GOSIF: A Global, 0.05-Degree Product of Solar-Induced Chlorophyll Fluorescence Derived from OCO-2, MODIS, and Reanalysis Data

Description:

Solar-induced chlorophyll fluorescence (SIF) brings major advancements in measuring the terrestrial photosynthesis. Several recent studies have evaluated the potential of SIF retrievals from the Orbiting Carbon Observatory-2 (OCO-2) in estimating gross primary productivity (GPP). However, the spatially and temporally sparse nature of OCO-2 data makes it challenging to use these data for many applications from ecosystem scale to the globe. We developed a new global, OCO-2-based SIF data set (GOSIF) with high spatial and temporal resolutions (i.e., 0.05°, 8-day) using discrete OCO-2 SIF soundings, remote sensing data from the Moderate Resolution Imaging Spectroradiometer (MODIS), and meteorological reanalysis data. Our SIF estimates are highly correlated with GPP from 91 FLUXNET sites ($R^2 = 0.73$, $p < 0.001$). Compared with the coarse-resolution SIF data that are directly aggregated from OCO-2 soundings, GOSIF has finer spatial resolution, globally continuous coverage, and a much longer record. GOSIF is useful for assessing terrestrial photosynthesis and ecosystem function 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 the GOSIF data, co-authorship may be appropriate. You should 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:

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: 0.0001
Units: W m^{-2} μm^{-1} sr^{-1}
Fill values: 32767 (water bodies) and 32766 (lands under snow/ice throughout the year)

Citation:

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.

<to be continued>

Download:

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

Changes from the original version:

Update on 3/30/2025: *Our 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 has been slightly improved using five subcommittee models rather than three subcommittee models; (3) a new data type (signed short rather than double) and a scale factor were used to reduce data volume.

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

Citation:

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.

Relevant Publications:

GOSIF GPP product:

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.

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:

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.