Supporting Information for Multiscale assessment of North American terrestrial carbon balance

Kelsey T. Foster[1,2], Wu Sun[1], Yoichi P. Shiga[3], Jiafu Mao[4], Anna M. Michalak [1,2]

[1] Department of Global Ecology, Carnegie Institution for Science, Stanford, 94305, USA

5   [2] Department of Earth System Science, Stanford University, Stanford, 94305, USA

[3] Independent Researcher, San Francisco, CA, USA

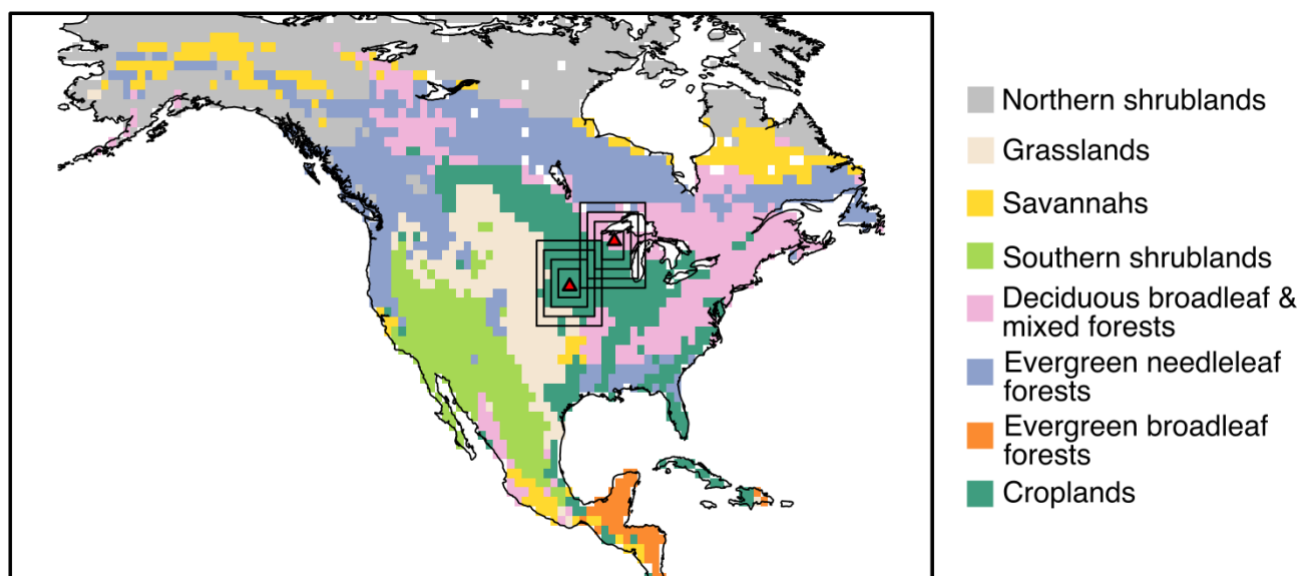
[4] Environmental Sciences Division and Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, 37830, USA

10   **Figure S1: Map of biomes in North America with the locations of two continuous-monitoring towers and outlines visualizing the regions where consistency is evaluated. Red triangles represent locations of towers with high temporal coverage where there are also eddy covariance flux towers nearby. The innermost outlined boxes around each red triangle represents the 3° x 3° box, centered on the 1° x 1° grid cell, where consistency is evaluated by determining whether the TBM or inversion ensemble has the smaller standard deviation across all models within each ensemble. The remaining consecutive outlined boxes represent the 5° x**
15   **5°, 7° x 7°, and 9° x 9° scales where consistency is also evaluated.**

Figure S2: The fraction of variance in atmospheric 3-hourly CO₂ explained by monthly mean fluxes (R^2). Filled squares represent models with an R^2 greater than APAR's R^2.

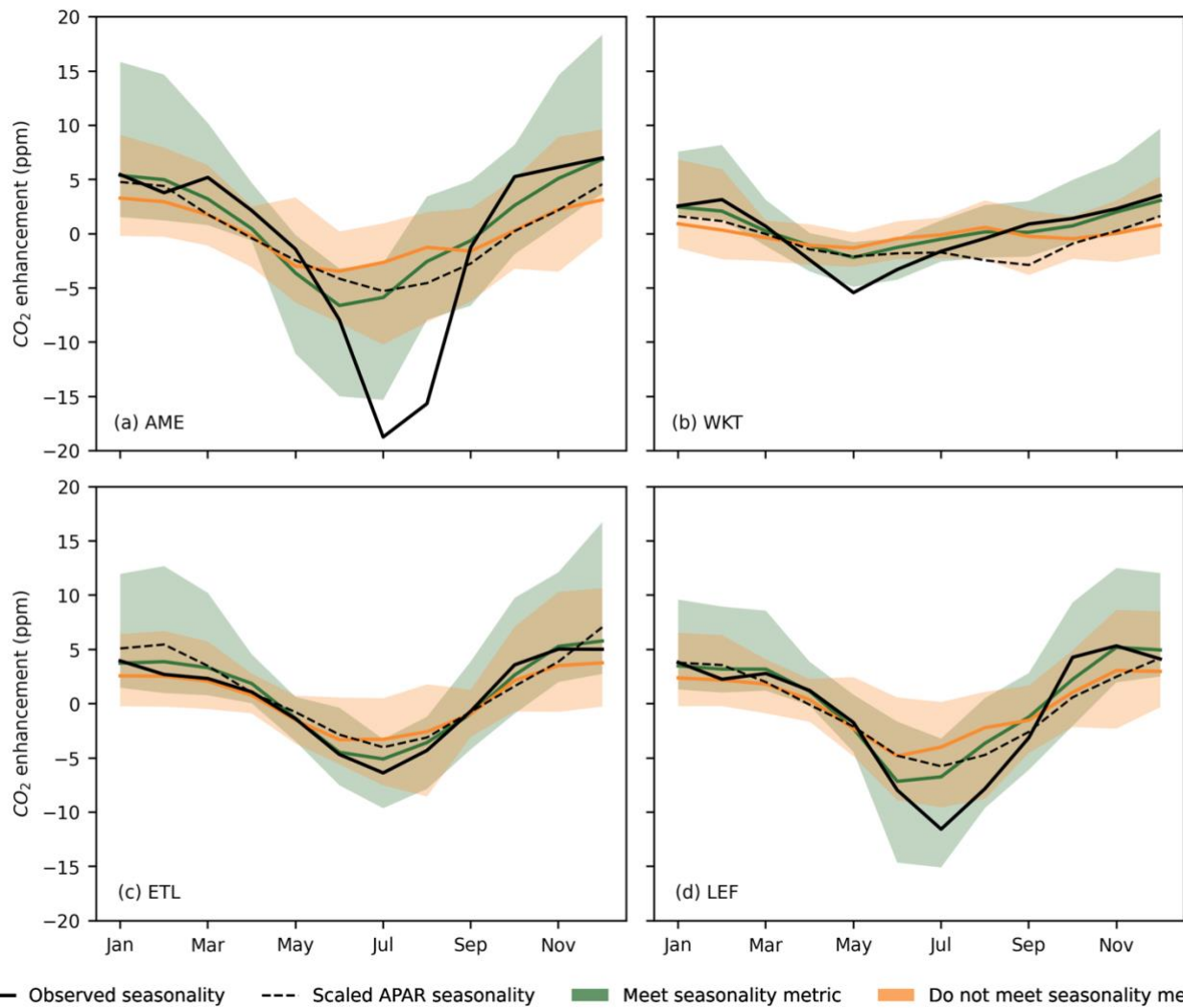



Figure S3: Monthly averaged seasonal cycles of observed CO_2 enhancements and CO_2 enhancements resulting from modeled carbon fluxes from TBMs. The black line represents the seasonality observed at each tower site and the dotted line is the seasonality of rescaled APAR (see Sect. 2.3). The green line is the mean of models that meet the seasonality metric (i.e., at least two of the seasonality sub-metrics) at all four sites and the green shading represents the full range of these estimates. The orange line is the mean of models that do not meet the seasonality metrics at all four sites and the orange shading represents the full range of these estimates.

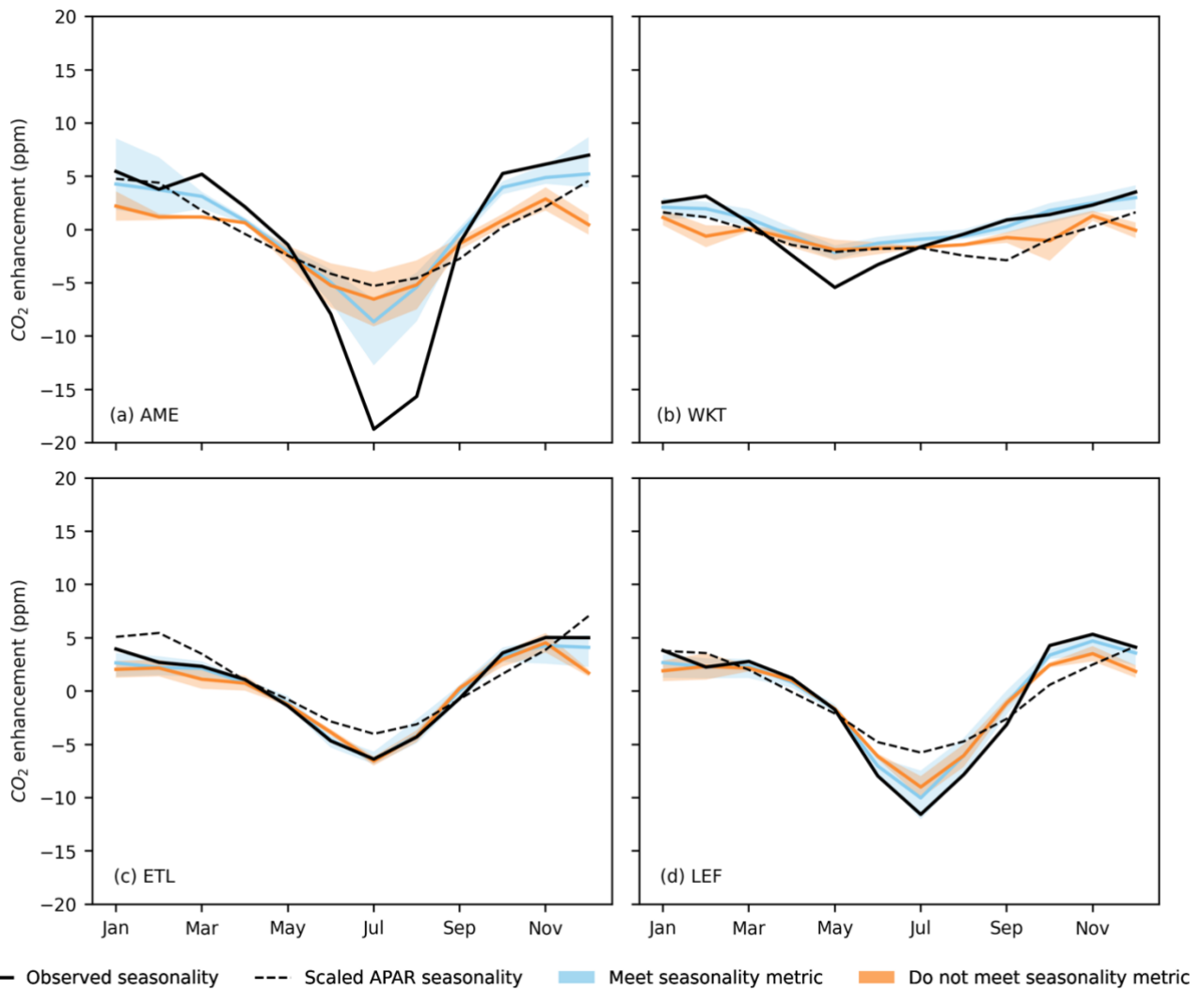



Figure S4: Monthly averaged seasonal cycles of observed CO_2 enhancements and CO_2 enhancements resulting from modeled carbon fluxes from inversions. The black line represents the seasonality observed at each tower site and the dotted line is the seasonality of rescaled APAR (see Sect. 2.3). The blue line is the mean of models that meet the seasonality criteria (i.e., at least two of the seasonality sub-metrics) at all four sites and the blue shading represents the full range of these estimates. The orange line is the mean of models that do not meet the seasonality metrics at all four sites and the orange shading represents the full range of these estimates.

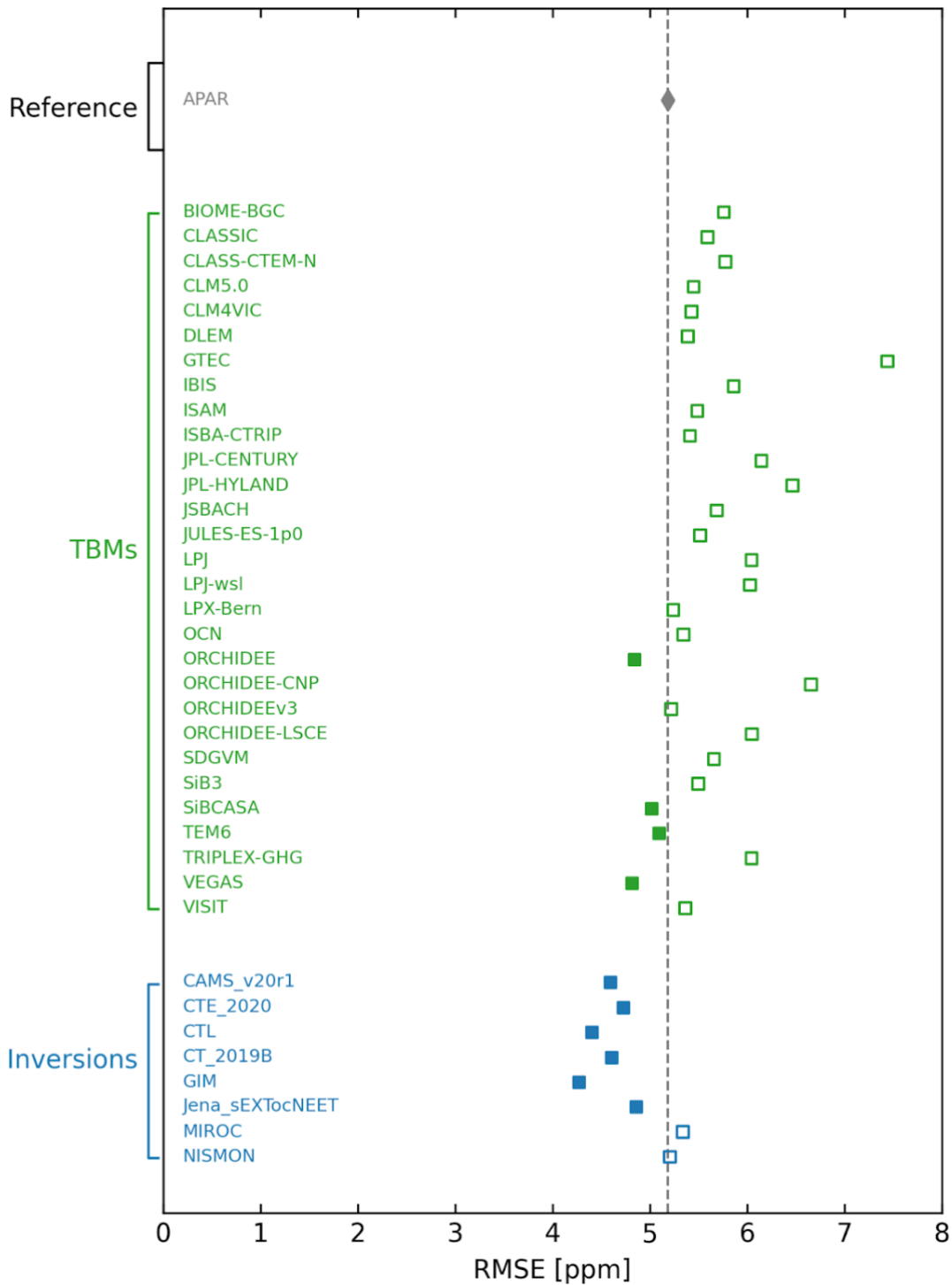



Figure S5: The root mean squared error (RMSE) between measured atmospheric 3-hourly CO_2 and modeled monthly CO_2 signals. Filled squares represent models that have a smaller RMSE than the RMSE of rescaled APAR.

40

Site Name	Site Location	Latitude	Longitude	Height (m)	Principal Investigators
AAC	Austin Cary Memorial Forest, Gainesville, FL, USA	29.7381	-82.2188	32	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
ACR	Chestnut Ridge, TX, USA	35.9311	-84.3324	61	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
ACV	Canaan Valley, WV, USA	39.119	-79.4523	7	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
AME	Mead, NE, USA	41.1649	-96.4701	4.5	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
AMT	Argyle, ME, USA	45.0346	-68.6821	107	Arlyn Andrews (NOAA)
AOZ	Ozark, MO, USA	38.7441	-92.2	30	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
BAO	Boulder Atmospheric Observatory, CO, USA	40.05	-105.004	300	Arlyn Andrews (NOAA)
BCK	Behchoko, NT, Canada	62.7979	-115.918	60	Doug Worthy (EC)
BRA	Bratt's Lake, SK, Canada	50.2016	-104.711	35	Doug Worthy (EC)
BRW	Barrow Atmospheric Baseline Observatory, AK, USA	71.323	-156.6114	16.46	Kirk Thoning and Pieter Tans (NOAA)
CDL	Candle Lake, SK, Canada	53.9871	-105.1179	30	Doug Worthy (EC)
CHM	Chibougamau, QC, Canada	49.6925	-74.3423	30	Doug Worthy (EC)
EGB	Egbert, ON, Canada	44.231	-79.7838	3	Doug Worthy (EC)
ESP	Estevan Point, BC, Canada	49.3829	-126.544	40	Doug Worthy (EC)
EST	Esther, AB, Canada	51.67	-110.206	3	Doug Worthy (EC)
ETL	East Trout Lake, SK, Canada	54.3537	-104.987	105	Doug Worthy (EC)
FPK	Fort Peck, MT, USA	48.3079	-105.1017	3	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
FSD	Fraserdale, ON, Canada	49.8752	-81.5698	40	Doug Worthy (EC)

HDP	Hidden Peak, UT, USA	40.56	-111.65	17.7	Britton Stephens (NCAR)
HFM	Harvard Forest, MA, USA	42.5378	-72.1714	29	Steve Wofsy and Bill Munger (Harvard)
KCMP	Rosemount Research and Outreach Center, MN, USA	44.6886	-93.0728	200	Tim Griffis (UMN)
LEF	Park Falls, WI, USA	45.9453	-90.2744	396	Arlyn Andrews (NOAA)
LLB	Lac La Biche, AB, Canada	54.9538	-112.467	10	Doug Worthy (EC)
MVY	Marthas Vineyard, MA, USA	41.325	-70.5667	10	Colm Sweeney (NOAA)
NWR	Niwot Ridge, CO, USA	40.0531	-105.5864	5.1	Britton Stephens (NCAR)
OFR	Fir, OR, USA	44.6465	-123.5514	38	Beverly Law (Oregon State) and Andres Schmidt (RWTH Aachen)
OMP	Mary's Peak, OR, USA	44.5043	-123.553	10	Beverly Law (Oregon State) and Andres Schmidt (RWTH Aachen)
OMT	Meolius, OR, USA	44.4524	-121.5572	33	Beverly Law (Oregon State) and Andres Schmidt (RWTH Aachen)
ONG	Burns, OR, USA	43.4704	-119.691	6	Beverly Law (Oregon State) and Andres Schmidt (RWTH Aachen)
OYQ	Yaquina Head, OR, USA	44.675	-124.067	12	Beverly Law (Oregon State) and Andres Schmidt (RWTH Aachen)
RBA	Roof Butte, AZ	36.4614	-109.0956	21.9	Britton Stephens (NCAR)
RCE	Centerville, IA, USA	40.7919	-92.8775	110	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
RGV	Galesville, WI, USA	44.091	-91.3382	140	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
RKW	Kewanee, IL, USA	41.2762	-89.9724	140	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
RMM	Mead, NE, USA	41.1386	-96.4559	120	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
RRL	Round Lake, MN, USA	43.5263	-95.4137	110	Natasha Miles, Scott Richardson, and Ken Davis (PSU)
SCT	Beech Island, SC, USA	33.4057	-81.8334	305	Arlyn Andrews (NOAA) and Matt

					Parker (SRNL)
SGP	Southern Great Plains, OK, USA	36.607	-97.489	60	Sebastien Biraud and Margaret Torn (LBNL)
SNP	Shenandoah National Park, VA, USA	38.617	-78.35	17	Arlyn Andrews (NOAA) and Stephan De Wekker (UVA)
SPL	Storm Peak Laboratory, CO, USA	40.45	-106.73	9.1	Britton Stephens (NCAR)
WBI	West Branch, IA, USA	41.7248	-91.3529	379	Arlyn Andrews (NOAA)
WGC	Walnut Grove, CA, USA	38.265	-121.4911	483	Arlyn Andrews (NOAA) and Marc Fischer (LBNL)
WKT	Moody, TX, USA	31.3149	-97.3269	457	Arlyn Andrews (NOAA)
WSA	Sable Island, NS, Canada	43.9323	-60.0126	25	Doug Worthy (EC)

Table S1: Tower sites for atmospheric CO_2 observations from ObsPack CO_2 GLOBALVIEWplus v3.2.