



National Aeronautics and Space
Administration Goddard Earth Science Data
Information and Services Center (GES DISC)

README Document for Version 3 of the Carbon Monitoring System (CMS) Carbon Flux Data Sets

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Revision History

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1.0 Introduction

This document provides basic information for using the 6 Carbon Monitoring System (CMS) datasets listed in Table 1.

Table 1. Datasets in this collection.

Dataset Title (ShortName)	DOI
Carbon Monitoring System Carbon Flux FossilFuel Prior L4 V3 (CMSFluxFossilFuelPrior)	10.5067/Y7QUDGMD2HUG

Carbon Monitoring System Carbon Flux Land Prior L4 V3 (CMSFluxLandPrior)	10.5067/1XO0PZAZOR1H
Carbon Monitoring System Carbon Flux NBE L4 V3 (CMSFluxNBE)	10.5067/TA1ED4IZFZ47
Carbon Monitoring System Carbon Flux Ocean Prior L4 V3 (CMSFluxOceanPrior)	10.5067/3K9PK956EIQ9
Carbon Monitoring System Carbon Flux Ocean L4 V3 (CMSFluxOcean)	10.5067/9H6GCQKP28AI
Carbon Monitoring System Carbon Flux Total Prior L4 V3 (CMSFluxTotalPrior)	10.5067/C0RXB7GVC2S9
Carbon Monitoring System Carbon Flux Total L4 V3 (CMSFluxTotal)	10.5067/ONM38W5QE1QI

1.1 Description of the Data Sets

These datasets contain global estimates of various components of the carbon cycle constrained by satellite observations through the Carbon Monitoring System Flux (CMS-Flux) carbon cycle data assimilation system as shown in Figure 1. The methodology and technical details of the system are described in Liu et al. 2020 and Friedlingstein et al. 2023. Older versions of the algorithm are described in Liu et al. 2014 and Bowman et al. 2017. The total CO₂ flux, which is the net sum of all carbon fluxes, from 2010-2016 are constrained with GOSAT v7.3 whereas total fluxes from 2015-2022 are constrained by OCO-2 v9r.

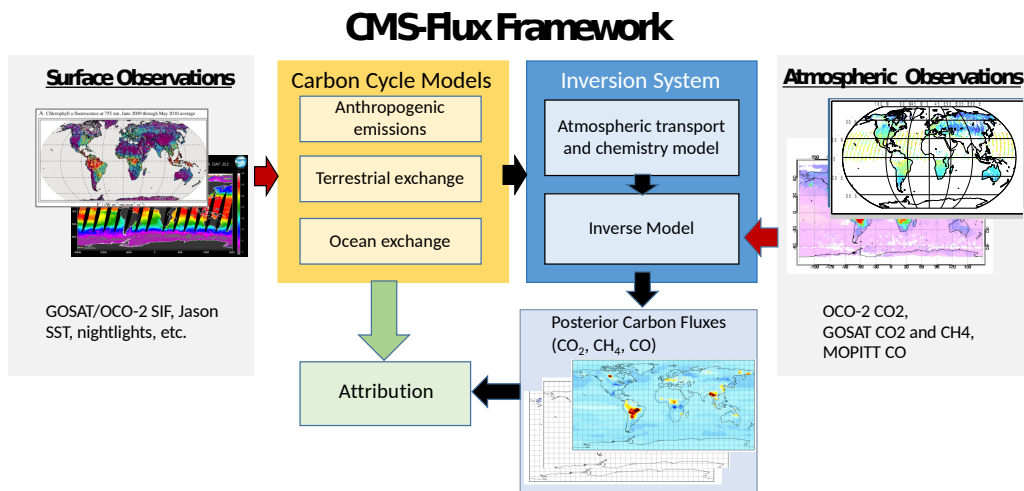


Figure: Carbon Monitoring System Flux (CMS-Flux) Framework. Satellite observations of surface data are integrated into a suite of anthropogenic (FFDAS), ocean (ECCO2-Darwin), and terrestrial (CASA-GFED) carbon cycle models. These are in turn used to compute surface fluxes that drive a chemistry and transport model (GEOS-Chem). Atmospheric observations of CO₂, CO, CH₄ are ingested into an inverse model that computes posterior estimates of carbon surface fluxes. The combination of fluxes is used to attribute carbon and then reconcile those differences with prior carbon cycle models (from Bowman et al, 2017).

1.2 Data Disclaimer and Digital Object Identifier (DOI)

The data sets may be acknowledged in publications using the Digital Object Identifiers listed in Table 1.

2.0 Data Organization

The data in all the files are organized on an equal angle $1^{\circ} \times 1^{\circ}$ grid in longitude and latitude with a 1 month temporal resolution.

2.1 File Naming Convention

The filenames composed of the product ShortName followed by the date range and version of the dataset as follows:

```
CMSFluxFossilFuelPrior201001_202212_v3.nc  
CMSFluxNBE201001_202212_v3.nc  
CMSFluxOceanPrior201001_202212_v3.nc  
CMSFluxTotalPrior201001_202212_v3.nc  
CMSFluxLandPrior201001_202212_v3.nc  
CMSFluxOcean201001_202212_v3.nc  
CMSFluxTotal201001_202212_v3.nc
```

2.2 File Format and Structure

The files are stored in NetCDF-4 format.

3.0 Data Contents

The dimensions and variables of each of the CMS-Flux products are listed below.

CMSFluxFossilFuelPrior

dimensions:

```
latitude = 180 ;  
longitude = 360 ;  
time = 156 ;
```

variables:

```
float fossil(time, latitude, longitude) ;  
    fossil:missing_value = -999.f ;  
    fossil:_FillValue = -999.f ;  
    fossil:units = "g/m^2/day" ;  
    fossil:long_name = "Gridded Fossil Emission Dataset (GridFED), gram carbon per  
square meter per day" ;  
float area(latitude, longitude) ;  
    area:missing_value = -999.f ;  
    area:_FillValue = -999.f ;  
    area:units = "m^2" ;  
    area:long_name = "area of each 1x1 grid box" ;  
float latitude(latitude) ;
```

```
latitude:units = "degrees_north" ;
latitude:long_name = "latitude" ;
float longitude(longitude) ;
longitude:units = "degrees_east" ;
longitude:long_name = "longitude" ;
float time(time) ;
time:units = "months since 2010-01-15" ;
time:long_name = "time" ;
```

CMSFluxLandPrior

dimensions:

```
latitude = 180 ;
longitude = 360 ;
time = 156 ;
```

variables:

```
float NBE_prior(time, latitude, longitude) ;
NBE_prior:missing_value = -999.f ;
NBE_prior:_FillValue = -999.f ;
NBE_prior:units = "g/m^2/day" ;
NBE_prior:long_name = "Net biosphere exchange prior from CARDAMOM
```

model,unit:gram carbon per square meter per day" ;

```
float area(latitude, longitude) ;
area:missing_value = -999.f ;
area:_FillValue = -999.f ;
area:units = "m^2" ;
area:long_name = "area of each 1x1 grid box" ;
```

```
float latitude(latitude) ;
latitude:units = "degrees_north" ;
latitude:long_name = "latitude" ;
```

```
float longitude(longitude) ;
longitude:units = "degrees_east" ;
longitude:long_name = "longitude" ;
```

```
float time(time) ;
time:units = "months since 2010-01-15" ;
time:long_name = "time" ;
```

CMSFluxNBE

dimensions:

```
latitude = 180 ;
longitude = 360 ;
time = 156 ;
```

variables:

```
float NBE_post(time, latitude, longitude) ;
NBE_post:missing_value = -999.f ;
NBE_post:_FillValue = -999.f ;
NBE_post:units = "g/m^2/day" ;
```

```

        NBE_post:long_name = "Posterior Net Biosphere Exchange,unit:gram carbon per
square meter per day" ;
    float area(latitude, longitude) ;
        area:missing_value = -999.f ;
        area:_FillValue = -999.f ;
        area:units = "m^2" ;
        area:long_name = "area of each 1x1 grid box" ;
    float latitude(latitude) ;
        latitude:units = "degrees_north" ;
        latitude:long_name = "latitude" ;
    float longitude(longitude) ;
        longitude:units = "degrees_east" ;
        longitude:long_name = "longitude" ;
    float time(time) ;
        time:units = "months since 2010-01-15" ;
        time:long_name = "time" ;

```

CMSFluxOcean

dimensions:

```

    latitude = 180 ;
    longitude = 360 ;
    time = 156 ;

```

variables:

```

    float ocean_post(time, latitude, longitude) ;
        ocean_post:missing_value = -999.f ;
        ocean_post:_FillValue = -999.f ;
        ocean_post:units = "g/m^2/day" ;
        ocean_post:long_name = "posterior air-sea fluxes,unit:gram carbon per square meter per
day" ;
    float area(latitude, longitude) ;
        area:missing_value = -999.f ;
        area:_FillValue = -999.f ;
        area:units = "m^2" ;
        area:long_name = "area of each 1x1 grid box" ;
    float latitude(latitude) ;
        latitude:units = "degrees_north" ;
        latitude:long_name = "latitude" ;
    float longitude(longitude) ;
        longitude:units = "degrees_east" ;
        longitude:long_name = "longitude" ;
    float time(time) ;
        time:units = "months since 2010-01-15" ;
        time:long_name = "time" ;

```

CMSFluxOceanPrior

dimensions:

```

    latitude = 180 ;

```

```

longitude = 360 ;
time = 156 ;
variables:
float Ocean-Prior(time, latitude, longitude) ;
    Ocean-Prior:missing_value = -999.f ;
    Ocean-Prior:_FillValue = -999.f ;
    Ocean-Prior:units = "g/m^2/day" ;
    Ocean-Prior:long_name = "Ocean prior from MOM6,unit:gram carbon per square meter
per day" ;
float area(latitude, longitude) ;
    area:missing_value = -999.f ;
    area:_FillValue = -999.f ;
    area:units = "m^2" ;
    area:long_name = "area of each 1x1 grid box" ;
float latitude(latitude) ;
    latitude:units = "degrees_north" ;
    latitude:long_name = "latitude" ;
float longitude(longitude) ;
    longitude:units = "degrees_east" ;
    longitude:long_name = "longitude" ;
float time(time) ;
    time:units = "months since 2010-01-15" ;
    time:long_name = "time" ;

```

CMSFluxTotal

dimensions:

```

latitude = 180 ;
longitude = 360 ;
time = 156 ;

```

variables:

```

float total_post(time, latitude, longitude) ;
    total_post:missing_value = -999.f ;
    total_post:_FillValue = -999.f ;
    total_post:units = "g/m^2/day" ;
    total_post:long_name = "total posterior fluxes that include fossil and natural carbon
fluxes,unit:gram carbon per square meter per day" ;
float area(latitude, longitude) ;
    area:missing_value = -999.f ;
    area:_FillValue = -999.f ;
    area:units = "m^2" ;
    area:long_name = "area of each 1x1 grid box" ;
float latitude(latitude) ;
    latitude:units = "degrees_north" ;
    latitude:long_name = "latitude" ;
float longitude(longitude) ;
    longitude:units = "degrees_east" ;
    longitude:long_name = "longitude" ;

```

```
float time(time) ;  
    time:units = "months since 2010-01-15" ;  
    time:long_name = "time" ;
```

CMSFluxTotalPrior

dimensions:

```
latitude = 180 ;  
longitude = 360 ;  
time = 156 ;
```

variables:

```
float total_prior(time, latitude, longitude) ;  
    total_prior:missing_value = -999.f ;  
    total_prior:_FillValue = -999.f ;  
    total_prior:units = "g/m^2/day" ;  
    total_prior:long_name = "total prior fluxes that include fossil and natural carbon
```

fluxes,unit:gram carbon per square meter per day" ;

```
float area(latitude, longitude) ;  
    area:missing_value = -999.f ;  
    area:_FillValue = -999.f ;  
    area:units = "m^2" ;  
    area:long_name = "area of each 1x1 grid box" ;
```

```
float latitude(latitude) ;  
    latitude:units = "degrees_north" ;  
    latitude:long_name = "latitude" ;
```

```
float longitude(longitude) ;  
    longitude:units = "degrees_east" ;  
    longitude:long_name = "longitude" ;
```

```
float time(time) ;  
    time:units = "months since 2010-01-15" ;
```