Supplementary Materials: Use of Sun-Induced Chlorophyll Fluorescence Obtained by OCO-2 and GOME-2 for GPP Estimates of the Heihe River Basin, China. *Remote Sensing* 2018, *12*, remotesensing-397061

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Five figures and one table.

1. Scale Effect Between the Tower GPP and SIF from OCO-2 and GOME-2

OCO-2 SIF data were extracted based on the coordinates of the flux towers within a varying window surrounding the tower GPP, namely, within pixels of 0.2°, 0.3°, 0.4°, and 0.5°. Then, a simple sensitivity analysis was performed to examine how the GPP-SIF relationship was affected by footprint heterogeneity and size (Figure S1). The analysis is feasible largely because of the mismatch between the unusually large tower footprint and the availability of a large number of soundings within the footprint. We compared the GPP-SIF relationships derived from the 0.2°, 0.3°, 0.4° and 0.5° pixels and found that the correlations among different pixels changed obviously (for SIF_{757}, R^2=0.69 to 0.84, $p<0.0001$ at Daman and R^2=0.86 to 0.91, $p<0.0001$ at A'rou; for SIF_{771}, R^2=0.60 to 0.68, $p<0.0001$ at Daman and R^2=0.33 to 0.80 $p<0.001$ at A'rou). Specifically, the OCO-2 SIF presented a stronger correlation with the flux tower GPP when the bins became bigger. Correspondingly, the slope also significantly varied with samples of soundings (0.43 to 0.64 mg C m^{-2} s^{-1}/W $m^{-2}\mu^{-1}$ sr^{-1} and 0.61 to 0.89 mg C m^{-2} s^{-1}/W $m^{-2}\mu^{-1}$ sr^{-1} for SIF_{757} and SIF_{771} at the Daman site, respectively, and 0.17 to 0.27 mg C m^{-2} s^{-1}/W $m^{-2}\mu^{-1}$ sr^{-1} and 0.16 to 0.39 mg C m^{-2} s^{-1}/W $m^{-2}\mu^{-1}$ sr^{-1} for SIF_{757} and SIF_{771} at the A'rou site, respectively). As shown in Table S1, the numbers of OCO-2 retrievals on average for each bin also varied as the window size changes, and the soundings were sorted into larger or smaller bins. Our results showed that the GPP-SIF relationship was significantly influenced by changes in the window size.
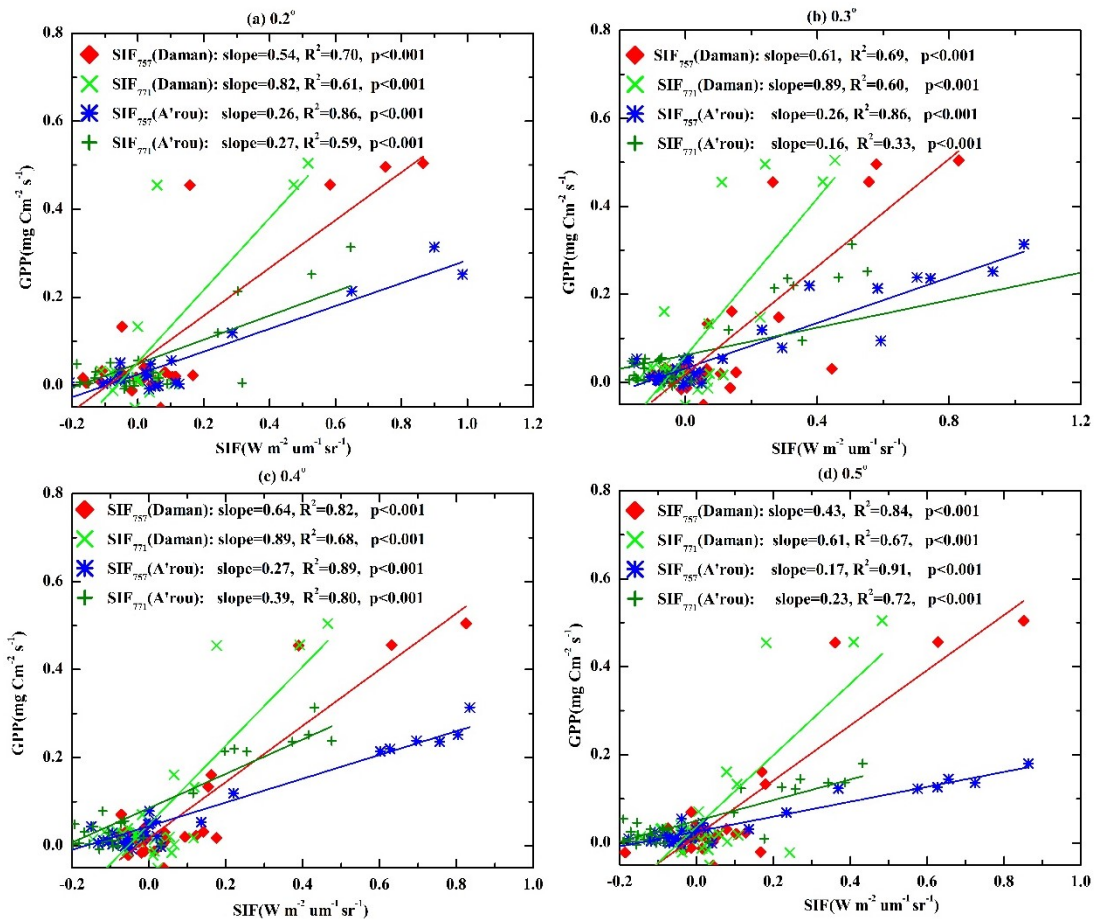
Figure S1. Effect of OCO-2 pixel extraction on the GPP-SIF relationship: (a) 0.2°; (b) 0.3°; (c) 0.4°; and (d) 0.5°. The relationships shown above are for 757 nm and 771 nm at instantaneous timescales.

GOME-2 SIF_{740} data were extracted based on the coordinates of the flux towers within a varying window surrounding the tower, namely, within pixels of 0.2°, 0.3°, 0.4°, and 0.5°. Then, a simple sensitivity analysis was conducted to examine how the GPP-SIF_{740} relationship was affected by the heterogeneity and size of the footprint (Figure S2). We compared the GPP-SIF_{740} relationships derived from the 0.2°, 0.3°, 0.4°, and 0.5° pixels. Although the correlations for different pixels changed slightly (R^2=0.17 to 0.22 at Daman, R^2=0.24 to 0.27 at A'rou), the corresponding slopes were very close and not significantly different. The numbers of retrievals for each bin changed considerably as the bin sizes changed. We found that the scale effect between the tower GPP and SIF_{757} and SIF_{771} exhibited more evident variability than that between the tower GPP and SIF_{740} as the landscape coverage and window size changed.
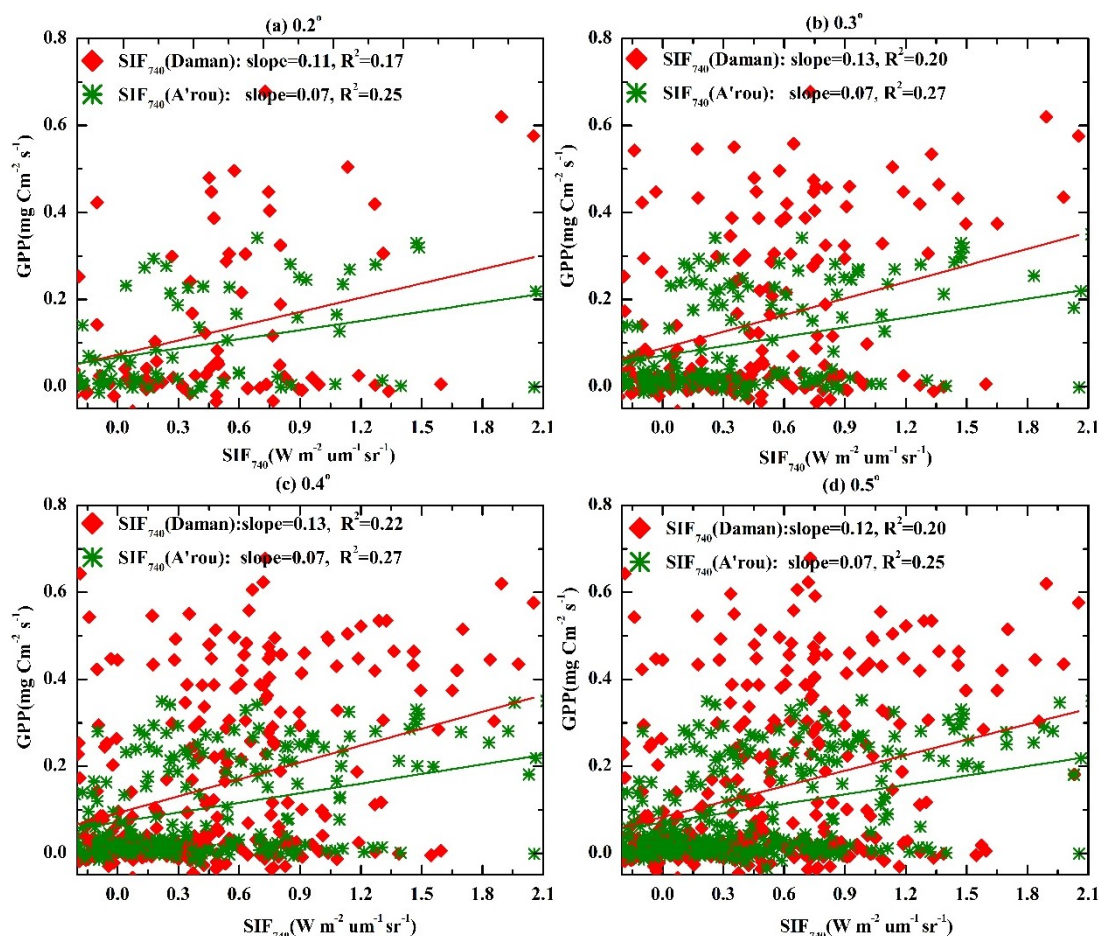
Figure S2. Effect of GOME-2 pixel extraction on the GPP-SIF relationship: (a) 0.2°; (b) 0.3°; (c) 0.4°; and (d) 0.5°. The relationships shown above are for 740 nm at the instantaneous timescale.

Table S1. Number of OCO-2 and GOME-2 retrievals for each bin.

		Bands	**0.2°**	**0.3°**	**0.4°**	**0.5°**
Daman	OCO-2	757 nm	25	31	36	37
		771 nm	25	31	36	37
	GOME-2	740 nm	108	240	409	497
A'rou	OCO-2	757 nm	25	31	33	34
		771 nm	25	31	33	34
	GOME-2	740 nm	92	207	327	410

2. Effects of Clouds on the Tower GPP and GOME-2 SIF Measurements

Clouds and aerosols are present in nearly every observation, and although a small amount of cloud contamination can be tolerated, a large amount of clouds will screen the surface signal from the satellite view and further influence the SIF values. All GOME-2 V27 pixels are provided in level 2 files with an additional quality flag to allow for more flexibility when performing gridding or averaging with different amounts of cloudiness. The quality flags, i.e., flag=1 (good and did not pass the cloud check) and flag=2 (good and passed the cloud check, meaning that the cloud cover was less than 30 percent), were used to extract GOME-2 SIF data. We compared the instantaneous SIF_{740} with flag=1 and flag=2 together against SIF_{740} with flag=2 and found that the tower GPP showed a stronger linear correlation with SIF_{740} with flag=2 than with flag=1 and flag=2 at an instantaneous scale. This finding suggests that clouds could be a factor that influenced the SIF signals (Figure S3).
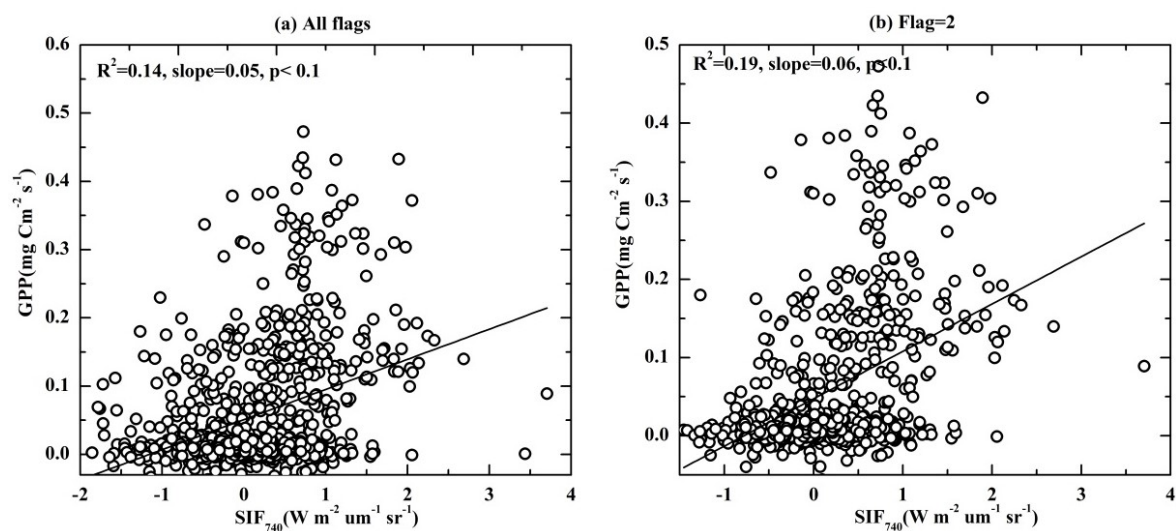
Figure S3. Effects of clouds on the relationships between GOME-2 SIF_{740} and tower GPP at instantaneous timescales: (a) tower GPP versus GOME-2 SIF_{740} with flag=1 and flag=2 together; (b) tower GPP versus GOME-2 SIF_{740} with flag=2.
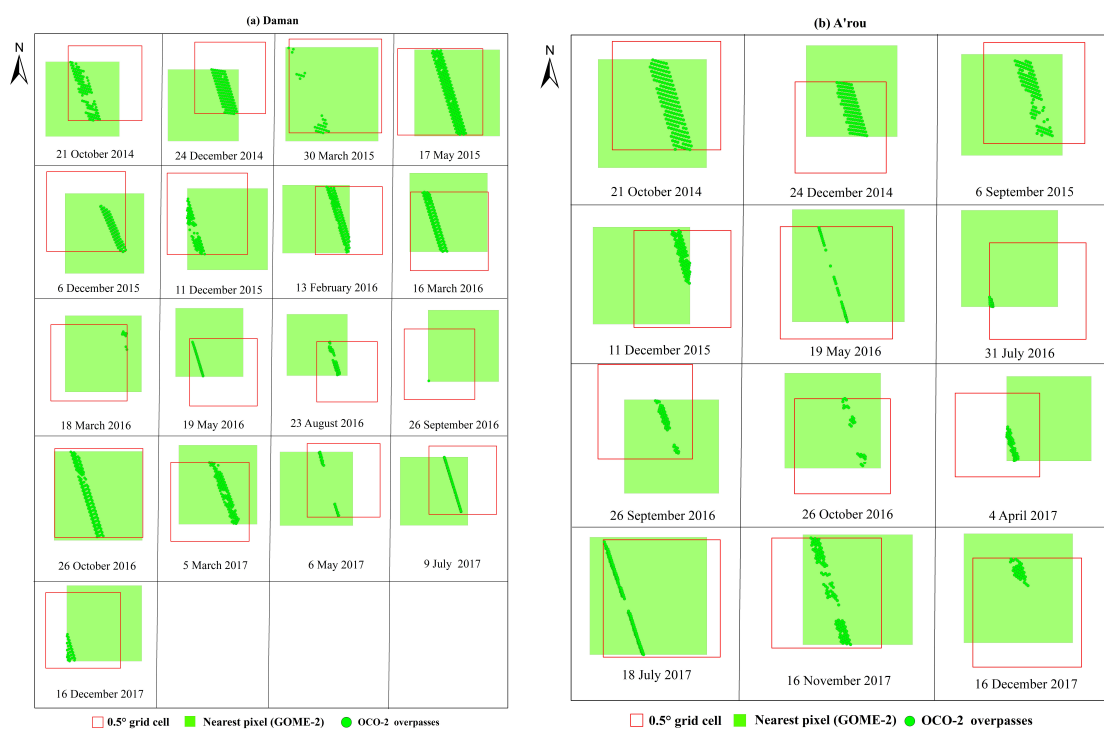
3. OCO-2 Soundings

Figure S4. Spatial overlap of OCO-2 overpasses and the nearest GOME-2 SIF pixels within the 0.5° grid cell at the (a) Daman and (b) A'rou sites.
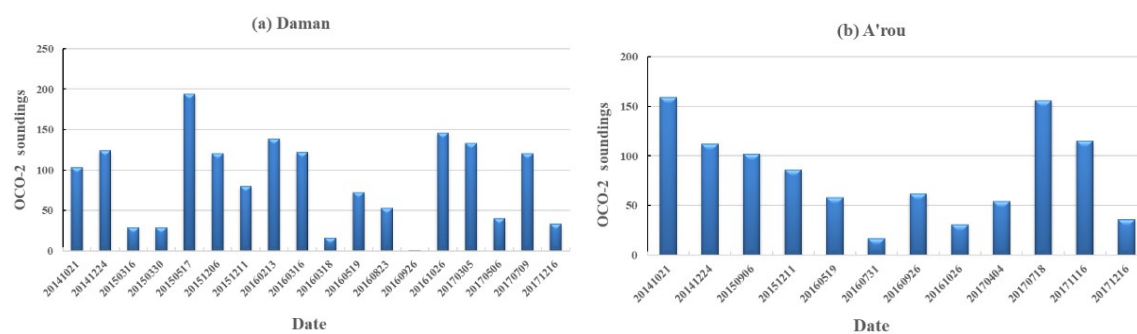
Figure S5. Number of soundings of OCO-2 overpasses within the overlaps of OCO-2 and GOME-2 SIF for the 0.5° grid cell on the corresponding date at the (a) Daman and (b) A'rou sites.