



Supplement of

The role of OCO-3 XCO₂ retrievals in estimating global terrestrial net ecosystem exchanges

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TableS1. Additional assimilation experiments conducted in this study

Name	XCO ₂
Exp_OCO3L	LNLG of OCO-3 XCO ₂ retrievals
Exp_OCO2L	LNLG of OCO-2 XCO ₂ retrievals
Exp_OCO3&2L	LNLG of OCO-3 and OCO-2 XCO ₂ retrievals
Exp_OCO2r	Only the OCO-2 XCO ₂ retrievals located between 52°S and 52°N retrievals were assimilated
Exp_OCO3tc	All the observation times of the OCO-3 XCO ₂ retrievals were changed to 1.30 p.m. local time
Exp_OCO3ts	Only OCO-3 XCO ₂ retrievals with observation times between 12 and 3 p.m. local time were assimilated

Table S2. Global carbon budget estimated in the additional inversion experiments (PgC yr⁻¹).

Exp. Name	FOSSIL emissions	FIRE emissions	NEE	OCN fluxes	Global net carbon fluxes	Observed global CO ₂ growth rates
Exp_OCO3L			-3.33	-2.77	5.58	
Exp_OCO2L			-3.91	-2.83	4.93	
Exp_OCO3&2L	9.71	1.97	-3.89	-2.8	4.98	4.93
Exp_OCO2r			-3.63	-2.64	5.41	
Exp_OCO3tc			-3.88	-2.84	4.96	
Exp_OCO3ts			-3.11	-2.72	5.85	

Table S3. Regional NEE estimated from the additional experiments

Regions	Exp_ OCO3L	Exp_ OCO2L	Exp_ OCO3&2L	Exp_ OCO2r	Exp_ OCO3tc	Exp_ OCO3t2
Boreal North America	-0.25	-0.35	-0.32	-0.26	-0.35	-0.31
Temperate North America	-0.21	0.04	-0.25	-0.34	-0.01	-0.12
Tropical South America	-0.3	-0.24	-0.1	-0.3	-0.22	-0.47
Temperate South America	-0.02	-0.4	-0.28	-0.06	-0.41	-0.02
Northern Africa	-0.08	-0.02	-0.01	-0.11	-0.02	-0.12
Southern Africa	-0.27	-0.49	-0.51	-0.29	-0.47	-0.19
Boreal Asia	-0.41	-0.51	-0.32	-0.4	-0.49	-0.41
Temperate Asia	-0.31	-0.33	-0.32	-0.33	-0.31	-0.34
Tropical Asia	-0.31	-0.36	-0.32	-0.31	-0.35	-0.35
Australia	-0.21	-0.14	-0.23	-0.24	-0.14	-0.12
Europe	-0.85	-1.02	-1.12	-0.88	-1.02	-0.52
Northern Hemisphere lands	-2.02	-2.17	-2.33	-2.22	-2.17	-1.71
Tropical lands	-0.95	-1.09	-0.94	-1.00	-1.05	-1.13
Southern Hemisphere lands	-0.24	-0.54	-0.52	-0.30	-0.55	-0.14

Table S4. Error statistics between the simulated CO₂ concentrations and surface flask observations of the additional experiments (ppm)

Exp. Name	Bias	Mae	Rmse
Exp_OCO3L	0.35	2.47	4.58
Exp_OCO2L	0.14	2.47	4.54
Exp_OCO3&2L	0.16	2.35	4.46
Exp_OCO2r	0.23	2.42	4.59
Exp_OCO3tc	0.00	2.44	4.50
Exp_OCO3ts	0.23	2.59	4.68

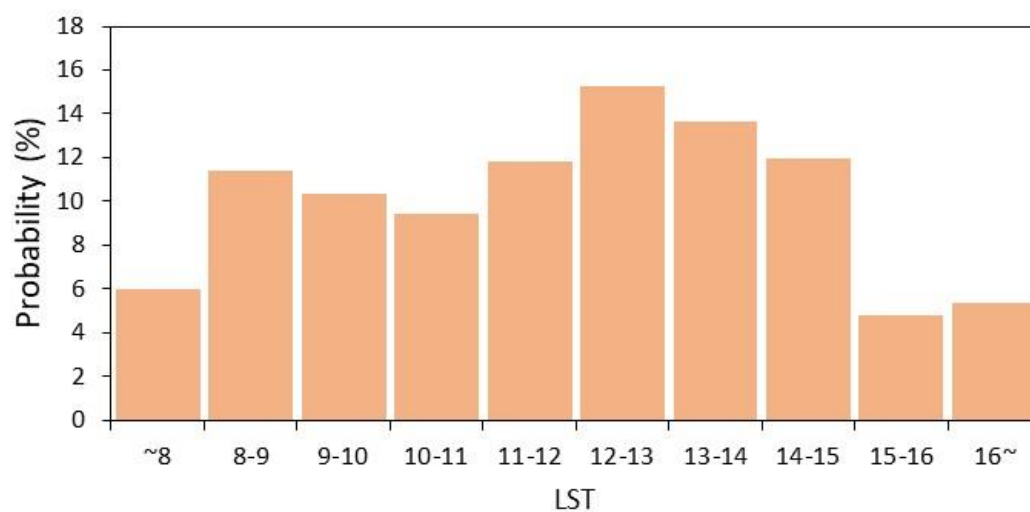


Figure S1. Probability distribution of the observation time of OCO-3 satellite in East China

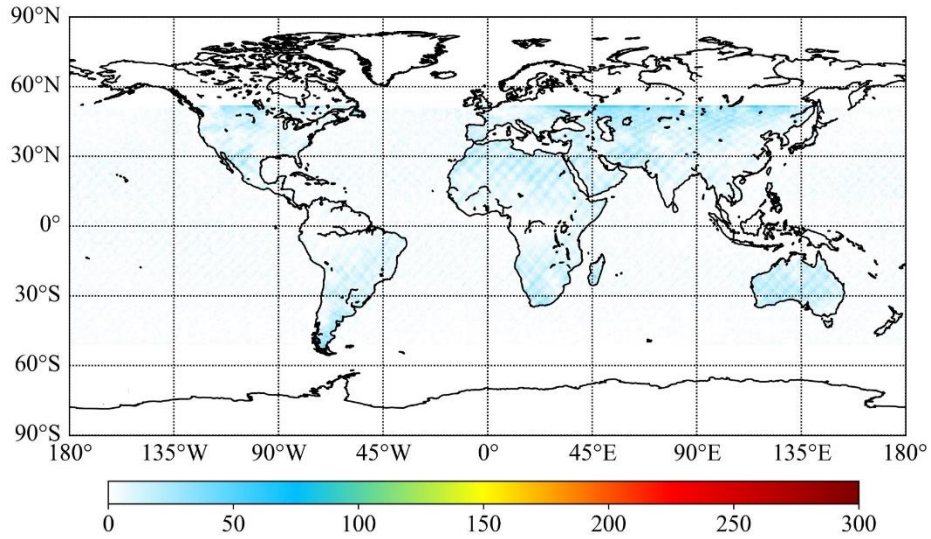


Figure S2. Data amount (the sum of 2020-2022) of OCO-3 XCO₂ in each grid cell (land, 1°× 1°; ocean, 5°× 5°) and at each latitude with observation time between 12 and 3 p.m. LST

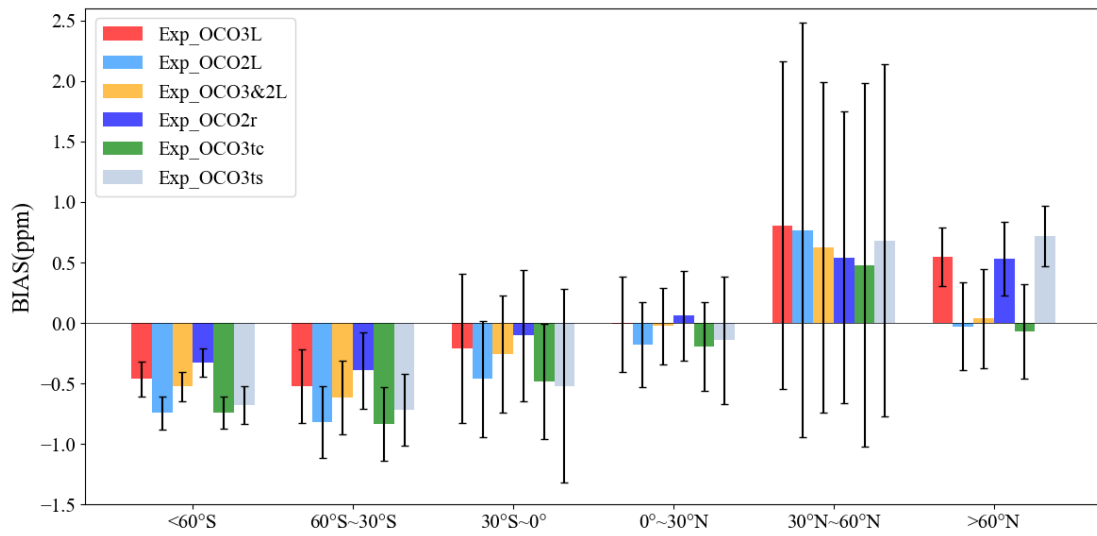


Figure S3. The posterior CO₂ BIAS at different latitudinal zones of the additional experiments

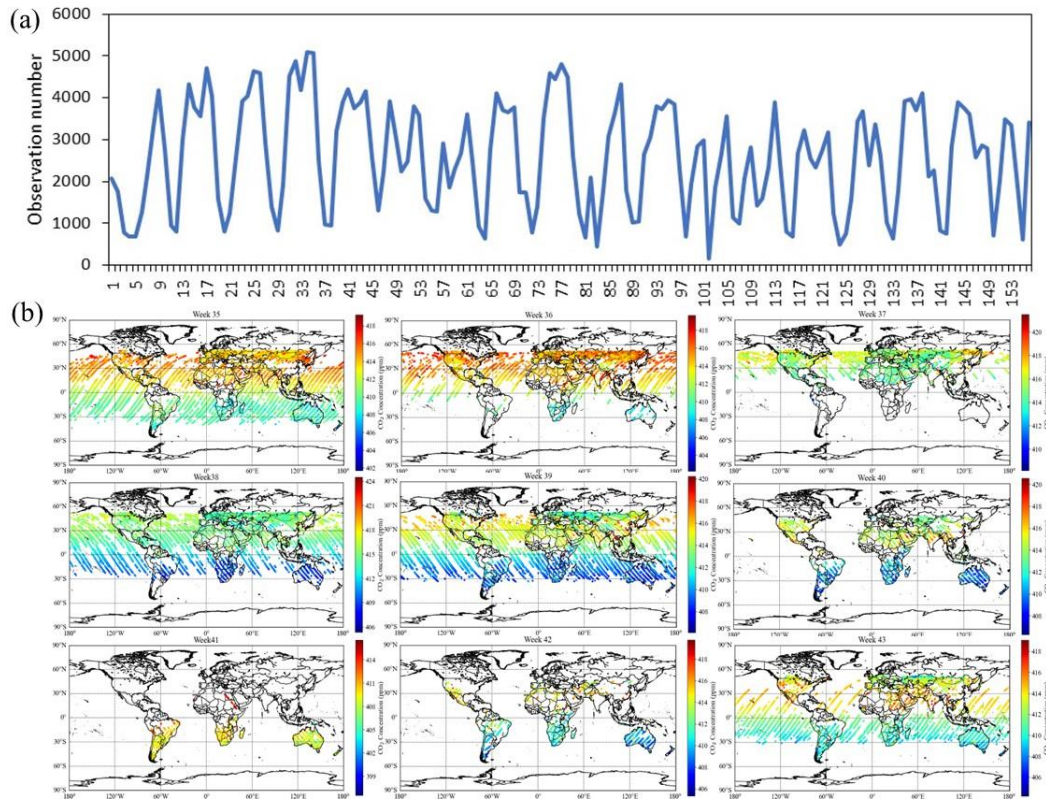


Figure S4. Temporal variations of the OCO-3 observation number (a, weekly number of global observations from Jan 2020 to Dec 2022; b, spatial distribution of global observations for 9 consecutive weeks; re-gridded data (land, $1^\circ \times 1^\circ$; ocean, $5^\circ \times 5^\circ$) was used in this plot)

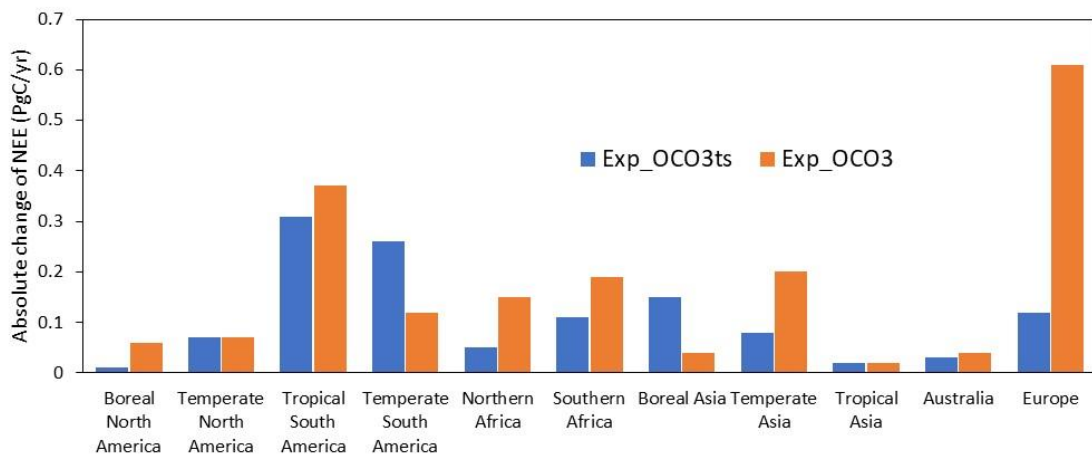


Figure S5. Absolute changes of NEE compared to the a priori