



AGU Advances

Supporting Information for

Cropland carbon uptake delayed by 2019 Midwest floods

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Supplementary Figures

Figure S1. Schematic illustration of the methods used in this study.

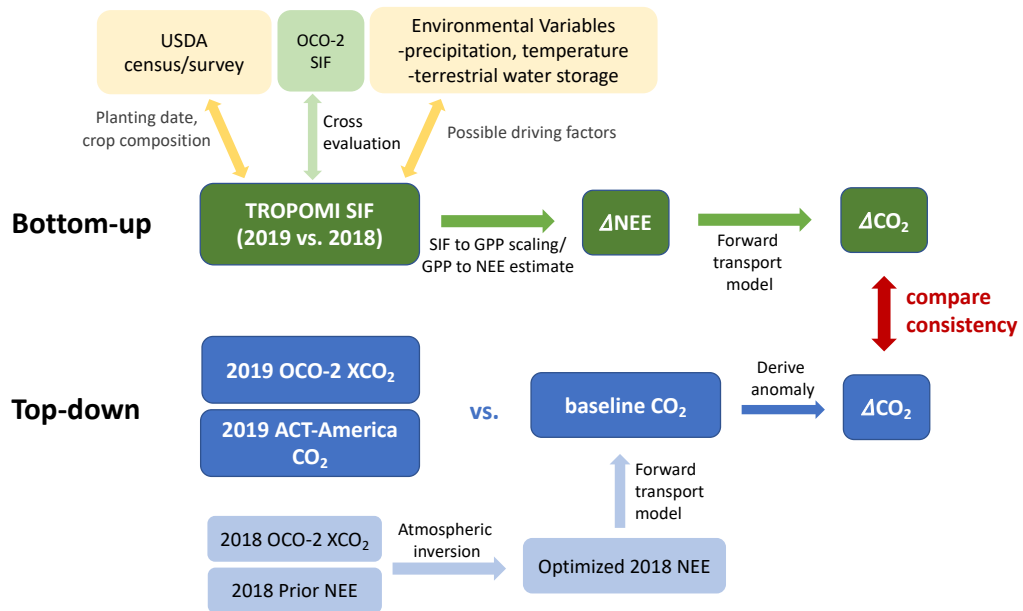


Figure S2. Seasonal cycle of climate variables including cumulative precipitation, mean daily temperature, and mean daily vapor pressure deficit (VPD) averaged over areas with cropland fractions larger than 25% in the Midwest states. Red lines represent 2019; blue lines show the climatology of 1979-2018 averages, with shaded areas showing 1-sigma standard deviation. Data from ERA5 reanalysis. The state masks and cropland fractions are shown in Figure S3.

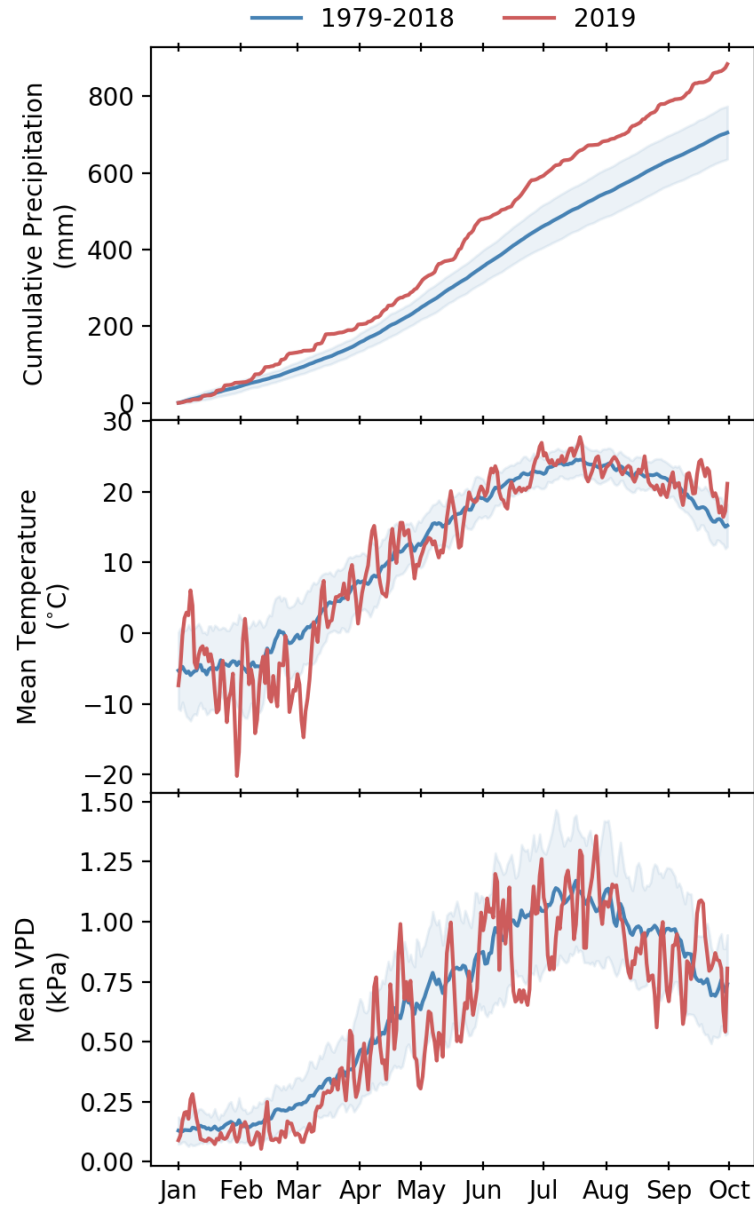


Figure S3. Crop emergence date from field survey in the 12 Midwest states as reported by USDA weekly.

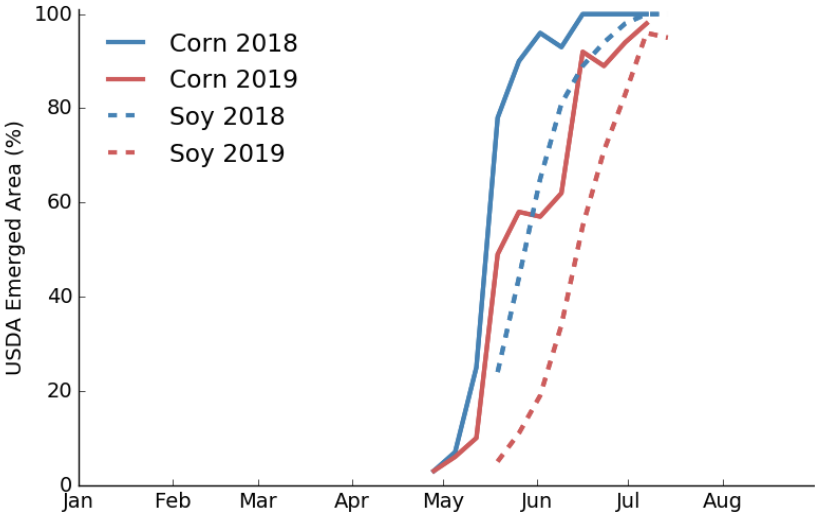


Figure S4. Distribution of estimated differences in GPP between 2019 and 2018. The 17 states located in the Midwest and Southern U.S. along Missouri and Mississippi watershed that are included in the statistics of this study are shown. The crop area density is also illustrated.

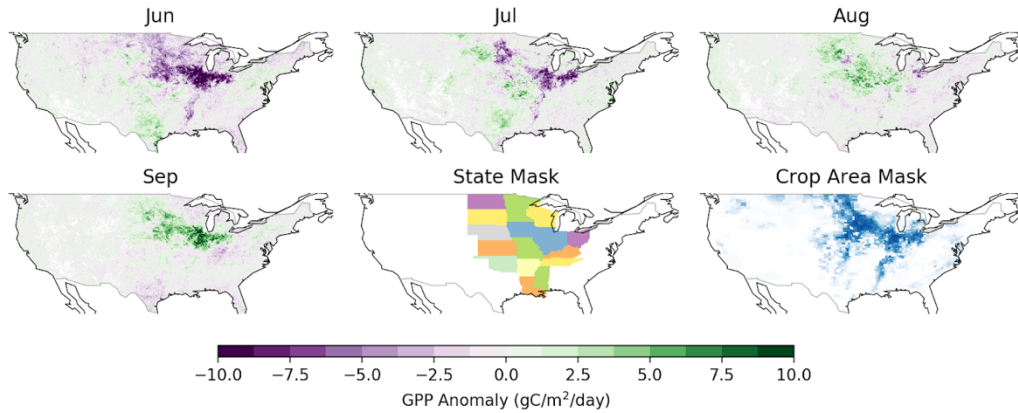


Figure S5. (a) Comparison of 2018 and 2018 growing season SIF for Midwest counties with cropland fraction larger than 20%. Growing seasons are defined as values larger than 10% of the corresponding 2018 peak value. **(b)** Spatial distribution of predicted yield changes between 2019 and 2018 inferred from growing season SIF following He et al., (in review).

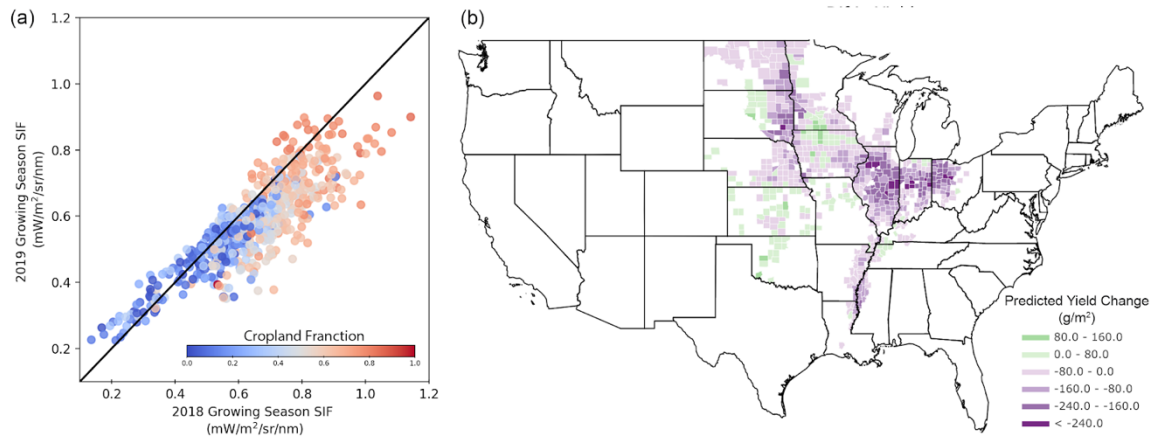


Figure S6. Histograms of differences between OCO-2 observations and corresponding modelled values using posterior 2018 NEE fluxes for (a) the temperate northern extratropics and (b) the U.S. Midwest and downwind areas. Note that the model states are simulated with 2018 and 2019 meteorology respectively.

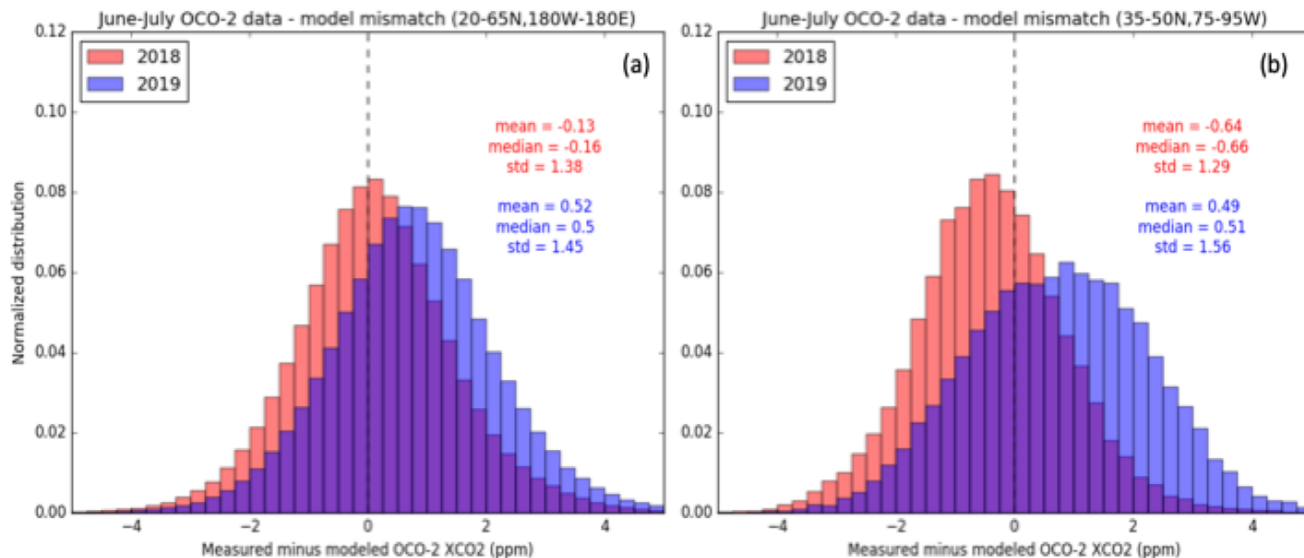
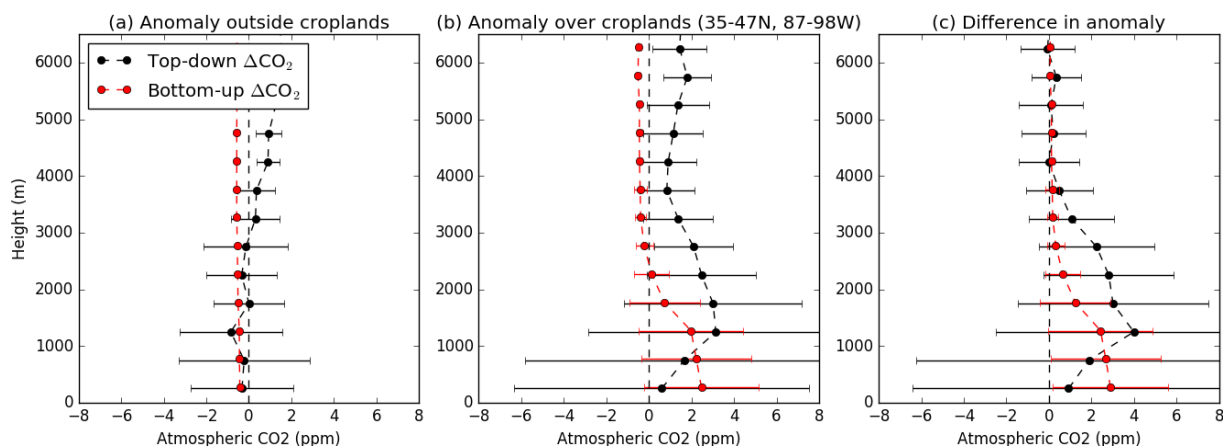


Figure S7. Mean vertical profiles of CO₂ anomalies estimated using bottom-up and top-down methods at the sampling track of ACT-America from June 9 to July 14. (a) Profiles outside the croplands, (b) within the croplands (35°-47°N, 87°-98°W), and (c) differences between the two – illustrating the net signal removing potential systematic biases of the background. The vertical levels are determined by height above the ground level.



Supplementary Tables

Table S1. SIF-based estimates of differences in GPP between 2019 and 2018 in different months for areas with different cropland density (Unit PgC/month). The State mask for the 17 states included in the analysis is shown in Fig. S3

	All US	17 States	cropland <10%	cropland 10-30%	cropland 30-50%	cropland 50-70%	cropland >70%	Total cropland >10%
Apr	0.08	0.03	0.02	0.01	0.00	0.00	0.00	0.01
May	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01
Jun	-0.14	-0.15	-0.02	-0.01	-0.03	-0.05	-0.05	-0.14
Jul	0.01	-0.04	0.02	0.00	-0.01	-0.02	-0.03	-0.06
Aug	0.07	0.07	0.02	0.01	0.01	0.02	0.01	0.05
Sep	0.08	0.08	0.00	0.01	0.02	0.03	0.04	0.08
Sum	0.10	-0.02	0.04	0.01	-0.01	-0.03	-0.03	-0.06

Table S2. Changes in planted areas of soybean and corn between 2019 and 2018 as reported by USDA (unit: million acres).

	Soy 2018	Soy 2019	Soy 19-18 (%)	Corn 2018	Corn 2019	Corn 19-18 (%)	Both Crops (%)	2018 C3/C4 ratio	2019 C3/C4 ratio
ILLINOIS	10.80	10.00	-7.4	11.00	10.50	-4.5	-6.0	0.98	0.95
INDIANA	6.00	5.40	-10.0	5.35	5.10	-4.7	-7.5	1.12	1.06
IOWA	9.95	9.20	-7.5	13.20	13.50	2.3	-1.9	0.75	0.68
KANSAS	4.75	4.60	-3.2	5.45	6.40	17.4	7.8	0.87	0.72
MICHIGAN	2.33	1.75	-24.9	2.30	2.05	-10.9	-17.9	1.01	0.85
MINNESOTA	7.75	6.90	-11.0	7.90	7.80	-1.3	-6.1	0.98	0.88
MISSOURI	5.85	5.10	-12.8	3.50	3.25	-7.1	-10.7	1.67	1.57
NEBRASKA	5.65	5.00	-11.5	9.60	10.10	5.2	-1.0	0.59	0.50
NORTH DAKOTA	6.90	5.60	-18.8	3.15	3.55	12.7	-9.0	2.19	1.58
OHIO	5.05	4.30	-14.9	3.50	2.80	-20.0	-17.0	1.44	1.54
SOUTH DAKOTA	5.65	3.60	-36.3	5.30	4.40	-17.0	-26.9	1.07	0.82
WISCONSIN	2.22	1.75	-21.2	3.90	3.85	-1.3	-8.5	0.57	0.45
TOTAL	72.90	63.20	-13.3	74.15	73.30	-1.1	-7.2	0.98	0.86