Quarterly Soil Core Analyses from the Missouri Ozarks AmeriFlux (MOFLUX) Site, Ashland, Missouri, 2017-2023

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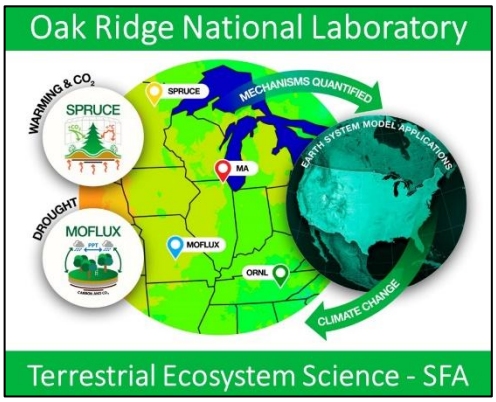

1. Data Set Overview:

This dataset contains quarterly soil core measurements from the Missouri Ozarks AmeriFlux (MOFLUX) site located at the University of Missouri's Thomas H. Baskett Wildlife Research and Education Area near Ashland, Missouri. These data will be used to parameterize an ensemble of MOFLUX-optimized soil C-N models, used to simulate C and N cycling responses to future hydroclimatic scenarios and the trajectory of soil C stocks with concomitant forest decline. Beginning in 2017, eight soil cores were collected approximately quarterly near plot 1 of the SE transect, near the automated soil respiration flux chambers, from 0–15 cm depth. Data are currently available through 2023 (2017-06-14 to 2023-11-13); additional observations will be appended to this dataset as they become available. Cores were analyzed for gravimetric moisture content, pH, total carbon and nitrogen, texture, microbial biomass carbon and nitrogen, and extractable dissolved organic carbon and nitrogen. This dataset contains one data file in comma separate (*.csv) format.

Data Citation:

Cite this data set as follows:
Mayes, Melanie A., Jana R. Phillips, Sarah L. Ottinger, Wyn Zenni, Julia Brenner, Joanne Childs, Thomas J. Mead, Joshua M. Birkebak, Bennett Wickenhauser, Drew Anderson, Brian Widmer, Sami S. Overby, Jeffrey D. Wood, and Lianhong Gu. 2024. **Quarterly Soil Core and Root Analyses from the Missouri Ozarks AmeriFlux (MOFLUX) Site, Ashland, Missouri, 2017-2023**. Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A. https://doi.org/10.25581/ornlsfa.034/2530530

Related Publication:

Portions of these data files have been analyzed and reported on in the following papers:

Liang, J., Wang, G., Singh, S., Jagadamma, S., Gu, L., Schadt, C.W., Wood, J.D., Hanson, P.J., Mayes, M.A. (2021) Intensified soil moisture extremes decrease soil organic carbon decomposition: a mechanistic modeling analysis. Journal of Geophysical Research - Biogeosciences 126, e2021JG006392 https://doi.org/10.1029/2021JG006392.

Liang, J., Wang, G., Riccuito, D.M., Gu, L., Hanson, P.J., Wood, J.D., Mayes, M.A. (2019) Evaluating the E3SM Land Model at a temperate forest site using flux and soil water measurements. Geoscientific Model Development 12, 1601-1612. https://doi.org/10.5194/gmd-12-1601-2019

Related Data Sets:

AmeriFlux BASE: https://doi.org/10.17190/AMF/1246081
Citation: Jeffrey Wood, Lianhong Gu (2022), AmeriFlux BASE US-MOz Missouri Ozark Site, Ver. 11-5, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/1246081

AmeriFlux FLUXNET: https://doi.org/10.17190/AMF/1854370
Citation: Jeffrey Wood, Lianhong Gu (2021), AmeriFlux FLUXNET-1F US-MOz Missouri Ozark Site, Ver. 3-5, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/1854370

Liang, J., Wang, G., Singh, S., Jagadamma, S., Gu, L., Schadt, C.W., Wood, J.D., Hanson, P.J., Mayes, M.A. 2021. MOFLUX intensified soil moisture extremes decrease soil organic carbon decomposition: Modeling archive. Oak Ridge National Laboratory, TES SFA, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A. https://doi.org/10.25581/ornlsfa.023/1804106

2. Data Characteristics:

Spatial Coverage

Core were collected at the Missouri Ozarks AmeriFlux (MOFLUX) site (https://ameriflux.lbl.gov/sites/siteinfo/US-MOz) at the University of Missouri's Thomas H. Baskett Wildlife Research and Education Area (https://moaes.missouri.edu/central-missouri-research-extension-and-education-center/baskett-forest/) near Ashland, Missouri within the temperate broadleaf deciduous forest biome (38.7441m -92.2000 at elevation 219.40 m)

Temporal Coverage

Cores were collected quarterly from 2017 through 2023 (2017-06-14 to 2023-11-13), however, the following collection events were missed: 2017 Q4, 2018 Q4, 2019 Q1, 2019 Q2, 2021 Q4, 2022 Q2, and 2022 Q4. Additional observations will be appended to this dataset as they become available.

Soil chemistry analyses were conducted on all collected samples, except for the first collection in which some samples were lost before analyses could be complete, and September of 2022 in which the chloroform fumigation for determination of the microbial biomass carbon and nitrogen could not be performed within a week of receipt.

Data File Description

These data are considered at **Quality Level 1**. Level 1 indicates an internally consistent data product that has been subjected to quality checks and data management procedures.

This data set contains one file in comma separate (*.csv) format:

- *MOFLUX_quarterly_soil_cores_2017_2023.csv*
    - Contains measurements of gravimetric moisture content, pH, total carbon and nitrogen, texture, microbial biomass carbon and nitrogen, and extractable dissolved organic carbon and nitrogen for quarterly soil cores collected at MOFLUX.

Missing numeric data are indicated by -9999 and missing text data are indicated by 'N/A'

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Data Dictionary for *MOFLUX_quarterly_soil_cores_2017_2023.csv*

Column Name	Units	Description
Sample_Date		Date sample was taken
Sample_Name		Human readable sample name
IGSN		IGSN (International Generic Sample Number) assigned to each unique sample when registered in the SESAR2 portal
Sample_doi		URL link to the sample metadata page in SESAR2
Core_Mass	g	mass of the entire core
GMC	(g water g-1 dry soil)	[mass of moist soil - mass of dried soil] / mass of dried soil
pH	Standard Units	pH of sample dissolved in Milli-Q water (1:4)
Total_C	percent	Amount of total carbon measured in soil
Total_N	percent	Amount of total nitrogen measured in soil
CN_ratio		Ratio of C to N in bulk soil sample
DOC_unfumigated	mg C g-1 dry soil	Dissolved organic carbon [Unfumigated TOC * (0.035/dry unfumigated soil weight)]

DN_unfumigated	mg N g-1 dry soil	Dissolved nitrogen [Unfumigated TN * (0.035/dry unfumigated soil weight)]
MBC	mg C g-1 dry soil	Microbial biomass carbon [[Fumigated DOC - Unfumigated DOC] / 0.45]
MBN	mg N g-1 dry soil	Microbial biomass nitrogen [[Fumigated DN - Unfumigated DN] / 0.54]
Sand	percent	Proportion of sample mineral content determined to be sand using particle size analysis
Silt	percent	Proportion of sample mineral content determined to be silt using particle size analysis
Clay	percent	Proportion of sample mineral content determined to be clay using particle size analysis
Texture		USDA Soil Texture Class

3 Applications and Derivation

These data will be used to parameterize an ensemble of MOFLUX-optimized soil C-N models, used to simulate C and N cycling responses to future hydroclimatic scenarios and the trajectory of soil C stocks with concomitant forest decline. These past and continuing measurements, along with long-term EC, SIF, and meteorology datastreams at MOFLUX, will enable a comprehensive modeling activity focused on connections between aboveground and belowground activities and functions.

4. Quality Assessment:

These data are considered at **Quality Level 1**. Level 1 indicates an internally consistent data product that has been subjected to quality checks and data management procedures. Established calibration procedures were followed. Results are reported for triplicate subsamples from the parent core for many of the analyses performed. If only one value is given, a single sample was analyzed.

5. Data Acquisition Materials and Methods:

Study Site

The Missouri Ozarks AmeriFlux (MOFLUX) site (https://ameriflux.lbl.gov/sites/siteinfo/US-MOz) is located at the University of Missouri's Thomas H. Baskett Wildlife Research and Education Area (https://moaes.missouri.edu/central-missouri-research-extension-and-education-center/baskett-forest/) near Ashland, Missouri within the temperate broadleaf deciduous forest biome (38.7441m -92.2000 at elevation 219.40 m) (Gu et al. 2016). The MOFLUX tower began

collecting carbon dioxide and water vapor data beginning in 2004 and continuing to the present. Soil fluxes of carbon dioxide and water vapor have been collected beginning in 2004 and continuing to the present.

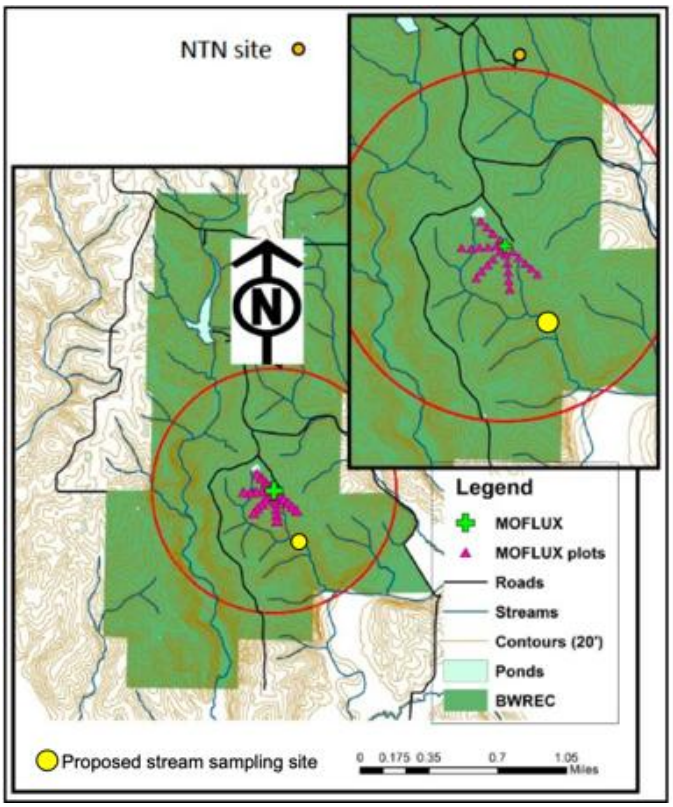

Figure 1. Footprint of the MOFLUX site (red circle), with the location of the eddy covariance tower (green cross), soil plots 1-6 (pink triangles), along 5 different transects (NW, W, SW, S, SE**).**

Methods

Sample Collection

For each time period, 8 soil cores were collected using a 2-inch diameter hammer corer to 15 cm depth. Soil cores were returned (on blue ice) to ORNL and stored at 4 ºC. Samples were sieved to < 2 mm before analysis.

Fresh subsamples were analyzed for gravimetric moisture content (GMC), Dissolved Organic Carbon (DOC), Dissolved Nitrogen (DN), Microbial Biomass Carbon (MBC), and Microbial Biomass Nitrogen (MBN) within one week of sampling. Subsamples were dried at 60–70 ºC for pH; total nitrogen (TN), total carbon (TC), C:N, and texture (percent sand, silt, clay). Three analytical replicates were performed for each core, except texture analysis (one sample). The remaining sample was air-dried and archived.

Soil Characterization and Chemistry

Gravimetric moisture content (GMC) (dry %) was calculated by allowing ~5 g of field moist soil to dry at 60–70 ºC for two days and using the equation:

GMC (dry %) = $[(m_f - m_d)/m_d] \times 100$

where m_f is the mass of fresh field moist soil and m_d is the mass of the dried soil.

Particle size analysis for soil texture (% sand, silt, clay) was evaluated with the Bouyoucos hydrometer method (Gee and Or, 2002). Textural analyses were performed at the University of Georgia Agricultural and Environmental Services Laboratories (AESL). All other analyses were conducted at ORNL. Soil pH was determined by shaking 1 part soil in 4 parts MQ water solution and measuring the pH of the supernatant using a pH probe. Total C and N of ground soils were determined by a Leco Tru-Spec CN combustion analyzer (Leco Corp., St. Joseph, MI, USA) or an Elementar combustion analyzer (Elementar UNICUBE Trace, Ronkonkoma, NY, USA).

Three subsamples of 7.5 ± 0.5 g fresh soil were used to extract DOC and DN or were fumigated with chloroform for a total of 48 ± 4 hours prior to extraction. For both extractions, soil was combined with 35 mL of 0.5 M K_2SO_4 and shaken on a reciprocating shaker for 1–2 hours. Afterward, the soil suspensions were centrifuged (3,500 rcf for 10 minutes), gravity filtered through a Whatman No. 42 filter paper, and stored at -20° C until analysis. The extracts were analyzed for total organic carbon/non-purgeable organic carbon and total nitrogen (2017–2022: Shimadzu TOC-L CSH/CSN analyzer, Baltimore, MD, USA; 2023: Elementar Vario TOC Cube, Ronkonkoma, NY, USA). Microbial Biomass (C and N) was calculated using the following equation:

$MB = K_x/E_x$

where MB refers to either MBC or MBN; K_x is the difference between extractable elements before and after fumigation; and E_x is the extraction efficiency coefficient (Vance et al. 1987). Although extraction efficiency will vary by individual soil, standard values were used for E_x; specifically, 0.45 for C (Beck et al. 1997) and 0.54 for N (Brookes et al. 1985).

6. Related References:

Beck, T., R. G. Joergensen, E. Kandeler, F. Makeschin, E. Nuss, H. R. Oberholzer, and Scheu, S. 1997. An inter-laboratory comparison of ten different ways of measuring soil microbial biomass C. Soil Biology & Biochemistry 29, 1023–1032.

Brookes, P. C., A. Landman, G. Pruden, and Jenkinson, D.S. (1985) Chloroform fumigation and the release of soil nitrogen: a rapid direct extraction method to measure microbial biomass nitrogen in soil. Soil Biology & Biochemistry 17, 837–842.

Gee, G.W., and Or, D. (2002) Particle-size analysis. In: Dame, J.H., and Topp, G.C. (Eds.), Methods of Soil Analysis, Part 4 – Physical Methods. Soil Science Society of America, Madison, Wisconsin, USA, pp. 255–293.

Gu, L., Pallardy, S. G., Yang, B., Hosman, K. P., Mao, J., Ricciuto, D., Shi, X., Sun, Y. 2016. Testing a land model in ecosystem functional space via a comparison of observed and modeled ecosystem responses to precipitation regimes and associated stresses in a central U.S. forest, Journal Of Geophysical Research: Biogeosciences, 121:7, 1884-1902.

Vance, E.D., Brookes, P.C., and Jenkinson, D.S. (1987) An extraction method for measuring soil microbial biomass – C. Soil Biology & Biochemistry 19, 703–707.

7. Data Access:

Get Data

For public access to data from the US Department of Energy Terrestrial Ecosystem Science Scientific Focus Ares (TES-SFA) please visit: **https://tes-sfa.ornl.gov/node/80**. Data will also be made available on ESS-DIVE: **https://ess-dive.lbl.gov/**.

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