GOSIF GPP: A Global, 0.05-Degree Product of Gross Primary Production Derived from OCO-2 Solar-induced chlorophyll fluorescence (SIF)

Description:

We used the global, OCO-2-based SIF product (GOSIF) and linear relationships between SIF (Solar-induced chlorophyll fluorescence) and GPP to map GPP globally at a 0.05° spatial resolution and 8-day time step for the period from 2000 to 2024. To account for the uncertainty of GPP estimates resulting from the SIF-GPP relationship, we used eight SIF-GPP relationships (universal and biome-specific, with and without intercept) at both site and grid cell levels to estimate GPP. All the eight SIF-GPP relationships performed well in estimating GPP globally. The ensemble mean 8-day GPP was generally highly correlated with flux tower GPP for 91 eddy covariance flux sites across the globe (R^2 = 0.74, RMSE = 1.92 g C m^{-2} d^{-1}). GOSIF GPP is useful for studying photosynthesis, carbon cycle, agricultural production, and ecosystem responses to climate change and disturbances, informing ecosystem management, and benchmarking terrestrial biosphere and Earth system models. The methodology, validation, and spatial and temporal patterns of this product are described in our paper (Li and Xiao, 2019).

Fair Data Use Policy:

We make this data product available to the research community as we believe that the dissemination of this data set will lead to advancement in science. If you plan to use our data in a manuscript or presentation, we request that you inform us at an early stage of your work. You should ensure that your research does not significantly overlap with what we are currently working on with this product. In addition, if this data set is essential to your work, or if an important result or finding depends on our data, co-authorship may be appropriate. You must inform us of your analysis and publication plans well in advance of submission of a paper, give us an opportunity to read and intellectually contribute to the manuscript, and, if appropriate, offer co-authorship.

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Metadata:

For each time step, GOSIF GPP consists of the mean and standard deviation (SD) of GPP; the mean and SD are based on the eight different sets of GPP estimates; mean is recommended for most analyses, and SD can be used to account for the uncertainty of GPP.

Spatial resolution: 0.05 degree
Spatial extent: globe
Temporal resolution: 8 day (and monthly, annual)
Temporal extent: 2000 -2024
File format: GeoTIFF;
Map projection: Geographic
Scale factor: 0.001 (8-day GPP); 0.01 (monthly GPP); 0.1 (annual GPP)
Fill values: 65535 (water bodies) and 65534 (lands under snow/ice throughout the year)
Units: g C m^{-2} d^{-1} (8-day GPP), g C m^{-2} mo^{-1} (monthly GPP), g C m^{-2} yr^{-1} (annual GPP)

Citation:

Li, X., Xiao, J. (2019) Mapping photosynthesis solely from solar-induced chlorophyll fluorescence: A global, fine-resolution dataset of gross primary production derived from OCO-2. *Remote Sensing*, 11(21), 2563; https://doi.org/10.3390/rs11212563.

<to be continued>

Download:

Global Ecology Group Data Repository: http://globalecology.unh.edu/data/GOSIF-GPP.html. *Please visit our webpage for any update to this product.*

Changes from the original version:

Update on 3/30/2025: *The data have been extended to December 2024.*

Update on 5/14/2023: *We made a mistake in generating the data for 2022 that were released in early April 2023; this mistake has been corrected and the data files have been updated. If you previously downloaded the 2022 data, please replace them with the new files.*

The new version (V2) has been updated from the original version in the following ways: (1) the dataset has been extended to 2022; (2) GOSIF that was used to estimate GPP has been slightly improved; (3) a new data type (unsigned short rather than double) and a scale factor were used to reduce data volume.

V2 was released on December 1, 2019 and last updated on March 30, 2025.

Citation:

Li, X., Xiao, J. (2019) Mapping photosynthesis solely from solar-induced chlorophyll fluorescence: A global, fine-resolution dataset of gross primary production derived from OCO-2. *Remote Sensing*, 11(21), 2563; https://doi.org/10.3390/rs11212563.

Relevant Publications:

GOSIF product:

Li, X., Xiao, J. (2019) A global, 0.05-degree product of solar-induced chlorophyll fluorescence derived from OCO-2, MODIS, and reanalysis data. *Remote Sensing*, 11, 517; https://doi.org/10.3390/rs11050517.

SIF-GPP relationships:

Li, X., Xiao, J., He, B., Arain, M.A., Beringer, J., Desai, A.R., Emmel, C., Hollinger, D.Y., Krasnova, A., Mammarella, I., Noe, S.M., Ortiz, P.S., Rey-Sanchez, C., Rocha, A.V., Varlagin, A. (2018) Solar-induced chlorophyll fluorescence is strongly correlated with terrestrial photosynthesis for a wide variety of biomes: First global analysis based on OCO-2 and flux tower observations. *Global Change Biology*, 24, 3990-4008. https://doi.org/10.1111/gcb.14297.

Xiao, J., Li, X., He, B., Arain, M.A., Beringer, J., Desai, A.R., Emmel, C., Hollinger, D.Y., Krasnova, A., Mammarella, I., Noe, S.M., Ortiz, P.S., Rey-Sanchez, C., Rocha, A.V., Varlagin, A. (2019) Solar-induced chlorophyll fluorescence exhibits a universal relationship with gross

primary productivity across a wide variety of biomes. *Global Change Biology*, 25, e4–e6, https://doi.org/10.1111/gcb.14565.

Li, X., Xiao, J. (2022) TROPOMI observations allow for robust exploration of the relationship between solar-induced chlorophyll fluorescence and terrestrial gross primary production. Remote Sensing of Environment, 268, 112748. https://doi.org/10.1016/j.rse.2021.112748.

Applications:

Li, X., Xiao, J., Kimball, J.S., Reichle, R.H., Scott, R.L., Litvak, M.E., Bohrer, G., Frankenberg, C. (2020) Synergistic use of SMAP and OCO-2 data in assessing the responses of ecosystem productivity to the 2018 U.S. drought. *Remote Sensing of Environment*, 251, 112062. https://doi.org/10.1016/j.rse.2020.112062.

Li, X., Xiao, J. (2020) Global climatic controls on interannual variability of ecosystem productivity: similarities and differences inferred from solar-induced chlorophyll fluorescence and enhanced vegetation index. *Agricultural and Forest Meteorology*, 288-289, 108018. https://doi.org/10.1016/j.agrformet.2020.108018.

Review article:

Xiao, J., Chevallier, F., Gomez, C., Guanter, L., Hicke, J.A., Huete, A.R., Ichii, K., Ni, W., Pang, Y., Rahman, A.F., Sun, G., Yuan, W., Zhang, L., Zhang, X. (2019) Remote sensing of the terrestrial carbon cycle: A review of advances over 50 years. *Remote Sensing of Environment*, 233, 111383. https://doi.org/10.1016/j.rse.2019.111383.