂ emissions and flat emissions. In the figure, a) for alltime cycle emissions (ACE); b) for monthly emissions (MCE); c) for diurnal cycle emissions (DCE) and d) for weekly cycle emissions (WCE).