

CMS: Global 0.5-deg Wetland Methane Emissions and Uncertainty (WetCHARTs v1.3.3)

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Documentation Revision Date: 2024-06-03
Dataset Version: 1.3.3

Summary

This dataset provides global monthly wetland methane (CH₄) emissions estimates at 0.5 by 0.5-degree resolution for the period 2001-01-01 to 2022-08-31 that were derived from an ensemble of multiple terrestrial biosphere models, wetland extent scenarios, and CH₄:C temperature dependencies that encompass the main sources of uncertainty in wetland CH₄ emissions. There are 18 model configurations. WetCHARTs v1.3.3 is an updated product of WetCHARTs v1.3.1 dataset. The intended use of this product is as a process-informed wetland CH₄ emission data set for atmospheric chemistry and transport modeling. Users can compare estimates by model configuration to explore variability and sensitivity with respect to ensemble members. The data are provided in netCDF format.

There are 22 files in netCDF format included in this dataset.

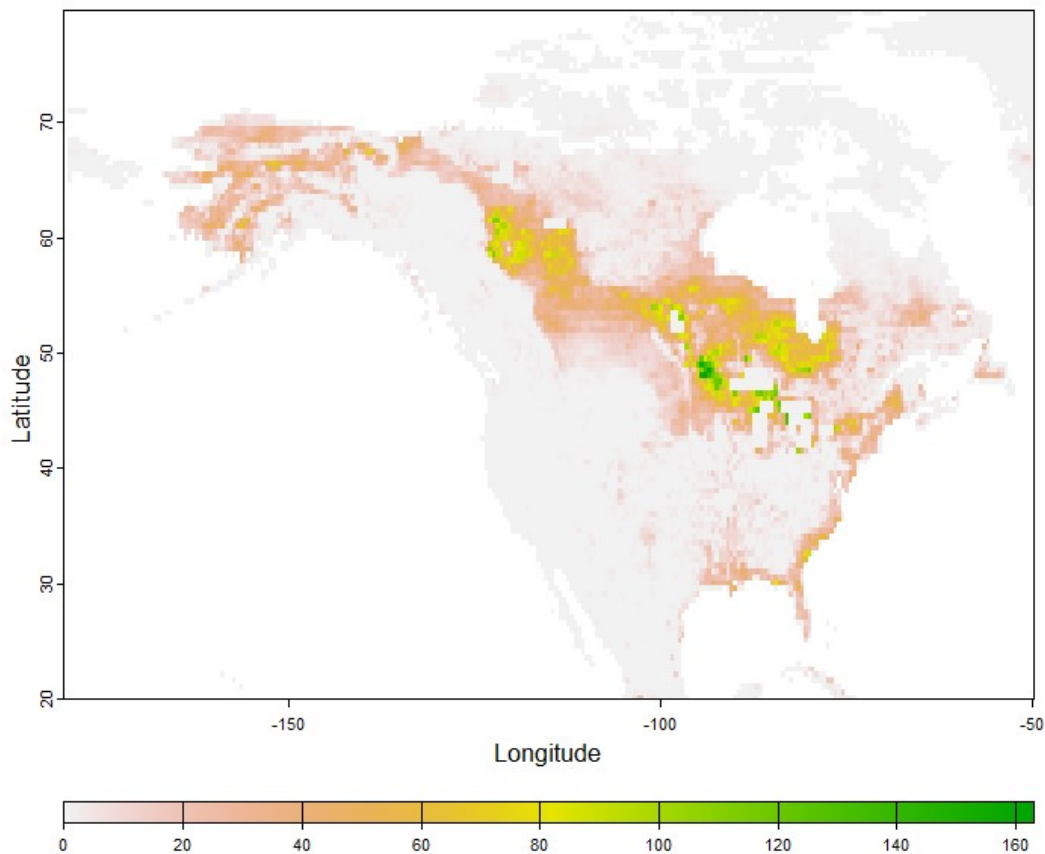


Figure 1. Estimated daily emissions of methane from wetlands (mg CH₄ m⁻² d⁻¹) in North America for July 2010. Estimates were produced using the WetCHARTs v1.3.3 model using ensemble member 1931, which includes a global scale factor of 124.5 Tg CH₄ y⁻¹, the CARDAMOM heterotrophic respiration model, a temperature-dependent CH₄:C q₁₀=3, and extent parameterization based on the Global Lakes and Wetlands Database. Source: WetCHARTs_v1_3_3_2010.nc

Citation

Bloom, A.A., K.W. Bowman, M. Lee, A.J. Turner, R. Schroeder, J.R. Worden, R.J. Weidner, K.C. McDonald, and D.J. Jacob. 2024. CMS: Global 0.5-deg Wetland Methane Emissions and Uncertainty (WetCHARTs v1.3.3). ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2346>

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1. Dataset Overview

This dataset provides global monthly wetland methane (CH₄) emissions estimates at 0.5 by 0.5-degree resolution for the period 2001-01-01 to 2022-08-31 that were derived from an ensemble of multiple terrestrial biosphere models, wetland extent scenarios, and CH₄:C temperature dependencies that encompass the main sources of uncertainty in wetland CH₄ emissions. There are 18 model configurations. WetCHARTs v1.3.3 is an updated product of WetCHARTs v1.3.1 dataset. The intended use of this product is as a process-informed wetland CH₄ emission data set for atmospheric chemistry and transport modeling. Users can compare estimates by model configuration to explore variability and sensitivity with respect to ensemble members.

Project: [Carbon Monitoring System](#)

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System will use the full range of NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS will maintain a global emphasis while providing finer scale regional information, utilizing space-based and surface-based data, and will rapidly initiate generation and distribution of products both for user evaluation and to inform near-term policy development and planning.

Related Publications

Bloom, A.A., K.W. Bowman, M. Lee, A.J. Turner, R. Schroeder, J.R. Worden, R. Weidner, K.C. McDonald, and D.J. Jacob. 2017. A global wetland methane emissions and uncertainty dataset for atmospheric chemical transport models (WetCHARTs version 1.0). *Geoscientific Model Development* 10:2141–2156. <https://doi.org/10.5194/gmd-10-2141-2017>

Ma, S., J.R. Worden, A. Anthony Bloom, Y. Zhang, B. Poulter, D.H. Cusworth, Y. Yin, S. Pandey, J.D. Maasakkers, X. Lu, L. Shen, J. Sheng, C. Frankenberg, C.E. Miller, and D.J. Jacob. 2021. Satellite methane observations constrain the latitudinal distribution of wetland emissions and their temperature sensitivity. *AGU Advances*. <https://doi.org/10.1029/2021AV000408>

Related Dataset

Bloom, A.A., K. Bowman, M. Lee, A.J. Turner, R. Schroeder, J.R. Worden, R.J. Weidner, K.C. McDonald, and D.J. Jacob. 2017. CMS: Global 0.5-deg Wetland Methane Emissions and Uncertainty (WetCHARTs v1.0). ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1502>

- This is an early version of this dataset derived from WetCHARTs model version 1.0.

Bloom, A.A., K.W. Bowman, M. Lee, A.J. Turner, R. Schroeder, J.R. Worden, R.J. Weidner, K.C. McDonald, and D.J. Jacob. 2021. CMS: Global 0.5-deg Wetland Methane Emissions and Uncertainty (WetCHARTs v1.3.1). ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1915>

- This is the previous version of this dataset derived from WetCHARTs model version 1.3.1 and covering years 2001 - 2019.

2. Data Characteristics

Spatial Coverage: Global

Spatial Resolution: 0.5-degree resolution

Temporal Resolution: Monthly

Temporal Coverage: 2001-01-01 to 2022-08-31

Site Boundaries: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Global	-180	180	90	-90

Data File Information

There are 22 data files in netCDF (*.nc) format included in this dataset. Each file holds model outputs for 18 ensembles for a single year.

The files are named WetCHARTs_v1_3_3_YYYY.nc, where YYYY is a year from 2001–2022.

Data File Details

- Spatial reference system: WGS 84 (EPSG:4326)
- Spatial resolution: 0.5 x 0.5 degree
- No data value: -9999

Table 1. Variables in the data files.

Variable	Units	Description
wetland_CH4_emissions	mg m ⁻² d ⁻¹	Daily emissions of methane from wetlands in mg CH ₄

Variable	Units	Description
latitude	degrees_north	Latitude coordinate
longitude	degrees_east	Longitude coordinate
model	-	Four-digit code specifying the 18 model configuration (e.g., 1931; Table 3), where: • first position = global_scale_factors • second position = heterotrophic_respiration_model • third position = temperature_dependence • fourth position = extent_parameterization
time	days since 2001-01-01 00:00:00	Middle day of each month
crs	-	Details of the coordinate reference system
time_bnds	days since 2001-01-01 00:00:00	Start and end time for each time stamp

Table 3. Model configuration codes. The ensemble model member names follow a 4-digit format (e.g., 1234).

Position	Values	Description
1	global_scale_factors	1 = 124.5 Tg CH ₄ /yr 2 = 166 Tg CH ₄ /yr 3 = 207.5 Tg CH ₄ /yr
2	heterotrophic_respiration_model	1–8 = MsTMIP models 9 = CARDAMOM
3	temperature_dependence	1 = CH ₄ :C q10 is 1 2 = CH ₄ :C q10 is 2 3 = CH ₄ :C q10 is 3
4	extent_parameterization	1 = SWAMPS & GLWD 2 = SWAMPS & GLOBCOVER 3 = PREC & GLWD 4 = PREC & GLOBCOVER

- CARDAMOM: global CARbon DATA Model fraMework (CARDAMOM) terrestrial carbon analysis (Bloom et al., 2016)
- GLOBCOVER: Wetland and freshwater land cover types (all flooded, waterlogged and inland water body land cover types) from Bontemps et al. (2011)
- GLWD: Global Lakes and Wetlands Database, based on Lehner and Döll (2004)
- MsTMIP: Multi-scale Synthesis and Terrestrial Model Intercomparison Project (Huntzinger et al., 2013; Wei et al., 2014)
- SWAMPS: Surface WATER Microwave Product Series multi-satellite surface water product (Schroeder et al., 2015)
- PREC: ERA-Interim precipitation from European Centre for Medium-Range Weather Forecasts reanalysis (ECMWF ERA-Interim) synoptic monthly means (<http://apps.ecmwf.int>).

3. Application and Derivation

Bloom et al. (2017) have constructed a global wetland CH₄ emission model ensemble for use in atmospheric chemical transport models (WetCHARTs v1.0).

Ma et al. (2021) have tested and refined a range of bottom-up models including the WetCHARTs v1.3.1 with satellite-based top-down estimates, adding new constraints on the latitudinal distributions of CH₄ and its temperature sensitivity.

4. Quality Assessment

The mean extended ensemble wetland emissions data were compared against a range of independent wetland CH₄ regional emission estimates (Bloom et al., 2017).

5. Data Acquisition, Materials, and Methods

This process-informed wetland CH₄ emission dataset for atmospheric chemistry and transport modeling (WetCHARTs Extended Ensemble, 18 simulations) is derived by combining a range of CH₄:C temperature sensitivities, global wetland emissions scaling factors, and dynamic wetland extent maps to represent the uncertainty. The wetland CH₄ emissions statistics within each 0.5° x 0.5° grid cell are derived based on precipitation and the data-constrained terrestrial carbon cycle analysis derived for the period 2001–2022. The mean of the extended model ensembles was incorporated into GEOS-Chem and the model outputs have been compared against a suite of regional flux estimates. The wetland CH₄ emission ensembles robustly represent the global magnitude and uncertainty of wetland CH₄ missions. The ensemble configurations of inundation extent, carbon decomposition, and temperature dependence have together provided a characterization of the dominant source of uncertainty in global wetland CH₄ estimates and can then be used to quantify (a) the probability of individual ensemble members; and (b) the combined probability distribution of carbon models, CH₄:C temperature dependencies and wetland extent scenarios.

WetCHARTs v1.3.3 is an updated product of WetCHARTs v1.3.1 dataset. Three new features in the updated version include:

1. The model output data have been updated to span 2001–2022,
2. The model meteorological drivers are replaced from using ERA-interim to ERA5 reanalysis data, and
3. The GLWD (Global Lakes and Wetlands Database) wetland extent definitions within WetCHARTs have been adjusted for the 50-100% Wetland, 25-50% Wetland, and Wetland Complex (0-25% Wetland) categories (that span 75%, 37.5% and 17.5% of land area respectively).

For details see Bloom et al. (2017).

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[CMS: Global 0.5-deg Wetland Methane Emissions and Uncertainty \(WetCHARTs v1.3.3\)](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
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7. References

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8. Dataset Revisions

Version	Release Date	Revision Notes	DOI
1.3.3	2024-XX-XX	Output based on WetCHARTs version 1.3.3.	https://doi.org/10.3334/ORNLDAAC/2346
1.3.1.1	2022-05-05	Latitude, longitude variable names changed in the data files to improve compatibility with GIS software	https://doi.org/10.3334/ORNLDAAC/1915
1.3.1	2021-09-23	WetCHARTs v1.3.1 is an updated product of WetCHARTs v1.0 Extended Ensemble (Bloom et al., 2017). The new features are described in Section 5.	https://doi.org/10.3334/ORNLDAAC/1915
1	2017-06-05	Initial release.	https://doi.org/10.3334/ORNLDAAC/1502



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