Litter Production of Oak-Hickory Forest at Missouri Ozark (MOFLUX) Site: 2003-2015

ORNL TERRESTRIAL ECOSYSTEM SCIENCE

SCIENTIFIC FOCUS AREA

Climate Variability and Extreme Events

Summary:

Litter production has been measured at the second-growth upland oak-hickory forest at the Missouri Ozark AmeriFlux (MOFLUX) site. The MOFLUX site is located in the University of Missouri Baskett Wildlife Research area (BWREA), situated in the Ozark Border Region of central Missouri, USA, and is part of the AmeriFlux network (site ID: US-MOz).

During 2003, 24 circular vegetation plots (each 0.08 ha) were established in the MOFLUX forest. The plots were situated 50 m apart on 5 linear transects radiating out from the flux tower base in SE, S, SW, W and NW directions—there were 5 plots per transect except for the NW one, which had only 4 due to the presence of a small pond at the terminus (Fig. 1). Litter measurements were initiated in October 2003 and continue to the present. Data through 2015 are reported in this current dataset.

On each plot, two subplots were established for the collection of litter. Subplots were setup using a stratified random design to ensure the collectors were not immediately adjacent to one another. Litter collectors were usually emptied at monthly intervals, or less during the autumn leaf drop. Samples were dried to constant mass and then sorted before determining the dry mass of leaf, vegetative and woody litter.

There is one comma separated (.csv) data file of vegetation inventory in this data set, with a related published article included as a companion file (Liang et al. 2020).

Data Citation:

Cite this data set as follows:

Wood, J.D., Pallardy, S.G., Gu, L., and Hosman, K.P. 2020. **Litter Production of Oak-Hickory Forest at Missouri Ozark (MOFLUX) Site: 2003-2015.** Oak Ridge National Laboratory, TES SFA, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A. https://doi.org/10.25581/ornlsfa.019/1619052

Please include these citations to the related publications:

Liang, J., Wang, G., Singh, S., Jagadamma, S., Gu, G., Schadt, C., **Wood, J.**, Hanson, P., Mayes, M. Intensified Soil Moisture Extremes Decrease Soil Organic Carbon Decomposition: A Mechanistic Modeling Analysis. *Journal of Geophysical Research: Biogeosciences*, Manuscript # 2020JG005807, submitted 2020-04-25.

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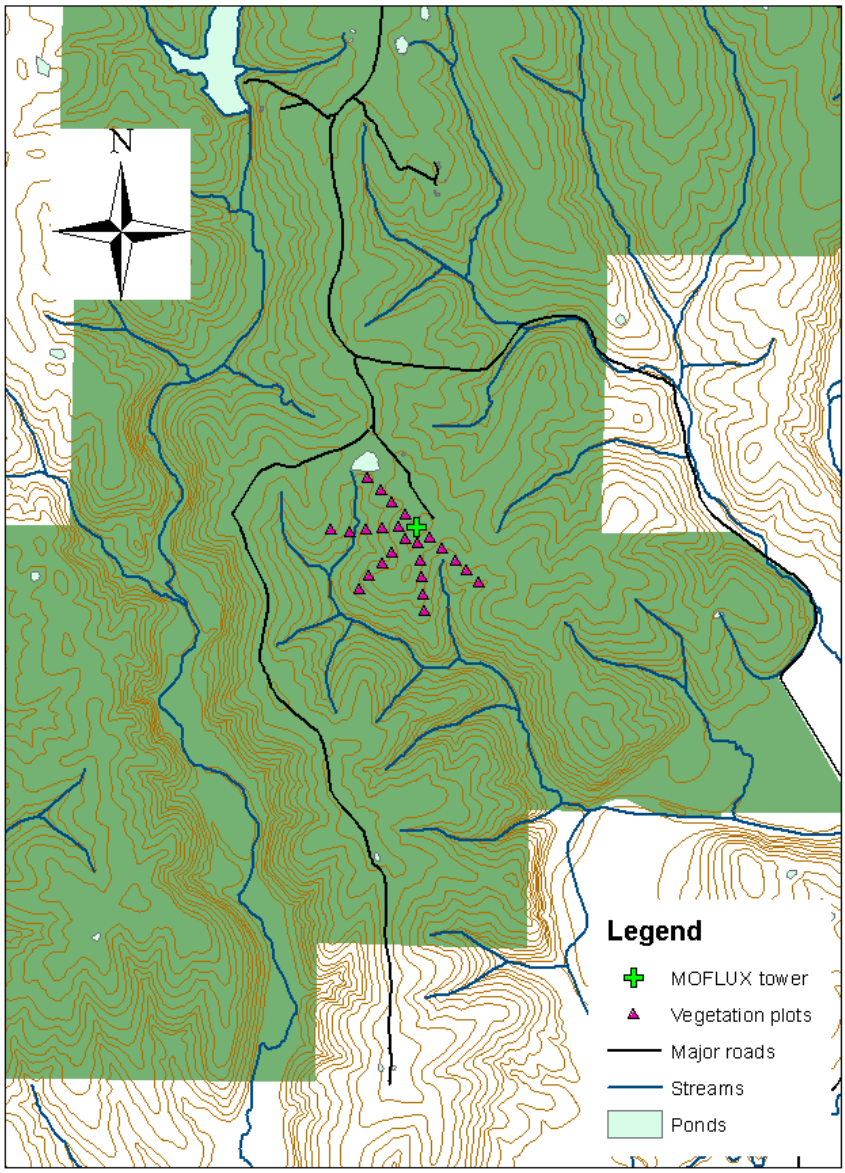

Figure 1. Map showing the spatial distribution of vegetation plots relative to the MOFLUX tower site at the Baskett Wildlife Research and Education Center (green shaded area) near Ashland MO (from Wood et al., 2018, doi: 10.1088/1748-9326/aa94fa). The brown lines represent 20' contours.

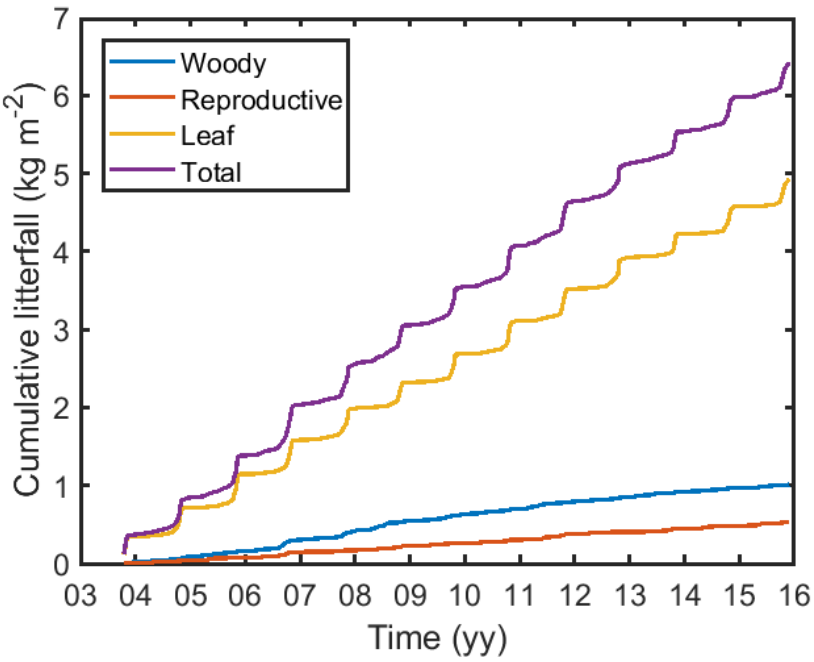

Figure 2. Cumulative production of woody, reproductive, leaf and total litter from 2004 through 2015 and the MOFLUX site.

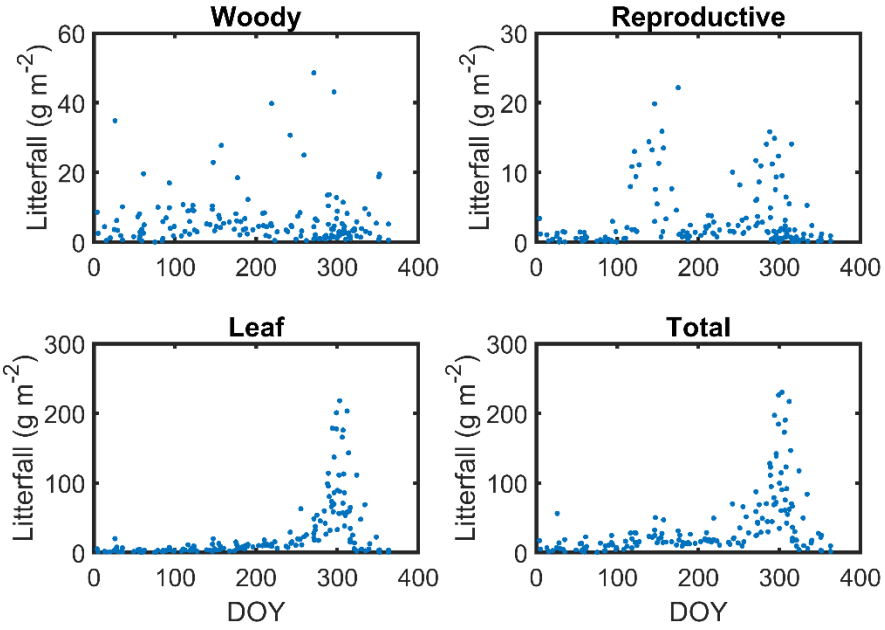

Figure 3. Seasonality of woody, reproductive, leaf and total litter from 2004 through 2015 and the MOFLUX site.

Data and Documentation Access:

Get Data

For public access to data please visit the ORNL TES-SFA Web Site: https://tes-sfa.ornl.gov/home

Published Papers included as a companion file: N/A

Links to Supplemental Data and Information

AmeriFlux: Missouri Ozark / US-MOz (http://ameriflux.lbl.gov/sites/siteinfo/US-MOz)

Related Data Sets:

Pallardy, S.G., Gu, L., Wood, J.D., Hosman, K.P., & Hook, L.A. *Vegetation Inventory of Oak-Hickory Forest at Missouri Ozark (MOFLUX) Site: 2004-2017*. United States. https://doi.org/10.25581/ornlsfa.016/1498529

Pallardy, S.G., Gu, L., Wood, J.D., Hosman, K. P., Sun, Y., & Hook, Les. *Predawn Leaf Water Potential of Oak-Hickory Forest at Missouri Ozark (MOFLUX) Site: 2004-2017*. United States. https://doi.org/10.3334/CDIAC/ORNLSFA.004

ORNL TES-SFA Data Policy: Archiving, Sharing, and Fair-Use

Project Description

Investigators have been monitoring litter production and predawn leaf water potential at the Missouri Ozark AmeriFlux (MOFLUX) site since 2004, and vegetation inventory since 2005.

The different tree species monitored at the MOFLUX site exhibit a range of drought tolerance. During the study period, a wide range of precipitation regimes from abundant rain to extreme drought occurred at the MOFLUX site, resulting in large inter-annual fluctuations in plant water stress levels, associated tree mortality and litter production dynamics.

Table of Contents:

1. Data Set Overview:

This data set reports litter production (leaf, vegetative and woody tissues) data that have been collected during the 2004 to 2017 growing seasons of the second-growth upland oak-hickory forests at the Missouri Ozark AmeriFlux (MOFLUX) site. The MOFLUX site is located in the University of Missouri Baskett Wildlife Research area (BWREA), situated in the Ozark region of central Missouri, USA.

2. Data Characteristics:

Spatial Coverage

Litter production was measured on 24 circular plots for which centers were within ~250 m of the tower (Fig. 1). See location in Site boundary table below and Figure 1 for the layout of the site.

Spatial Resolution

All 24 plots, each of area 0.08 ha, were included in the litter collection.

Site boundaries: Latitude and longitude given in decimal degrees.

Site	Latitude	Longitude	Elevation (meters amsl)	Geodetic Datum	UTM Zone
Missouri Ozark Site (US-MOz)	38.7441	-92.2000	212	WGS84	15S

Source: AmeriFlux: Missouri Ozark/US-MOz, http://ameriflux.lbl.gov/sites/siteinfo/US-MOz

Temporal Coverage

The data cover the period October 2003 through calendar year 2015. *Full data years are thus provided for years 2004 through 2015*.

Temporal Resolution

Litter was usually collected at around monthly intervals, with more frequent sampling (~weekly intervals) at times during the autumn leaf drop.

Data File Description

The data are provided in one comma separated (.csv) data file of litter production.

MOFLUX_LeafLitter_L2_2004_2015_v20200608.csv

A row is uniquely defined by the YEAR, and DOY and the file is sorted by YEAR and DOY.

Data Dictionary:

Column #	Column name	Description†	Range of values	Missing value
1	Year	Observation year (YYYY)	2003–2015	None
2	DOY	The day of year that samples were collected.	1–366	None
3	WOODY	Mean woody litter production (g/m^2 of dry mass since prior collection)	0.06–48.57	None
4	REPRODUCTIVE	Mean reproductive litter production (g/m^2 of dry mass since prior collection)	0.00–22.18	None
5	LEAF	Mean leaf litter production (g/m^2 of dry mass since prior collection)	0.34–217.69	None
6	TOTAL	Mean total litter production (g/m^2 of dry mass since prior collection)	0.58–230.06	None
7	WOODY_SE	Standard error of woody litter production (g/m^2 of dry mass since prior collection)	0.03–40.31	None

Column #	Column name	Description†	Range of values	Missing value
8	REPRODUCTIVE_SE	Standard error of reproductive litter production (g/m^2 of dry mass since prior collection)	0.00–11.63	None
9	LEAF_SE	Standard error of leaf litter production (g/m^2 of dry mass since prior collection)	0.06–9.46	None
10	TOTAL_SE	Standard error of total litter production (g/m^2 of dry mass since prior collection)	0.15–40.63	None

†For each data record, means and standard errors (N = 48) were calculated by pooling all subplots to yield forest-level statistics.

Example data records:

```
YEAR,DOY,WOODY,REPRODUCTIVE,LEAF,TOTAL,WOODY_SE,REPRODUCTIVE_SE,LEAF_SE,TOTAL_SE
,,g/m2,g/m2,g/m2,g/m2,g/m2,g/m2,g/m2,g/m2
2003,289,5.13,3.53,113.88,122.54,1.16,1.08,7.91,7.95
2003,296,1.54,0.99,69.61,72.13,0.32,0.37,4.62,4.74
2003,303,1.96,0.50,87.73,90.19,0.43,0.36,4.85,5.10
2003,310,0.79,0.84,53.37,55.01,0.24,0.36,4.44,4.61
2003,316,1.32,0.30,19.01,20.63,0.61,0.12,2.10,2.33
2004,35,10.14,1.43,7.04,18.61,3.72,0.47,1.17,3.80
2004,62,4.99,0.71,3.47,9.17,1.83,0.23,0.58,1.87
2004,99,4.57,0.05,2.66,7.27,2.72,0.02,0.44,3.03
2004,127,2.99,11.08,1.64,15.71,0.64,0.81,0.29,1.09
…
2005,25,3.62,0.86,2.79,7.27,1.14,0.27,1.17,1.79
2005,57,1.81,0.15,0.38,2.35,0.69,0.10,0.06,0.68
2005,89,6.99,0.41,3.24,10.64,1.86,0.19,0.54,1.89
2005,121,9.28,13.01,6.38,28.67,2.44,0.74,0.71,2.69
2005,151,4.51,11.30,3.72,19.53,1.16,0.89,0.61,1.61
2005,181,5.90,1.57,7.10,14.57,1.82,0.55,1.78,2.61
…
2015,208,8.21,1.41,10.02,19.64,3.96,0.26,2.48,4.45
2015,239,3.03,1.57,7.35,11.95,0.91,0.4,1.2,1.4
2015,273,2.19,3.7,37.78,43.67,0.63,1.03,3.99,4
2015,303,2.82,9.55,217.69,230.06,0.7,3.05,8.11,8.68
2015,334,9.62,5.29,68.86,83.77,2.55,1.72,7.49,8.15
```

3. Data Application and Derivation:

These litter data were used in a theoretical modeling investigation to examine the impacts of intensifying moisture extremes (i.e., moisture excess and deficit conditions) on soil carbon cycling. The data were used as inputs for the Mirobial ENzyme Decomposition (MEND) model, which was used to simulate five scenarios characterized by different intensities and frequencies of moisture extremes (both water excess and deficits). Results showed that the changes in active microbial biomass C and the corresponding turnover rates of SOC pools were more sensitive to extreme soil drying than soil wetting. This study emphasized the nonlinear response of SOC decomposition to soil moisture changes, which caused decreased decomposition by microbes under drying that is not compensated by increased decomposition under wetting conditions

4. Quality Assessment:

These data are considered at **Quality Level 2**. Level 2 indicates a complete, externally consistent data product that has undergone interpretative and diagnostic analyses, and have been aggregated to forest-level means. The data product has been subjected to quality checks and data management procedures (Level 1).

5. Data Acquisition Materials and Methods:

Site Description

The MOFLUX site is located in the University of Missouri Baskett Wildlife Research area (BWREA), situated in the Ozark region of central Missouri. The site is uniquely located in the ecologically important transitional zone between the central hardwood region and the central grassland region of the US. The land has been publically owned since the 1930s, and is on a land tract that was forested with the same dominant species before settlement in the early 1800s. BWREA is within the Ozark border region of central Missouri. Second-growth upland oak-hickory forests constitute the major vegetation type at the BWREA (Rochow, 1972; Pallardy et al., 1988). Major tree species include white oak (*Quercus alba* L.), black oak (*Q. velutina* Lam.), shagbark hickory (*Carya ovata* (Mill.) K. Koch), sugar maple (*Acer saccharum* Marsh.), and eastern redcedar (*Juniperus virginiana* L.). Although these species co-occur in MOFLUX forests, there are differences in which species dominate in particular locations.

Figure 3. View of the forest from the top of the tower looking west.

Figure 4. View of the forest from the ground looking to the southeast from near the base of the tower.

Figure 5. View of the forest near the base of the tower that is located inside the fenced area at right.

Litter Collection

Litter was collected on 24 circular vegetation plots (each 0.08 ha) in the MOFLUX forest. The plots were situated 50 m apart on 5 linear transects radiating out from the flux tower base in SE,

S, SW, W and NW directions—there were 5 plots per transect except for the NW one, which had only 4 due to the presence of a small pond at the terminus (Fig. 1). Litter measurements were initiated in October 2003.

On each plot, two subplots were established for the collection of litter. Subplots were setup using a stratified random design to ensure the collectors were not immediately adjacent to one another. On each plot, traps A and B were deployed at random azimuths ranging from 0–180° and 181–360º, respectively, and at random distances ranging from 2–15 m from the plot center. When randomizing, if both traps fell within 90º of one another (i.e., in the same quadrant) or both were within 2.5 m of the plot center, the randomization was redone.

The collectors were Sterilite storage tubs (Fig. 6) having approximate dimensions of 54 cm × 41 cm × 38 cm (length × width × depth, with rounded corners). Holes were drilled in the bottom of the tubs to permit the drainage of water. Each collector was deployed on a wooden platform constructed from CCA treated wood. The platform consisted of a piece of plywood on top of three wooden stakes (4.5 × 4.5 cm), with the top of the platform being a minimum of 20 cm above the ground.

The litter collectors were usually emptied at monthly intervals, or less during the autumn leaf drop. Samples were stored in paper bags for transportation to the lab. Samples were dried to constant mass and then sorted before determining the dry mass (±0.01 g) of leaf, vegetative and woody litter.

Figure 6. Photograph of one of the litter collectors.

Additional Site Measurements

- The MOFLUX site is an active AmeriFlux site and the standard flux product can be retrieved from the AmeriFlux database (https://ameriflux.lbl.gov/).
- Weekly to bi-weekly measurements of the predawn leaf water potential of common tree species have been made since 2004. Data are available at: https://tes-sfa.ornl.gov/node/80.
- Forest inventory has been tracked on vegetation plots since 2005. Data are available at https://tes-sfa.ornl.gov/node/80.
- The MOFLUX site was part of a comparative study examining the differences in micrometeorological responses to a total solar eclipse over forest, soybean and prairie vegetation. Data are available at https://tes-sfa.ornl.gov/node/80.

6. References:

Liang, J., Wang, G., Singh, S., Jagadamma, S., Gu, G., Schadt, C., **Wood, J.**, Hanson, P., Mayes, M. Intensified Soil Moisture Extremes Decrease Soil Organic Carbon Decomposition: A Mechanistic Modeling Analysis. *Journal of Geophysical Research: Biogeosciences*, Manuscript # 2020JG005807, submitted 2020-04-25.

Pallardy SG, Gu L., Wood JD, Hosman KP, Sun Y., and Hook L. Predawn Leaf Water Potential of Oak-Hickory Forest at Missouri Ozark (MOFLUX) Site: 2004-2017. United States: N. p., 2018. Web. doi:10.3334/CDIAC/ORNLSFA.004.

Pallardy SG, Nigh TA, Garrett HE (1988) Changes in forest composition in central Missouri: 1968–1982. The American Midland Naturalist, 120, 380–390.

Rochow JJ (1972) A vegetational description of a mid-Missouri forest using gradient analysis techniques, American Midland Naturalist, 87, 377–396.

Wood JD, Knapp BO, Muzika R-M, Stambaugh MC and Gu L (2018) The importance of drought-pathogen interactions in driving oak mortality events in the Ozark Border Region, Environmental Research Letters, 13:015004, doi: 10.1088/1748-9326/aa94fa.

Data Access:

For public access to ORNL TES SFA data please visit the TES SFA Web Site: https://tes-sfa.ornl.gov/home

Contact for Data Access Information: https://mnspruce.ornl.gov/contact