NEON USER GUIDE TO COARSE DOWNED WOOD LOG SURVEY (NEON.DP1.10010)

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CHANGE RECORD

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1 DESCRIPTION

1.1 Purpose

This document provides an overview of the data included in this NEON Level 1 data product, the quality controlled product generated from raw Level 0 data, and associated metadata. In the NEON data products framework, the raw data collected in the field, for example, the dry weights of litter functional groups from a single collection event are considered the lowest level (Level 0). Raw data that have been quality checked via the steps detailed herein, as well as simple metrics that emerge from the raw data are considered Level 1 data products.

The text herein provides a discussion of measurement theory and implementation, data product provenance, quality assurance and control methods used, and approximations and/or assumptions made during L1 data creation.

1.2 Scope

This document describes the steps needed to generate the L1 data product, Coarse Downed Wood Log Survey - The tally and raw measurement of coarse downed wood particles ≥ 2 cm diameter and ≥ 1 m length - and associated metadata from input data. This document also provides details relevant to the publication of the data products via the NEON data portal, with additional detail available in the file, NEON Data Publication Workbook for TOS Coarse Downed Wood: QA/QC of Raw Field Tally Data (NEON.DP1.10010) (AD[05]), provided in the download package for this data product.

This document describes the process for ingesting and performing automated quality assurance and control procedures on the data collected in the field pertaining to TOS Field and Lab Protocol: Coarse Downed Wood (AD[07]). The raw data that are processed in this document are detailed in the file, NEON Raw Data Ingest Workbook for TOS Coarse Downed Wood: Field Tally Data (NEON.DP0.10010) (AD[04]), provided in the download package for this data product. Please note that raw data products (denoted by 'DP0') may not always have the same numbers (e.g., '10010') as the corresponding L1 data product.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Associated Documents

AD[01]	NEON.DOC.000001	NEON Observatory Design (NOD) Requirements
AD[02]	NEON.DOC.000913	TOS Science Design for Spatial Sampling
AD[03]	NEON.DOC.002652	NEON Level 1, Level 2 and Level 3 Data Products Catalog
AD[04]	NEON.DP0.10010.001 _dataValidation.csv	NEON Raw Data Ingest Workbook for TOS Coarse Downed Wood: Field Tally Data (NEON.DP0.10010)
AD[05]	NEON.DP1.10010.001 _variables.csv	NEON Data Publication Workbook for TOS Coarse Downed Wood: QA/QC of Raw Field Tally Data (NEON.DP1.10010)
AD[06]	NEON.DOC.000914	TOS Science Design for Plant Biomass, Productivity, and Leaf Area Index
AD[07]	NEON.DOC.001711	TOS Field and Lab Protocol: Coarse Downed Wood
AD[08]	NEON.DOC.000913	TOS Science Design for Spatial Sampling
AD[09]	NEON.DOC.000913	TOS Science Design for Plant Diversity
AD[10]	NEON.DOC.000008	NEON Acronym List
AD[11]	NEON.DOC.000243	NEON Glossary of Terms
AD[12]	NEON.DOC.001710	TOS Protocol and Procedure: Measurement of Litterfall and Fine Woody Debris
AD[13]	NEON.DOC.000987	TOS Protocol and Procedure: Measurement of Vegetation Structure
AD[14]	OS_Generic_Transitions .pdf	NEON Algorithm Theoretical Basis Document: OS Generic Transitions
AD[15]		NEON's Ingest Conversion Language (NICL) specifications

2.2 Acronyms

Acronym	Definition
CDW	Coarse Downed Wood
LIDS	Line Intercept Distance Sampling

3 DATA PRODUCT DESCRIPTION

The Coarse Downed Wood Survey data product provides volume estimates of downed logs ≥ 2cm diameter across NEON sites. Tally surveys are completed according to the Line Intercept Distance Sampling method (LIDS; Affleck 2008). LIDS sampling tallies logs with probability proportional to volume and restricts the search for logs to a transect or group of radial transects at each sampling point (Affleck 2008, 2010). By using transects, detection errors in brushy or complex terrain are minimized compared to other techniques that require searching for logs over large areas (Jordan et al. 2004). The length of the transect is not fixed with the LIDS method; instead, the length of the transect increases for large-volume logs, ensuring that a representative sample of large logs is tallied across multiple field sites (Affleck 2008).

Qualifying particles of CDW are divided into three different diameter size categories, as defined by Keller et al. (2004): 2-5 cm, 5-10 cm, and ≥ 10 cm. To qualify for inclusion, logs or portions of logs within a given size category must also be ≥ 1 m in length (Harmon and Sexton 1996). Dead trees (i.e. snags) that have not yet fallen to an angle > 45° from vertical are accounted for via the Vegetation Structure protocol (AD[13]), and logs that are suspended in the air > 2 m above the ground at the transect intersection point are ignored. Woody particles with diameter < 2 cm at the transect intersection point are considered fine woody debris and are sampled according to the Litterfall and Fine Woody Debris protocol (AD[12]).

Data recorded for each qualifying log encountered on a transect include: - taxonID - physical characteristics (length, diameter at transect intersect point(s), distance from transect origin) - decay class (including presence/absence of leaves and branches, % bark cover, etc.)

3.1 Spatial Sampling Design

Coarse downed wood surveys are completed at all terrestrial NEON sites that contain woody vegetation. At sites where qualifying CDW particles are present, sampling occurs at each Tower Plot (20-30 plots), and a subset of randomly selected Distributed Plots (20 plots maximum), for a maximum of 50 plots at any given site. At each plot, three LIDS transects radiate outward from the plot centroid, with 120° separating each transect (Figure 1). The azimuthal orientation of each group of transects is chosen randomly for each plot, in order to minimize effects of topography, directional blowdown, logging management, etc., on selection of CDW particles across all sampling locations. See TOS Science Design for Plant Biomass, Productivity, and Leaf Area Index (AD[06]), TOS Field and Lab Protocol: Coarse Downed Wood (AD[07]), TOS Science Design for Spatial Sampling (AD[08]) and TOS Science Design for Plant Diversity (AD[09]) for further details on sampling design, specific protocol steps, plot allocation, and species identification, respectively.

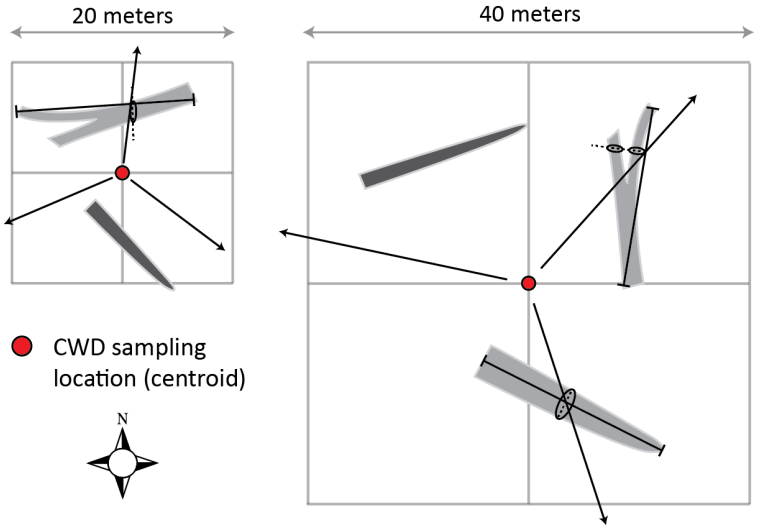

Figure 1: Illustration of three randomly oriented LIDS transects (arrow vectors) superimposed over a 20m x 20m plot (left), and a 40m x 40m plot (right). There is a 3m gap between the sampling location (i.e. the plot centroid), and the start of each transect which minimizes the chance that CDW particles close to the plot centroid get double- or triple-counted. Gray shapes represent CDW particles, dashed lines show the location and orientation of cross-sectional area measurement(s) (ovals) for those particles that intersect a LIDS transect, and capped black lines imply the particles' central axes that are measured for length. Note that CDW particles selected for tally and/or bulk density sampling may lie outside of the plot boundary.

3.2 Temporal Sampling Design

Coarse downed wood tally bouts are completed in all selected plots once every three years (i.e. one site per year in domains with three sites). Sampling should take no longer than 3 months to complete. New coarse downed wood particles are typically produced during periods of high wind or rain events associated with seasonal storm activity. Sampling bouts at any given site are scheduled to occur after the expected storm season. For example, in the Southeast (D03) and Atlantic Neotropical domains (D04), CDW tally sampling occurs during either the winter/spring season, outside of the summer/fall hurricane seasons. In contrast, in the Pacific Northwest (D16), most storm activity occurs primarily in the winter, and CDW tally sampling occurs in the summer/autumn seasons.

3.3 Variables Reported

All variables reported from the field or laboratory (L0 data) are listed in the file, NEON Raw Data Ingest Workbook for TOS Coarse Downed Wood: Field Tally Data (NEON.DP0.10010) (AD[04]). All variables reported in the published data (L1 data) are also provided separately in the file, NEON Data Publication Workbook for TOS Coarse Downed Wood: QA/QC of Raw Field Tally Data (NEON.DP1.10010) (AD[05]).

Field names have been standardized with Darwin Core terms (http://rs.tdwg.org/dwc/; accessed 16 February 2014), the Global Biodiversity Information Facility vocabularies (http://rs.gbif.org/vocabulary/gbif/; accessed 16 February 2014), and the VegCore data dictionary (https://projects.nceas.ucsb.edu/nceas/projects/bien/wiki/

VegCore; accessed 16 February 2014), where applicable. NEON TOS spatial data employs the World Geodetic System 1984 (WGS84) for its fundamental reference datum and GEOID09 for its reference gravitational ellipsoid. Latitudes and longitudes are denoted in decimal notation to six decimal places, with longitudes indicated as negative west of the Greenwich meridian.

Some variables described in this document may be for NEON internal use only and will not appear in downloaded data.

3.4 Spatial Resolution and Extent

The finest resolution at which spatial data are reported is the point location of the log along a transect.

The spatial hierarchy from finest to coarsest resolution is:

point (see below to calculate) → **plotID** → **siteID** → **domainID**

The basic spatial data included in the data downloaded include the latitude, longitude, and elevation of the centroid of the plot where sampling occurred + associated uncertainty due to GPS error and plot width. Shapefiles of all NEON Terrestrial Observation System sampling locations can be found in the Document Library: http://data.neonscience.org/documents.

To derive a more precise estimate of the location of each log, there are two options:

- Use the def.calc.geo.os function from the geoNEON package, available here: https://github.com/NEONScience/NEON-geolocation
- Or follow these steps to perform the same calculation:

1. The namedLocation field in the data is the named location of the plot.
2. Use the API (http://data.neonscience.org/api; e.g. http://data.neonscience.org/api/v0/locations/HARV_052.basePlot.cdw) to query for elevation("locationElevation"), easting("locationUtmEasting"), northing("locationUtmNorthing"), coordinateUncertainty ("Value for Coordinate uncertainty"), elevationUncertainty ("Value for Elevation uncertainty"), and utmZone ("locationUtmZone") as inputs to the next step.
3. Calculate the geolocation of each log according to the equation:

$$Easting = locationUtmEasting + d * \sin\theta \quad (1)$$

and

$$Northing = locationUtmNorthing + d * \cos\theta \quad (2)$$

where,

$$\theta = \frac{lidsAzimuth * \pi}{180} \tag{3}$$

$$locationUtmEasting = \tag{4}$$

the easting value associated with the plotID (plot centroid)

$$locationUtmNorthing = \tag{5}$$

the northing value associated with the plotID (plot centroid)

$$d = \tag{6}$$

logDistance

5. Increase coordinateUncertainty by an appropriate amount to account for error introduced by navigating along the transect. Additional error may be introduced due to tape stretching and drift from a compass heading.

3.5 Temporal Resolution and Extent

The finest resolution at which temporal data are reported for a given log tally record is the range between **startDate** and **endDate** associated with when the transect was tallied.

date (date range a transect was tallied) → **eventID** (bout-level identifier)

The NEON Data Portal currently provides data in monthly files for query and download efficiency. Queries including any part of a month will return data from the entire month. Code to stack files across months is available here: https://github.com/NEONScience/NEON-utilities.

3.6 Associated Data Streams

The Coarse Downed Wood Log Survey data product (NEON.DP1.10010) is tightly integrated with the Coarse Downed Wood Bulk Density Sampling data product (NEON.DP1.10014). Together, these two data products allow calculation of CDW dry mass per sizeCategory per decayClass per taxonID. Although these two data products are related, there are no linking variables that allow joining tables across the products.

3.7 Product Instances

A maximum of 50 plots will be selected for coarse downed wood survey, once every three years, at a given site. Each plot has 3 transects, with the total number of logs tallied along all 3 transects for a given plot ranging between 0-50. Thus, each site should generate no more than approximately 2,500 data product instances over a three year period.

3.8 Data Relationships

The protocol dictates that each transect is surveyed only once in a sampling year. If no particles ≥ 2cm diameter and ≥ 1m length are present, only a single record will be generated for the transect, and these records will have **targetTaxaPresent**= 'No', indicating that the transect was checked and no qualifying particles were discovered. For transects where **targetTaxaPresent**= 'Yes', each qualifying particle along the transect results in a distinct record. Duplicates and/or missing data may exist where protocol and/or data entry aberrations have occurred; users should check data carefully for anomalies before joining field tally table with other data products.

cdw_fieldtally.csv → One record expected per **plotID** + **lidsAzimuth** + **logID** combination per year.

An **individualID** and **individualBarcode** is generated for each tallied particle with logMaxDiameter ≥ 10 cm, and the **individualID** is built from the **logID** for these particles. No **individualID** is generated for logs with logMaxDiameter < 10 cm. For particles < 10 cm diameter, **logID** values are incremented values that reset for each **plotID**, and are denoted with the letter "L" preceding an incremented value (e.g. L005), and the **individualID** field will be null. Note that the CDW **individualID** cannot be matched with the **individiualID** created for other NEON plant data products (described below).

Recently downed logs in the CDW Log Survey dataset that were previously measured while standing according to one or more protocols are identified in the CDW Log Survey dataset by the **vstTagID** field. To match **vstTagID** with the linked **individualID** reported in other NEON data products, an end-user must perform the following steps:

- Flag **vstTagID** with leading zeroes until the total string length is 6 characters
- Concatenate: "NEON.PLA.D##.SITE" + "." + "**vstTagID**", where:
  - D## = **domainID**
  - SITE = **siteID**
- Match the resulting string with **individualID** in any/all of the following associated data products:
  - Woody Plant Vegetation Structure (NEON.DP1.10095)
  - Plant Canopy Leaf Mass per Area (NEON.DP1.10048)
  - Plant Foliar Stable Isotopes (NEON.DP1.10053)
  - Plant Phenology Observations (NEON.DP1.10055)

3.9 Special Considerations

A subset of records for coarse downed wood particles < 10 cm diameter, measured between 2016-04-04 and 2017-06-19, were recorded without **decayClass**. These records have been flagged as a **dataQF**="decayClassNotRecorded". Affected records can be used to calulate volume of coarse downed wood, but

do not contain sufficient information to calculate wood density or mass when combined with the Coarse Downed Wood Bulk Density product.

4 DATA QUALITY

4.1 Data Entry Constraint and Validation

Many quality control measures are implemented at the point of data entry within a mobile data entry application or web user interface (UI). For example, data formats are constrained and data values controlled through the provision of dropdown options, which reduces the number of processing steps necessary to prepare the raw data for publication. An additional set of constraints are implemented during the process of ingest into the NEON database. The product-specific data constraint and validation requirements built into data entry applications and database ingest are described in the document NEON Raw Data Ingest Workbook for TOS Coarse Downed Wood: Field Tally Data (NEON.DP0.10010), provided with every download of this data product. Contained within this file is a field named 'entryValidationRulesForm', which describes syntactically the validation rules for each field built into the data entry application. Data entry constraints are described in Nicl syntax in the validation file provided with every data download, and the Nicl language is described in NEON's Ingest Conversion Language (NICL) specifications ([AD[15]).

Data collected prior to 2017 were processed using a paper-based workflow that did not implement the full suite of quality control features associated with the interactive digital workflow.

4.2 Automated Data Processing Steps

Following data entry into a mobile application or web user interface, the steps used to process the data through to publication on the NEON Data Portal are detailed in the NEON Algorithm Theoretical Basis Document: OS Generic Transitions (AD[14]).

4.3 Data Revision

All data are provisional until a numbered version is released; the first release of a static version of NEON data, annotated with a globally unique identifier, is planned to take place in 2020. During the provisional period, QA/QC is an active process, as opposed to a discrete activity performed once, and records are updated on a rolling basis as a result of scheduled tests or feedback from data users. The Change Log section of the data product readme, provided with every data download, contains a history of major known errors and revisions.

4.4 Quality Flagging

The **dataQF** field in each data record is a quality flag for known errors applying to the record. Please see the *Special Considerations* section of this document for a list of known errors that may be present in the data, and below for an explanation of **dataQF** codes specific to this product.

fieldName	value	definition
dataQF	legacyData	Data recorded using a paper-based workflow that did not implement the full suite of quality control features associated with the interactive digital workflow
dataQF	decayClass NotRecorded	Records collected with no decayClass; see *Special Considerations* section above for more information.

5 REFERENCES

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