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AirMOSS: L2 Airborne Carbon Flux at Selected AirMOSS Sites, 2012-2014

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Data Set Version: V1

Summary

This data set contains carbon flux measurements recorded by an aircraft at the Duke, Harvard, and Howland Forest sites during the summers of 2012-2014 as part of the Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) project. Frequent measurements of CO₂ and H₂O were obtained using a cavity ring down spectrometer on board the Airborne Laboratory for Atmospheric Research, operated by Purdue University. Estimates of surface CO₂ flux, sensible and latent heat fluxes, their corresponding uncertainties, and average wind speed and direction are provided for each of the 26 flights.

There are 27 files in comma-separated (*.csv) format included with this data set.

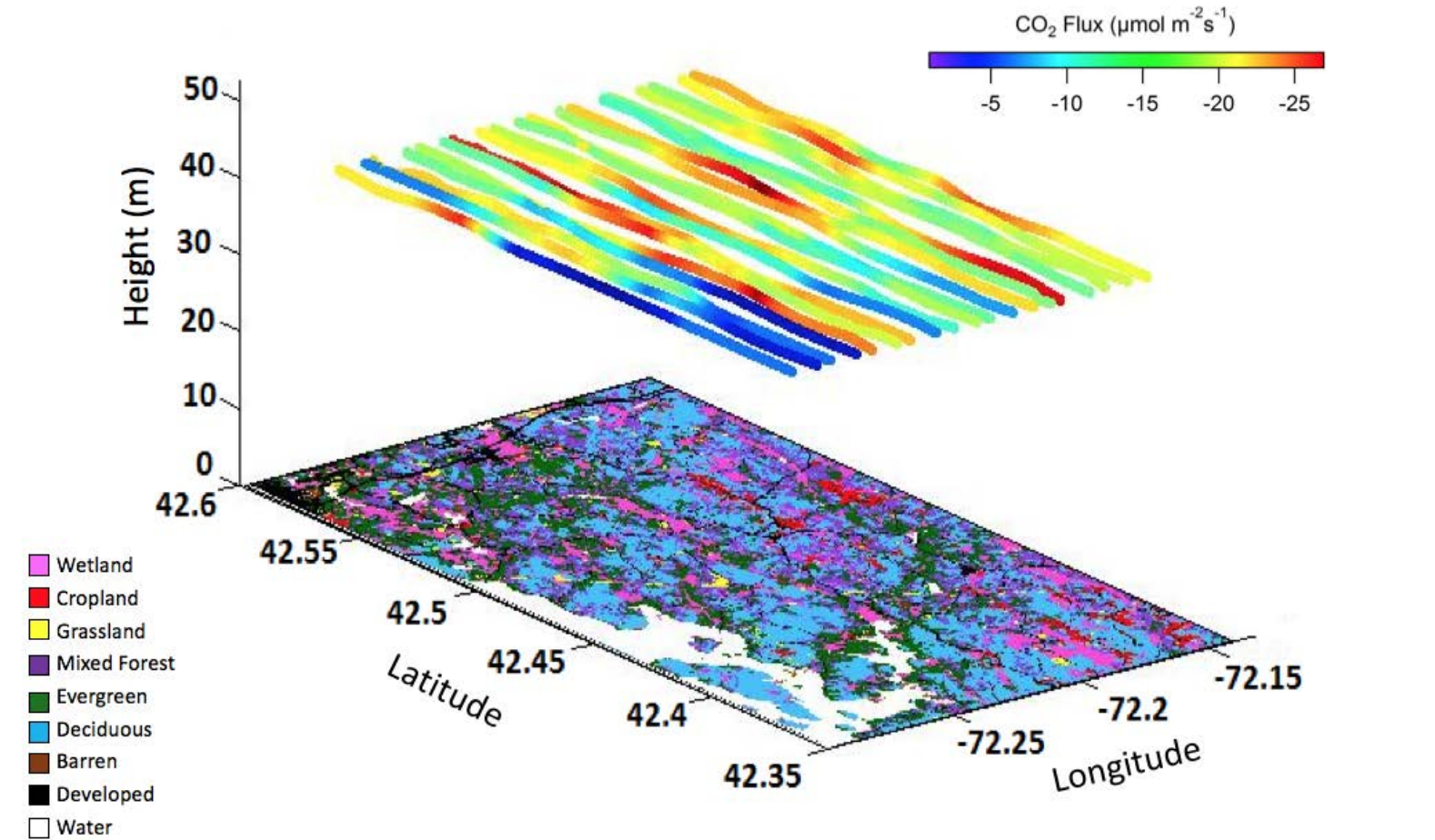


Figure 1: Fluxes of carbon dioxide observed during airborne sampling over the Harvard Forest site on June 1, 2014.

Citation

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1. Data Set Overview

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:

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

2. Data Characteristics

Spatial Coverage: 3 AirMOSS sites in North America

Spatial Resolution: Each value represents the average of all measurements obtained throughout one AirMOSS flight.

Temporal Coverage: 20120707 - 20140601

Temporal Resolution: Each value represents the average of all measurements obtained throughout one AirMOSS flight.

Study Area (coordinates in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
North America	-79.504	-68.430	45.643	35.770

Data File Information

This data set includes 26 comma-separated values (*.csv) files. Scientific data is in **AirMOSS_aircraft_Cflux_v2.csv**. The remaining files provide coordinates for the flight paths.

File naming convention

Files containing flight path coordinates are named as follows:

Flight_YYYYMMDD_S#_L2_flight_path.csv

where:

YYYYMMDD = flight date

S# = distinguishes between site 1 and site 2 when multiple flights were conducted on the same day

L2 = processing level 2

Example file names: Flight_20120707_S2_L2_flight_path.csv

Flight_20130819_L2_flight_path.csv

Table 1. AirMOSS sites where airborne carbon flux was measured.

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.

Table 2. Data fields in the data file. (*AirMOSS_aircraft_Cflux_v2.csv*)

Data Field	Units	Description
flight_date	yyyy-mm-dd UTC	Date of the carbon flux sampling flight
site		Name of the AirMOSS site
flight_mid_time_utc	hh:mm UTC	Time in seconds after midnight (UTC) corresponding to the middle of the flight
wind_direction	degrees	Average observed wind direction during the flight
wind_speed	m/s	Average observed wind speed during flight
H_flux	W m-2	Sensible heat (H) flux
H_std_dev	W m-2	SD of sensible heat (H) flux
LE_flux	W m-2	Latent heat (LE) flux
LE_std_dev	W m-2	SD of latent heat (LE) flux
CO2_flux	umol m-2 s-1	Carbon dioxide (CO2) flux
CO2_std_dev	umol m-2 s-1	SD of carbon dioxide (CO2) flux

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

These data are provided with no QA information other than the standard deviation of observations during each flight.

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).

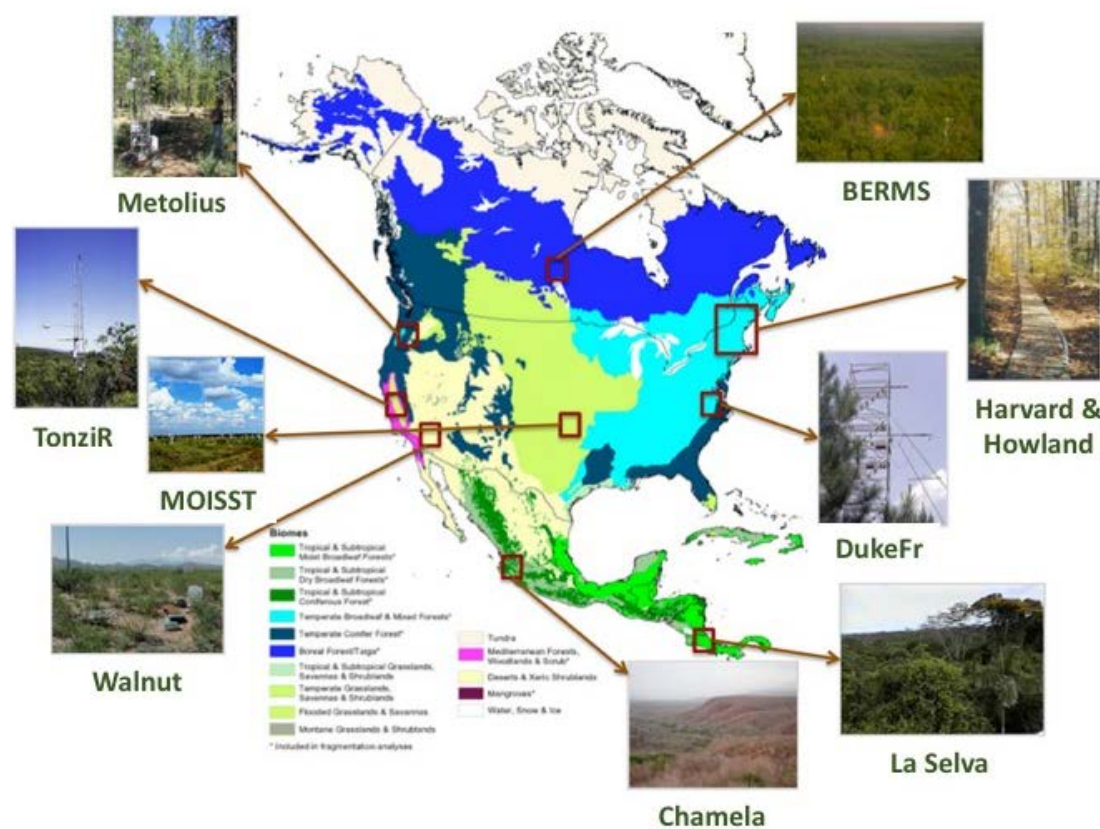


Figure 2. AirMOSS study sites were co-located with flux towers in nine different biomes across North America.

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.

Year	Site										
	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 2 Carbon Flux Data Product

Measurements were made with a Picarro Wavelength-Scanned Cavity Ring Down Spectrometer, a greenhouse gas analyzer that measures spatial variations in atmospheric CO₂, CH₄, and H₂O over the duration of flight. Rapid (12 Hz) measurements of CO₂ and H₂O were used to estimate CO₂ and latent heat flux, respectively.

Spatially averaged fluxes of latent heat (F_{LE}), sensible heat (F_H), and CO₂ were calculated according to Equations 1-3, respectively, to account for fluctuations in the aircraft's airspeed (Caulton 2014):

$$F_{LE} = \frac{\rho L}{\bar{S}_T} \cdot \sum w' q' S_i \Delta t \quad (1)$$

$$F_H = \frac{\rho C_p}{\bar{S}_T} \cdot \sum w' \theta' S_i \Delta t \quad (2)$$

$$F_{CO_2} = \frac{\rho}{\bar{S}_T} \cdot \sum w' CO_2' S_i \Delta t \quad (3)$$

Where ρ is the average dry-air density along the transect, L is the latent heat of vaporization of water, C_p is the specific heat of dry air at constant pressure, \bar{S}_T is the average groundspeed of the aircraft over the length of the transect (20 km), and T is the time to complete a transect. The variation in scalar concentration about the transect mean is given by q' , the perturbations in specific humidity for Equation 1, and θ' , the perturbations in potential temperature for Equation 2. CO_2' are perturbations in CO₂ concentration. The aircraft's instantaneous groundspeed is denoted by S_i , and the discrete sampling interval by Δt . Fluxes are calculated using 20 km-long averaging lengths to ensure adequate sampling of the spectrum of eddy sizes for the cruising speed of ~55 m s⁻¹. Units have been converted to report latent and sensible heat fluxes in W m⁻² and CO₂ flux in $\mu\text{mol m}^{-2} \text{s}^{-1}$. Negative flux values indicate the surface is a sink.

6. Data Access

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

[AirMOSS: L2 Airborne Carbon Flux at Selected AirMOSS Sites, 2012-2014](https://airmoss.ornl.gov/flights.html)

Contact for Data Center Access Information:

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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>

Caulton, Dana R. 2014. "Aircraft-Based Measurements for the Identification and Quantification of Sources and Sinks in the Carbon Cycle." Order No. 3686870, Purdue University. [Dissertation](#)



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