Supplement of

Towards monitoring CO₂ source-sink distribution over India via inverse modelling: Quantifying the fine-scale spatiotemporal variability of atmospheric CO₂ mole fraction

Vishnu Thilakan e t al.

Correspondence to: Dhanyalekshmi Pillai (<u>dhanya@iiserb.ac.in</u>, kdhanya@bgc-jena.mpg.de)



Figure S1: Spatial variability in annual CO₂ concentration for different global reanalysis products for the year 2017. (a) CarboScope (b) Carbon Tracker (c) LSCE FT (d) LSCE.



Figure S2: Monthly averaged values of representation error estimated $(0.5^{\circ} \times 0.5^{\circ} \text{ boxes})$ for surface CO₂ concentration during 2017. (a) July daytime (11:30 to 16:30 local time). (b) July nighttime (23:30 to 4:30 local time). (c) November daytime. (d) November nighttime.



Figure S3: Monthly averaged values of representation error estimated $(0.5^{\circ} \times 0.5^{\circ} \text{ boxes})$ for column averaged CO₂ concentration during 2017. (a) July daytime (11:30 to 16:30 local time). (b) July nighttime (23:30 to 4:30 local time). (c) November daytime. (d) November nighttime.



Figure S4: Variability of representation error over India with altitude during 1-20 November, 2017. Mean values are plotted with black curves and the shaded region indicates 25 to 75 percentiles of data. 21-30, November 2017 is characterised with strong synoptic system activities over India. Comparison of this figure and Fig. 10 shows the increase in surface representation error due to synoptic events.



Figure S5: The relationship between topographic variability and variation in representation error over India. Variability is estimated as the standard deviation of each variable within $1^{\circ} \times 1^{\circ}$ boxes over the domain and linear fit is calculated as explained in Sect. 3.3. (a) July daytime (11:30 to 16:30 local time). (b) July nighttime (23:30 to 4:30 local time). (c) November daytime. (d) November nightime.



Figure S6: Monthly averaged values of representation error estimated for column averaged CO_2 concentration during daytime (11:30 to 16:30 local time) in 2017. (a) Representation error derived from WRF-GHG simulations as explained in Sect. 2.3. (b) Representation error calculated from the linear model using only topography as explained in Sect. 3.5. (c) Bias of the linear model (difference between (a) and (b)).