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Dataset Working Title: SiB4 Modeled 0.5-degree COS vegetation and soil fluxes, 53-90N, 2000-2020

Summary: This dataset provides Simple Biosphere Model (v4.2) hourly 0.5-degree gridded fluxes of gross primary productivity, carbonyl sulfide uptake by vegetation and soil, conductances of COS (apparent mesophyll and total) and stomatal conductance of water. Fluxes have dimensions of latitude, longitude, time, and plant functional type. Model output spans 53N to 90N, -180W to 180E, 2000-2020.

Investigators:

1. Aleya Kaushik, aleya.kaushik@noaa.gov, ORCID ID 0000-0002-2516-8454

2. Lei Hu, lei.hu@noaa.gov, ORCID ID 0000-0002-5624-3832

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DATASET OVERVIEW

Summary: Gridded 0.5-degree biosphere model output of gross primary productivity and carbonyl sulfide fluxes for the pan-Arctic domain 2000-2020.

Related Publication: Atmospheric evidence of rising atmospheric CO2 enhancing Arctic CO2 seasonal cycle, submitted.

Related Datasets: Haynes, K.D., I.T. Baker, and A.S. Denning. 2021. SiB4 Modeled Global 0.5-Degree Monthly Carbon Fluxes and Pools, 2000-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1848>

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DATASET CHARACTERISTICS

Spatial Coverage: 53N to 90N, -180W to 180E

Spatial Resolution: 0.5-degree latitude and longitude

Temporal Coverage: 2000-01-01 00:30:00 to 2020-12-31 23:30:00

Temporal Resolution: hourly

Study Area: 53N to 90N, -180W to 180E

Global Change Master Directory (GCMD) Keywords (optional): carbon cycle model, photosynthesis, carbonyl sulfide flux, conductance

File Naming Convention:

compressed annual files: sib4\_xxxx.tar.gz, where xxxx is the year. Each annual compressed file contains the entire year’s daily files.

uncompressed daily files: sib4-hourly-yyyy-mm-dd.nc - files are daily, named for model name (sib), model version (4), temporal resolution (hourly) and date (year-month-day).

File Descriptions: This dataset consists of 21 compressed files (one for each year of data), which contain 7671 daily files in total when uncompressed. Each daily file contains 0.5-degree hourly data of fluxes and conductances. Code is available at https://gitlab.com/kdhaynes/sib4v2\_corral. A data documentation companion file is also provided (SiB4\_COS\_Data\_Documentation.docx).

Data File Properties: Variables have dimensions of latitude (unit: degrees\_north), longitude (unit: degrees\_east), time (units: days since start of year) and plant functional type (15 plant types).

Data Details:

Table 1. Modeled variables.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Dimensions | Units | Description |
| assim | lon, lat, npft, time | µmole m-2 s-1 | Assimilation (or Gross Primary Productivity) in micromoles of carbon per m2 per second |
| cos\_assim | lon, lat, npft, time | pmole m-2 s-1 | Carbonyl Sulfide (COS) Vegetation Assimilation |
| cos\_grnd | lon, lat, npft, time | pmole m-2 s-1 | COS Soil Uptake |
| cosgm | lon, lat, npft, time | mole m-2 s-1 | Apparent mesophyll conductance of COS |
| cosgt | lon, lat, npft, time | mole m-2 s-1 | Total conductance of COS |
| gsh2o | lon, lat, npft, time | mole m-2 s-1 | Stomatal conductance of water (H2O) |

Table 2. Input variable descriptions.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Dimensions | Units | Description |
| crs |  |  | The Coordinate Reference System, WGS84 (EPSG:4326) |
| lat | lat | degrees\_north | Latitude |
| lon | lon | degrees\_east | Longitude |
| pft\_area | lon, lat, npft | 1 | Fractional areal coverage of PFT in each grid cell |
| pft\_names | npft, clen |  | Names of 15 plant functional types (PFT); three-character string abbreviations (*clen*) defined in Table 3. Output variables are partitioned by PFT and indexed by the *npft* dimension. |
| time | time | d | Timestep in days since the beginning of the year |
| time\_bnds | time, bnds | d | Timestep in days since the beginning of the year (*bnds*=2) |

Table 3. Plant functional types (PFT) from Haynes et al. (2020).

|  |  |  |
| --- | --- | --- |
| npft | clen | PFT |
| 1 | DBG | Desert and Bare Ground |
| 2 | ENF | Evergreen Needleleaf Forest |
| 3 | DNF | Deciduous Needleleaf Forest |
| 4 | EBF | Evergreen Broadleaf Forest |
| 5 | DBF | Deciduous Broadleaf Forest |
| 6 | SHB | Shrubs (Non-Tundra) |
| 7 | SHA | Tundra Shrubs |
| 8 | C3A | Tundra Grassland |
| 9 | C3G | C3 Grassland |
| 10 | C4G | C4 Grassland |
| 11 | C3C | C3 Generic Crop |
| 12 | C4C | C4 Generic Crop |
| 13 | MZE | Maize |
| 14 | SOY | Soybeans |
| 15 | WWT | Winter Wheat |

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APPLICATION & DERIVATION

COS fluxes are used in the carbon cycle community as a proxy for gross plant uptake, and for plant stomatal conductance. COS fluxes and conductances were used for calculating the seasonal cycle trends and results explored in the submitted manuscript. SiB4 gross primary productivity (GPP) was used as a comparison to COS-derived GPP. More details can be found in the manuscript “Atmospheric evidence of rising atmospheric CO2 enhancing Arctic CO2 seasonal cycle” (submitted, in review).

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QUALITY ASSESSMENT

The model was run once with a fixed set of parameters. This study does not include uncertainty based on parameter selection. Annual GPP values included in this dataset were found to be reasonable compared to other datasets when tested with the ILAMB framework (unpublished). Previous SiB4 datasets published on the ORNL DAAC have included more extensive comparisons with other datasets (e.g. see QA section in https://doi.org/10.3334/ORNLDAAC/1848).

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DATA ACQUISITION, MATERIALS & METHODS

This dataset is output from a SiB4 simulation, following SiB4 methodology described in Haynes et al. (2019a), (2020) and Section 5 of https://doi.org/10.3334/ORNLDAAC/1848.

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REFERENCES

Atmospheric evidence of rising atmospheric CO2 enhancing Arctic CO2 seasonal cycle, Hu et al., 2023, submitted to Nature, in review.

Haynes, K. D., I.T. Baker, A.S. Denning, R. Stöckli, K. Schaefer, E.Y. Lokupitiya, and J.M. Haynes. 2019a. Representing grasslands using dynamic prognostic phenology based on biological growth stages: 1. Implementation in the Simple Biosphere Model (SiB4 Journal of Advances in Modeling Earth Systems 11:4423–4439. <https://doi.org/10.1029/2018MS001540>

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