Description: Using the CASA GFED3 model we calculated monthly NPP and RH carbon fluxes at 0.5 by 0.5 degree resolution. These data were used to calculate NEE at a 3-hourly timestep and 1 by 1.25 degree resolution for CO2 modeling studies. In addition, biomass burning and fuel wood carbon emissions were estimated by the model on daily and monthly time steps, respectively. These calculations are driven by analyzed meteorological data from the Goddard Modeling and Assimilation Office (GMAO) for the period January 2003 through December 2011.

**The Goddard Space Flight Center CASA-GFED3 Terrestrial Carbon Cycle Model**

The Carnegie-Ames-Stanford-Approach – Global Fire Emissions Database version 3 (CASA-GFED3) derives from Potter et al. (1993), diverging in development since Randerson et al, (1996). CASA is a light use efficiency type model: net primary production (NPP) is expressed as the product of photosynthetically active solar radiation, a light use efficiency parameter, scalars that capture temperature and moisture limitations, and fractional absorption of solar radiation by the vegetation canopy (FPAR). This latter variable is derived from satellite data.

Fire parameterization was incorporated into the model by van der Werf et al. (2004) producing CASA-GFED and the model has undergone revisions (van der Werf et al, 2006, 2010) leading to its most recent version CASA-GFED3. Wildfire and fuel wood burning are counted individually.

Input data include air temperature, precipitation, incident solar radiation, a soil classification map, and a number of satellite derived products (MODIS MOD12Q1 vegetation classification, MODIS MOD44B vegetation continuous fields, MODIS MOD09GA/MYD09GA based burned area, and AVHRR NDVI). Here, meteorological data (temperature, precipitation, solar radiation) are taken from the GMAO Modern-Era Retrospective Analysis for Research and Applications (MERRA, Reinecker et al., 2011 and http://gmao.gsfc.nasa.gov/merra/).

CASA-GFED3 is run at monthly time steps with 0.5-degree spatial resolution. For this project it uses MERRA meteorology and FPAR derived from AVHRR NDVI (Tucker et al., 2005) according to the procedure of Los et al. (2000). The original 8-km, biweekly AVHRR NDVI was aggregated up to the monthly, 0.5 degree×0.5 degree grid by averaging.

The model output includes NPP, heterotrophic respiration (RH), wildfire emissions (FIRE), and fuel wood burning emissions (FUEL). Wildfire emissions were disaggregated from monthly to quasi-daily using the eight-day MODIS MYD14A2 Active Fire Product (data not included here but derivable from 3 hourly data).

Using 3 hourly MERRA air temperature and incident solar radiation, monthly fluxes were disaggregated into 3 hourly gross biological fluxes and added to produce the 3 hourly net carbon flux to the atmosphere according to the approach of Olsen and Randerson, 2004.

These and earlier versions of MERRA-driven CASA-GFED carbon fluxes have been used in a number of atmospheric CO2 transport studies (e.g. Campbell et al., 2008, Kawa et al., 2010, Hammerling et al., 2012).

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Information About the Data Files (netCDF format):

The following four file types are monthly, 0.5x0.5 degree, one file per year 2003-2011.

1. NPP.monthly.0.5x0.5.*year*.nc, net primary productivity data. Unit is gC/m^2/month.

2. RH.monthly.0.5x0.5.*year*.nc, heterotrophic respiration data. Unit is gC/m^2/month.

3. FIRE.monthly.0.5x0.5.*year*.nc, monthly wild fire emissions. Unit is gC/m^2/month.

4. FUEL.monthly.0.5x0.5.*year*.nc, fuel wood emissions. Unit is gC/m^2/month.

The next four file types contain 3 hourly data starting January 1, 00 GMT at 1 x 1.25 degrees (latitude x longitude), one file per year 2003-2011. Derived from monthly data according to procedure of Olsen and Randerson, 2004.

1. GEE.3hrly.1x1.25.*year*.nc, gross ecosystem exchange. Unit is kg C/m^2/s.

2. NEE.3hrly.1x1.25.*year*.nc, net ecosystem exchange. Unit is kg C/m^2/s.

3. FIRE.3hrly.1x1.25.*year*.nc, wild fire emissions. Unit is kg C/m^2/s.

4. FUEL.3hrly.1x1.25.*year*.nc, fuel wood emissions. Unit is kg C/m^2/s.

Conversion of Units:

1 kgC/m^2/s = 86,400s/day x 1e3gC/kgC x #days/month = # gC/m^2/month

Glossary:

FIRE: wildfire emission flux to the atmosphere

FUEL: fuel wood emission flux to the atmosphere

GEE: gross ecosystem exchange, carbon uptake from the atmosphere

NEE: net ecosystem exchange, net carbon flux to the atmosphere

NPP: net primary productivity, carbon flux to the vegetation

NEP: net carbon flux to the vegetation

RH: heterotrophic respiration from ecosystem

Derivable flux variables:

NEP: monthly net ecosystem productivity, NEP=NPP-RH

NBP: monthly net biome productivity, net flux to the ecosystem, NBP=NPP-RH-FIRE-FUEL

3 hourly net flux to the atmosphere = NEE+FIRE+FUEL

RE: 3 hourly total ecosystem respiration: RE=NEE-GEE

MERRA data is produced by the Global Modeling and Assimilation Office (GMAO) and distributed by the Goddard Earth Sciences Data and Information Services Center (GES DISC).