AirMOSS: L4 Daily Modeled Net Ecosystem Exchange (NEE), AirMOSS sites, 2012-2014

Get Data

Documentation Revision Date: 2016-11-21

Data Set Version: V1

Summary

This data set provides Level 4 daily estimates of Net Ecosystem Exchange (NEE) of CO2 at a spatial resolution of 30 arc-seconds (~1 km) for seven of the sites covered by the Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) flights, each site spanning ~2500 km2. The daily NEE estimates are generally available from October 2012 through October 2014, although the exact time ranges vary by site. The AirMOSS L4 daily NEE were produced by the Ecosystem Demography Biosphere Model (ED2) augmented by the AirMOSS-derived L2/3 root zone soil moisture data as an additional input. The AirMOSS soil moisture data were used to estimate the sensitivity of carbon fluxes to soil moisture and to diagnose and improve estimation and prediction of NEE by constraining the model's predictions of soil moisture and its impact on above- and below-ground fluxes.

This data set includes 7 files in netCDF (*.nc4) format. Each file contains the estimated L4 daily NEE at a particular site over the entire sampling period. The algorithm theoretical basis document (ATBD) for this data product is included as a companion file.

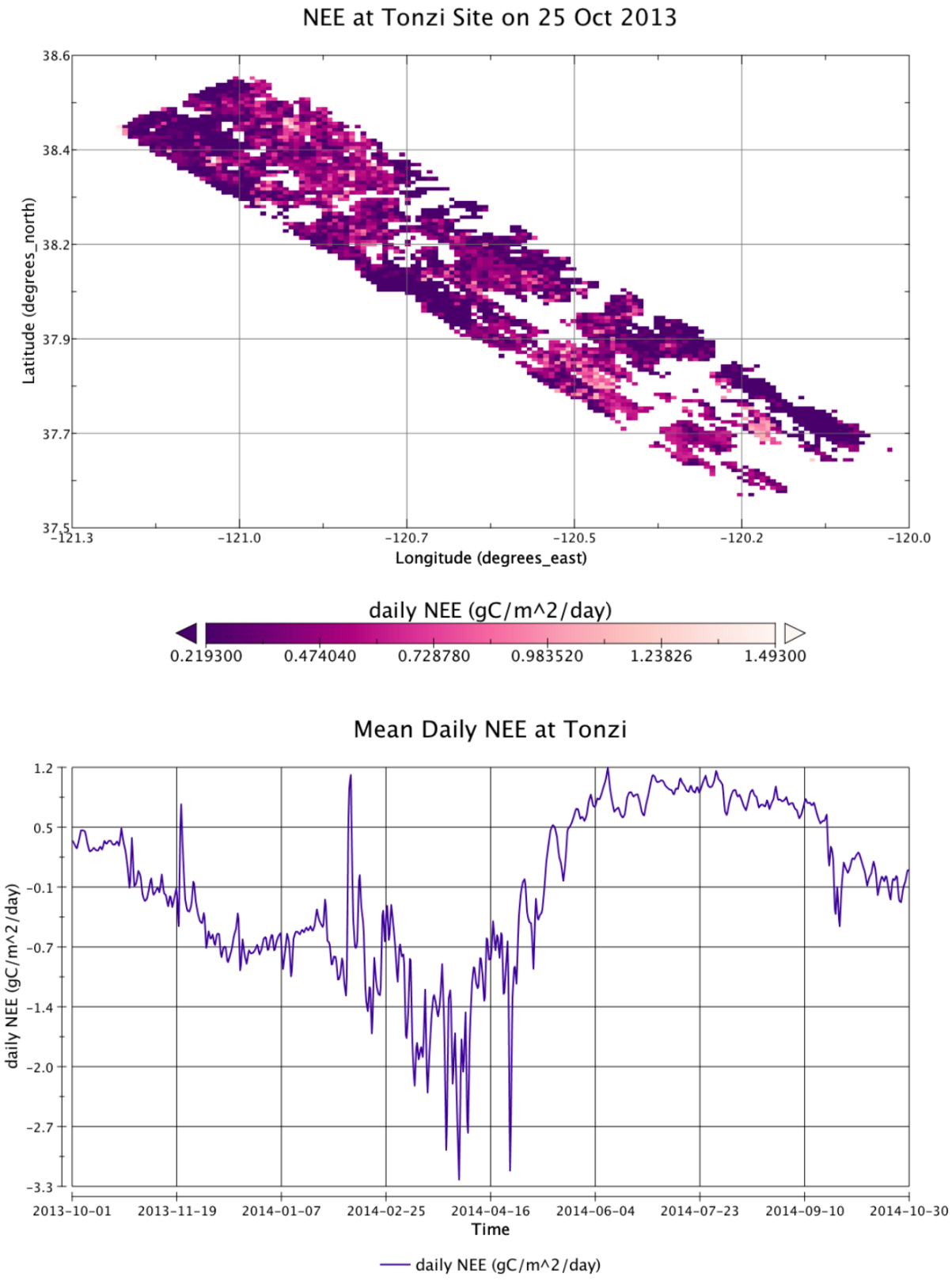

Figure 1: Spatial and temporal variability in Net Ecosystem Exchange (NEE) of CO2 at the Tonzi Ranch site.

Citation

Zhang, K., A.A. Ali, A. Antonarakis, and P.R. Moorcroft. 2016. AirMOSS: L4 Daily Modeled Net Ecosystem Exchange (NEE), AirMOSS sites, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1422

Table of Contents

1. Data Set Overview

This data set provides Level 4 daily estimates of Net Ecosystem Exchange (NEE) of CO2 at a spatial resolution of 30 arc-seconds (~1 km) for seven of the sites covered by the Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) flights, each site spanning ~2500 km2. The daily NEE estimates are generally available from October 2012 through October 2014, although the exact time ranges vary by site. The AirMOSS L4 daily NEE were produced by the Ecosystem Demography Biosphere Model (ED2) augmented by the AirMOSS-derived L2/3 root zone soil moisture data as an additional input. The AirMOSS soil moisture data were used to estimate the sensitivity of carbon fluxes to soil moisture and to diagnose and improve estimation and prediction of NEE by constraining the model's predictions of soil moisture and its impact on above- and below-ground fluxes.

Project: Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS)

The goal of NASA's Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) investigation is to provide high-resolution observations of root-zone soil moisture over regions representative of the major North American climatic habitats (biomes), quantify the impact of variations in soil moisture on the estimation of regional carbon fluxes, and extrapolate the reduced-uncertainty estimates of regional carbon fluxes to the continental scale of North America.

- The AirMOSS campaign used an airborne ultra-high frequency synthetic aperture radar flown on a Gulfstream-III aircraft to derive estimates of soil moisture down to approximately 1.2 meters.
- Extensive ground, tower, and aircraft in-situ measurements were collected to validate root-zone soil measurements and carbon flux model estimates.

The AirMOSS soil measurements can be used to better understand carbon fluxes and their associated uncertainties on a continental scale. Additionally, AirMOSS data provide a direct means for validating root-zone soil measurement algorithms from the Soil Moisture Active & Passive (SMAP) mission and assessing the impact of fine-scale heterogeneities in its coarse-resolution products.

Related Data:

The following AirMOSS data were directly used to generate this data:

Moghaddam, M., A. Tabatabaeenejad, R.H. Chen, S.S. Saatchi, S. Jaruwatanadilok, M. Burgin, X. Duan, and M.L. Tuong-Loi. 2016. AirMOSS: L2/3 Volumetric Soil Moisture Profiles Derived From Radar, 2012-2015. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1418

A full list of AirMOSS data products is available at:https://airmoss.ornl.gov/dataproducts.html

2. Data Characteristics

Spatial Coverage: Seven AirMOSS sites across North America

Spatial Resolution: 30 arc-seconds (~1 km)

Temporal Coverage: Most sites have data from October 2012 through October 2014, although the exact time range varies by site.

Temporal Resolution: Daily

Study Area (coordinates in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
North America	-122.88	-68.33	45.78	31.49

Table 1. AirMOSS sites where L4 Daily NEE data were estimated. Three additional AirMOSS sites at La Selva, Costa Rica, BERMS, Saskatchewan, Canada, and Chamela, Mexico, do not have L4 Daily NEE data.

Site name	North latitude	South latitude	East longitude	West longitude	Fluxnet Site ID	Description
DukeFr	36.368	35.437	-78.694	-79.849	US-Dk1,US-Dk2, US-	

					Dk3	Duke Forest site, North Carolina, USA. Landcover: Mature oak-hickory dominated hardwood forest. Elevation: 169m.
Harvrd	43.376	42.293	-71.839	-72.389	US-Ha1 & US-Ha2	Harvard Forest site, Massachusetts, USA. Landcover: temperate deciduous forest. Elevation: 353m.
Howlnd	45.778	44.669	-68.336	-69.086	US-Ho1, US-Ho2, US-Ho3	Howland Forest site, Maine, USA. Landcover: boreal - northern hardwood transitional forest. Elevation 72m.
Metoli	45.242	43.38	-120.363	-123.283	US-Me1 to US-Me6	Metolius site, Oregon, USA. Landcover: evergreen needleleaf forest. Elevation 1237m.
Moisst	36.880	35.775	-96.824	-98.996	US-ARM	The Marena, Oklahoma In Situ Sensor Testbed (MOISST) is located in Oklahoma, USA. Landcover: temperate grasslands, crops. Elevation: 312m.
TonziR	38.625	37.501	-120.001	-121.25	US-Ton	Tonzi Ranch site, California, USA. Landcover: oak savanna and grazed grassland. Elevation 170m.
Walnut	32.125	31.501	-109.376	-111.5	US-Wkg & US-Whs	Walnut Gulch site, Arizona, USA. Landcover: warm season C4 grassland with a few shrubs. Elevation 1524m.

Data File Information

This data set includes 7 files in netCDF (*.nc4) format. Each file contains the estimated L4 daily NEE at a particular site over the entire sampling period. The algorithm theoretical basis document (ATBD) for this data product is included as a companion file (**AirMOSS_L4NEE_ATBD_V2.0_160928.pdf**).

File naming convention

AirMOSS L4 Daily NEE data file names have the format:

L4ANEE_AssmltdL23_sssss_vv_dailync4

where:

sssss = 6-character sitename where data was acquired

vv = version number

Example file name:

L4ANEE_AssmltdL23_Tonzi_v1_dailync4

Table 2. Data fields in the L4A Daily NEE data files. Missing data are represented by -999.

Data Field	Units	Description
lat	degrees North	Latitude of grid cell
lon	degrees East	Longitude of grid cell
time	days since 2010-01-01 00:00:00 UTC	Date of modeled output
NEE	gC/m^2/day	Net ecosystem exchange of CO2 per grid cell

3. Application and Derivation

The AirMOSS data products and expected science results are tailored to meet the need to reduce uncertainty in estimates of net ecosystem exchange (NEE) through the development of methodologies to integrate remote sensing observations, in-ground soil sensors, and flux tower data into regional/continental flux models. Additionally, AirMOSS data provide a direct means for evaluating RZSM algorithms of the SMAP Decadal Survey mission and assessing the impact of fine-scale heterogeneities in its coarse-resolution products.

4. Quality Assessment

A key science objective of AirMOSS is a quantitative understanding of the impact of root-zone soil moisture on ecosystem carbon fluxes. The sensitivity of carbon flux to changes in soil moisture was calculated by comparing between ED2 model simulations that did, or did not, make use of AirMOSS soil moisture data. These comparisons are shown in the ATBD document for this data product.

5. Data Acquisition, Materials, and Methods

The goal of the Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) investigation is to provide high-resolution observations of root-zone soil moisture over regions representative of the major North American climatic habitats (biomes), quantify the impact of variations in soil moisture on the estimation of regional carbon fluxes, and extrapolate the reduced-uncertainty estimates of regional carbon fluxes to the continental scale of North America.

AirMOSS Flights

For AirMOSS, NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) was flown on a Gulfstream-III aircraft, making frequent flights over ten sites (Figure 2) in 9 different biomes of North America over the course of four years (Chapin et al. 2012).

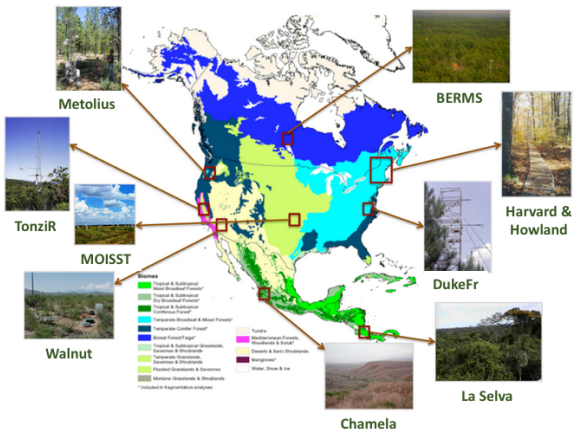

Figure 2. AirMOSS study sites were co-located with flux towers in nine different biomes across North America.

Beginning in September 2012, the AirMOSS instrument flew 215 flight campaigns. A summary of flight campaigns by year and site is found in Table 3. Typically, the aircraft made repeat visits to sites in the same region in a single week and then proceeded to another region. Most sites had at least three campaigns per year. The Harvard and Howland forest sites were flown together in a single day. In 2012, Chamela, La Selva, and Tonzi were not surveyed.

Table 3. Summary of AirMOSS flight campaigns.

	Site									
Year	**BermsP**	**Chamel**	**DukeFr**	**Harvrd**	**HowInd**	**LaSelv**	**Metoli**	**Oklaho**	**TonziR**	**Walnut**
2012	3	0	3	3	3	0	4	3	0	3
2013	6	3	9	9	9	6	7	8	5	6
2014	7	3	10	9	9	3	9	9	6	5
2015	9	2	5	5	5	3	9	6	5	6
Total	25	8	27	26	26	12	29	26	16	20

A complete list of AirMOSS flights can be found at: https://airmoss.ornl.gov/flights.html

AirMOSS Level 4A Daily NEE Data Product

Root-zone soil moisture and its spatial and temporal heterogeneity influences NEE. The AirMOSS L4A NEE data were produced by the Ecosystem Demography Model (ED2), augmented by inputs from AirMOSS L2/3 RZSM data. Specifically, the AirMOSS L2/3 RZSM data were used to estimate the sensitivity of carbon fluxes to soil moisture and to diagnose and improve estimation and prediction of NEE in ED2.

The Ecosystem Demography Biosphere Model (ED2) is an integrated terrestrial biosphere model incorporating hydrology, land-surface biophysics, vegetation dynamics, and soil carbon and nitrogen biogeochemistry (Medvigy *et al.* 2009). The inputs include: meteorological forcing data, soil properties information, definition of initial ecosystem structure and composition, and prescribed phenology data regarding the timing of leaf flush and leaf drop. AirMOSS L2/3 soil moisture data were used to constrain the model's predictions of soil moisture and its impact on above- and below-ground fluxes, as described Figure 3 below, and in the algorithm theoretical basis document (ATBD) for this data product, included with this data set, **AirMOSS_L4NEE_ATBD_V2.0_160928.pdf**

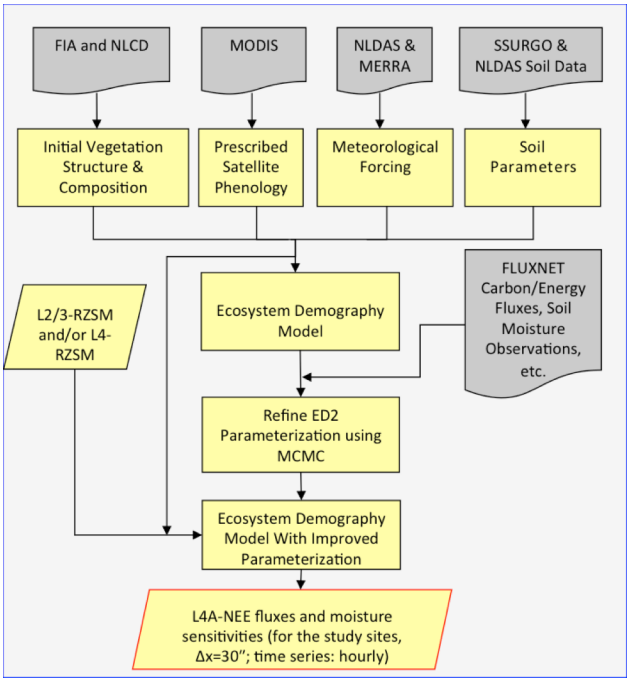

Figure 3. Flowchart describing the inputs, forcings, and initial conditions needed to produce the L4A-NEE products from the ED2 model.

6. Data Access

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

AirMOSS: L4 Daily Modeled Net Ecosystem Exchange (NEE), AirMOSS sites, 2012-2014

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Chapin, E., A. Chau, J. Chen, B. Heavey, S. Hensley, Y. Lou, R. Machuzak, and M. Moghaddam. 2012. AirMOSS: An Airborne P-band SAR to measure root-zone soil moisture, *2012 IEEE Radar Conference*, Atlanta, GA, 2012, pp. 0693-0698. http://dx.doi.org/10.1109/RADAR.2012.6212227

Medvigy, D, SC Wofsy, J.W. Munger, D.Y. Hollinger and P.R. Moorcroft (2009). Mechanistic scaling of ecosystem function and dynamics in space and time: the Ecosystem Demography model version 2, *Journal of Geophysical Research – Biogeosciences*, **114**(G1). http://dx.doi.org/10.1029/2008JG000812