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Prior biosphere model impact on global terrestrial CO_2 fluxes estimated from OCO-2 retrievals

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Table S1: Data corresponding to Figure 7. Seasonally-averaged NEE (PgC yr^{-1}) averaged over the 11 TransCom-3 land regions (refer to Fig. 1) for the MsTMIP ("truth"), CASA-GFED (prior) and posterior mean from three different prior uncertainties (PgC yr^{-1}). The differences between the posterior NEE values are presented as SD (1σ) and range. Prior model values are presented in standard font and posterior estimates are in bold. Seasons are represented as Winter (W): December-February, Spring (Sp): March-May, Summer (Su): June-August and Fall (F): September-November. The synthetic observations in these OSSE simulations correspond to the OCO-2 LN+LG observing modes.

	NEE: Truth				**NEE: Prior, and Posterior Mean**								**Posterior SD**				**Posterior Range**			
Region*	W	Sp	Su	F	W		Sp		Su		F		W	Sp	Su	F	W	Sp	Su	F
1	1.1	-0.2	-2.8	0.7	1.4	**1.2**	1.1	**0.4**	-3.7	**-2.7**	1.4	**0.9**	**0.1**	**0.2**	**0.2**	**0.2**	**0.1**	**0.5**	**0.3**	**0.3**
2	1.5	-1.5	-2.3	0.0	2.6	**1.5**	0.3	**-1.3**	-4.4	**-2.5**	1.1	**-0.1**	**0.4**	**0.5**	**0.2**	**0.3**	**0.8**	**0.8**	**0.4**	**0.5**
3	-0.6	-0.2	-1.4	-1.3	0.4	**-0.6**	1.4	**0.6**	-2.2	**-1.1**	-0.6	**-1.3**	**0.3**	**0.3**	**0.1**	**0.1**	**0.6**	**0.6**	**0.1**	**0.1**
4	-1.5	-0.4	0.7	-0.4	-1.9	**-1.4**	-0.1	**-0.4**	1.3	**0.8**	0.8	**0.0**	**0.2**	**0.1**	**0.1**	**0.1**	**0.3**	**0.2**	**0.3**	**0.3**
5	1.3	1.0	-1.9	-2.0	-0.4	**0.4**	0.2	**0.2**	-0.2	**-1.2**	-1.4	**-1.8**	**0.5**	**0.0**	**0.7**	**0.2**	**1.0**	**0.0**	**1.2**	**0.3**
6	-2.4	-1.6	1.2	1.2	-0.9	**-1.7**	-2.5	**-1.8**	-0.7	**0.5**	0.7	**1.0**	**0.3**	**0.1**	**0.5**	**0.4**	**0.5**	**0.1**	**0.8**	**0.7**
7	1.2	1.0	-4.6	1.2	2.0	**1.6**	2.3	**1.2**	-7.4	**-5.0**	2.4	**1.5**	**0.2**	**0.3**	**0.1**	**0.3**	**0.3**	**0.6**	**0.3**	**0.5**
8	1.4	0.0	-1.9	-0.4	1.3	**1.2**	-0.1	**-0.3**	-2.2	**-2.0**	0.1	**-0.5**	**0.0**	**0.1**	**0.2**	**0.2**	**0.0**	**0.2**	**0.4**	**0.4**
9	-0.1	0.4	-0.3	-0.5	0.1	**0.4**	-0.4	**0.4**	-0.3	**-0.1**	-0.6	**-0.4**	**0.2**	**0.4**	**0.1**	**0.1**	**0.3**	**0.8**	**0.3**	**0.1**
10	-0.6	-0.6	-0.2	-0.7	0.5	**-0.5**	-0.3	**-0.5**	0.0	**-0.3**	-0.8	**-1.0**	**0.3**	**0.1**	**0.2**	**0.1**	**0.5**	**0.3**	**0.4**	**0.3**
11	2.8	-1.7	-3.2	1.6	2.8	**2.5**	0.0	**-1.3**	-5.2	**-3.2**	2.5	**1.5**	**0.1**	**0.1**	**0.2**	**0.2**	**0.1**	**0.2**	**0.3**	**0.3**

***TransCom-3 region name and location displayed in Fig. 1.**

Table S2: Data corresponding to Figure 8. Seasonally-averaged NEE (PgC yr^{-1}) averaged over the 11 TransCom-3 land regions (refer to Fig. 1) for the MsTMIP ("truth"), multi-model prior mean and multi-model posterior mean (PgC yr^{-1}). The differences between the prior and posterior model NEE values are presented as SD (1σ) and range. Prior model values are presented in standard font and posterior estimates are in bold. Seasons are represented as Winter (W): December-February, Spring (Sp): March-May, Summer (Su): June-August and Fall (F): September-November. The synthetic observations in these OSSE simulations correspond to the OCO-2 OG observing modes.

	NEE: Truth				**NEE: Mean**								**NEE: Standard Deviation**								**NEE: Range**							
Region*	W	Sp	Su	F	W		Sp		Su		F		W		Sp		Su		F		W		Sp		Su		F	
1	1.1	-0.2	-2.8	0.7	1.1	**1.1**	0.4	**0.4**	-3.4	**-3.1**	1.3	**1.0**	0.5	**0.4**	0.5	**0.2**	0.8	**0.2**	0.5	**0.2**	1.2	**0.9**	1.0	**0.4**	1.9	**0.3**	1.2	**0.5**
2	1.5	-1.5	-2.3	0.0	1.9	**1.7**	-1.0	**-1.8**	-3.2	**-2.4**	0.6	**-0.2**	1.1	**0.3**	1.3	**0.2**	2.0	**0.1**	0.8	**0.2**	2.3	**0.7**	3.2	**0.5**	4.3	**0.2**	1.6	**0.4**
3	-0.6	-0.2	-1.4	-1.3	0.4	**-0.8**	0.6	**0.3**	-0.7	**-0.7**	0.1	**-1.4**	0.1	**0.3**	0.8	**0.2**	1.4	**0.0**	2.6	**0.3**	0.2	**0.7**	1.8	**0.4**	3.1	**0.1**	5.9	**0.6**
4	-1.5	-0.4	0.7	-0.4	-1.1	**-1.4**	-0.1	**-0.7**	0.6	**0.6**	0.0	**-0.1**	0.9	**0.2**	0.4	**0.2**	0.8	**0.1**	0.9	**0.1**	2.0	**0.5**	0.9	**0.4**	1.9	**0.3**	2.0	**0.2**
5	1.3	1.0	-1.9	-2.0	0.7	**1.0**	0.6	**0.3**	-0.8	**-1.7**	-1.4	**-2.1**	1.0	**0.2**	0.8	**0.2**	0.9	**0.1**	1.2	**0.2**	2.3	**0.4**	1.6	**0.5**	2.0	**0.3**	3.0	**0.5**
6	-2.4	-1.6	1.2	1.2	-0.9	**-2.0**	-1.1	**-1.7**	0.3	**0.8**	0.7	**1.0**	0.5	**0.1**	1.0	**0.1**	1.2	**0.2**	0.7	**0.2**	1.2	**0.3**	2.2	**0.3**	2.6	**0.5**	1.7	**0.4**
7	1.2	1.0	-4.6	1.2	1.5	**1.3**	0.9	**0.7**	-5.6	**-4.3**	2.0	**1.4**	0.9	**0.7**	1.0	**0.3**	1.6	**0.3**	0.6	**0.2**	1.8	**1.6**	2.2	**0.8**	3.3	**0.8**	1.3	**0.5**
8	1.4	0.0	-1.9	-0.4	1.4	**1.3**	-1.0	**-0.1**	-2.3	**-2.0**	0.1	**-0.7**	1.3	**0.2**	0.9	**0.4**	2.5	**0.1**	1.7	**0.3**	3.0	**0.6**	2.1	**0.9**	5.7	**0.1**	3.7	**0.6**
9	-0.1	0.4	-0.3	-0.5	0.1	**0.0**	0.0	**0.5**	-0.4	**0.0**	-0.5	**-0.4**	0.4	**0.0**	0.4	**0.1**	0.4	**0.1**	0.8	**0.0**	0.8	**0.1**	0.7	**0.3**	0.8	**0.2**	1.9	**0.1**
10	-0.6	-0.6	-0.2	-0.7	-0.1	**-0.3**	0.0	**-0.5**	0.1	**-0.2**	-0.1	**-0.7**	0.4	**0.1**	0.3	**0.1**	0.3	**0.1**	0.6	**0.0**	0.9	**0.3**	0.6	**0.2**	0.7	**0.3**	1.2	**0.1**
11	2.8	-1.7	-3.2	1.6	2.3	**2.8**	-0.9	**-1.4**	-3.7	**-3.2**	1.6	**1.4**	0.4	**0.7**	1.2	**0.2**	1.5	**0.1**	0.6	**0.4**	0.9	**1.6**	2.5	**0.6**	3.5	**0.1**	1.5	**0.9**

***TransCom-3 region name and location displayed in Fig. 1.**

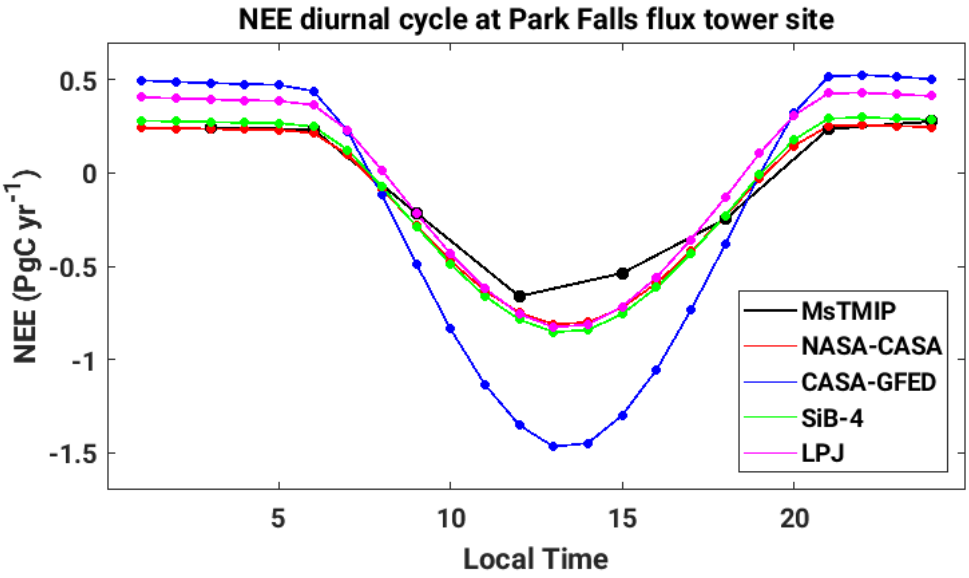

Figure S1: The monthly-averaged diurnal variation of NEE from the "true" (MsTMIP, 3-hourly resolution) and prior biosphere models (NASA-CASA, CASA-GFED, SiB-4 and LPJ; hourly resolution) for July 2015 at the Park Falls flux tower site (45.95°N, 90.27°W).

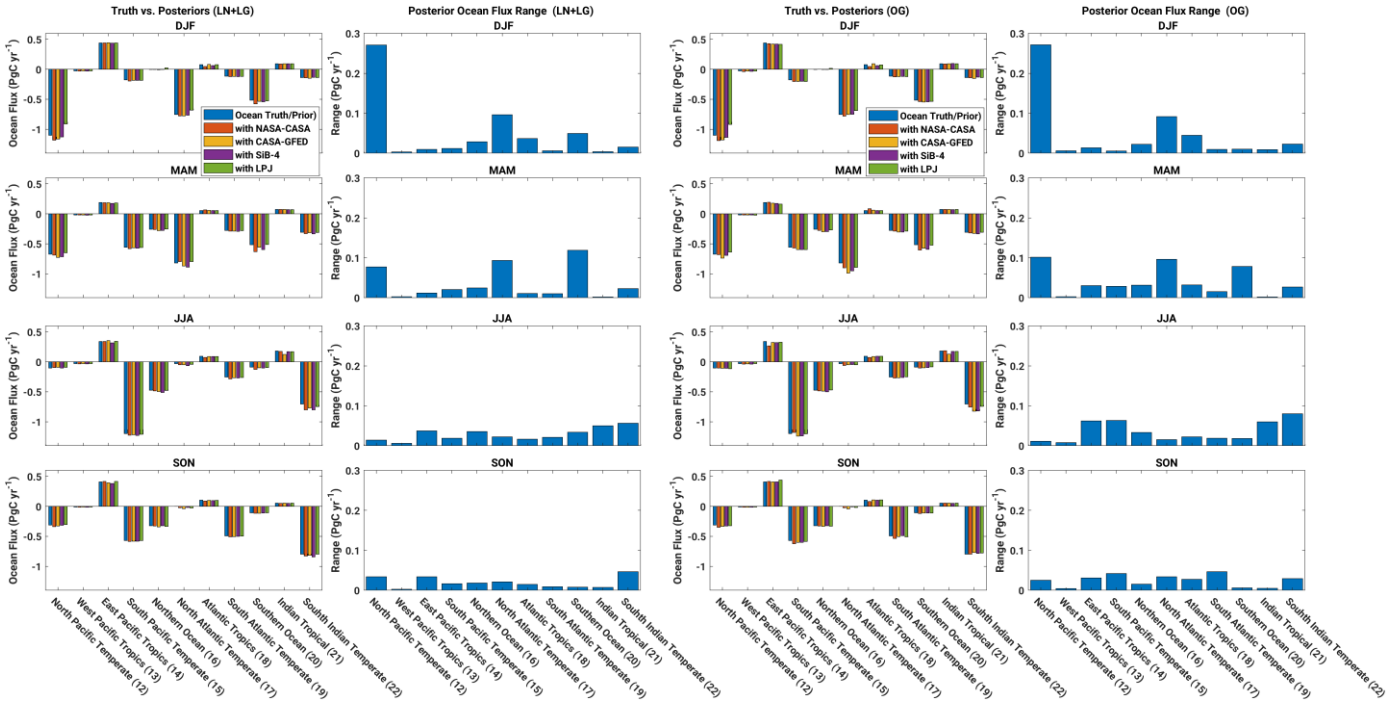

Figure S2: Seasonally-averaged oceanic CO_2 flux (PgC yr^{-1}) over the 11 TransCom-3 oceanic regions from the CarbonTracker 2016 model output ("truth" and prior) and the posterior oceanic flux estimates from four OSSEs (with prior NEE fluxes from the NASA-CASA, CASA-GFED, SiB-4 and LPJ biosphere models) (first and third columns) and the corresponding range of posterior oceanic CO_2 flux (second and fourth columns). The synthetic observations in the OSSE simulations correspond to the OCO-2 LN+LG (two columns on the left) and OG (two columns on the right) observing modes.

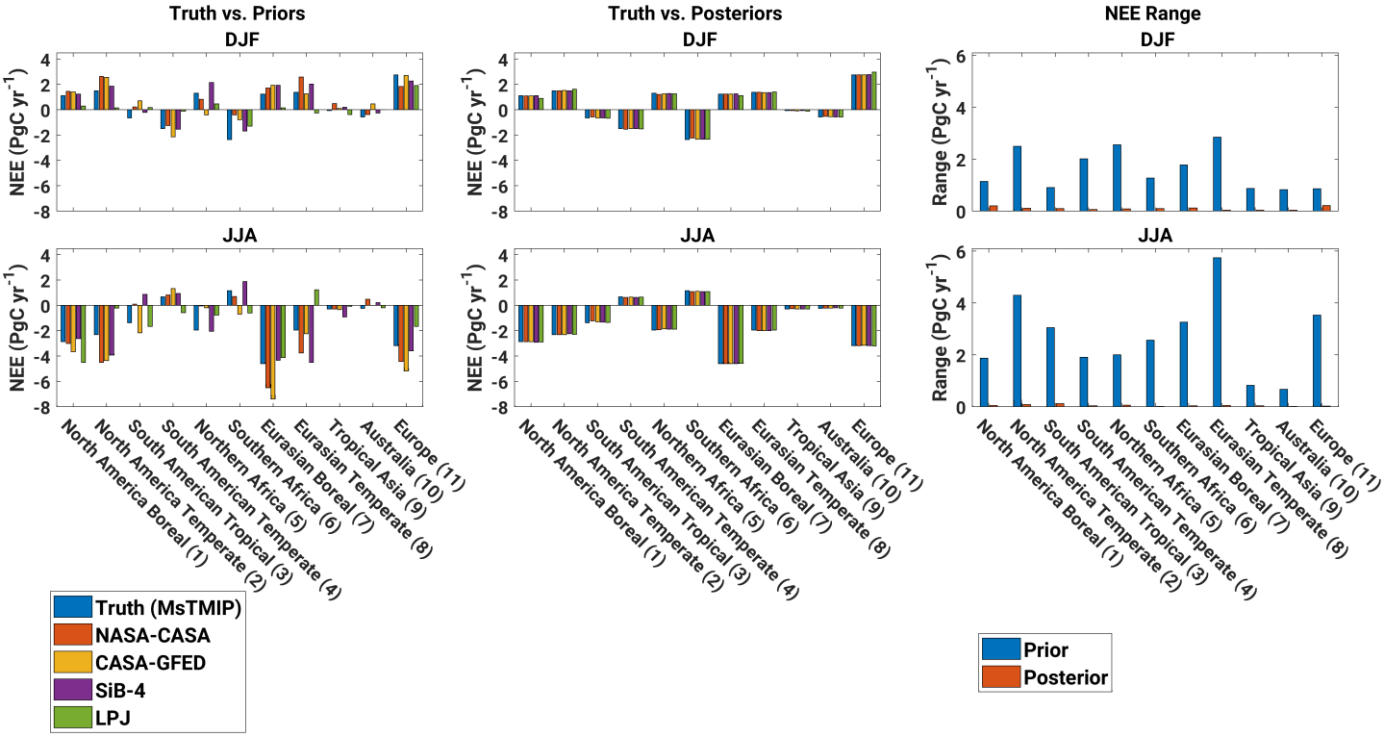

Figure S3: Seasonally-averaged NEE (PgC yr^{-1}) over the 11 TransCom-3 land regions from MsTMIP ("truth") versus the prior biosphere models (NASA-CASA, CASA-GFED, SiB-4 and LPJ) (left column), posterior estimates (middle column) from the "pseudo" data assimilations (refer to Sect. 2.4.8) and the corresponding range of prior and posterior NEE estimates (right column). The "pseudo" observations in these OSSE simulations are the simulated hourly surface CO_2 concentrations for all grid boxes of the GEOS-Chem model.

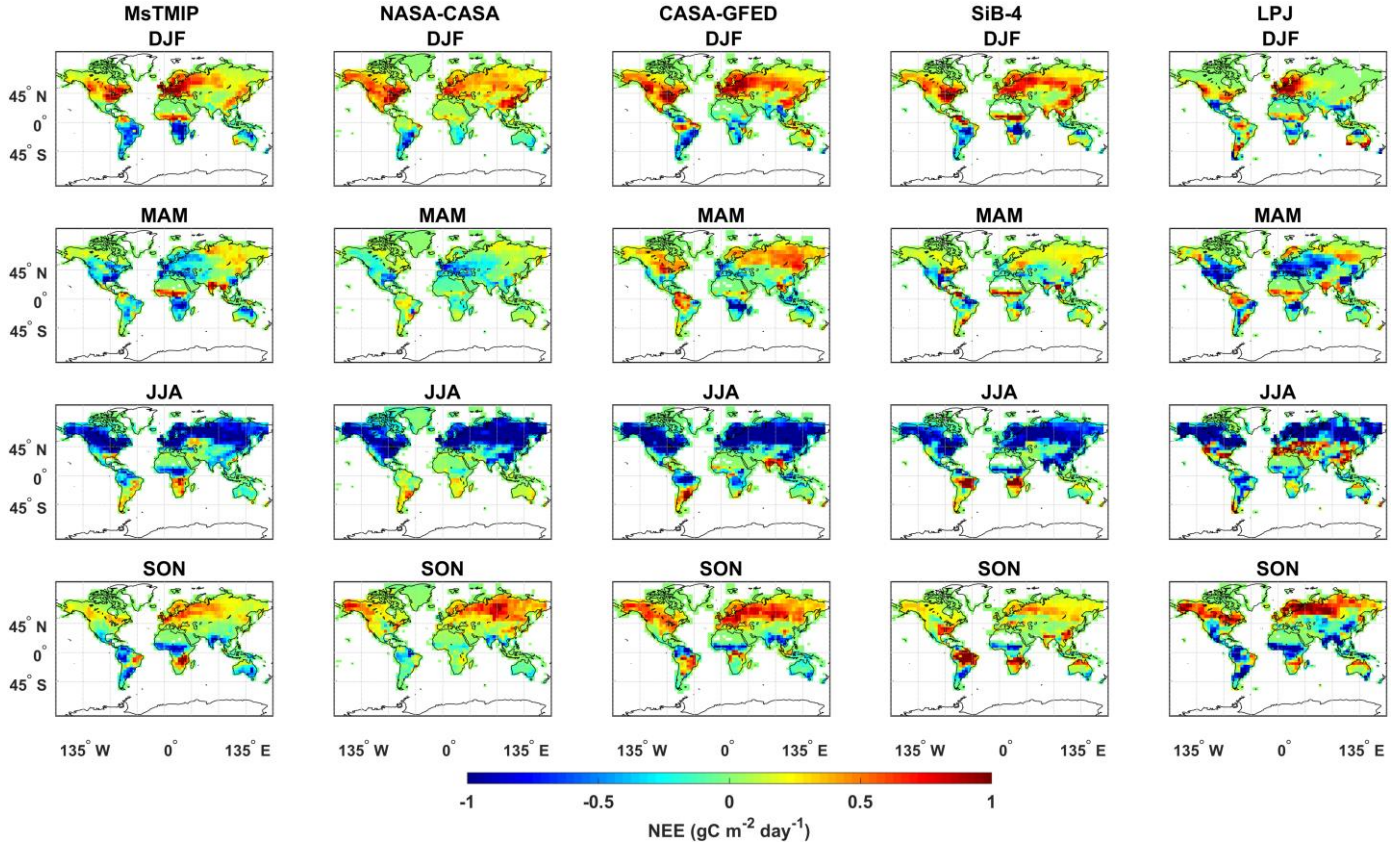

Figure S4: Seasonally-averaged NEE (gC m^{-2} day^{-1}) flux for MsTMIP ("truth" in OSSEs), NASA-CASA, CASA-GFED, SiB-4 and LPJ prior biosphere models for the year 2015.

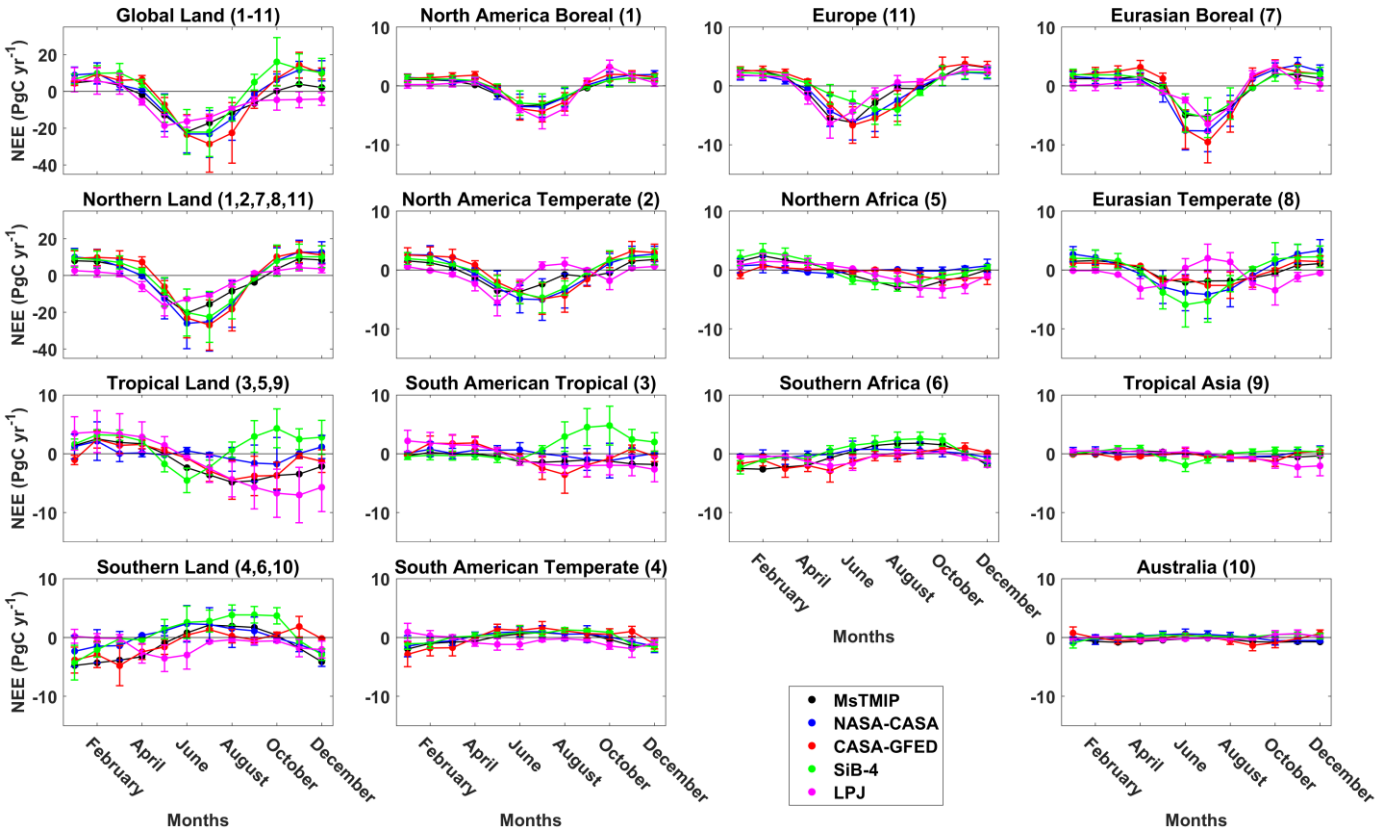

Figure S5: Monthly-mean NEE (PgC yr^{-1}) (dots) averaged over the TransCom-3 land regions (Global land, three hemisphere-scale land regions and 11 individual land regions) from MsTMIP ("truth" in OSSEs) and the prior biosphere model NEE and 1σ prior uncertainties (error bars) used in the OSSEs (NASA-CASA, CASA-GFED, SiB-4 and LPJ). Note that the y-axis is different for Global Land and Northern Land (top two panels in the left column).

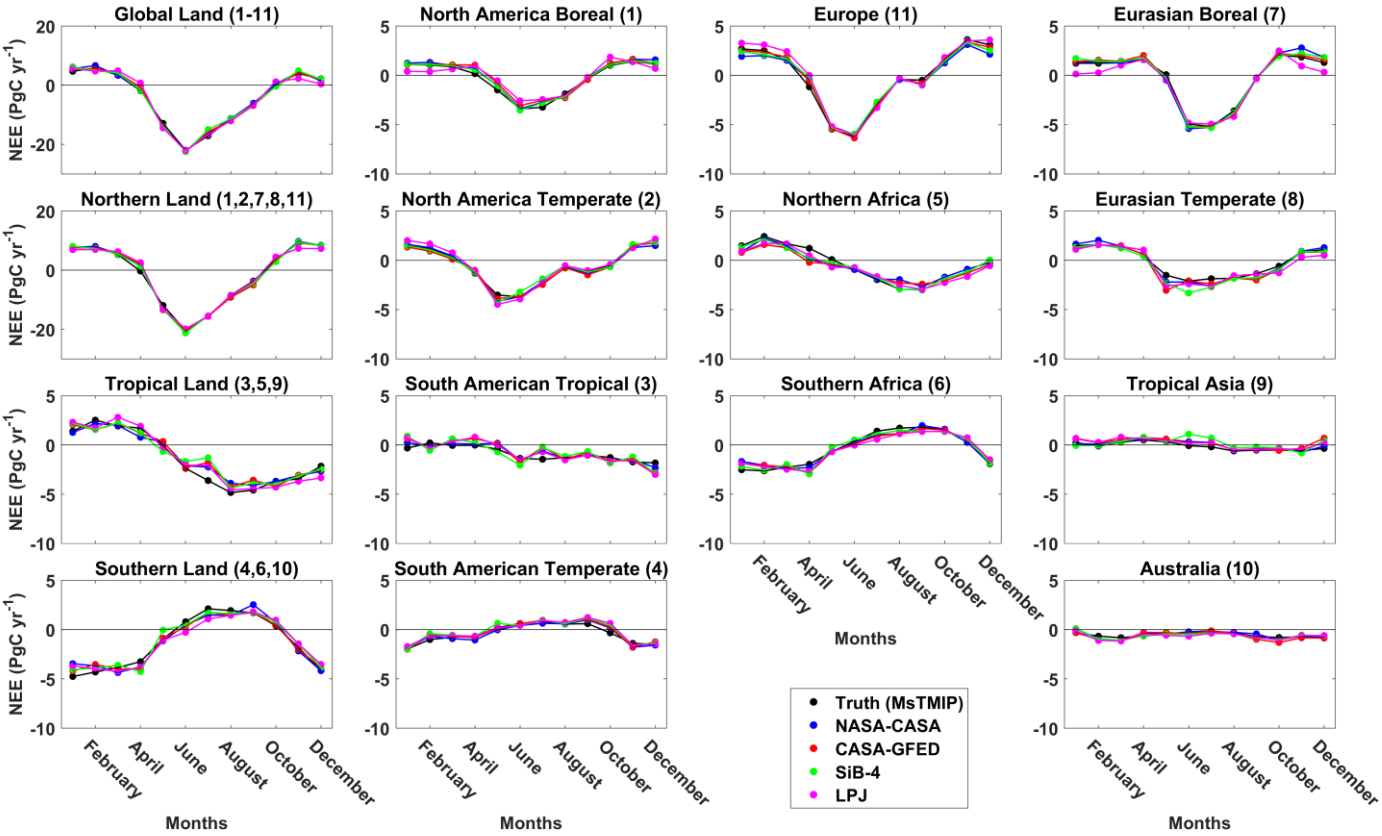

Figure S6: Monthly-mean NEE (PgC yr^{-1}) (dots) averaged over the TransCom-3 land regions (Global land, three hemisphere-scale land regions and 11 individual land regions) from MsTMIP ("truth") versus posterior estimates using different prior biosphere models in the OSSEs (NASA-CASA, CASA-GFED, SiB-4 and LPJ). Note that the y-axis is different for Global Land and Northern Land (top two panels in the left column). The synthetic observations in these OSSE simulations correspond to the OCO-2 LN+LG observing modes.

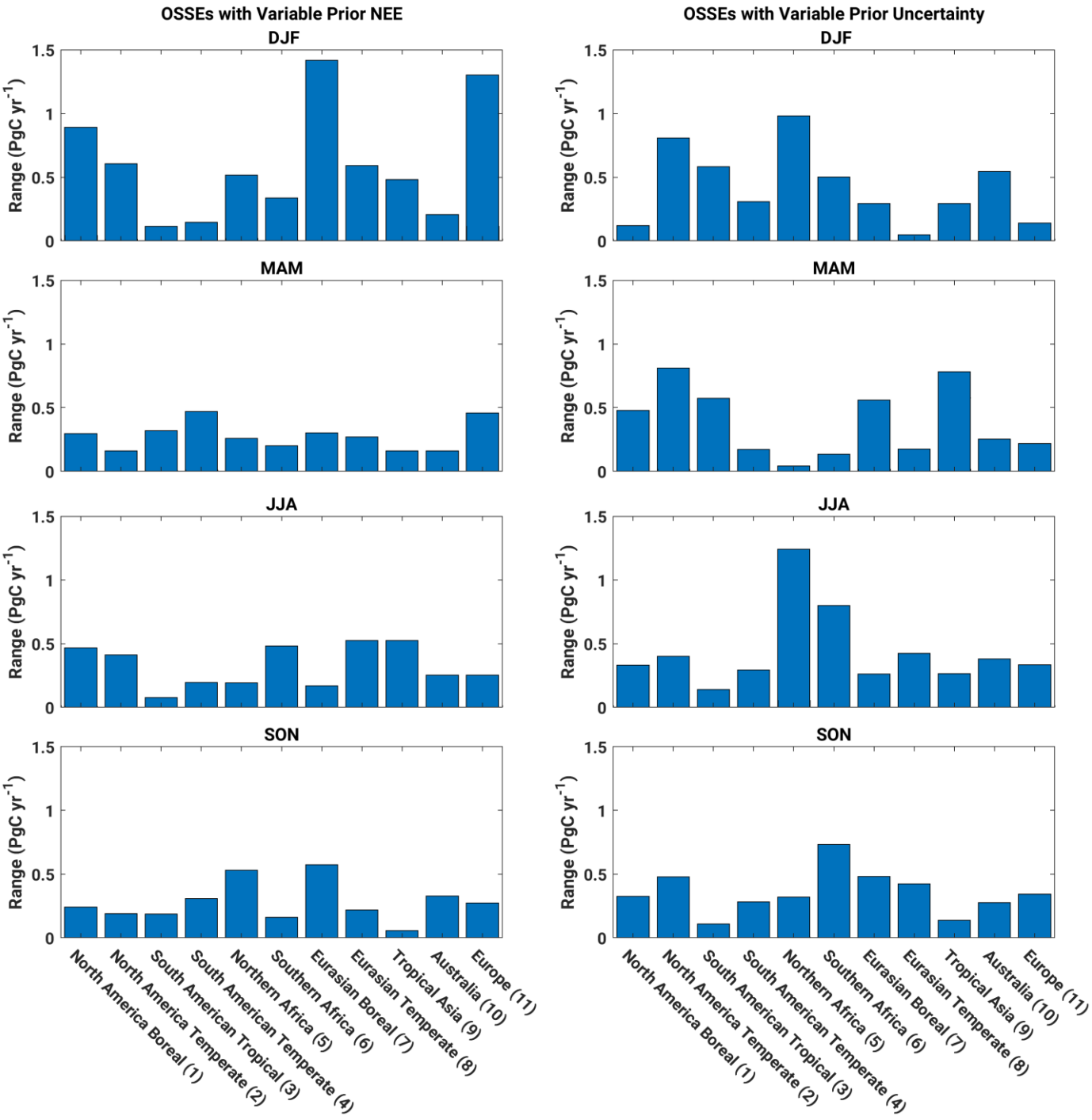

Figure S7: Seasonally-averaged posterior NEE range (PgC yr^{-1}) averaged over the 11 TransCom-3 land regions from OSSE simulations with variable prior NEE fluxes considered (left column) and from OSSE simulations with variable prior uncertainty assumptions (right column). The synthetic observations in OSSE simulations correspond to the OCO-2 LN+LG observing modes.