NEON Data Product Catalog

DP1.00001.001 2D wind speed and direction

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Gill - Wind Observer II; Extreme Weather Wind Observer

Coverage

2D wind speed is measured at all NEON terrestrial and aquatic sites.

Description

Two-dimensional wind speed and direction, available as two- and thirty-minute aggregations of 1 Hz observations. Observations are made by 2-D sonic anemometer sensors located at multiple heights on the tower infrastructure and by 2-D sonic anemometer sensors located on the aquatic meteorological station.

Abstract

Wind plays an important role in atmospheric and environmental sciences. A function of differential heating of Earth's surface and subsequent pressure gradients, horizontal and vertical winds are responsible for advection of atmospheric pollutants, moisture, heat and momentum (Stull 1988). As such, horizontal and vertical winds will be measured throughout the Observatory.

Design Description

Multiple 2D anemometers are deployed at tower sites. They are located on each boom arm below the tower-top level at terrestrial sites. A single 2D anemometer is located at the top of the aquatic met station at a standard height of 3m above ground level. Two- and thirty-minute averages of horizontal wind speed and direction are calculated. Each 2D anemometer represents the point at which it is placed on the tower infrastructure.

DP1.00010.001 3D wind attitude and motion reference

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Xsens North America Inc. MTI-300-2A5G4 Attitude Heading Reference System

Coverage

These data are collected at all terrestrial sites to study the attitude and motion of the 3D sonic anemometer at the tower top.

Description

Measurement of 3D anemometer attitude and motion. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product provides the attitude statistics for the 3D sonic anemometer. The key sub-data products include the three attitude angles of the 3D sonic anemometer at the tower top. It contains the quality-controlled measurement data and associated metadata in HDF5 format. It is also used alongside other data products to generate the momentum flux, sensible heat flux, latent heat flux and carbon flux data products. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

The ARMS sensor is mounted on the top of sensor block of CSAT3 3D sonic anemometer. This AMRS sensor is configured to use forward-left-up body coordinate system, and data is reported in east-north-up reference coordinate system. The L0 data products of the AMRS sensor are recorded at a rate of 40Hz, and are used to calculate the L1 data products at 1-min and 30-min time resolution.

DP1.00007.001 3D wind speed, direction and sonic temperature

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Campbell Scientific. CSAT-3 3-D Sonic Anemometer

Coverage

These data are collected at all terrestrial sites to study the 3-dimensional wind speed and wind direction above the ecosystem canopy.

Description

Three-dimensional windspeed and direction measured by sonic anemometer; air temperature measured by the 3-D sonic anemometer. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product provides the turbulent wind speed and wind direction statistics. The key sub-data products include the three wind components at the tower top. It contains the quality-controlled measurement data and associated metadata in HDF5 format. It is also used alongside other data products to generate the momentum flux, sensible heat flux, latent heat flux and carbon flux data products.

Design Description

This sensor is mounted on the tower top. The level 0 (L0) data products of this sensor are recorded at a rate of 20 Hz, and these L0 data products are used to calculate the level 1 (L1) data products at 1-min and 30-min time resolution.

DP1.20046.001 Air temperature above water on-buoy

Subsystem

Aquatic Instrument System (AIS)

Sensor

Vaisala HUMICAP Humidity and Temperature Probe- HMP 155

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Air temperature, available as one- and thirty-minute averages. Observations are made by a sensor located on the meteorology station on the buoy in lakes and rivers. Temperature observations are made using platinum resistance thermometers, which are housed in a passive shield to reduce radiative bias.

Abstract

Air temperature on buoys is measured every minute and is reported as 1-minute instantaneous measurements and 30-minute mean values. Unlike other locations, such as aquatic met stations and the terrestrial tower, there is not a separate sensor for air temperature. The temperature measurements from the relative humidity sensor are used for this buoy data product and these data are a subset of the Relative Humidity of the air above lakes on buoy (DP1.20271.001).

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP2.30011.001 Albedo - spectrometer - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Total amount of solar radiation in the 0.4 to 2.5 micron band reflected by the Earth surface into an upward hemisphere divided by the total amount incident from this hemisphere; data are provided by flightline

Abstract

Albedo, the ratio of a surface's reflected energy to its incident energy, is an important measurement for characterizing earth system energy balance. Light and dark surfaces correspond to high and low albedo, respectively. An opaque surface's difference in energy reflected as compared to the energy incident on it is absorbed by the surface, increasing its temperature. (Sabins, Jr., 1978). Albedo values depend on wavelength, illumination sources and geometry, sensor viewing geometry, reflectance as a function of angle and wavelength, as well as the scattering, absorbing, and re-radiating effects of the atmosphere. These factors are modeled/accounted for to best approximate a bi-hemispherical reflectance as would be measured in a laboratory setting. To this end, the wavelength-integrated surface reflectance, weighted with the global flux on the ground, is produced as the best practically achievable albedo measurement. (Richter & Schlapfer, 2017) L2 Albedo is distributed by flight line.

Design Description

Albedo data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Albedo as best practically approximated by wavelength-integrated surface reflectance, weighted with the global flux on the ground. L2 Albedo is distributed in the original North/South flight lines.

DP3.30011.001 Albedo - spectrometer - mosiac

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Total amount of solar radiation in the 0.4 to 2.5 micron band reflected by the Earth's surface into an upward hemisphere divided by the total amount incident from this hemisphere

Abstract

Albedo, the ratio of a surface's reflected energy to its incident energy, is an important measurement for characterizing earth system energy balance. Light and dark surfaces correspond to high and low albedo, respectively. An opaque surface's difference in energy reflected as compared to the energy incident on it is absorbed by the surface, increasing its temperature. (Sabins, Jr., 1978). Albedo values depend on wavelength, illumination sources and geometry, sensor viewing geometry, reflectance as a function of angle and wavelength, as well as the scattering, absorbing, and re-radiating effects of the atmosphere. These factors are modeled/accounted for to best approximate a bi-hemispherical reflectance as would be measured in a laboratory setting. To this end, the wavelength-integrated surface reflectance, weighted with the global flux on the ground, is produced as the best practically achievable albedo measurement. (Richter & Schlapfer, 2017) L3 Albedo is distributed in 1km tiles created by taking the most-nadir pixels from the clearest flightlines acquired for each pixel.

Design Description

Albedo data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Albedo as best practically approximated by wavelength-integrated surface reflectance, weighted with the global flux on the ground. L3 Albedo is distributed in 1 km square tiles with 1 m pixels.

DP1.20063.001 Aquatic plant bryophyte chemical properties

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

C and N concentrations of aquatic plant and bryophytes from benthic collections in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, field sampling metadata for aquatic plant and bryophyte carbon and nitrogen analyses. Benthic field samples are collected in wadeable streams, rivers, and lakes, and processed at the domain support facility. Aquatic plant and bryophyte chemistry samples are derived from clip harvest samples, collected once per year during the mid-summer aquatic biological sampling bout. Samples are collected from a known benthic area, separated by taxon in the domain lab, identified, and ground and shipped to a contracting laboratory for chemical analyses. For additional details, see NEON.DOC.003039: AOS Protocol and Procedure: Aquatic Plant, Bryophyte, Lichen and Macroalgae Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Aquatic plant and bryophyte clip harvest sampling is conducted once per year at aquatic sites (during the mid-summer aquatic biology window). Ten samples are collected per site if aquatic vegetation are present. In wadeable streams, clip harvest samples are collected near plant transect locations. In lakes and rivers, ten randomly selected points are sampled at depths that are colonized by vegetation. These samples are partitioned in the domain support facility into subsamples for chemical analyses of carbon and nitrogen and shipped to an external facility.

DP1.20066.001 Aquatic plant bryophyte macroalgae clip harvest

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Dry weight of aquatic plant, bryophyte, and macroalgae from benthic quadrats in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, field sampling metadata and associated taxonomic, and biomass data for aquatic plants, bryophytes, and macroalgae. Benthic field samples are collected in wadeable streams, rivers, and lakes, and processed at the domain support facility. Clip harvest samples are collected once per year during the mid-summer aquatic biological sampling bout, and additional presence/absence data are collected in lakes and rivers during bouts 1 and 3 (similar to point transect data for streams). Grab samples are collected from a known benthic area, separated by taxon in the domain lab, identified, and processed for dry mass and ash-free dry mass. For additional details, see NEON.DOC.003039: AOS Protocol and Procedure: Aquatic Plant, Bryophyte, Lichen and Macroalgae Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Aquatic plant, bryophyte, and macroalgae clip harvest sampling is conducted once per year at wadeable streams (during the mid-summer aquatic biology window) and three times per year in rivers and lake sites. During the first and third bouts in rivers and lakes, only presence/absence of vegetation is noted; during the mid-summer bout, samples are collected via quadrats in wadeable streams, and rake collection in lakes and rivers. Ten samples are collected per site if plants are present. In wadeable streams, clip harvest samples are collected near plant transect locations. In lakes and rivers, ten randomly selected points are sampled at depths that are colonized by plants. These samples are partitioned into samples for ash-free dry mass analyses and chemical analyses.

DP1.20072.001

Aquatic plant, bryophyte, lichen, and macroalgae point counts in wadeable streams

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON wadeable stream sites.

Description

Point counts of aquatic plants, bryophytes, lichens, and macroalgae from transects in wadeable streams

Abstract

This data product contains the quality-controlled, field sampling metadata and associated taxonomic, and biomass data for aquatic plants, bryophytes, and macroalgae. Field data are collected at 10 permanent transects in wadeable streams three times per year. For additional details, see NEON.DOC.003039: AOS Protocol and Procedure: Aquatic Plant, Bryophyte, Lichen and Macroalgae Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Aquatic plant, bryophyte, lichen, and macroalgae point count data are collected three times per year at wadeable streams, during aquatic biology bout windows, roughly in spring, summer, and fall. Data are collected at ten permanent transect locations that are revisited during each sampling bout.

DP1.00036.001 Atmospheric CO2 isotopes

Subsystem

Terrestrial Instrument System (TIS)

Sensor

PICARRO - G2131-i isotopic CO2 analyzer

Coverage

This data product is collected at all terrestrial sites. The sensor is located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to the sensor for analysis.

Description

Profile measurements of CO2 isotope concentration, 13C stable isotope ratio in CO2, and water vapor concentration at each tower level. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains the quality-controlled Atmospheric CO2 isotopes measurement data and associated metadata in HDF5 format. The key sub-data products include CO2 molar fraction, H2O molar fraction and delta 13C in CO2 in the air at different measurement heights on tower at all NEON terrestrial sites. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

The level 0 (L0) data products (DPs) under Atmospheric CO2 isotopes are recorded at a rate of 0.5 Hz, and these L0 DPs are used to calculate the level 1 (L1) DPs of 9-min and 30-min averages for each measurement height on tower.

DP1.00037.001 Atmospheric H2O isotopes

Subsystem

Terrestrial Instrument System (TIS)

Sensor

PICARRO - L2130-i isotopic water analyzer

Coverage

This data product is collected at all terrestrial core sites plus 1 relocatable site (D19 BARR). The sensor is located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to the sensor for analysis.

Description

Profile measurements of water vapor isotope concentration, 18O and 2H stable isotope ratio in water vapor at each tower level. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains the quality-controlled measurement data and associated metadata in HDF5 format. The key sub-data products include H2O molar fraction, delta 18O and delta 2H in water vapor in the air at different measurement heights on the tower at all terrestrial core sites and one relocatable site (D19 BARR). The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

The level 0 (L0) data products (DPs) under atmospheric 18O and 2H isotopes are recorded at a rate of 0.5 Hz, and these L0 DPs are used to calculate the level 1 (L1) DPs of 9-min and 30-min averages for each measurement height on tower.

DP1.00004.001 Barometric pressure

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Vaisala - BAROCAP Digital Barometer PTB330

Coverage

At terrestrial sites the pressure sensor will be located on the tower infrastructure at a site specific installation height (h) above ground level (AGL). At aquatic sites the pressure sensor will be located on a field-based met station (tripod) at a standard installation height of above ground level. Lake sites will have an additional pressure sensor located on a buoy at a standard installation height above water level (AWL), but at a different sampling frequency and that data will be handled in a separate ATBD. Therefore, barometric (station) pressure will represent the point in space at which the barometer is located.

Description

Barometric pressure is available as one- and thirty-minute averages for station pressure, which is determined from 0.1 Hz observations. Barometric pressure corrected to sea level and surface level (defined as water surface at aquatic sites and soil surface at terrestrial sites) is derived from station pressure averages and available at one- and thirty-minute increments. Observations are made by a single digital barometer located on the tower infrastructure and a single digital barometer located on the aquatic meteorological station.

Abstract

Barometric pressure, or static atmospheric pressure, is a vital measurement for NEON. Barometric pressure is significant in influencing weather conditions as well as aqueous chemistry (e.g. the amount of gas that can dissolve in solution). Recording static atmospheric pressure will allow atmospheric gas mixing ratios to be converted into mass quantities. Barometric pressure will be recorded over NEON's entire operational range.

Design Description

Barometric pressure will be recorded at a rate of 0.1 Hz for L0 DPs, and these L0 DPs will be used to calculate the L1 DPs, one- and thirty-minute averages of station and sea level pressure, as well as one- minute averages of soil plot pressure.

DP1.20004.001 Barometric pressure above water on-buoy

Subsystem

Aquatic Instrument System (AIS)

Sensor

Vaisala - BAROCAP Digital Barometer PTB330

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Barometric pressure, available as one- and thirty-minute averages for both station pressure and pressure reduced to sea level. Observations are made on the meteorology station on the buoy in lakes and rivers.

Abstract

Barometric pressure on buoys is measured every minute and is reported as 1-minute instantaneous measurements and 30-minute mean values. Other than the data collection frequency, this data product has the same data streams and processing as barometric pressure measured at aquatic met stations.

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP4.00132.001 Bathymetric and morphological maps

Subsystem

Aquatic Observation System (AOS)

Sensor

Humminbird 1198c Si Combo

Coverage

Measured at all NEON lakes and non-wadeable streams (rivers).

Description

Bathymetry of lake bottoms and non-wadeable streams for detecting environmental change as well as for determining lake morphology, estimating primary productivity, habitat features, and water quality.

Abstract

Bathymetric maps are obtained using hydroacoustic (sonar) instrumentation and interfaced with differential global positioning system (DGPS) mounted on a boat. Hydroacoustics are utilized to detect the depth of a water body, sediment characteristics as well as the presence or absence, approximate abundance, distribution, size, and behavior of underwater biota. For additional details, see [NEON.DOC.001197: AOS Protocol and Procedure: Bathymetry and Morphology of Lakes and Non-Wadeable Streams]((http://data.neonscience.org/api/v0/documents/NEON.DOC.001197vE).

Design Description

A dual beam echosounder with side scan sonar and WAAS GPS are used to collect bathymetric (depth) and backscatter (signal strength) data. These data are collected using a boat-mounted system applied during surveys of NEON lakes and river sites. Bathymetric surveys are completed every 5 years; if an extreme event results in substantial changes to the physical environment then an out-of-cycle survey may be conducted. Depth data are used to produce bathymetric maps and side scan sonar data are used to classify subaquatic features to produce a habitat map.

DP1.20086.001 Benthic microbe community composition

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON wadeable stream sites.

Description

Counts and relative abundances of archaeal, bacterial, and fungal taxa observed in benthic microbial communities

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON bacterial, archaeal, and fungal community composition data derived from benthic microbial sampling in wadeable streams. Taxon tables are derived from the 16S and ITS marker gene sequencing data product, NEON.DP1.20280. Taxonomic data are generated from quality-filtered sequence data using standard bioinformatics software. For additional details about sampling methods and design, see NEON.DOC.003044: AOS Protocol and Procedure: Aquatic Microbial Sampling; and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Benthic microbe samples are collected at the same time and location as periphyton (microalgae) samples thre times per year in wadeable streams during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using field-sterile methods using the most approriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools). All samples are frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and high-throughput sequence analysis using primer sets targeting the small subunit of the ribosomal RNA gene. Quality-filtered sequence data are processed bioinformatically and taxon tables are generated.

DP1.20277.001 Benthic microbe group abundances

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON wadeable stream sites.

Description

Counts and relative abundances of marker genes from total archaea, bacteria, and fungi observed by qPCR in benthic microbial communities

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON's benthic bacterial, archaeal, and fungal group abundances analysis, which are derived from benthic sampling in wadeable streams. Benthic and water column field samples are collected in wadeable streams, rivers, and lakes three times per year during the growing season. For additional details, see protocol NEON.DOC.003044 AOS Protocol and Procedure: Aquatic Microbial Sampling and science design NEON.DOC.001152 NEON Aquatic Sampling Strategy.

Design Description

Benthic microbe samples are collected at the same time and location as periphyton (microalgae) samples three times per year in wadeable streams during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using field-sterile methods using the most appropriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools). All samples are frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and qPCR analysis using primer sets targeting the small subunit of the ribosomal RNA gene. Laboratory data are passed through the NEON automated ingest process for basic QC testing and acceptance, and then are published on the NEON data portal.

DP1.20280.001 Benthic microbe marker gene sequences

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON wadeable stream sites.

Description

DNA sequence data from ribosomal RNA marker genes from benthic samples

Abstract

This data product contains the quality-controlled laboratory metadata and 16S and ITS marker gene sequences derived from NEON's benthic microbial sampling in wadeable streams. For details about the methods and design, see AOS Protocol and Procedure: Aquatic Microbial Sampling (NEON.DOC.003044) and NEON Aquatic Sampling Strategy (NEON.DOC.001152).

Queries for this data product return a downloadable data package with laboratory methods and DNA extraction, PCR amplification, and sequencing metadata for samples from the queried sites and date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository. Sequence data may also be obtained by querying NEON data sets at the NCBI Sequence Read Archive (NCBI SRA) and the European Bioinformatics Institute (EMBL-EBI).

Design Description

Benthic microbe samples are collected at the same time and location as periphyton (microalgae) samples three times per year in wadeable streams during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using field-sterile methods using the most appropriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools). Cobble scrubs are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. Grab samples of sediment (silt, sand) or plant material/epiphyton are collected when appropriate and flash frozen in the field. Frozen samples are shipped to an analytical facility for DNA extraction, sample preparation and high-throughput sequence analysis using primer sets targeting the ribosomal RNA gene. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.20279.001 Benthic microbe metagenome sequences

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON wadeable stream sites.

Description

Metagenomic sequence data from benthic samples

Abstract

This data product contains the primary field and quality-controlled laboratory metadata and QA results for NEON's shotgun metagenomic sequences derived from benthic microbial sampling in wadeable streams. Benthic samples are collected concurrently with stream periphyton samples. Cobble scrubs are are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. Grab samples of sediment (silt, sand) or plant material/epiphyton are collected when appropriate and flash frozen in the field. For additional details, see protocol [NEON.DOC.003044vB] (http://data.neonscience.org/api/v0/documents/NEON.DOC.003044vB): AOS Protocol and Procedure for Aquatic Microbial Sampling. Queries for this data product will return metadata tables that include field observations and measurements, laboratory methods, and results from DNA extraction, sample preparation, and sequencing for samples from the specified sites and within the specified date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository.

Design Description

Benthic microbe samples are collected at the same time and location as periphyton (microalgae) samples three times per year in wadeable streams during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using field-sterile methods using the most appropriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools). Cobble scrubs are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. Grab samples of sediment (silt, sand) or plant material/epiphyton are collected when appropriate and flash frozen in the field. Frozen samples are shipped to an analytical facility for DNA extraction, sample preparation and shotgun metagenomic sequencing. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.10003.001 Breeding landbird point counts

Subsystem

Terrestrial Observation System (TOS)

Coverage

This sampling occurs at all NEON terrestrial sites.

Description

Count, distance from observer, and taxonomic identification of breeding landbirds observed during point counts

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's breeding landbird sampling. Breeding landbirds are defined as "smaller birds (usually exclusive of raptors and upland game birds) not usually associated with aquatic habitats" (Ralph et al. 1993). The breeding landbird point counts product provides records of species identification of all individuals observed during the 6-minute count period, as well as metadata which can be used to model detectability, e.g., weather, distances from observers to birds, and detection methods. The NEON point count method is adapted from the Integrated Monitoring in Bird Conservation Regions (IMBCR): Field protocol for spatially-balanced sampling of landbird populations (Hanni et al. 2017; http://bit.ly/2u2ChUB). For additional details, see protocol NEON.DOC.014041: TOS Protocol and Procedure: Breeding Landbird Abundance and Diversity and science design NEON.DOC.000916: TOS Science Design for Breeding Landbird Abundance and Diversity.

Design Description

Depending on the size of the site, sampling for this product occurs either at either randomly distributed individual points or grids of nine points each. At larger sites, point count sampling occurs at five to fifteen 9-point grids, with grid centers collocated with distributed base plot centers (where plant, beetle, and/or soil sampling may also occur), if possible. At smaller sites (i.e., sites that cannot accommodate a minimum of 5 grids) point counts occur at the southwest corner (point 21) of 5-25 distributed base plots. Point counts are conducted once per breeding season at large sites and twice per breeding season at smaller sites. Point counts are six minutes long, with each minute tracked by the observer, following a two-minute settling-in period. All birds are recorded to species and sex, whenever possible, and the distance to each individual or flock is measured with a laser rangefinder, except in the case of flyovers.

DP1.10035.001 Bryophyte clip harvest

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites with at least 20% bryophyte cover, averaged across all tower plots. Bryophyte clip harvest is not performed in Distributed Plots.

Description

Dry weight of bryophyte biomass samples

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Bryophyte productivity clip harvest sampling. Bryophytes are operationally defined in this protocol as mosses (including Sphagnum sp.) and liverworts. The sampling period for each collection is a year. For additional details, see NEON.DOC.001709: TOS Protocol and Procedure: Bryophyte Productivity and NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity, and Leaf Area Index.

Design Description

Clip harvest of bryophyte biomass occurs within randomly located clip-harvest strips in 20 m x 20 m plots or subplots. At sites with 20 m x 20 m Tower plots a maximum of 30 plots are sampled, within a single clip cell per plot (maximum of 30 clip cells). At sites with 40 m x 40 m Tower plots, a maximum of 20 plots are sampled, with two out of four subplots randomly selected, and a single clip cell per selected subplot (maximum of 40 clip cells). Plots are sampled once per year.

DP4.00200.001 Bundled data products - eddy covariance

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer; Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude Heading Reference System; LI-COR - LI840A; PICARRO - G2131-i isotopic CO2 analyzer; PICARRO - l2130-i isotopic H2O analyzer

Coverage

Data are collected at all terrestrial sites, along the vertical tower profile from the ground to the tower top above the canopy. These data are used to determine the net ecosystem exchange of heat and gases (CO2, H2O, etc.) between the atmosphere and the ecosystem of interest.

Description

Bundle of eddy-covariance data products, including related meteorological and soil data products.

Abstract

Net surface-atmosphere exchange, or "flux" quantifies how much heat, H2O and CO2 are transferred between an ecosystem and the atmosphere. Fluxes are useful in a variety scientific applications, including to study ecosystem processes, to interpret and calibrate satellite observations of the earth system, and to constrain ecosystem and earth system models. One of the most direct approaches to observe the net surface-atmosphere exchange is the in-situ eddy-covariance method. Calculation of the net surface-atmosphere exchange involves the estimation of at least two major terms (assuming horizontally homogenous surface conditions): the turbulent flux and the storage flux. In addition, stable isotope measurements of CO2 and H2O within and above the ecosystem canopy can support the subsequent partitioning of the net surface-atmosphere exchange into ecosystem constituent fluxes. For example, partitioning CO2 into photosynthesis and respiration, or evaporation and transpiration in the case of H2O.

For data product and algorithm details please see NEON.DOC.004571; in short: this data product bundle contains derived eddy-covariance data products and associated metadata in HDF5 format. Each file contains metadata about the file structure, table formats, and attributes. For more information on using HDF5 files, please visit The HDF Group website at https://www.hdfgroup.org/. This is a provisional product and query reproducibility cannot be guaranteed. During nominal Operations, earliest anticipated availability of the provisional product is 5 days after data acquisition, with planned annual re-processing and publication of consistent, versioned datasets. Data, quality flags and metrics (qfqm), and uncertainty metrics (ucrt) are currently provided in folders using the following naming convention within the HDF5 file structure: data_product_level/type_of_data_available/data_product_abbreviation (e.g., "dp01/data/soni"). Empty folders within the file structure are being incrementally filled in future publications. The data products embedded in this bundle currently include the following:

Data Product | Type of data available | Abbreviation | Temporal Resolution

DP1.00002 Single aspirated air temperature | data, qfqm, ucrt | tempAirLvl | 1-min, 30-min

DP1.00003 Triple aspirated air temperature | data, qfqm, ucrt | tempAirTop | 1-min, 30-min

DP1.00007 3D wind speed, direction and sonic temperature | data, qfqm, ucrt | soni | 1-min, 30-min

DP1.00010 3D wind attitude and motion reference | data, qfqm, ucrt | amrs | 1-min, 30-min

DP1.00034 CO2 concentration - turbulent | data, qfqm, ucrt | co2Turb | 1-min, 30-min

DP1.00035 H2O concentration - turbulent | data, qfqm, ucrt | h2oTurb | 1-min, 30-min

DP1.00036 Atmospheric CO2 isotopes | data, qfqm, ucrt | isoCo2 | 9-min, 30-min

DP1.00037 Atmospheric H2O isotopes | data, qfqm, ucrt | isoH2o | 9-min, 30-min

DP1.00099 CO2 concentration - storage | data, qfqm, ucrt | co2Stor | 2-min, 30-min

DP1.00100 H2O concentration - storage | data, qfqm, ucrt | h2oStor | 2-min, 30-min

DP2.00008 CO2 concentration rate of change | data, qfqm | co2Stor | 30-min

DP2.00009 H2O concentration rate of change | data, qfqm | h2oStor | 30-min

DP2.00024 Temperature rate of change | data, qfqm | tempStor | 30-min

DP3.00008 Temperature rate of change profile | data, qfqm | tempStor | 30-min

DP3.00009 CO2 concentration rate of change profile | data, qfqm | co2Stor | 30-min

DP3.00010 H2O concentration rate of change profile data | qfqm | h2oStor | 30-min

DP4.00002 Sensible heat flux | data, qfqm | fluxTemp | 30-min

DP4.00007 Momentum flux | data, qfqm | fluxMome | 30-min

DP4.00067 Carbon dioxide flux | data, qfqm | fluxCo2 | 30-min

DP4.00137 Latent heat flux | data, qfqm | fluxH2o | 30-min

DP4.00201 Flux footprint characteristics | data, qfqm | foot | 30-min

Design Description

All terrestrial NEON sites are equipped with a tower and sensors that collect turbulent flux measurements at the tower top. The CSAT-3 sonic anemometer (Campbell Scientific Inc., Logan, Utah, USA) records 3-dimensional wind speed and wind direction data at 20 Hz. The attitude and motion reference system (AMRS, Xsens North America Inc., model MTI-300-2A5G4; Culver City, California, USA) tracks the motion of the CSAT-3 sonic anemometer and records pitch, roll and yaw data at 40 Hz. The LI-7200 gas analyzer (Li-Cor Inc., Lincoln, Nebraska, USA) records CO2 and H2O concentration at 20 Hz. These dp00 raw data are used to generate 1-min and 30-min dp01 descriptive statistics data products, as well as 30-min dp04 turbulent flux data products.

The storage flux system consists of a suite of sensors that record temperature, CO2 and H2O along the tower vertical profile. The air temperature profile is measured at 1 Hz with aspirated temperature sensors (MetOne Instruments, Inc., model 076B-7388; Grant Pass, Oregon, USA). In addition, air samples from all vertical measurement levels on the tower are drawn and delivered to a gas analyzer (Li-Cor, Inc., model LI-840A; Lincoln, Nebraska, USA) in the instrument hut for analysis. The LI840A gas analyzer records the CO2 and H2O concentration at 1 Hz. These data are used to generate 2-min and 30-min dp01 descriptive statistics data products, which are used to further produce 30-min dp02 temporally interpolated data products, dp03 spatially interpolated data products, and derived dp04 storage flux data products.

Sensors for stable isotopic measurements are located inside the instrument hut. Air samples along the tower vertical profile are drawn and delivered to the sensors for analysis. The PICARRO G2131-i CO2 isotopic analyzer records the CO2 concentration and delta 13C at ~1 Hz; the PICARRO L2130-i H2O isotopic analyzer records the H2O concentration and delta 18O and 2H at ~1 Hz. These data are used to generate 9-min and 30-min dp01 descriptive statistics data products.

For command, control and configuration details please see NEON.DOC.000456.

DP2.30022.001 Canopy lignin - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of canopy lignin concentration; data are provided by flightline

Abstract

Lignin, or Normalized Difference Lignin Index (NDLI), estimates the relative amounts of lignin contained in vegetation canopies. Leaf lignin concentration and canopy foliage biomass are the determining factors for vegetation reflectance spectra at 1754 nm. NDLI uses leaf lignin concentration and canopy foliar biomass, as combined in the 1750 nm range, as a means for predicting total canopy lignin content. NDLI is most frequently used for ecosystem analysis and detection of surface plant litter. (Serrano, Penuelas, & Ustin, 2002) L2 Canopy Lignin is distributed in the original North/South flight lines.

Design Description

Canopy Lignin data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Lignin. L2 Canopy Lignin is distributed in the original North/South flight lines.

DP3.30022.001 Canopy lignin - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of canopy lignin concentration. Level 2 products derived from individual flight lines over a given site are mosaiced into single product; spatial resolution is 1m.

Abstract

Canopy Lignin, or Normalized Difference Lignin Index (NDLI), estimates the relative amounts of lignin contained in vegetation canopies. Leaf lignin concentration and canopy foliage biomass are the determining factors for vegetation reflectance spectra at 1754 nm. NDLI uses leaf lignin concentration and canopy foliar biomass, as combined in the 1750 nm range, as a means for predicting total canopy lignin content. NDLI is most frequently used for ecosystem analysis and detection of surface plant litter. (Serrano, Penuelas, & Ustin, 2002) L3 Canopy Lignin is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

Design Description

Canopy Lignin data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Lignin. L3 Canopy Lignin is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

DP2.30018.001 Canopy nitrogen - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized difference nitrogen index from remotely sensed data; data are provided by flightline

Abstract

Canopy Nitrogen, or Normalized Difference Nitrogen Index (NDNI), estimates the relative amounts of nitrogen in vegetation land cover. The index uses reflectance at 1510 nm (determined largely by nitrogen concentration in plants and foliar biomass) and at 1680 nm (sensitive to biomass but not to nitrogen absorption). NDNI is a relatively new spectral index in remote sensing. L2 NDNI is distributed in the original North/South flight lines.

Design Description

Canopy Nitrogen data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce bidirectional reflectance distribution function (BRDF) effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Nitrogen. L2 Canopy Nitrogen is distributed in the original North/South flight lines.

DP3.30018.001 Canopy nitrogen - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Measure of canopy nitrogen concentration in remotely sensed data. Level 2 products derived from individual flight lines over a given site are mosaicked into single product; spatial resolution is 1m.

Abstract

Canopy Nitrogen, or Normalized Difference Nitrogen Index (NDNI), estimates the relative amounts of nitrogen in vegetation land cover. The index uses reflectance at 1510 nm (determined largely by nitrogen concentration in plants and foliar biomass) and at 1680 nm (sensitive to biomass but not to nitrogen absorption). NDNI is a relatively new spectral index in remote sensing. L3 NDNI is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

Design Description

Canopy Nitrogen data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Nitrogen. L3 Canopy Nitrogen is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

DP2.30019.001 Canopy water content - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of canopy water content; data are provided by flightline

Abstract

The Canopy Water Content data products are a family of 5 spectral indices: MSI, NDII, NDWI, NMDI, and WBI. These indices use regions vegetation reflectance spectra known to be indicators of leaf water content, relative canopy water content, changes in canopy water content, soil and canopy water content, and changes in canopy water status, respectively. L2 Canopy Water Content is distributed in the original North/South flight lines and is packaged as a zip file containing one GeoTIFF for each index.

Design Description

Canopy Water Content data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Water Content. L2 Canopy Water Content is distributed in the original North/South flight lines.

DP3.30019.001 Canopy water content - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of canopy water content. Level 2 products derived from individual flight lines over a given site are mosaicked into single product; spatial resolution is 1m.

Abstract

The Canopy Water Content data products are a family of 5 spectral indices: MSI, NDII, NDWI, NMDI, and WBI. These indices use regions vegetation reflectance spectra known to be indicators of leaf water content, relative canopy water content, changes in canopy water content, soil and canopy water content, and changes in canopy water status, respectively. L2 Canopy Water Content is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections. Each tile is packaged as a zip file containing one GeoTIFF for each index.

Design Description

Canopy Water Content data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Water Content. L3 Canopy Water Content is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections. Each tile is packaged as a zip file containing one GeoTIFF per spectral index.

DP2.30020.001 Canopy xanthophyll cycle - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of xanthophyll concentration; data are provided by flightline

Abstract

Canopy Xanthophyll, or Photochemical Reflectance Index (PRI), is a reflectance ratio index that is sensitive to changes in carotenoid pigments, particularly xanthophyll pigments, in live foliage (Gamon, Penuelas, & Field, 1992). Carotenoid pigments are proxies for photosynthetic light use efficiency, or the rate of carbon dioxide uptake by foliage per unit energy absorbed. PRI is used in studies of vegetation productivity and stress. Applications include vegetation health in evergreen shrublands, forests, and agricultural crops prior to senescence. L2 Canopy Xanthophyll is distributed in the original North/South flight lines.

Design Description

Canopy Xanthophyll Cycle data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Xanthophyll Cycle. L2 Canopy Xanthophyll Cycle is distributed in the original North/South flight lines.

DP3.30020.001 Canopy xanthophyll cycle - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Normalized index of xanthophyll concentration. Level 2 products derived from individual flight lines over a given site are mosaicked into single product; spatial resolution is 1m.

Abstract

Canopy Xanthophyll, or Photochemical Reflectance Index (PRI), is a reflectance ratio index that is sensitive to changes in carotenoid pigments, particularly xanthophyll pigments, in live foliage (Gamon, Penuelas, & Field, 1992). Carotenoid pigments are proxies for photosynthetic light use efficiency, or the rate of carbon dioxide uptake by foliage per unit energy absorbed. PRI is used in studies of vegetation productivity and stress. Applications include vegetation health in evergreen shrublands, forests, and agricultural crops prior to senescence. L3 Canopy Xanthophyll is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

Design Description

Canopy Xanthophyll Cycle data products are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce bidirectional reflectance distribution function (BRDF) effects. These data are processed to orthorectified directional surface reflectance and then to Canopy Xanthophyll Cycle. L3 Canopy Xanthophyll Cycle is distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

DP4.00067.001 Carbon dioxide flux

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer; Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude and Motion Reference System; LI-COR - LI840A

Coverage

Data are collected at all terrestrial sites, along the tower profile from the ground to the tower top above the canopy, in order to study the ecosystem exchange of scalars (CO2, H2O, etc.) and energy between the atmosphere and the ecosystem of interest.

Description

Carbon dioxide flux of CO2 is estimated based on the eddy covariance technique from sonic anemometer measurements of vertical winds and an IRGA measurement of CO2 concentration and tower profile measurements of CO2 concentration. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

Carbon dioxide flux is estimated based on the eddy-covariance technique using high frequency sonic anemometer measurements of vertical winds velocity and a infrared gas analyzer (IRGA) measurements of CO2 concentration to calculate turbulent flux, and tower profile measurements of CO2 concentration to calculate storage flux. This data product contains the measurement data and associated metadata in HDF5 format. The key sub-data products include storage flux, turbulent flux, and net surface-atmosphere exchange (NSAE) which is defined as the sum of storage flux and turbulent flux, on a 30 min basis. The data are delivered with the Bundled Eddy Covariance (DP4.00200.001) data product.

Design Description

Please see the Bundled Eddy Covariance (DP4.00200.001) data product for more information.

DP1.20092.001 Chemical properties of groundwater

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected in the fall and spring at all NEON aquatic sites except for MCRA, CUPE, and TECR where there are no groundwater wells.

Description

Grab samples of groundwater chemistry including general chemistry, anions, cations, and nutrients.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's groundwater chemistry sampling protocol. Subsamples are analyzed at NEON domain headquarters for alkalinity and acid neutralizing capacity (ANC); other subsamples are sent to external facilities for a broad suite of analytes, including dissolved and total nutrients and carbon, cations and anions, and general chemistry. For additional details on protocol, see the AOS Protocol and Procedure: Water Chemistry Sampling in Surface Waters and Groundwater (NEON.DOC.002905).

Design Description

Grab samples of groundwater are collected twice per year at NEON aquatic sites from permanently installed groundwater wells. There are up to eight wells at each site; currently four are sampled for water chemistry. The field protocol used by NEON for collecting groundwater chemistry samples in small (2-in diameter) shallow (<100 ft depth) groundwater observation wells follows the general procedure for minimal drawdown sampling detailed by EPA report Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (Puls and Barcelona, 1996). Sample handling and preparation portions of this protocol follow the general requirements set forth by the USGS National Water-Quality Assessment (NAWQA) Program (USGS 2006).(http://data.neonscience.org/api/v0/documents/NEON.DOC.002905vD).

DP1.20093.001 Chemical properties of surface water

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites.

Description

Grab samples of surface water chemistry including general chemistry, anions, cations, and nutrients.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's surface water chemistry sampling protocol. Subsamples are analyzed at NEON domain headquarters for alkalinity and acid neutralizing capacity (ANC); other subsamples are sent to external facilities for a broad suite of analytes, including dissolved and total nutrients and carbon, cations and anions, and general chemistry. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Water Chemistry Sampling in Surface Waters and Groundwater (NEON.DOC.002905).

Design Description

Grab samples of surface water at NEON aquatic sites are collected in streams 26 times per year and 12 times per year in lakes. In streams, 12 samples are collected at regular intervals during the sampling season, while the remaining 14 are collected on an irregular basis to capture major flow events. In lakes, samples are collected approximately monthly and to capture ice-on and ice-off events. The field protocol used by NEON for collecting surface water chemistry samples follows the general requirements set forth by the 2011 USGS National Water-Quality Assessment (NAWQA) Program and the Arctic LTER standard operating procedures (SOP). Sample handling and preparation portions of this protocol follow the general requirements set forth by the USGS National Water-Quality Assessment (NAWQA) Program (USGS 2006).

DP1.00099.001 CO2 concentration - storage

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

This data product is monitored at all terrestrial sites. Sensors are located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to sensors for analysis.

Description

Concentration of CO2 in profile of tower; used in calculation of storage terms in eddy covariance calculations of carbon exchange. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains the quality-controlled measurement data and associated metadata in HDF5 format. The key sub-data products include CO2 molar fraction in the air at different measurement heights on tower at all NEON terrestrial sites, and sensor associated environmental data. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

The L0 data products used to calculate CO2 concentration - storage are recorded at a rate of 1 Hz, and are used to calculate 2 minute and 30 minute averages for each measurement height on tower.

DP1.00034.001 CO2 concentration - turbulent

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer

Coverage

These data are collected at all terrestrial sites to study the turbulent CO2 concentration above the ecosystem canopy.

Description

Concentration of CO2 at the top of the tower; used in calculation of turbulent terms in eddy covariance calculations of carbon exchange. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product provides the turbulent CO2 concentration statistics. The key sub-data products include CO2 molar fraction in the air at the tower top. It contains the quality-controlled measurement data and associated metadata in HDF5 format. It is also used alongside other data products to generate the CO2 flux data product. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

This sensor is mounted on the tower top, collocated with the 3D sonic anemometer. The inlet of the gas intake tube is displaced 15 cm horizontally and 0 cm vertically from the center of 3D wind measurement volume. The L0 data products of this sensor are recorded at a rate of 20 Hz, and these L0 data products are used to calculate the L1 data products at 1-min and 30-min time resolution.

DP2.00008.001 CO2 concentration rate of change

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

These data are measured at all terrestrial sites. Sensors are located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to sensor for analysis.

Description

Time rate of change of CO2 concentration (storage component only) over 30 minutes at each measurement level along the vertical tower profile. Gap-filling is not applicable. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product is the temporally interpolated CO2 data (time rate of change for CO2) at the 30 minute time scale at different measurement levels on the tower. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP3.00009.001 CO2 concentration rate of change profile

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

These data are measured at all terrestrial sites. Sensors are located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to sensor for analysis.

Description

Time rate of change of CO2 concentration (storage component only) over 30 min, spatially interpolated along the vertical tower profile. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains spatially interpolated CO2 data at a 0.1 m vertical interval based on the 30 minute time rate of change for CO2 molar fraction at different measurement levels on the tower. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP1.10014.001 Coarse downed wood bulk density sampling

Subsystem

Terrestrial Observation System (TOS)

Coverage

Sampling for Coarse Downed Wood bulk density is conducted at all terrestrial sites with qualifying logs where repeat CDW Survey tally sampling is performed. Functionally, this includes forested sites, and some sites dominated by woody shrub/scrub vegetation.

Description

Raw bulk density measurements of coarse downed wood >= 2 cm diameter

Abstract

The Coarse Downed Wood bulk density sampling data product contains the quality-controlled, native sampling resolution volume, mass and calculated bulk density data from cross-sectional disks cut from downed logs at each of NEON's terrestrial sites at which qualifying logs are present. Disks are preferentially collected from logs that fall into the most abundant 'decayClass x sizeCategory x taxonID' combinations, as informed by the Coarse Downed Wood survey data product. In addition to bulk density from each collected disk, log-level decay, size category and taxonID information is also recorded for each log from which disks are sampled. Data are reported per disk per log, and when multiple disks are collected from the same log, multiple records will exist in the data. Logs are typically associated with a plotID, and disks may also be collected from logs that fall outside of NEON plots. For additional details, see protocol NEON.DOC.001711vD: TOS Protocol and Procedure: Coarse Downed Wood, and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity and Leaf Area Index.

Design Description

Coarse Downed Wood bulk density samples are collected from terrestrial sites with qualifying logs where repeat CDW Survey sampling is performed. CDW Bulk Density sampling is implemented twice per site, the first time within the first three years of data collection at a site, and the second time 5-6 years after the first sampling event. When possible, the same logs are targeted for sampling at both sampling time points. Sampling may occur in up to 20 Distributed Plots and all Tower Plots, and unlike all other NEON TOS sampling, collection of disks may also occur outside of NEON plot boundaries, due to the sparsely distributed nature of target logs. Logs sampled for bulk density are parsed into five decay categories that broadly match existing USFS definitions, three size categories (2-5 cm, 5-10 cm, and greater than 10 cm diameter), and are identified to the highest taxonomic resolution possible according to the USDA Plants database. The bulk density sampling effort is inherently variable from site to site, as it is driven by the number of 'decayClass x sizeCategory x taxonID' (DST) combinations, which is strongly dependent on site-level tree diversity. For each site, sampling is considered complete once all rank-ordered DSTs that cumulatively make up 80% of the total tallies have been sampled. Target disk sample size per DST is n=10 for DSTs >= 10 cm diameter, and n=5 for DSTs < 10 cm diameter.

DP1.10010.001 Coarse downed wood log survey

Subsystem

Terrestrial Observation System (TOS)

Coverage

Tallies for Coarse Downed Wood are conducted at all terrestrial NEON sites at which qualifying logs greater than or equal to 2 cm diameter are found. Functionally, surveyed sites include forested sites, and somes sites dominated by woody shrub/scrub vegetation.

Description

Tally and raw measurement of coarse downed wood >= 2 cm diameter

Abstract

The Coarse Downed Wood log survey data product contains the quality-controlled, native sampling resolution data from in-situ tallies and measurements of downed logs from each of NEON's terrestrial sites at which qualifying logs are present. Qualifying logs are tallied within each plot according to the Line Intercept Distance Sampling (LIDS) method, and additional diameter, length and decay class characteristics are measured for each tallied log. Data are reported per log per plot, and when forked logs are tallied, additional diameter data are reported for each qualifying log fork. For additional details, see protocol NEON.DOC.001711vD: TOS Protocol and Procedure: Coarse Downed Wood, and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity and Leaf Area Index.

Design Description

Coarse Downed Wood tallies are performed at least once at all sites at which logs greater than or equal to 2 cm diameter exist. Additional surveys are performed at 3 year intervals at each site if initial LIDS estimates of CDW volume are non-zero. Sampling occurs in n=20 randomly selected Distributed Plots at the site scale, and also in Tower Plots established within the airshed of the NEON Tower. Within each plot, 3 randomly oriented transects are established, and transect lengths vary dynamically by site according to F-values selected to enable tallying of 7-10 qualifying logs per plot. Tallied logs are parsed into three size categories (2-5 cm, 5-10 cm, and greater than 10 cm diameter), five decay categories that are broadly matchable to existing USFS definitions, and are identified to the highest taxonomic resolution possible according to the USDA Plants database.

DP1.20254.001 Depth profile at specific depths

Subsystem

Aquatic Observation System (AOS)

Sensor

YSI Pro2030

Coverage

Measured at all NEON lake and non-wadeable stream sites.

Description

Measurements of water column temperature and depth profile in non-wadeable streams and lakes

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Depth profile at specific depths data collection. Depth profile data are collected along with anyother sampling in the water column. Depth profile data include water temperature, conductivity, and dissolved oxygen data collected every 0.5 m through the water column using a handheld proble. Depth profile data are only collected at the deepest location of the lake (buoy) or near the non-wadeable stream sensor set. These data not only provide metadata to accompany the sampling modules, but also inform sampling depths based the thermocline (if present) for water chemistry and associated analytes, surface water microbes, and phytoplankton sampling. Depth profiles are collected year-round, including under ice at northern sites, a minimum of 12 times per year. For additional details, see [NEON.DOC.002792]: AOS Protocol and Procedure: Secchi Depth and Depth Profile Sampling in Lakes and Non-Wadeable Streams and [NEON.DOC.001152]: NEON Aquatic Sampling Strategy.

Design Description

Depth profile data are collected during sample collection for any protocol that samples the water column in a lake or river (phytoplankton, zooplankton, pelagic surface water microbes, and pelagic surface water chemistry), and may be collected during other sampling visits to lake and river sites. Measurements are collected only near the buoy sensors in lakes and rivers, and data are collected year-round, including under ice. Measurements of water temperature, conductivity, and dissolved oxygen are collected every 0.5 m through the water column, with larger intervals (1.0 m) in the hypolimnion of deep lakes. Data are collected a minimum of 12 times per year.

DP1.10017.001 Digital hemispheric photos of plot vegetation

Subsystem

Terrestrial Observation System (TOS)

Sensor

Full-frame Nikon DSLR (D750/D800/D810 model) equipped with a 16 mm Nikkor full-frame fisheye lens

Coverage

These data are collected at NEON terrestrial sites.

Description

Upward and/or downward facing digital 180-degree images of vegetation in plots used to calculate leaf area index

Abstract

This data product contains the quality-controlled, native sampling resolution field data and 180 degree hemispherical images that enable ground-based calculation of Leaf Area Index (LAI) and/or Plant Area Index (PAI). For forests, both upward-facing photos of canopy vegetation, and photos of understory vegetation are collected. For shorter-stature ecosystems, only downward-facing images of 'understory' vegetation are collected, where 'understory' is defined to include all vegetation. Photos are acquired with a full-frame DSLR camera equipped with a fisheye lens, and are provided in RAW image format. For additional details, see protocol NEON.DOC.014039: TOS Protocol and Procedure: Measurement of Leaf Area Index, and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity and Leaf Area Index.

Design Description

Digital Hemispheric Photos (DHPs) of plot vegetation are collected every 3 y from twenty randomly selected Distributed Plots, and collection from these plots is timed such that DHPs are acquired within a one month window that also includes a NEON AOP remote-sensing flight over the site. Ground collection of DHPs and the AOP flight are both timed to co-occur with the window of peak greenness according to a 10 y average of the MODIS-EVI greenness index. To better frame the window of peak green in a given year, DHPs are also collected from n=3 Tower Plots on a 2 week interval, from leaf-out to senescence. Within each plot, photo points are arranged according to the shape of a square cross, oriented in alignment with the cardinal axes, and with points spaced every 4 meters. At each photo point within the plot, photos of understory vegetation are acquired, with 'understory' defined as vegetation typically less than 2 meters height. In grasslands and scrublands, the understory is therefore the only vegetation photographed. When an overstory is present, i.e. vegetation greater than 2 m height, photographs of overstory are also acquired at each photo point. Overstory images are typically acquired in the crepuscular hours of the day, when direct sunlight is not illuminating the foliage, and may also be acquired when it is overcast such that the sun does not cast a shadow. Understory images are typically acquired during daylight hours.

DP1.30003.001 Discrete return LiDAR point cloud

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) LiDAR - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Unclassified three-dimensional point cloud stored in LAS format. Classifications follow ASPRS definition. All point coordinates are provided in meters. Data provided by flightline.

Abstract

The NEON AOP Discrete Return Light Detection and Ranging (LiDAR) Point Cloud is an American Society for Photogrammetry and Remote Sensing (ASPRS) LASer format data product in UTM map projection. It provides the X, Y, and Z coordinates for each laser return point. AOP discrete LiDAR is collected at approximately 4 points per square meter, and each point can have up to 5 returns. L1 LiDAR point clouds are distributed in their original flight lines with one flight line per file.

Design Description

LiDAR point cloud data products are derived from NEON Airborne Observation Platform (AOP) LiDAR (NIS) data collected in North-South oriented flight lines. These data are processed to orthorectified point clouds and distributed in ASPRS LAS standard format.

DP1.20097.001 Dissolved gases in surface water

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Grab samples of surface water dissolved gases including carbon dioxide, methane, and nitrous oxide

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's surface water dissolved gas sampling protocol. Water samples are equilibrated with air in the field. Samples of reference air (pre-equilibration) and equilibrated air (post-equilibration) are sent to external facilities for analysis to determine carbon dioxide, methane, and nitrous oxide concentrations in the gas samples. Data users should refer to the user guide for dissolved gases in surface water (NEON_dissolvGasInWater_UserGuide) for suggestions on how to calculate dissolved concentrations of carbon dioxide, methane, and nitrous oxide in the surface waters from which samples were collected using Henry's Law and mass balance equations. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Surface Water Dissolved Gas Sampling NEON.DOC.001199.

Design Description

The dissolved gas sampling protocol is completed in conjunction with the water chemistry and aquatic stable isotope protocol. Grab samples of surface water at NEON aquatic sites are collected in streams 26 times per year and 12 times per year in lakes. In streams, 12 samples are collected at regular intervals during the sampling season, while the remaining 14 are collected on an irregular basis to capture major flow events. In lakes, samples are collected approximately monthly and to capture ice-on and ice-off events. For more information see NEON.DOC.001199.

DP1.00017.001 Dust and particulate size distribution

Subsystem

Terrestrial Instrument System (TIS)

Sensor

TSI DustTrak model: 8533EP

Coverage

NEON terrestrial sites

Description

Near real-time measurements of PM1.0, PM2.5, PM4, PM10, PM15 and TSP in the atmosphere using a optical sensor.

Abstract

By deploying optical particulate matter analyzers at a total of 6 sites across three Domains (10, 13, and 15) NEON's aim is to help the scientific community gain insight on the regional dust transport across the Rocky Mountain region. Aerosol dust can be composed of numerous inorganic and organic elements; everything from biological components such as pollen to the byproducts of incomplete combustion.

Design Description

The particulate size analyzer has two main components, the DustTrak sensor (TSI DustTrak 8533EP) and its supporting infrastructure, which shelters the sensor from the environment, and provides an flow rate for the sampler that complies with EPA recommendations.

DP3.30015.001 Ecosystem structure

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) LiDAR - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Height of the top of canopy above bare earth; data are mosaicked over AOP footprint; mosaicked onto a spatially uniform grid at 1 m spatial resolution in 1 km by 1 km tiles.

Abstract

Forests store and sequester a considerable proportion of the terrestrial global carbon budget. Forest canopy metrics are directly measurable with LiDAR sensors because laser pulses will be reflected from the uppermost canopy layers and remaining energy will penetrate to, and reflect from, under-story and the ground surface. The near simultaneous direct measurement of ground and canopy elevation allows the canopy height to be estimated through differencing. The CHM is generated by creating a continuous surface of canopy height estimates across the entire spatial domain of the LiDAR survey. The CHM is derived directly from the LiDAR point cloud. The LiDAR point cloud is produced from LiDAR return signals from both surface features and the true-ground as LiDAR pulses will be reflected from the uppermost layers of the canopy, as well as the underlying ground surface. To produce the CHM, the point cloud is separated into classes representing the ground and vegetation returns. The ground classified points allow calculation of a height normalized point cloud to provide a relative estimate of vegetation elevation. A surface is then generated using the height normalized vegetation points to produce the CHM.

Design Description

The Ecosystem Structure product is a canopy height model (CHM) in GeoTIFF raster data format in UTM projection and ITRF00 datum. The CHM is normalized by ground height, indicating all ground elevations are set to zero and canopy height is the height of vegetation above the ground in meters. The CHM rasters for a site are distributed in 1 km by 1 km tiles.

DP3.30024.001 Elevation - LiDAR

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) LiDAR - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Bare earth elevation given in meters above mean sea level (topographic information with vegetation and man-made structures removed) and mosaicked onto a spatially uniform grid at 1 m spatial resolution in 1 km by 1 km tiles. Surface features given in meters above mean sea level (topographic information with vegetation and man-made structures removed) and mosaicked onto a spatially uniform grid at 1 m spatial resolution in 1 km by 1 km tiles.

Abstract

The elevation product, in the form of a DTM, provides information on terrain structure, and is an important data layer in spatially driven models of landscape processes, and these models allow for spatially explicit predictability of phenomena internal and external to the landscape. Currently, LIDAR sensors provide the most efficient means for collecting an accurate and dense sample of the terrain among competing remote sensing or positioning systems. For example, high-resolution digital stereo photogrammetry can compete in terms of point density in open terrain, but suffers from sparse sampling beneath tree canopy. The DSM provides two important functions as complimentary information to the optical sensors on the AOP. The first function is strictly as a tool in the geolocation processing of the hyperspectral sensor and the RGB digital camera. The DSM also provides information on the structure of surface features, including derived vegetation structure, which can be used as a proxy to estimate important ecological quantities of interest.

Design Description

The elevation products supplied include a digital terrain model (DTM) and a digital surface model (DSM). The DTM includes only elevations that relate to the physical terrain surface, while the DSM also includes elevations that relate to surface features (eg. buildings, vegetation). Elevation values for both the DTM and DSM are reported with reference to Geoid12A datum (NGS, 2012), while horizontal coordinates are referenced to the ITRF00 datum, projected to the Universal Transverse Mercator (UTM) mapping frame. The DTM and DSM are distributed as 1 km by 1 km tiles, which have corners spatially referenced to an even kilometer. The product is stored in GeoTIFF format.

DP1.20100.001 Elevation of groundwater

Subsystem

Aquatic Instrument System (AIS)

Sensor

In-Situ, Inc. - Aqua TROLL 200

Coverage

These data are collected in the fall and spring at all NEON aquatic sites except for MCRA, CUPE, and TECR where there are no groundwater wells.

Description

Sensor based measurement of groundwater elevation calculated from pressure transducer readings in each well

Abstract

There are important linkages and feedbacks between groundwater and surface water in streams, rivers, and lakes. NEON measurements of groundwater elevation at high resolution temporal changes informs these linkages. Three to eight wells are available per aquatic site. In this way, magnitude and direction of groundwater flow can be calculated. Wells are located both near the water body and further from the water body to enable investigation of hyporheic groundwater flow paths. This data product contains continuous, quality-controlled, groundwater depth converted to elevation above mean sea level. Measurements are captured every five minutes and reported as 5-minute instantaneous measurements and 30-minute averages.

Design Description

Multiple groundwater wells per aquatic site are installed in triangular arrays where local features allow. Elevation of groundwater is measured in an site-specific array designed to capture shallow groundwater flow and exchange with the surface water feature at the site.

DP1.20016.001 Elevation of surface water

Subsystem

Aquatic Instrument System (AIS)

Sensor

In-Situ, Inc. - Level TROLL 500

Coverage

Elevation of surface water is measured at all aquatic sites. It is measured at the upstream and downstream sensor stations in wadeable streams; at a single station in rivers and at the inlet and outlet of lake sites.

Description

Measurements of water surface elevation, available as one-, five-, and thirty-minute averages in lakes and wadeable streams. Based on sensor measurements of water pressure.

Abstract

Surface water elevation is controlled by precipitation at both the landscape and channel scales, overland flow, interflow and groundwater flow. It is correlated to discharge and is critical to understanding how water moves through the environment, carrying nutrients and sediment, modulating aquatic ecosystem structure and function. This data product contains continuous, quality-controlled, surface water depth converted to elevation above mean sea level. Measurements are captured once per minute and reported as 1-minute instantaneous measurements and 30-minute averages.

Design Description

Elevation of surface water will be used to provide continuous discharge measurements in wadeable streams, rivers and lakes where flowing inlet and outlet streams are present. Pressure transducers will be placed at both the upstream and downstream sensor stations in wadeable streams, at a single station in rivers and at the inlet and outlet locations of lake sites.

DP1.30012.001 Field spectral data

Subsystem

Airborne Observation Platform (AOP)

Sensor

ASD field spectrometer

Coverage

All NEON sites.

Description

Reflectance of collected sample(s) or transects using an ASD Field Spectrometer; level of effort product, provided when collected.

Abstract

NEON AOP Field Spectral Data are collected using an ASD field spectrometer for calibrations tarps and representative ground and landcover materials while the airborne data are being simultaneously collected. The Field Spectral Data are collected and distributed as a Level Of Effort activity and as such are not collected for every flight or site. Typical collection rates are 2 to 3 sites per year.

Design Description

NEON AOP Field Spectral Data are collected using an ASD field spectrometer for calibrations tarps and representative ground and landcover materials while the airborne data are being simultaneously collected. The Field Spectral Data are collected and distributed as a Level Of Effort activity and as such are not collected for every flight or site. Typical collection rates are 2 to 3 sites per year.

DP1.20107.001 Fish electrofishing, gill netting, and fyke netting counts

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected in the fall and spring at all NEON wadeable stream sites except for Como Creek (COMO, not sampled), Martha Creek (MART, sampled Fall only) and McRae Creek (MCRA, sampled Fall only) and at all lake sites except for Suggs Lake (SUGG) and Barco Lake (BARC).

Description

Counts of fish from electrofishing surveys in wadeable streams, or electrofishing, gill netting, and/or fyke netting surveys in lakes. Includes fish standard length and individual mass

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's fish sampling. Fish are sampled using a combination of electrofishing, gill-nets and mini-fyke nets. Field technicians identify fish to the lowest practical taxonomic level and then weigh and measure a subset of captured individuals before releasing. For additional details see protocols DOC.001295: AOS Protocol and Procedure: Fish Sampling in Wadeable Streams and DOC.001296: AOS Protocol and Procedure: Fish Sampling in Lakes and science design NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Fish are sampled twice per year at lakes and wadeable stream sites, during spring and fall. 10 fish sampling reaches or segments are established at each site; with 3 fixed reaches sampled during every sampling bout and a random subset of 3 additional reaches or segments selected for sampling each year.

DP1.20105.001 Fish sequences DNA barcode

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

CO1 DNA sequences from select fish in lakes and wadeable streams

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's cytochrome oxidase I (COI) barcoding of fish sequences. Fin clips are taken from a subset of collected fish for DNA analysis. The DNA barcoding procedure involves the removal of tissue, extracting and sequencing DNA from the tissue, and matching that sequence data to sequences from previously identified voucher specimens. DNA analysis serves a number of purposes, including verification of taxonomy of specimens that do not receive expert identification, clarification of the taxonomy of rare or cryptic species, and characterization of diversity using molecular markers. For additional details on fish collection, see protocol NEON.DOC.001295: AOS Protocol and Procedure: Fish Sampling in Wadeable Streams and NEON.DOC.001296: AOS Protocol and Procedure: Fish Sampling in Lakes . Queries for this data product will return metadata tables formatted for submission to the Barcode of Life Database. These queries will also provide links to the actual sequence data, which are publicly available on the Barcode of Life Datasystem (BOLD, http://www.barcodinglife.com/). The sequence data can be obtained by following the links from the NEON data portal, or by directly querying NEON data sets on the BOLD server. From the NEON portal, the link "BOLD Project: Fish sequences DNA barcode" redirects to a page on the BOLD public data portal for the queried data. This is a dynamic link and will automatically update based on the user query.

Design Description

Fin clips will be collected from 5-10 individuals of a target species. These tissues will be preserved in an appropriate tissue vial and shipped to an external lab. DNA will be extracted and target sequences amplified via PCR. Barcodes of cytochrome oxidase I will be generated per specimen.

DP4.00201.001 Flux footprint characteristics

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer; Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude and Motion Reference System

Coverage

Data are collected at all terrestrial sites, along the tower profile from the ground to the tower top above the canopy, in order to study the ecosystem exchange of scalars (CO2, H2O, etc.) and energy between the atmosphere and the ecosystem of interest.

Description

The eddy-covariance flux measurement sources its information from an upstream surface, the footprint. Footprint characteristics provide the biophysical surface information of this time-varying area, necessary to distinguish temporal effects (e.g., biological activity) from spatial effects (e.g., changing wind direction). This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

A footprint model as described by Metzger et al. (2012) is used to determine where on the ground surface emissions measured by the eddy-covariance turbulent exchange system originated from. This allows interpretation of observed emission rates against hour-to-hour variations in flux footprint over surface properties such as land cover, soil moisture etc. e.g. from gridded remote-sensing data products. This data product contains the quality-controlled measurement data and associated metadata in HDF5 format. The key sub-data products include model inputs, footprint statistics, and footprint weight matrices, on a 30 min basis. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP2.30014.001 fPAR - spectrometer - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

The fraction of incident photosynthetically active radiation (400-700 nm) absorbed by the green elements of a vegetation canopy; calculated by an industry standard (ATCOR) algorithm based on Soil Adjusted Vegetation Index (SAVI) as input; data are provided by flightline at equivalent resolution to spectrometer orthorectified surface directional reflectance, carbon and nutrient cycling due to its relationship with vegetative productivity.

Abstract

The fraction of photosynthetically active radiation (fPAR) describes the relative quantity of incident solar radiation of relevant photosynthetically active wavelengths (0.4-0.7 microns) absorbed by vegetative material. The fPAR is an important biophysical variable used in the simulation of water, carbon and nutrient cycling due to its relationship with vegetative productivity. Theoretically, if a plant is able to intercept and absorb relevant photosynthetically active wavelengths, this will result in a higher state of productivity, gas exchange and transpiration. The application of this theory is critical in assessments of productivity change through time, and simulation of climate models to predict ecosystems response to climate variability. The level 2 version of the fPAR product is distributed by flight line.

Design Description

The products supplied include a fPAR (fraction of photosynthetically active radiation) map and fPAR uncertainty map, both in raster format by flight line. The fPAR and uncertainty in fPAR maps are derived from the directional surface reflectance, through the intermediate SAVI (Soil Adjusted Vegetation Index) and LAI (Leaf Area Index) products. Raster maps for fPAR and fPAR uncertainty are reported with horizontal reference to the ITRF00 datum and projected to the Universal Transverse Mercator (UTM) mapping frame. The fPAR is reported as a unit-less value which describes the fraction of absorbed radiation by plant material. The product is distributed in a GeoTIFF format with each file containing one flight line.

DP3.30014.001 fPAR - spectrometer - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

The fraction of incident photosynthetically active radiation (400-700 nm) absorbed by the green elements of a vegetation canopy; mosaiced from the fPAR level 2 product onto a spatially uniform grid at 1 m spatial resolution and provided as 1 km by 1 km tiles.

Abstract

The fraction of photosynthetically active radiation (fPAR) describes the relative quantity of incident solar radiation of relevant photosynthetically active wavelengths (0.4-0.7 microns) absorbed by vegetative material. The fPAR is an important biophysical variable used in the simulation of water, carbon and nutrient cycling due to its relationship with vegetative productivity. Theoretically, if a plant is able to intercept and absorb relevant photosynthetically active wavelengths, this will result in a higher state of productivity, gas exchange and transpiration. The application of this theory is critical in assessments of productivity change through time, and simulation of climate models to predict ecosystems response to climate variability. The level 3 version of the fPAR product is distributed in 1 km by 1 km tiles which are mosaics of the most-nadir pixels of the flight lines collected.

Design Description

The products supplied include a fPAR (fraction of photosynthetically active radiation) map and fPAR uncertainty map, both in raster format by flight line. The fPAR and uncertainty in fPAR maps are derived from the directional surface reflectance, through the intermediate SAVI (Soil Adjusted Vegetation Index) and LAI (Leaf Area Index) products. Raster maps for fPAR and fPAR uncertainty are reported with horizontal reference to the ITRF00 datum and projected to the Universal Transverse Mercator (UTM) mapping frame. The fPAR is reported as a unit-less value which describes the fraction of absorbed radiation by plant material. The product is distributed in a GeoTIFF format with each file containing one 1 km by 1 km tile, whose corners are spatially referenced to an even kilometer.

DP1.20267.001 Gauge height

Subsystem

Aquatic Instrument System (AIS)

Sensor

Oregon Rule Co. staff gauge

Coverage

Gauge height is measured at all NEON aquatic sites.

Description

Gauge height, in meters, measured at lakes, wadeable streams and non-wadeable streams.

Abstract

Gauge height is the height of the water surface above an established altitude where the stage is zero. The zero level is arbitrary, but is often close to the streambed. Gauge height at stream sites will be related to measurements of stream discharge to formulate stage-discharge rating curves at all NEON stream and river sites. Rating equations will be applied to continuous surface water elevation data in order to calculate continuous stream discharge at all NEON aquatic sites. For additional details, see protocol NEON.DOC. 001085: AOS Protocol and Procedure: Stream Discharge, NEON.DOC.001646: General AQU Field Metadata Sheet, and NEON.DOC.001152: Aquatic Sampling Design.

Design Description

Gauge measurements and field metadata are collected at all aquatic sites whenever any other protocol is implemented. For protocols that may be performed in shifts multiple times a day, e.g. fish sampling, there can be multiple gauge records per site per date that cover different time ranges. In total, gauge height is measured several times per month per site.

DP1.10020.001 Ground beetle sequences DNA barcode

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

CO1 DNA sequences from select ground beetles

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's cytochrome oxidase I (COI) barcoding of ground beetles sequences. The DNA barcoding procedure involves the removal of tissue, extracting and sequencing DNA from the tissue, and matching that sequence data to sequences from previously identified voucher specimens. DNA analysis serves a number of purposes, including verification of taxonomy of specimens that do not receive expert identification, clarification of the taxonomy of rare or cryptic species, and characterization of diversity using molecular markers. For additional details on ground beetle collection, see protocol NEON.DOC.014050: TOS Protocol and Procedure: Ground Beetle Sampling and science design NEON.DOC.000909vA: TOS Science Design for Ground Beetle Abundance and Diversity. Queries for this data product will return metadata tables formatted for submission to the Barcode of Life Database. These queries will also provide links to the actual sequence data, which are publicly available on the Barcode of Life Datasystems (BOLD, http://www.barcodinglife.com/). The sequence data can be obtained by following the links from the NEON data portal, or by directly querying NEON data sets on the BOLD server. From the NEON portal, the link "BOLD Project: Ground beetle sequences DNA barcode" redirects to a page on the BOLD public data portal for the queried data. This is a dynamic link and will automatically update based on the user query.

Design Description

Ground beetle legs are subsampled from individual specimens collected as part of the Ground beetles sampled from pitfall traps (DP1.10022.001) data product. Up to 10 individuals per species per site for a total of up to 95 individuals per site per year are selected for barcoding. Beetles that are rare, particularly difficult to identify, or poorly represented in previous collection events are prioritized for DNA sequencing. Only beetle specimens that have been identified by an expert taxonomist are eligible for DNA barcoding. Leg tissue is preserved in an appropriate tissue vial and shipped to an external lab, where DNA is extracted and target sequences amplified via PCR. Barcodes of cytochrome oxidase I are generated per specimen.

DP1.10022.001 Ground beetles sampled from pitfall traps

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Taxonomically identified ground beetles and the plots and times from which they were collected.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's ground beetle sampling and specimen processing protocols. Ground beetle abundance and diversity are sampled via pitfall trapping at regular intervals by NEON field technicians at core and relocatable sites. Following trap collection, all beetles from the family Carabidae are sorted by NEON technicians and identified to species or morphospecies. A subset of collected Carabidae are pointed or pinned, while other specimens (non-pinned/non-pointed carabids, invertebrate bycatch, and vertebrate bycatch) are stored in 95% ethanol for archiving, and may be pooled into a single archive vial per plot. Regardless of storage method, all collections data are reported at a per trap resolution. A subset of pinned ground beetles (up to 467 per site per year) are sent to an expert taxonomist for secondary identification. Identifications performed on these individuals may be used to estimate uncertainty in parataxonomist identification by NEON technicians.

Design Description

Ground beetles are sampled using pitfall traps (16 oz deli containers filled with 150 or 250 mL of propylene glycol). Four traps are deployed in each of 10 plots at each terrestrial NEON site (40 traps per site), with traps arrayed approximately 20 meters from the center of the plot in each of the four cardinal directions. Sampling occurs biweekly throughout the growing season (when temperatures are above 4 degrees C).

DP1.00100.001 H2O concentration - storage

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

This data product is monitored at all terrestrial sites. Sensors are located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to sensors for analysis.

Description

Concentration of H2O in profile; used in calculation of storage terms in eddy covariance calculations of water vapor exchange. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains the quality-controlled measurement data and associated metadata in HDF5 format. The key sub-data products include H2O molar fraction in the air at different measurement heights on the tower at all NEON terrestrial sites, and sensor-associated environmental data. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

The L0 data products used to calculate H2O concentration - storage are recorded at a rate of 1 Hz, and are used to calculate 2 minute and 30 minute averages for each measurement height on tower.

DP1.00035.001 H2O concentration - turbulent

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer

Coverage

These data are collected at all terrestrial sites to study the turbulent H2O concentration above the ecosystem canopy.

Description

Concentration of H2O at the top of the tower; used in calculation of turbulent terms in eddy covariance calculations of water vapor exchange. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product provides the turbulent H2O concentration statistics. The key sub-data products include H2O molar fraction in the air at the tower top. It contains the quality-controlled measurement data and associated metadata in HDF5 format. It is also used alongside other data products to generate the latent heat flux data product. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

This sensor is mounted on the tower top, collocated with the 3D sonic anemometer. The inlet of the gas intake tube is displaced 15 cm horizontally and 0 cm vertically from the center of 3D wind measurement volume. The L0 data products of this sensor are recorded at a rate of 20 Hz, and these L0 data products are used to calculate the L1 data products at 1-min and 30-min time resolution.

DP2.00009.001 H2O concentration rate of change

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

These data are measured at all terrestrial sites. Sensors are located inside the instrument hut near the bottom of the tower. The air samples from different measurement heights are pumped through gas tubing to sensor for analysis.

Description

Time rate of change of H2O concentration (storage component only) over 30 minutes at each measurement level along the vertical tower profile. Gap-filling is not applicable. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product is the temporally interpolated H2O data (time rate of change for H2O) at the 30 minute time scale at different measurement levels on the tower. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP3.00010.001 H2O concentration rate of change profile

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI840A

Coverage

Please see the Bundled Eddy Covariance (DP4.00200.001) data product for more information.

Description

Time rate of change of H2O concentration (storage component only) over 30 min, spatially interpolated along the vertical tower profile. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains spatially interpolated H2O data at a 0.1 m vertical interval based on the 30 minute time rate of change for H2O molar fraction at different measurement levels on the tower. The data are delivered with the Bundled Eddy Covariance (DP4.00200.001) data product.

Design Description

Please see the Bundled Eddy Covariance (DP4.00200.001) data product for more information.

DP1.10023.001 Herbaceous clip harvest

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Dry weight of herbaceous vegetation harvested from individual clip strips, by functional type

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Herbaceous biomass clip harvest sampling. Herbaceous vegetation is operationally defined in this protocol as non-woody plants (i.e. grasses, sedges, forbs, some bryophytes, and non-woody vines such as Convolvulus spp. and certain Rubus spp.), as well as woody-stemmed plants with diameter at decimeter height (ddh) < 1 cm at the time of sampling. For additional details, see protocol NEON.DOC.014037: TOS Protocol and Procedure: Measurement of Herbaceous Biomass and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity, and Leaf Area Index.

Design Description

Clip-harvest of herbaceous biomass occurs within randomly located clip-harvest strips in 20m x 20m plots or subplots. Up to 20 non-forested Distributed plots (containing 1 clip strip per plot) and up to 30 tower plots (containing 1- 4 clip strips per plot) are sampled at each site. Tower plots are sampled every year. Tower plots at ungrazed sites are sampled once per year if there is a single annual biomass peak, and twice at sites with two biomass peaks per year in order to capture both warm season and cool season production. At grazed sites, sampling in Tower plots occurs once every 4 weeks while livestock are present. Distributed plots are sampled once every 3 years. Once every 5 years, an additional clip harvest bout is conducted in Distributed plots for biogeochemical analyses.

DP1.30010.001 High-resolution orthorectified camera imagery

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) High Resolution Digital Camera - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

White balanced 8 bit RGB images orthorectified and output onto a fixed, uniform spatial grid using nearest neighbor resampling to a 10 cm spatial resolution.

Abstract

The digital camera is part of a suite of instruments on the NEON Airborne Observation Platform (AOP) that also includes a full-waveform, small-footprint LiDAR system and the NEON Imaging Spectrometer. In the orthorectification process, the digital imagery is remapped to the same geographic projection as the LiDAR and imaging spectrometer data that is acquired simultaneously. The resulting images will share the same map projection grid space as the orthorectified spectrometer and LiDAR imagery. Since the digital camera imagery is acquired at higher spatial resolution than the imaging spectrometer data, it can aid in identifying features in the spectrometer images including manmade features (e.g., roads, fence lines, and buildings) that are indicative of land-use change. Level 1 RGB camera images are distributed as one camera frame per GeoTIFF file.

Design Description

The Level 1 high-resolution RGB orthorectified camera imagery product is a single color camera frame in GeoTIFF raster data format in UTM projection and ITRF00 datum.

DP3.30010.001 High-resolution orthorectified camera imagery mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) High Resolution Digital Camera - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Level 1 high-resolution orthorectified camera images are mosaiced and tiled into 1 km by 1 km data sets. Mosiac is output onto a fixed, uniform spatial grid using nearest-neighbor resampling; spatial resolution is maintained at 0.1 m.

Abstract

The digital camera is part of a suite of instruments on the NEON Airborne Observation Platform (AOP) that also includes a full-waveform, small-footprint LiDAR system and the NEON Imaging Spectrometer. In the orthorectification process, the digital imagery is remapped to the same geographic projection as the LiDAR and imaging spectrometer data that is acquired simultaneously. The resulting images will share the same map projection grid space as the orthorectified spectrometer and LiDAR imagery. Since the digital camera imagery is acquired at higher spatial resolution than the imaging spectrometer data, it can aid in identifying features in the spectrometer images including manmade features (e.g., roads, fence lines, and buildings) that are indicative of land-use change. Level 3 RGB camera images are distributed as mosaics of individual camera images in 1 km by 1 km tiles in GeoTIFF format.

Design Description

The Level 3 high-resolution RGB orthorectified camera imagery product is distributed in GeoTIFF raster data format in UTM projection and ITRF00 datum. The Level 3 imagery for a site is distributed in 1 km by 1 km tiles.

DP1.00005.001 IR biological temperature

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Apogee SI-111 infrared (IR) temperature sensor

Coverage

These data are collected at all NEON terrestrial sites.

Description

Infrared temperature, available as one- and thirty-minute averages of 1 Hz observations. Biological temperature (i.e. surface temperature) is measured via IR temperature sensors located in the soil array and at multiple heights on the tower infrastructure.

Abstract

Infrared Biological Temperature (i.e., surface temperature) is available as one- and thirty-minute averages of 1 Hz observations. Biological temperature can be used in conjunction with other measurements to draw conclusions on topics such as plant respiration, evapotranspiration rates, and stomatal conductance.

Design Description

Biological temperature (i.e., surface temperature) is measured via IR temperature sensors located in the soil array and on the tower infrastructure.

DP2.30012.001 LAI - spectrometer - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

The ratio of upper leaf surface area to ground area (for broadleaf canopies), or projected conifer needle surface area to ground area (for coniferous plants) for a given unit area; measured by an industry standard (ATCOR) algorithm based on Soil Adjusted Vegetation Index (SAVI) as input; data are provided by flightline.

Abstract

The leaf area index (LAI) is a derived spectral product from remotely sensed data that is used as a proxy for describing leaf area across areas larger than can be measured by more direct ground-based measurements such as hemispherical photography. It is often used as an input layer for productivity, landscape, and climate models. The Level 2 LAI product is distributed by flight line in GeoTIFF format.

Design Description

The Level 2 LAI data product is distributed in GeoTIFF raster data format containing one flight line per file in UTM projection and ITRF00 datum.

DP3.30012.001 LAI - spectrometer - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

The ratio of upper leaf surface area to ground area (for broadleaf canopies), or projected conifer needle surface area to ground area (for coniferous plants) for a given unit area; Level 2 products derived from individual flight lines over a given site are mosaiced into single product; spatial resolution is 1m.

Abstract

The leaf area index (LAI) is a derived spectral product from remotely sensed data that is used as a proxy for describing leaf area across areas larger than can be measured by more direct ground-based measurements such as hemispherical photography. It is often used as an input layer for productivity, landscape, and climate models. The Level 3 LAI product is distributed in 1 km by 1 km mosaic tiles using the most-nadir pixels from the original flight lines and is in GeoTIFF format.

Design Description

The Level 3 LAI data product is distributed in GeoTIFF raster data format in UTM projection and ITRF00 datum. Each file is a 1 km by 1 km tile.

DP1.20002.001 Land-water interface images

Subsystem

Aquatic Instrument System (AIS)

Sensor

Stardot NetCam SC CAM-SEC5IR-B

Coverage

Aquatic stream gauge images are recorded at all aquatic sites.

Description

RGB and IR images of the lake, river, or stream vegetation, stream surface, and stream gauge (where possible) taken from an automated camera. Images are collected every 15 minutes.

Abstract

Physical characteristics of a water body, e.g., flow data in streams and water level in lakes, are critical to interpreting chemical and biological measurements or estimating fluxes into and out of systems. At all NEON aquatic sites, water level is assessed via readings made from a fixed staff gauge with 1 cm resolution prior to and following the execution of an aquatic protocol. Photos may also be used for qualitative estimates of snow cover, riparian characteristics, or weather. At stream sites, a stage-discharge rating curve can be developed for a specific, fixed cross section by collecting multiple measurements of discharge, channel area, and gauge height over a range of discharge levels. In lakes, water level will be tracked with gauge height in addition to using pressure transducer sensors at identified inflow and outflow locations.

Images are sent to and processed by PhenoCam, a cooperative network that archives and distributes imagery and derived data products from digital cameras deployed at research sites across North America and around the world. These images are available for viewing and downloading from the PhenoCam Gallery.

Design Description

A Stardot NetCam is deployed at each aquatic site, oriented toward a fixed staff gauge with 1 cm resolution. The water level is measured prior to and following the execution of an aquatic protocol, i.e., any field sample or measurement collection event. Every 15 minutes each camera captures back-to-back RGB and IR images separated by 30 seconds.

DP4.00137.001 Latent heat flux

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer; Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude and Motion Reference System; LI-COR - LI840A

Coverage

Data are collected at all terrestrial sites, along the tower profile from the ground to the tower top above the canopy, in order to study the ecosystem exchange of scalars (CO2, H2O, etc.) and energy between the atmosphere and the ecosystem of interest.

Description

Latent heat flux is estimated based on the eddy covariance technique using a sonic anemometer to measure vertical winds and an IRGA sensor to measure water vapor and tower profile measurements of water vapor. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

Latent heat flux is estimated based on the eddy-covariance technique using high frequency sonic anemometer measurements of vertical wind velocity and a infrared gas analyzer (IRGA) measurements of water vapor to calculate turbulent flux, and tower profile measurements of water vapor to calculate storage flux. This data product contains the measurement data and associated metadata in HDF5 format. The key sub-data products include storage flux, turbulent flux, and net surface-atmosphere exchange (NSAE) which is defined as the sum of storage flux and turbulent flux, on a 30 min basis. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP1.30001.001 LiDAR slant range waveform

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) LiDAR - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Outgoing pulse and slant range return waveform signals with geolocation information provided, but no spatial resampling. Data are provided by flightline in a binary format designed by NEON.

Abstract

The Level 1 Slant Range Waveform Lidar data product provides a geolocated waveform for each laser pulse in a binary output format. The X and Y coordinates are reported in the output horizontal datum and projection and the Z values are reported in absolute elevation in the output vertical datum. The waveform product saves the continuous received signal versus time (digitized into 1 nsec time bins. The waveform shapes might provide important information about scattering properties, especially in the case of vegetation. Each AOP flight line is saved as an individual zip file, which includes a set of binary files plus the quality check (QC) first return LAS file. A nominal 10 km long flight line flown at a speed of approximately 100 knots will take about 200 seconds to collect. At a pulse repetition frequency (PRF) value of 100 kHz, the resulting product will contain approximately 20 million laser pulses. The return waveforms are saved as a binary data file with 250 columns (the 1 nsec time bins) by the number of rows equaling the number of laser pulses. A nominal waveform .zip file will be approximately 50 GB and contains several files. Waveform lidar data have many uses: 3D visualization; generation of surface models such as bare-Earth digital elevation models (DEM) also referred to as digital terrain models (DTM), digital surface models (DSM), and canopy height models (CHM); analysis of vegetation structure, leaf area index, and biomass; analysis of canopy light penetration and attenuation; and watershed analysis.

Design Description

The Level 1 waveform data product is a geolocated slant-range waveform product where the return waveform is relative signal intensity versus 1 nsec time bins. The X and Y output coordinates will be reported as Easting and Northing values in a Universal Transverse Mercator (UTM) projection with the World Geodetic System 1984 (WGS84) International Terrestrial Reference Frame 2000 (ITRF 2000) ellipsoid horizontal datum with units of meters. The Z coordinates will be reported in a North American Vertical Datum 1988 (NAVD88) using the National Geodetic Survey Geoid12A height model with units of meters. The UTM zone will vary depending on the latitude/longitude of the specific NEON site. Each flight line will be saved as an individual output .zip file containing a series of files.

DP1.10031.001 Litter chemical properties

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites with overstory vegetation.

Description

Bulk litter chemistry at the scale of a plot. Data are reported by functional group (leaves vs. needles).

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of carbon, nitrogen, and lignin concentrations in litterfall. Litter is defined as material that is dropped from the forest canopy and has a butt end diameter <2 cm and a length <50 cm; this material is collected in elevated 0.5 m2 PVC traps. After sorting by functional group, needles and leaves are sent for chemical analysis. For additional details, see protocol NEON.DOC.001710: TOS Field and Lab Protocol for Litterfall and Fine Woody Debris.

Design Description

Litterfall sampling is executed at each terrestrial NEON site that contains woody vegetation > 2 m tall. Sampling occurs only in base plots within the tower airshed, in either 20 or 30 plots depending on the stature of site vegetation and plot sizes. Large plots have 2 litter traps while small plots have 1, but sorted material is composited by plot prior to chemical analysis. Litterfall sampling for mass occurs multiple times per year, but material from only one collection bout - either during peak senescence at deciduous sites, or autumn for evergreen sites - is analyzed for carbon, nitrogen, and lignin concentrations. This occurs once every five years.

DP1.10101.001 Litter stable isotopes

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites with overstory vegetation.

Description

Bulk litter stable isotope values at the scale of a plot. Data are reported by functional group (leaves vs. needles).

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of stable isotopes in litterfall. Litter is defined as material that is dropped from the forest canopy and has a butt end diameter <2 cm and a length <50 cm; this material is collected in elevated 0.5 m2 PVC traps. After sorting by functional group, needles and leaves are sent for isotope analysis. For additional details, see protocol NEON.DOC.001710: TOS Field and Lab Protocol for Litterfall and Fine Woody Debris.

Design Description

Litterfall sampling is executed at each terrestrial NEON site that contains woody vegetation > 2 m tall. Sampling occurs only in base plots within the tower airshed, in either 20 or 30 plots depending on the stature of site vegetation and plot sizes. Large plots have 2 litter traps while small plots have 1, but sorted material is composited by plot prior to isotopic analysis. Litterfall sampling for mass occurs multiple times per year, but material from only one collection bout - either during peak senescence at deciduous sites, or autumn for evergreen sites - is analyzed for stable isotopes. This occurs once every five years.

DP1.10033.001 Litterfall and fine woody debris sampling

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites with overstory vegetation.

Description

Dry weight of litterfall and fine woody debris collected from elevated litter traps and ground traps, by functional group

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Litterfall and fine woody debris sampling. Litter is defined as material that is dropped from the forest canopy and has a butt end diameter <2cm and a length <50 cm; this material is collected in elevated 0.5m2 PVC traps. Fine woody debris is defined as material that is dropped from the forest canopy and has a butt end diameter <2cm and a length >50 cm; this material is collected in ground traps as longer material is not reliably collected by the elevated traps. For additional details, see protocol NEON.DOC.001710: TOS Field and Lab Protocol for Litterfall and Fine Woody Debris and science design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity, and Leaf Area Index.

Design Description

Up to two trap-pairs (ground + elevated) are deployed per plot in forested ecosystems. Ground traps are sampled annually. Sampling interval of elevated litter traps is variable by dominant overstory vegetation. Deciduous forests are sampled once in the spring then multiple times during fall senescence; evergreen and coniferous forests are sampled year round. Traps are consistent with those used by the Smithsonian Center for Tropical Forest Science (CTFS). Mass data for each collection event are measured separately for functional groups: Leaves, Needles, Twigs/branches, Woody material, Seeds, Flowers and other non-woody reproductive structures, Other, and Mixed (unsorted). Once every five years, samples from a single collection will be analyzed for total C, N, and stable isotopes of C and N.

DP1.20120.001 Macroinvertebrate collection

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Collection of benthic macroinvertebrates using multiple sampling methods in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic Macroinvertebrate collection and field metadata, as well as associated taxonomic, morphometric, and count analyses data provided by a contracted lab. Benthic field samples are collected in wadeable streams, rivers, and lakes, three times per year during the growing season using the type of sampler most suitable to the habitat types present at the site. Samples are preserved in ethanol in the field and shipped to a contracting lab for analysis. For additional details, see NEON.DOC.003046 AOS Protocol and Procedure: Aquatic Macroinvertebrate Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Benthic macroinvertebrate samples are collected three times per year at wadeable stream, river, and lake sites during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using the most appropriate sampler for the habitat type, including Surber, Hess, hand corer, modified kicknet, D-frame sweep, and petite ponar samplers. In wadeable streams, samples are collected in the two most dominant habitat types (e.g. riffles, runs, pools, step pools). In lakes, samples are collected near the buoy, inlet, and outlet sensors using a petite ponar, and in littoral areas using a D-frame sweep. In rivers, samples are collected near the buoy and two other deep-water locations using a petite ponar sampler, and in littoral areas using a D-frame sweep or large-woody debris sampler. Samples are preserved in ethanol in the field, returned to the domain support facility for a preservative change where a small volume of glycerol is added to help keep invertebrates from getting brittle. Samples are shipped to a taxonomy lab for sorting and identification, including count of each taxon per size class (to nearest mm) and identification to lowest practical taxon (genus or species).

DP1.20126.001 Macroinvertebrate DNA barcode

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

CO1 DNA sequences of the aquatic macroinvertebrate community

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic Macroinvertebrate DNA barcode sampling protocol, as well as associated metadata provided by a contracted lab. Benthic field samples are collected in wadeable streams, rivers, and lakes, three times per year during the growing season using the type of sampler most suitable to the habitat types present at the site. Samples are preserved in ethanol in the field and shipped to a contracting lab for analysis. For additional details, see AOS Protocol and Procedure: Aquatic Macroinvertebrate Sampling (NEON.DOC.003046) and NEON Aquatic Sampling Strategy (NEON.DOC.001152).

Queries for this data product return a downloadable data package with laboratory methods and DNA extraction, PCR amplification, and sequencing metadata for samples from the queried sites and date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository. Sequence data may also be obtained by querying NEON data sets at the NCBI Sequence Read Archive (NCBI SRA) and the European Bioinformatics Institute (EMBL-EBI).

Design Description

Benthic macroinvertebrate DNA samples are collected three times per year at wadeable stream, river, and lake sites during aquatic biology bout windows, roughly in spring, summer, and fall, at the same time and location as morphological taxonomy samples. Samples are collected using the most appropriate sampler for the habitat type, including Surber, Hess, hand corer, modified kicknet, D-frame sweep, and petite ponar samplers. In wadeable streams, samples are collected in the most dominant habitat type (e.g. riffles, runs, pools, step pools). In lakes and rivers, samples are collected in littoral areas using a D-frame sweep. Samples are preserved in ethanol in the field, returned to the domain support facility for a preservative change prior to shipping to an external facility. Samples are shipped to a an external facility for homogenization and high-throughput sequencing (metabarcoding).

DP4.00007.001 Momentum flux

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude and Motion Reference System

Coverage

Data are collected at all terrestrial sites at the tower top above the canopy, in order to study the exchange of momentum and development of turbulence between the atmosphere and the ecosystem of interest.

Description

Momentum flux is estimated based on the eddy covariance technique using a sonic anemometer to measure vertical and horizontal winds. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

Momentum flux is estimated based on the eddy-covariance technique using a sonic anemometer to measure vertical and horizontal wind velocities. This data product contains the measurement data and associated metadata in HDF5 format. The key sub-data product include only the turbulent flux on a 30 min basis. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP1.10038.001 Mosquito sequences DNA barcode

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

CO1 DNA sequences from select mosquitoes

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's cytochrome oxidase I (COI) barcoding of mosquito sequences. The DNA barcoding procedure involves the removal of leg tissue from pinned specimens, extracting and sequencing DNA from the tissue, and matching that sequence data to sequences from previously identified voucher specimens. DNA analysis serves a number of purposes, including verification of taxonomy of specimens that do not receive expert identification, clarification of the taxonomy of rare or cryptic species, and characterization of diversity using molecular markers. For additional details on mosquito collection, see protocol NEON.DOC.014049: TOS Protocol and Procedure: Mosquito Sampling and science design NEON.DOC.000908: TOS Science Design for Terrestrial Microbial Diversity. Queries for this data product will return metadata tables formatted for submission to the Barcode of Life Database. These queries will also provide links to the actual sequence data, which are publicly available on the Barcode of Life Datasystem (BOLD, http://www.barcodinglife.com/). The sequence data can be obtained by following the links from the NEON data portal, or by directly querying NEON data sets on the BOLD server. From the NEON portal, the link "BOLD Project: Mosquito sequences DNA barcode" redirects to a page on the BOLD public data portal for the queried data. This is a dynamic link and will automatically update based on the user query.

Design Description

Mosquito legs will be collected from up to 10 individuals per species per domain. These tissues will be preserved in an appropriate tissue vial and up to 95 tissue samples per domain will be shipped to an external lab. DNA will be extracted and target sequences amplified via PCR. Barcodes of cytochrome oxidase I will be generated per specimen.

DP1.10041.001 Mosquito-borne pathogen status

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Presence/absence of a pathogen in a single mosquito sample (pool)

Abstract

This data product contains the quality-controlled, native sampling resolution data derived from NEON's mosquito pathogen testing. Products resulting from this sampling include pathogen test results of mosquito pools derived from identified mosquitoes collected during NEON mosquito sampling. See NEON Product Mosquitoes sampled from CO2 traps (DP1.10043.001) for data on the abundance and diversity of mosquitoes collected at NEON sites. Following collection, samples are sent to a professional taxonomist where a subsample of the catch generated from each trap is identified to species and sex. A subset of postively-identified mosquitoes are later processed for pathogen testing. Only female mosquitoes identified to the species-level and captured in sufficient quantity over a season from likely vector species are eligible for pathogen testing. Mosquitoes that meet pathogen-testing criteria collected within the same site and sampling bout are homogenized into a large pool of female conspecifics and then subdivided into testing vials of appropriate pool sizes for pathogen testing. Each vial is tested one or more times using a variety of methods using a variety of methods which may include RT-PCR, Vero cell culture, and melt curve assays. These methods vary in target specificity, from general (e.g., Vero cell culture) to specific viral species (e.g., RT-PCR). Most pools of mosquitoes are negative because pathogens are rare; when pools are determined to be positive for any virus, the identit(ies) of the virus(es) are determined to the species-level, if possible. Test results yield data on the presence of important mosquito pathogens (e.g., West Nile virus, Eastern equine encephalitis virus, Dengue, etc) in a subset of species that are known vectors of disease.. For additional details, see science design NEON.DOC.000911:TOS Science Design for Vectors and Pathogens.

Design Description

A set of up to 1000 individual mosquitoes per species per site per year are targeted for pathogen testing of arboviruses within the families Bunyaviridae, Alphaviridae, and Flavivirdae. Mosquito species are prioritized into three tiers, with highest priority given to Tier 1 species (Aedes aegypti and Aedes albopictus); followed by Tier 2 species: Culex tarsalis, Culex pipiens, and Aedes triseriatus; and then Tier 3 species: any other individuals identified to the species-level within the genera of Aedes and Culex. To be eligible for pathogen testing, a species must have a minimum of 100 (Tier 1 species) or 200 (Tiers 2 & 3) individuals present at a site in a year that are available for testing.

DP1.10043.001 Mosquitoes sampled from CO2 traps

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Taxonomically identified mosquitoes and the plots and times from which they were collected

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's mosquito sampling protocol. Mosquito abundance and diversity are sampled at regular intervals by NEON field technicians at core and relocatable sites. For additional details on protocol, see the TOS Protocol and Procedure: Mosquito Sampling. Following collection, samples are sent to a professional taxonomist where a subsample each catch generated from each trap is identified to species and sex. Identified mosquitoes are then processed for pathogen analysis or preserved for final archiving. Products resulting from this sampling and processing include records of when mosquitoes were sampled, the taxonomic and abundance data for a subset of mosquitoes captured, and information about the material archived from the sample. For additional details, see protocol NEON.DOC.014049: TOS Protocol and Procedure: Mosquito Sampling and science design NEON.DOC.000910: TOS Science Design for Mosquito Abundance, Diversity and Phenology.

Design Description

When adult mosquitoes are active, sampling occurs (via CDC light traps) every two weeks at core sites and every four weeks at relocatable sites. A sampling bout consists of two trapping nights and the intervening day for up to ten plots per site.

DP1.20033.001 Nitrate in surface water

Subsystem

Aquatic Instrument System (AIS)

Sensor

Satlantic - SUNA V2 UV nitrate sensor

Coverage

Upstream (S1) and downstream (S2) sensor stations are at all stream sites within NEON. Buoys (S1) will be deployed as a single station at alllake and large river (non-wadeable) sites within NEON.

Description

In situ sensor-based nitrate concentration, available as fifteen- and sixty-minute averages in surface water in lakes, wadeable and non-wadeable streams

Abstract

Nitrate is measured using an optical sensor at the downstream (S2) sensor station in streams and on the buoy (S1) at lake and river sites. It is reported as a 15-minute mean value from 50 measurements made during a 2-3 minute sampling burst every 15 minutes.

Design Description

The stream sensor stations measure PAR at water surface, water level, temperature, water quality, and at downstream stations, nitrate. The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.10045.001 Non-herbaceous perennial vegetation structure

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites at which qualifying growth forms are present at 10% cover or greater, or in the case of tree palms, when individuals are present in 10% or more of designated plots.

Description

Field measurements of individual non-herbaceous perennial plants (e.g. cacti, ferns)

Abstract

This data product contains the quality-controlled, native sampling resolution data from in-situ structural measurements of live and standing dead non-herbaceous perennial plants, from all terrestrial NEON sites with qualifying vegetation. Non-herbaceous perennial plants include agave, cactus, ferns, ocotillo, palms, xerophyllum and yucca species. The exact measurements collected per individual depend on growth form, and these measurements are focused on biomass and productivity estimation, when suitable allometries exist, and estimation of volume. Tree Palms are the only non-herbaceous perennial individuals that are consistently mapped; smaller palms such as Serenoa repens may be mapped if no taller overstory is present in a given plot. Tagging is also generally dependent on growth form, and may also depend on species. For example, palms are always tagged, large-stature cactus are tagged, small-stature cactus are not tagged, and ferns are never tagged. Individuals of all growth forms except tree palms may be subsampled according to a nested subplot approach in order to standardize the per plot sampling effort. Structure and mapping data are reported per individual per plot; sampling metadata, such as per growth form sampling area, are reported per plot. For additional details, see protocol NEON.DOC.000987vG: TOS Protocol and Procedure: Measurement of Vegetation Structure, and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity and Leaf Area Index.

Design Description

Non-herbaceous perennial vegetation structure data are collected from distributed and/or tower plots. Each distributed plot is sampled if at least one tree palm is present, or if tree palms are absent, if smaller qualifying individuals constitute $\geq$ 10% cover of the plot. Tower plots are sampled if at least one tree palm is present in $\geq$ 10% of tower plots at a site, or if smaller qualifying individuals constitute $\geq$ 10% of cover averaged across all tower plots at a site. Within a plot, tree palms are mapped and measured throughout the plot sampling area; if stem density thresholds are met, smaller qualifying individuals may be measured within nested subplots to standardize the sampling effort across plots.

At relatively mesic sites, distributed plots are sampled every 3 years, and a minimum of n=5 tower plots are sampled annually. At continental cold and/or dry sites, distributed plots and tower plots are sampled every 3 years. At boreal sites in Alaska, distributed and tower plots are sampled every 6 years, and relocatable sites are sampled a minimum of 3 time points. At sites with seasonal senescence, the onset of sampling in a given year is triggered by senescence of canopy or understory individuals, and must be completed before growth begins the following season. At sites with no distinct season, sampling begins within $\pm$ 2 weeks of the same date, and must be completed within 4 months of onset. See NEON.DOC.000987 for more details.

DP1.00101.001 Particulate mass

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Ecotech HiVol 3000

Coverage

These data are collected at six NEON terrestrial sites, on the eastern and western slopes of the Rocky Mountains.

Description

Dust mass and density measured by a high volume dust sampler and quartz filters.

Abstract

This product contains the quality-controlled, native sampling resolution data from NEON's particulate mass sampling protocol. Samples are collected by an automated assembly that pulls air through a quartz microfiber filter with a porosity of 10 micrometers, to collect PM10. Filters are weighed at high precision pre- and post-deployment to determine dust deposition mass. In addition to determining mass concentration of PM10, filters from the particulate mass analyzers will be archived in laboratory storage. Subsamples of the filters will be available to science community upon request to enable the assessment of chemical and nutrient inputs in the region.

Design Description

Particulate collection filters (Whatman 1851-8531 quartz microfiber filters) are deployed for two weeks in a HiVol 3000 collector at the top of NEON terrestrial towers at select sites. Filters are weighed pre- and post-deployment in an external facility. Throughout deployment, the HiVol collector records pressure, temperature, and the volume of air sampled.

DP1.20163.001 Periphyton, seston, and phytoplankton chemical properties

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

C, N, P, isotopes, chlorophyll a, and pheophytin of periphyton, seston, and phytoplankton from benthic and water column samples in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic periphyton, seston, and phytoplankton chemical analyses provided by a contracted lab. Benthic and water column field samples are collected in wadeable streams, rivers, and lakes, three times per year during the growing season using the type of sampler most suitable to the habitat and substratum types present at the site. Samples are processed at the domain support facility and separated into aliquots and filtered onto glass-fiber filters for chlorophyll, pheophytin, carbon, nitrogen, phosphorus, and carbon, nictrogen, and sulfur isotopes for analysis at an external facility. For additional details, see NEON.DOC.003045 AOS Protocol and Procedure: Periphyton, Seston, and Phytoplankton Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Periphyton, seston, and phytoplankton samples are collected three times per year at wadeable stream, river, and lake sites during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using the most approriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools), and seston samples are collected from the water column near the S2 sensor. In lakes, water-column phytoplankton samples are collected near the buoy, inlet, and outlet sensors using a Kemmerer sampler, and in littoral areas using the best benthic sampling method for the substratum type. In rivers, phytoplankton samples are collected near the buoy and two other deep-water locations using a Kemmerer sampler, and in littoral areas using the most benthic sampling method for the substratum type. All samples are subsampled at the domain support facility by filtering on glass-fiber filters then frozen and shipped to an external analytical facility for analysis.

DP1.20166.001 Periphyton, seston, and phytoplankton collection

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Collection and biomass of periphyton, seston, and phytoplankton using multiple benthic and water column sampling methods in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic periphyton, seston, and phytoplankton collection and field metadata, as well as associated taxonomic, morphometric, and count analyses data provided by a contracted lab. Benthic and water column field samples are collected in wadeable streams, rivers, and lakes three times per year during the growing season. Samples are processed at the domain support facility and separated into aliquots for taxonomic analysis (preserved in glutaraldehyde or Lugol's iodine) for shipment to an external facility, or filtered onto glass-fiber filters for biomass (ash-free dry mass). For additional details, see NEON.DOC.003045 AOS Protocol and Procedure: Periphyton, Seston, and Phytoplankton Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Periphyton, seston, and phytoplankton samples are collected three times per year at wadeable stream, river, and lake sites during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using the most approriate sampler for the habitat and substratum type, including rock scrubs, grab samples, and epiphyton. In wadeable streams, periphyton samples are collected in the two most dominant benthic habitat types (e.g. riffles, runs, pools, step pools), and seston samples are collected from the water column near the S2 sensor. In lakes, water-column phytoplankton samples are collected near the buoy, inlet, and outlet sensors using a Kemmerer sampler, and in littoral areas using the best benthic sampling method for the substratum type. In rivers, phytoplankton samples are collected near the buoy and two other deep-water locations using a Kemmerer sampler, and in littoral areas using the most benthic sampling method for the substratum type. All field-collected samples are split into subsamples in the domain support facility, which are either processed in the facility (ash-free dry mass) or preserved and shipped to a contracting taxonomy laboratory.

DP1.00033.001 Phenology images

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Stardot NetCam SC CAM-SEC5IR-B

Coverage

All terrestrial core and relocatable sites; camera is positioned on the top of each site's tower.

Description

RGB and IR images of the plant canopy taken from an automated camera on the tower top. Images are collected every 15 minutes and closely follow protocols of the Phenocam Network.

Abstract

Phenology is the study of reoccurring life cycle events that are driven by environmental factors (Morrisette et al., 2009). The timing of these events is driven by both short- and long-term variability in climate and is therefore valuable in understanding the effects of climate change (Richardson et al., 2006). Automated repeat digital images of plant canopies provide data for the extraction of indices (e.g. green chromatic coordinate (gcc)) that can be used to quantify changes in phenological events over time (Sonnentag et al., 2011).

NEON has deployed a Stardot NetCam on the top of all terrestrial core and re-locatable towers to study above-canopy phenology. Every 15 minutes each camera captures back-to-back RGB and IR images separated by 30 seconds. Over time, these images can be used to detect seasonal changes in vegetative canopies (e.g., onset of leaf growth and senescence). Images are sent to and processed by PhenoCam, a cooperative network that archives and distributes imagery and derived data products from digital cameras deployed at research sites across North America and around the world. NEON's phenocam images are available for viewing and downloading from the PhenoCam Gallery, along with images and data from other phenocam sites across the world.

Design Description

NEON has deployed a Stardot NetCam on the top of all terrestrial core and re-locatable towers to study above-canopy phenology. Every 15 minutes each camera captures back-to-back RGB and IR images separated by 30 seconds.

DP1.00024.001 Photosynthetically active radiation (PAR)

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Kipp & Zonen PQS 1 PAR Quantum Sensor

Coverage

All NEON terrestrial and aquatic sites.

Description

Photosynthetically Active Radiation (PAR) observations represent the radiation flux at wavelengths between 400-700 nm, which constitute the wavelengths that drive photosynthesis. This data product is available as one- and thirty-minute averages of 1 Hz observations. Observations are made by sensors located at multiple heights on the tower infrastructure and by sensors located on the aquatic meteorological station.

Abstract

Photosynthetically Active Radiation (PAR), available as one- and thirty-minute averages of 1 Hz observations. PAR represents the radiation at wavelengths between 400-700 nm (visible light), which constitutes the energy that drives photosynthesis.

Design Description

PAR observations are made by sensors located at multiple heights on the tower infrastructure. An additional downward facing sensor is located at the tower top to measure reflected PAR. A single (upward facing) sensor is located on the aquatic met station.

DP1.00066.001 Photosynthetically active radiation (quantum line)

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Licor LI-191-01 Quantum Line Sensor

Coverage

Sensors will be deployed at all NEON terrestrial sites within the soil plots.

Description

The quantum line sensor provides spatially averaged observations of photosynthetically active radiation (PAR), i.e., wavelengths between 400-700 nm, at the soil surface over a one meter length. This data product is available as one- and thirty-minute averages of 1 Hz observations. Observations are obtained by sensors located throughout the soil array.

Abstract

Photosynthetically active radiation measured at the soil surface via the quantum line sensor provides information on the light availability at the ground level. It is reported as 1-minute mean measurements and 30-minute mean values.

Design Description

Quantum Line Sensors are deployed in the soil array at NEON TIS sites to measure photosynthetically active radiation (PAR) at the soil surface. One quantum line sensor is deployed in three out of five soil plots. Their measurements will be representative of the point in space where they are located.

DP1.20042.001 Photosynthetically active radiation at water surface

Subsystem

Aquatic Instrument System (AIS)

Sensor

Kipp & Zonen - PQS1

Coverage

S1 (upstream) and S2 (downstream) sensor sets are at all stream sites within NEON. Buoys will be deployed at alllake and large river sites within NEON.

Description

Photosynthetically Active Radiation (PAR) observations represent the radiation flux at wavelengths between 400-700 nm, which constitute the wavelengths that drive photosynthesis. This data product is available as one-, five-, and thirty-minute averages. Observations are made at the aquatic sensor set location at lakes, non-wadeable streams, and wadeable streams.

Abstract

Photosynthetically active radiation at water surface is measured at 1 Hz at stream sensor sets and twice per minute on buoys at lake and river sites. It is reported as 1-minute mean measurements and 30-minute mean values.

Design Description

The stream sensor sets measure PAR at water surface, water level and temperature, and water quality. Downstream sensors also measure nitrate. The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.20261.001 Photosynthetically active radiation below water surface

Subsystem

Aquatic Instrument System (AIS)

Sensor

LI-COR LI-192A underwater PAR sensor

Coverage

Inlet and outlet sensor sets are at all lake sites within NEON. Buoys will be deployed at alllake and large river sites within NEON.

Description

Photosynthetically Active Radiation (PAR) observations represent the radiation flux at wavelengths between 400-700 nm, which constitute the wavelengths that drive photosynthesis. This data product is available as one- and thirty-minute averages. Observations are made at the aquatic sensor sets at the lake inlet, lake outlet, and lake buoy.

Abstract

Photosynthetically active radiation below water is measured at 1 Hz at lake inlet and outlet sensor sets and twice per minute on buoys at lake and river sites. It is reported as 1-minute mean measurements and 30-minute mean values.

Design Description

The inlet and outlet sensor sets measure PAR below water surface along with water level and temperature. The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.10026.001 Plant foliar physical and chemical properties

Subsystem

Terrestrial Observation System (TOS)

Coverage

Foliar sampling is conducted at all NEON terrestrial sites.

Description

Plant sun-lit canopy foliar physical (e.g., leaf mass per area) and chemical properties reported at the level of the individual (woody plants) or community (herbaceous plants).

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of foliar traits in sun-lit, georeferenced vegetation samples, including leaf mass per area, chlorophyll, major and minor elements, and lignin. Whenever possible, foliar data are collected in conjunction with overflights of the NEON Airborne Observation Platform (AOP). For additional details on sampling procedures, see NEON.DOC.001024: TOS Protocol and Procedure: Canopy Foliage Sampling. Queries for this data product will return field collection data and physical and chemical measurements on a per sample basis. For carbon and nitrogen stable isotope ratios measured in the same samples, see the Plant foliar stable isotopes data product.

Design Description

For sites with predominantly forest/shrubland cover, foliar sampling is conducted at 14 plots. In each plot, sun-lit foliage from one individual from each of the top three most abundant canopy species is sampled, yielding approximately 42 individuals per bout. Many of these individuals are also monitored in the Vegetation Structure protocol, and all are georeferenced. For grassland sites, foliage is sampled from 20 plots; all aboveground material in one or two (depending on plot size), randomly selected 0.1 X 2 m clip strips is harvested and homogenized, yielding 20-24 samples per bout. In sites with mixed cover, a combination of the two sampling approaches is employed. Foliar sampling occurs once every five years per site during the period of historic peak greenness. Whenever possible, sampling also occurs within two weeks of the AOP overflight. Chlorophyll subsamples are immediately frozen after collection, and additional processing of samples, including scans for leaf mass per area and initiation of sample drying for chemical analyses, occurs within 1-5 days of collection.

DP1.10053.001 Plant foliar stable isotopes

Subsystem

Terrestrial Observation System (TOS)

Coverage

Foliar sampling is conducted at all NEON terrestrial sites.

Description

Plant sun-lit canopy foliar stable isotope values reported at the level of the individual (woody plants) or community (herbaceous plants).

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of foliar stable isotope ratios in sun-lit, georeferenced vegetation samples, including delta 15N and delta 13C values. Whenever possible, foliar stable isotope ratios are collected in conjunction with overflights of the NEON Airborne Observation Platform (AOP). For additional details on sampling procedures, see [NEON.DOC.001024: TOS Protocol and Procedure: Canopy Foliage Sampling] (http://data.neonscience.org/api/v0/documents/NEON.DOC.001024vD). Queries for this data product will return carbon and nitrogen stable isotope ratios on a per sample basis. For field collection metadata and foliar physical and chemical properties (leaf mass per area, lignin, chlorophyll, major and minor elements) measured on the same samples, see the Plant foliar physical and chemical properties data product.

Design Description

For sites with predominantly forest/shrubland cover, foliar sampling is conducted at 14 plots. In each plot, sun-lit foliage from one individual from each of the top three most abundant canopy species is sampled, yielding approximately 42 individuals per bout. Many of these individuals are also monitored in the Vegetation Structure protocol, and all are georeferenced. For grassland sites, foliage is sampled from 20 plots; all aboveground material in one or two (depending on plot size), randomly selected 0.1 X 2 m clip strips is harvested and homogenized, yielding 20-24 samples per bout. In sites with mixed cover, a combination of the two sampling approaches is employed. Foliar sampling occurs once every five years per site during the period of historic peak greenness. Whenever possible, sampling also occurs within two weeks of the AOP overflight. Initiation of sample drying for stable isotope analysis occurs within 1-5 days of collection.

DP1.10055.001 Plant phenology observations

Subsystem

Terrestrial Observation System (TOS)

Coverage

Plant phenology is monitored at NEON terrestrial sites, typically within the tower airshed.

Description

Phenophase status and intensity of tagged plants

Abstract

This data product contains the quality-controlled, native sampling resolution data from in-situ observations of plant leaf development and reproductive phenophases, at each of NEON's terrestrial sites. Phenophase status and intensity definitions follow those of the USA National Phenology Network (USA-NPN). Status and intensity data are reported per phenophase per individual or patch, for each day observed. For additional details, see protocol NEON.DOC.014040: TOS Protocol and Procedure: Plant Phenology, and Science Design NEON.DOC.000907: TOS Science Design for Plant Phenology.

Design Description

Approximately 90 individual plants or plant patches are monitored at each site. Individuals of 3 dominant species at each site are targeted for monitoring during initial operations. Sampling intervals vary seasonally, ranging from 2-3x weekly during periods of rapid phenological transition to much less frequently during other times of year. NEON employs status-based monitoring in which the phenological condition of an individual is reported any time that individual is observed.

DP1.10058.001 Plant presence and percent cover

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Plant species presence as observed in multi-scale plots: species and associated percent cover at 1-m2 and plant species presence at 10-m2, 100-m2 and 400-m2

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's plant diversity sampling. The presence and percent cover of species is documented in square, multi-scale plots. The presence and percent cover of plant species and ground cover is observed in eight 1mˆ2 subplots per plot. The presence of species is observed in eight 10mˆ2 subplots and four 100mˆ2 subplots per plot, which can be combined for a list of species at the 400mˆ2 plot scale. For additional details, see protocol NEON.DOC.014042: TOS Protocol and Procedure: Plant Diversity Sampling; and science design NEON.DOC.000912: TOS Science Design for Plant Diversity.

Design Description

Up to thirty plots are measured at each site. Plots are sampled annually at most sites to correspond with peak greenness, and twice a year at select sites with bimodal peaks in greenness and species composition. The multi-scale plot design is consistent with methods of the Carolina Vegetation Project. The files provided with this data product also include records of plant vouchers and genetic material available for analysis by the ecological community that are stored at external archives.

DP1.00006.001 Precipitation

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Belfort AEPG II 600M weighing gauge (primary precipitation), Met One 372 tipping bucket (non-heated; secondary precipitation and throughfall) and 379 tipping bucket (heated; secondary precipitation)

Coverage

Some form of precipitation data are collected at all NEON terrestrial and aquatic sites.

Description

Precipitation is observed using one of two sensors. Primary precipitation is observed using a weighing gauge housed within a small double fence intercomparison reference, which is generally located within 0.5 km of the tower infrastructure. Secondary precipitation is observed using a tipping bucket located on the top of the tower infrastructure. Ground level precipitation (also known as throughfall) is also observed using tipping buckets at 3 of 5 soil array locations. Bulk precipitation is determined at five- and thirty-minute intervals for primary precipitation and at one- and thirty-minute intervals for secondary precipitation. AIS sites only include Primary (DFIR at Core Aquatic sites; currently only 2 or 3) or Secondary (tipping buckets at relocatable sites; currently about 8). No AIS sites have both; no AIS sites have the equivalent of throughfall.

Abstract

Across NEON sites two methods will be used to determine bulk precipitation. Bulk precipitation measurements at core sites consist of a weighing gauge surrounded by a double fence inter-comparison reference (DFIR). Bulk precipitation measurements at relocatable sites are made with a tipping bucket. Bulk precipitation measured using a DFIR and a weighing gauge is known to provide improved results over tipping bucket measurements. Thus, the weighing gauge surrounded by the DFIR is considered the “primary” method, while the tipping bucket is referred to as the “secondary” method.

Design Description

Primary precipitation will be measured by a weighing gauge surrounded by a small double fence inter-comparison reference (DFIR) at all core terrestrial sites. Secondary precipitation will be measured by a tipping bucket at all terrestrial relocatable sites, a select number of terrestrial core sites, and at aquatic sites. Throughfall will be measured by a tipping bucket equipped with troughs (extending outward from the tipping bucket) at all terrestrial sites where the canopy is seasonally taller than the height of the throughfall collectors’ inlets.

DP1.20190.001 Reaeration field and lab collection

Subsystem

Aquatic Observation System (AOS)

Sensor

YSI Pro2030, HOBO U24

Coverage

This data product is measured at NEON wadeable stream sites.

Description

Field and external laboratory data from the salt-tracer and gas injection field reaeration measurements, including stream widths, inert gas concentrations, gas loss rate calculations, and travel time calculations.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's wadeable stream reaeration sampling protocol. Grab samples of stream water at NEON aquatic sites are collected in streams at 4 sampling locations downstream of a continuous injection of an inert gas (SF6) and conservative tracer (NaCl or NaBr). Background samples are collected prior to tracer injection and are analyzed for background salt tracer concentrations. Plateau samples are collected once the tracer concentration reaches a constant concentration (as measured by conductivity) and 5 replicate samples from each station are analyzed for both salt and gas tracer concentrations. Data users should refer to the user guide for reaeration and salt-based discharge (NEON_ReaerSaltBasedQ_userGuide_vA) for suggestions on how to calculate reaeration rates from the published data packages. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Reaeration in Streams NEON.DOC.000693.

Design Description

Tracer injections of conservative salt and inert, volatile gas are completed 6-10 times per year to capture a range of flows at NEON wadeable stream sites. The first sampling station is located near sensor set #1 and the fourth sampling station is located near sensor set #2. Sampling stations #2 and #3 are approximately evenly spaced between sampling stations #1 and #4. The injection (drip) station is located far enough upstream of sampling station #1 that the tracer is well mixed within the stream channel for all sampling stations. Conductivity data loggers are located near sampling stations #1 and #4 as well to capture the rising limb and plateau in situ conductivity values. For more information see AOS Protocol and Procedure: Reaeration in Streams NEON.DOC.000693

DP1.00098.001 Relative humidity

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Vaisala HUMICAP Humidity and Temperature Probe- HMP 155

Coverage

Relative humidity is measured at NEON terrestrial and aquatic sites.

Description

Relative humidity, temperature, and dew or frost point temperature, available as one- and thirty-minute averages of 1 Hz observations. Observations are made by sensors located at the top of the tower infrastructure, in the soil array, and on the aquatic meteorologic station.

Abstract

This data product contains the relative humidity, air temperature, and dew point/frost point temperature measurements made at all NEON sites. It is reported as 1-minute mean measurements and 30-minute mean values.

Design Description

The sensors are installed at the top level of the tower infrastructure, at the soil array and on the aquatic met station at a standard height above ground level.

DP1.20271.001 Relative humidity above water on-buoy

Subsystem

Aquatic Instrument System (AIS)

Sensor

Vaisala HUMICAP Humidity and Temperature Probe- HMP 155

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Relative humidity, temperature, and dew or frost point temperature, available as one- and thirty-minute averages of 1 Hz observations. Observations are made by sensors located on the buoy in lakes and rivers.

Abstract

Relative humidity on buoys is measured every minute and is reported as 1-minute instantaneous measurements and 30-minute mean values. Other than the data collection frequency, this data product has the same data streams and processing as relative humidity measured at aquatic met stations and on the terrestrial instrument towers.

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.20275.001 Riparian composition and structure

Subsystem

Aquatic Observation System (AOS)

Sensor

NA

Coverage

Riparian composition and structure are measured at all NEON aquatic sites.

Description

Assessment of riparian vegetation composition and physical structure in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from the composition and structure components of NEON's riparian and habitat assessment protocol. This protocol provides a rapid estimate of the riparian vegetation, human impacts, and bank characteristics, which buffer the banks of NEON Aquatic lakes, rivers, and streams. For additional details, see protocol NEON.DOC. 003826:AOS Protocol and Procedure: Riparian Habitat Assessment and science design NEON.DOC.001152: Aquatic Sampling Design.

Design Description

Each aquatic site is surveyed once per year within the site-specific peak greenness window. Ten riparian transects are evenly distributed throughout the 1 km wadeable stream biological sampling reach. At lake sites, 10 evenly spaced transects are established around the lake perimeter. Large river sites include 5 right bank and 5 left bank transects that are evenly spaced throughout the 1 km reach. At each transect the physical habitat is characterized including vegetation structure and composition, bank characteristics including bank angle, revetment, and bank texture.

DP1.20191.001 Riparian vegetation % cover

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic wadeable stream sites.

Description

Assessment of riparian vegetation percent cover in wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from the stream canopy cover component of NEON's riparian habitat assessment protocol. Using a modified convex densiometer, 1/3 (17 points) of the view field is used to measure the riparian canopy cover at wadeable stream sites. For additional details, see protocol NEON.DOC. 003826: AOS Protocol and Procedure: Riparian Habitat Assessment and science design NEON.DOC.001152: Aquatic Sampling Design

Design Description

Each aquatic site is surveyed once per year within the site-specific peak greenness window. Ten riparian transects are evenly distributed throughout the 1 km wadeable stream biological sampling reach. At each transect, riparian canopy percent cover measurements are taken at 3 points: the center of the stream, 0.3 m from the left bank, and 0.3 m from right bank. At the center stream sampling point, 4 densiometer readings are taken facing upstream, downstream, river right, and river left; at the left and right banks a single densiometer reading is taken, facing the bank. Protocols are based on the U.S. EPA's Statewide Riparian Mapping protocol.

DP1.10064.001 Rodent-borne pathogen status

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites, except for PUUM (Puu Makaala Natural Area Reserve) and YELL (Yellowstone National Park).

Description

Presence/absence of a pathogen (or antibodies to a pathogen) in each single rodent sample

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's testing of blood samples from individual small mammals for seroposivity to Hantaviruses. The blood samples are collected as part of the mark-recapture, box trapping effort for small mammals (i.e., rodents (Rodentia) < 600 grams), with the field capture results available separately via the Small mammal box trapping data product (NEON.DP1.10072). Small mammals are sampled at regular intervals by NEON field technicians at core and relocatable sites. Blood samples are collected from individuals of target species of rodents, including all species in the families Cricetidae, Muridae, and Dipodidae, if an individual weighs more than 10 grams and is in good physical condition. In a typical year, only a subset of blood samples collected will be tested, up to approximately 140 samples per NEON site, with the remaining samples archived. The sample identifiers for the blood samples allow users to link the pathogen test results provided in this data product to the field collection information, included taxonomic identification of the capture, to the Small mammal box trapping data product (NEON.DP1.10072). For additional details, see protocol NEON.DOC.000481: TOS Protocol and Procedure: Small Mammal Sampling and science design NEON.DOC.000911: TOS Science Design for Vectors and Pathogens.

Design Description

Small mammal sampling is based on the lunar calendar, with timing of sampling constrained to occur within 10 days before or after the new moon. Typically, core sites are sampled 6 times per year, and relocatable sites 4 times per year. Small mammals are sampled using box traps (models LFA, XLK, H.B. Sherman Traps, Inc., Tallahassee, FL, USA) and, at sites in Puerto Rico, larger wire traps suitable for catching Rattus spp. (model 201, Tomahawk Live Trap, Hazelhurst, WI, USA). Box traps are arrayed in three to eight (depending on the size of the site) 10 x 10 grids with 10m spacing between traps at all sites. Blood samples for pathogen testing are collected only once per individual per sampling bout, but an individual may be resampled in subsequent bouts. Rodent-borne pathogen status data are typically only collected on three of the mammal trapping grids at each site, with these grids designated as 'pathogen grids'. Pathogen grids are trapped for three consecutive (or nearly) nights per sampling event to facilitate the generation of robust density estimates, whereas the remaining grids, 'diversity grids' are only sampled for one night per sampling event. Once a grid has been designated as a pathogen grid (after an initial assessment period of two years), that classification will apply for all subsequent trapping seasons for consistent, long-term data collection.

DP1.10102.001 Root chemical properties

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Fine root chemistry from cores or pits. Data are reported by size class.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of carbon and nitrogen concentrations in root biomass. Samples are either collected every five years using surface soil cores (top 30 cm) taken from each Tower base plot, or once from a single deep (2 meter) pit in the vicinity of the NEON Tower and soil sensors in 10-20 cm depth increments. For surface soil core sampling, roots are sieved, sorted into four size categories, and only live roots are analyzed for chemistry. For soil pit sampling, roots are sieved, sorted into two size categories, and both live and dead roots are analyzed. If sufficient mass is present, additional root material is archived and available upon request. For additional details on the sampling protocols, see NEON.DOC.014038: TOS Protocol and Procedure: Core Sampling for Plant Belowground Biomass and NEON.DOC.001708: TOS Protocol and Procedure: Soil Pit Sampling for Plant Belowground Biomass.

Design Description

For surface soil core sampling, each terrestrial site is sampled once every five years, with roots collected from all base plots (20-30) within the tower airshed (Tower plots). One or two 0.5 x 3 m 'clip cells' (depending on plot size) are randomly chosen out of a pre-determined clip cell list for root coring. A core is sampled from each clip cell to 30 cm maximum depth from both the northern and southern end. Then dried, weighed root material from a common size category is composited prior to chemical analysis. For soil pit sampling, each terrestrial site is sampled once. A soil pit is dug in the dominant soil type to maximum depth of 2 m. On the exposed face of the soil pit, a tape measure visually divides the soil profile into vertical increments. Each soil pit has three vertically-oriented sampling profiles, roughly corresponding to the left, center, and right of the pit sampling face. From each profile, a block of soil is removed from each 10 cm depth increment, starting from the surface down to 100 cm. Once a depth of 100 cm is reached, the each profile is divided into 20 cm depth increments. By the end of sampling, up to 45 soil samples are collected per pit.

DP1.10066.001 Root sampling (Megapit)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Fine root biomass in 10cm increments (first 1m depth) and 20cm increments (from 1m to 2m depth) from soil pit sampling

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's belowground plant biomass sampled from the megapit. Soil samples were collected at 10 cm depth increments to the first 100 cm below the surface, then 20 cm depth increments thereafter, along three vertical profiles from a single temporary soil pit at a location expected to be representative of NEON sensor-based soil plots. This sampling activity is expected to occur once at each NEON terrestrial site. Additional belowground plant biomass samples collected from the same soil pit are archived in the NEON Megapit Soil Archive and are available upon request. For additional details on the sampling protocol, see NEON.DOC.001708: TOS Protocol and Procedure: Soil Pit Sampling for Plant Belowground Biomass. Products resulting from this sampling include root biomass by size class and status.

Design Description

Each site is sampled a single time. At each site, a soil pit is dug in the dominant soil type to a maximum depth of 2 m. On the exposed face of the soil pit, a tape measure visually divides the soil profile into 10 cm depth increments. Each soil pit has three vertically-oriented sampling profiles, roughly corresponding to the left, center, and right of the pit sampling face. These profiles are referred to as profiles number 1, 2 and 3, respectively. From each profile, a block of soil is removed from each 10 cm depth increment, starting from the surface down to 100 cm. Once a depth of 100 cm is reached, the each profile is divided into 20 cm depth increments. By the end of sampling, up to 45 soil samples are collected. Roots are sieved and then divided into four categories distinguishing between status (alive or dead) and size ($>$ 2mm and $<$ 2 mm, unless otherwise noted).

DP1.10067.001 Root sampling tower plots

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Fine root biomass to 30cm depth via soil core sampling

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's belowground biomass protocol. These data enable estimation of the amount of belowground plant biomass <= 10 mm diameter within the area surrounding the NEON eddy covariance tower. At many sites this will also be the dominant vegetation type(s). NEON uses a 3-inch outside diameter (6.65 cm inside diameter) soil corer for belowground biomass sampling, with samples cored to 30 cm depth in order to be consistent with the sampling depth used for soil biogeochemistry and microbe sampling. Roots are sorted to two status classes (live or dead) and the following size category bins: < 0.5 mm, 0.5-1 mm, 1-2 mm, and 2-10 mm. Additional belowground plant biomass samples collected from the same soil cores are archived in the NEON Soil Archive and are available upon request. For additional details on the sampling protocol, see NEON.DOC.014038: TOS Protocol and Procedure: Core Sampling for Plant Belowground Biomass (AD[06]). Products resulting from this sampling include root biomass by size class and status.

Design Description

Each site is sampled every five years. At each terrestrial NEON site, roots are sampled from base plots (20-30) within the tower airshed (Tower plots). In each Tower plot, one or two clip cells (depending on plot size) are randomly chosen out of the pre-determined clip cell locations for root coring. The same clip cells are also used for annual aboveground Herbaceous Biomass sampling. In 20m x 20m Tower plots, two soil cores are sampled from one clip cell per bout. In 40m x 40m Tower plots soil core sampling occurs in two (out of four) randomly assigned 20m x 20m subplots, and two soil cores are sampled from one clip cell per subplot per bout. A root core is taken to 30 cm maximum depth from both the northern and southern end of the clip cell.

DP1.10099.001 Root stable isotopes

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Fine root stable isotope values from cores or pits. Data are reported by size class.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of stable isotope values of carbon and nitrogen in root biomass. Samples are either collected every five years using surface soil cores (top 30 cm) taken from each Tower base plot, or once from a single deep (2 meter) pit in the vicinity of the NEON Tower and soil sensors in 10-20 cm depth increments. For surface soil core sampling, roots are sieved, sorted into four size categories, and only live roots are analyzed for chemistry. For soil pit sampling, roots are sieved, sorted into two size categories, and both live and dead roots are analyzed. If sufficient mass is present, additional root material is archived and available upon request. For additional details on the sampling protocols, see NEON.DOC.014038: TOS Protocol and Procedure: Core Sampling for Plant Belowground Biomass and NEON.DOC.001708: TOS Protocol and Procedure: Soil Pit Sampling for Plant Belowground Biomass.

Design Description

For surface soil core sampling, each terrestrial site is sampled once every five years, with roots collected from all base plots (20-30) within the tower airshed (Tower plots). One or two 0.5 x 3 m 'clip cells' (depending on plot size) are randomly chosen out of a pre-determined clip cell list for root coring. A core is sampled from each clip cell to 30 cm maximum depth from both the northern and southern end. Then dried, weighed root material from a common size category is composited prior to chemical analysis. For soil pit sampling, each terrestrial site is sampled once. A soil pit is dug in the dominant soil type to maximum depth of 2 m. On the exposed face of the soil pit, a tape measure visually divides the soil profile into vertical increments. Each soil pit has three vertically-oriented sampling profiles, roughly corresponding to the left, center, and right of the pit sampling face. From each profile, a block of soil is removed from each 10 cm depth increment, starting from the surface down to 100 cm. Once a depth of 100 cm is reached, the each profile is divided into 20 cm depth increments. By the end of sampling, up to 45 soil samples are collected per pit.

DP1.20193.001 Salt-based stream discharge

Subsystem

Aquatic Observation System (AOS)

Sensor

YSI Pro2030, HOBO U24

Coverage

This data product is measured at NEON aquatic wadeable stream sites.

Description

Discharge measured using a constant-rate addition salt tracer during reaeration measurements

Abstract

This data product contains the quality-controlled, native sampling resolution data for NEON's Salt-based Discharge data product. The data for this data product is collected as part of the wadeable stream reaeration sampling protocol. Briefly, grab samples of stream water at NEON aquatic sites are collected in streams at 4 sampling locations downstream of a continuous injection of a conservative tracer (NaCl or NaBr). Background samples are collected prior to tracer injection and are analyzed for background salt tracer concentrations. Plateau samples are collected once the tracer concentration reaches a constant concentration (as measured by conductivity) and 5 replicate samples from each station are analyzed for salt tracer concentrations. Data users should refer to the user guide for reaeration and salt-based discharge (NEON_ReaerSaltBasedQ_userGuide_vA) for suggestions on how to calculate discharge values from the published data packages. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Reaeration in Streams NEON.DOC.000693.

Design Description

Tracer injections of conservative salt are completed 6-10 times per year to capture a range of flows at NEON wadeable stream sites as part of the wadeable stream reaeration protocol. The first sampling station is located near sensor set #1 and the fourth sampling station is located near sensor set #2. Sampling stations #2 and #3 are approximately evenly spaced between sampling stations #1 and #4. The injection (drip) station is located far enough upstream of sampling station #1 that the tracer is well mixed within the stream channel for all sampling stations. Conductivity data loggers are located near sampling stations #1 and #4 as well to capture the rising limb and plateau in situ conductivity values. For more information see AOS Protocol and Procedure: Reaeration in Streams NEON.DOC.000693.

DP1.20252.001 Secchi depth

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON lake and non-wadeable stream sites.

Description

Measurement of water column Secchi depth in non-wadeable streams and lakes

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Secchi depth data collection. Secchi measurements indicate water clarity, and secchi depth is used to determine the depth to which light penetrates. This value can also be used to calculate the depth of the euphotic zone in a lake or river. Secchi data are collected when collecting data for any standard operating procedure that samples the water column in a lake or river by lowering a Secchi disk through the water column, and recorded the depth(s) to which it disappears from view. Secchi depth measurements are collected only during ice-free periods, and are collected a minimum of 4 times per year, up to 12+ times per year. For additional details, see NEON.DOC.002792: AOS Protocol and Procedure: Secchi Depth and Depth Profile Sampling in Lakes and Non-Wadeable Streams and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Secchi data are collected during samples collection for any standard operating procedure that samples the water column in a lake or river (phytoplankton, zooplankton, pelagic surface water microbes, and pelagic surface water chemistry), and may be collected during other sampling visits to lake and river sites. Measurements are collected only near the buoy sensors in lakes and rivers, and data are not collected under the ice. Secchi depth measurements are only collected during ice-free periods, and are collected a minimum of 4 times per year, up to 12+ times per year.

DP1.20194.001 Sediment chemical properties

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Inorganic, organic, and organic contaminant analyses of wadeable stream, non-wadeable stream, and lake bed sediments

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic sediment collection and field metadata, as well as associated chemical data (Inorganic, organic, and metal analyses) provided by a contracted lab. Sediment field samples are collected in wadeable streams, rivers, and lakes two times per year during the growing season. Samples are homogenized from several depositional zones, and prepared for shipment to an external facility. For additional details, see NEON.DOC.001191: AOS Protocol and Procedure: Sediment Chemistry Sampling in Lakes and Non-Wadeable Streams, or NEON.DOC.001193: AOS Protocol and Procedure: Sediment Chemistry Sampling in Wadeable Streams and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Sediment samples are collected from 2 stations at each site: at wadeable streams and non-wadeable (large river) sites are divided in half longitudinally and sediment is collected throughout each half. In lakes, there are also 2 stations, the first near the buoy (the deep center point in the basin, called c0), and the second near the inlet infrastructure (about 1-2 m deep). Within each station, sediment samples are collected and homogenized from 5-10 deposition zones from both stations two times per year during the spring and fall aquatic biological sampling bouts. Samples are distributed into separate containers (one per analysis type: inorganic, organic, metals and sediment size) and shipped to an external lab for a suite of chemical analyses.

DP1.20197.001 Sediment physical properties

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Size analysis of wadeable stream, non-wadeable stream, and lake bed sediments

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's aquatic sediment collection and field metadata, as well as associated physical data (size analyses) provided by a contracted lab. Sediment field samples are collected in wadeable streams, rivers, and lakes two times per year during the growing season. Samples are homogenized from several depositional zones, and prepared for shipment to an external facility. For additional details, see NEON.DOC.001191: AOS Protocol and Procedure: Sediment Chemistry Sampling in Lakes and Non-Wadeable Streams, or NEON.DOC.001193: AOS Protocol and Procedure: Sediment Chemistry Sampling in Wadeable Streams and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Sediment samples are collected from 2 stations at each site: at wadeable streams and non-wadeable (large river) sites are divided in half longitudinally and sediment is collected throughout each half. In lakes, there are also 2 stations, the first near the buoy (the deep center point in the basin, called c0), and the second near the inlet infrastructure (about 1-2 m deep). Within each station, sediment samples are collected and homogenized from 5-10 depostion zones from both stations two times per year during the spring and fall aquatic biological sampling bouts. Samples are distributed into separate containers (one per analysis type: inorganic, organic, metals and sediment size) and shipped to an external lab for a suite of analyses.

DP4.00002.001 Sensible heat flux

Subsystem

Terrestrial Instrument System (TIS)

Sensor

LI-COR - LI7200 gas analyzer; Campbell Scientific CSAT-3 3-D Sonic Anemometer; Xsens North America Inc. MTI-300-2A5G4 Attitude and Motion Reference System;Thermometrics Climate RTD 100 Ω Probe

Coverage

Data are collected at all terrestrial sites, along the tower profile from the ground to the tower top above the canopy, in order to study the ecosystem exchange of scalars (CO2, H2O, etc.) and energy between the atmosphere and the ecosystem of interest.

Description

Sensible heat flux is estimated based on the eddy covariance technique using a sonic anemometer to measure vertical winds and air temperature and tower profile measurements of air temperature. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

Sensible heat flux is estimated based on the eddy-covariance technique using high frequency sonic anemometer to measurements of vertical wind velocity and air temperature to calculate turbulent flux and tower profile measurements of air temperature to calculate storage flux. This data product contains the measurement data and associated metadata in HDF5 format. The key sub-data products include storage flux, turbulent flux, and net surface-atmosphere exchange (NSAE) which is defined as the sum of storage flux and turbulent flux, on a 30 min basis. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Please see the Bundled data products - eddy covariance data product (DP4.00200.001) for more information.

DP1.00023.001 Shortwave and longwave radiation (net radiometer)

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Hukseflux NR01 Net Radiometer

Coverage

These data are collected at all NEON aquatic and terrestrial sites.

Description

Net radiation is composed of incoming and outgoing shortwave and longwave radiation. These data products are available as one- and thirty-minute averages of 1 Hz observations. Observations of net shortwave and longwave radiation are made by a sensor located at the top of the tower infrastructure, while only net longwave radiation is observed in the soil array. Observations of net shortwave and longwave radiation are made by a four-component sensor located on the aquatic meteorological station.

Abstract

The four components of net radiation, available as one- and thirty-minute averages of 1 Hz observations. Net radiation is the balance between incoming and outgoing shortwave and longwave radiation on a horizontal plane at the Earth's surface. This data product provides observations of incoming shortwave, outgoing shortwave, incoming longwave, and outgoing longwave radiation.

Design Description

Observations of incoming shortwave, outgoing shortwave, incoming longwave, and outgoing longwave radiation are made by a 4-component sensor located at the top of the tower infrastructure as well as on the aquatic met station, while only longwave radiation components are observed in the soil array.

DP1.20032.001

Shortwave and longwave radiation above water on-buoy (net radiometer)

Subsystem

Aquatic Instrument System (AIS)

Sensor

Hukseflux NR01 Net Radiometer

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Net radiation is composed of incoming and outgoing shortwave and longwave radiation. These data products are available as one- and thirty-minute averages. Observations of net shortwave and longwave radiation are made by a sensor located on the meteorology station on the buoy in lakes and rivers.

Abstract

Net shortwave and longwave radiation on buoys is measured every minute and is reported as 1-minute instantaneous measurements and 30-minute mean values. Other than the data collection frequency, this data product has the same data streams and processing as net radiation at aquatic met stations and on the terrestrial instrument towers.

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.00014.001 Shortwave radiation (direct and diffuse pyranometer)

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Delta-T Devices SPN1 Sunshine Pyranometer

Coverage

These data are collected at all NEON terrestrial sites.

Description

Total, direct beam, and diffuse shortwave radiation, available as one- and thirty-minute averages of 1 Hz observations. Observations are made by a sensor located at the top of the tower infrastructure.

Abstract

Total, direct, and diffuse shortwave radiation, available as one- and thirty-minute averages of 1 Hz observations. Direct radiation, also called direct beam radiation, is the solar radiation traveling in a straight line from the sun to a plane at the Earth's surface oriented perpendicular to the sun's rays. Diffuse radiation is the solar radiation scattered by particles in the atmosphere and received at a horizontal plane at the Earth's surface. Diffuse radiation comes from the entire sky dome, whereas direct radiation comes from a single direction. Total solar radiation is the sum of direct and diffuse solar radiation received at a horizontal plane at the Earth's surface.

Design Description

Observations are made by a sensor located at the top of the tower infrastructure.

DP1.00022.001 Shortwave radiation (primary pyranometer)

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Kipp and Zonen CMP22 Pyranometer

Coverage

These data are collected at core NEON terrestrial sites.

Description

Total shortwave radiation, available as one- and thirty-minute averages of 1 Hz observations. The primary pyranometer is housed in a heated and aspirated ventilation unit and observes incoming shortwave radiation at the top of the tower infrastructure.

Abstract

Total incoming solar shortwave radiation, available as one- and thirty-minute averages of 1 Hz observations. Shortwave radiation is composed of ultraviolet, visible, and a portion of infra-red wavelengths. Total shortwave radiation, also called global radiation, is the incendent shortwave solar radiation (direct and diffuse) received on a horizontal plane at the Earth's surface.

Design Description

The primary pyranometer is housed in a heated and aspirated ventilation unit at the top of the tower infrastructure.

DP1.00002.001 Single aspirated air temperature

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield

Coverage

These data are collected at all NEON terrestrial and aquatic sites.

Description

Air temperature, available as one- and thirty-minute averages of 1 Hz observations. Observations are made by sensors located at multiple heights on the tower infrastructure and by sensors located on the aquatic meteorological station. Temperature observations are made using platinum resistance thermometers, which are housed in a fan aspirated shield to reduce radiative bias.

Abstract

Single aspirated air temperature measurements, available as one- and thirty-minute averages of 1 Hz observations. Temperature is one of the most fundamental physical measurements. It is a primary driving factor for countless physical, chemical, and biological processes. The single aspirated sensor assembly comprises an individual Platinum Resistance Thermometer (PRT) housed within an aspirated shield.

Design Description

Multiple Single Aspirated Air Temperature (SAAT) assemblies are deployed at tower sites. SAAT assemblies are located on each boom arm below the top of the tower. A single SAAT assembly is deployed at aquatic sites and is located on the aquatic met station 3m above ground level.

DP3.30025.001 Slope and Aspect - LiDAR

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) LiDAR - Optech Gemini

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Slope is a ratio of rise over run (height over distance) of the bare earth elevation product given in degrees; aspect is the direction of the steepest slope of the bare earth elevation product (e.g., north, east, south, west) given in degrees clockwise from grid north; both mosaicked onto a spatially uniform grid at 1 m spatial resolution in 1 km by 1 km tiles.

Abstract

The NEON AOP LiDAR Slope and Aspect product includes a slope map and aspect map, both in raster GeoTIFF format. Slope and aspect maps are derived from the DTM, which includes only elevations which relate to the physical terrain or "bare earth" surface model. Raster maps for the slope and aspect are reported with horizontal reference to the ITRF00 datum and projected to the Universal Transverse Mercator (UTM) mapping frame. Slope is determined as the angle between a plane tangential to the local terrain surface and a plane tangential to the local Geoid12A surface, reported in degrees. Aspect is the direction of the steepest slope, given in degrees referenced to grid north. The slope and aspect rasters are divided into a set of 1 km by 1 km tiles, which have corners spatially referenced to an even kilometer.

Design Description

The data product includes a slope map and aspect map, both in raster format. Raster maps for the slope and aspect are reported with horizontal reference to the ITRF00 datum and projected to the Universal Transverse Mercator (UTM) mapping frame. Slope is determined using the local Geoid12A surface and is reported in degrees. Aspect is the direction of the steepest slope, given in degrees referenced to grid north. The slope and aspect rasters are divided into a set of 1 km by 1 km tiles, which have corners spatially referenced to an even kilometer. The product is stored in GeoTIFF format.

DP1.10072.001 Small mammal box trapping

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites, except the site in Hawaii.

Description

Individual- and trap-level data collected using box traps designed to capture small mammals

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's small mammal sampling protocol. Small mammal abundance and diversity are sampled at regular intervals by NEON field technicians at core and relocatable sites. Here small mammals are defined based on a combination of behavioral, dietary, and size constraints, as the NEON design is limited to species sampled by box traps. This definition includes any mammal that is (1) nonvolant; (2) nocturnally active; (3) forages predominantly aboveground; and (4) is greater than 5 grams but less than approximately 500-600 g. In North America, this includes cricetids, heteromyids, small sciurids, and introduced murids. It does not include shrews, large squirrels, rabbits, or weasels, despite the fact that individuals of these species may be incidentally captured. Products resulting from this sampling include the species identification and unique identifier for each individual captured, as well as a suite of standard size measurements and reproductive condition data. Sample identifiers for any blood, ear, hair, whisker, fecal, and/or voucher samples collected are also provided.

For additional details, see protocol NEON.DOC.000481: TOS Protocol and Procedure: Small Mammal Sampling and science design NEON.DOC.000914: TOS Science Design for Small Mammal Abundance and Diversity. For spatial data (text and shapefiles), download NEON_TOS_Plots.

Design Description

Small mammal sampling is based on the lunar calendar, with timing of sampling constrained to occur within 10 days before or after the new moon. Typically, core sites are sampled 6 times per year, and relocatable sites 4 times per year. Small mammals are sampled using box traps (models LFA, XLK, H.B. Sherman Traps, Inc., Tallahassee, FL, USA) and, at sites in Puerto Rico, larger wire traps suitable for catching Rattus spp. (model 201, Tomahawk Live Trap, Hazlehurst, WI, USA). Box traps are arrayed in three to eight (depending on the size of the site) 10 x 10 grids with 10m spacing between traps at all sites. Where used, wire traps are used only in alternate bouts of trapping and placed at every other trap station in the 10 x 10 grid, such that a total of 50 wire traps are set. Small mammal trapping bouts are comprised of one or three nights of trapping, depending on whether a grid is designated for pathogen sample collection (3 nights) or not (1 night).

DP1.10076.001 Small mammal sequences DNA barcode

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

CO1 DNA sequences from select small mammals

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's cytochrome oxidase I (COI) barcoding of small mammal sequences. The DNA barcoding procedure involves the non-distructive collection of tissue from live specimens in the field, extracting and sequencing DNA from the tissue, and matching that sequence data to sequences from previously identified voucher specimens. DNA analysis serves a number of purposes, including verification of taxonomy of specimens that do not receive expert identification, clarification of the taxonomy of rare or cryptic species, and characterization of diversity using molecular markers. For additional details on small mammal collection, see protocol NEON.DOC.000481: TOS Protocol and Procedure: Small Mammal Sampling and science design NEON.DOC.000915: TOS Science Design for Small Mammal Abundance and Diversity. Queries for this data product will return metadata tables formatted for submission to the Barcode of Life Database. These queries will also provide links to the actual sequence data, which are publicly available on the Barcode of Life Datasystem (BOLD, http://www.barcodinglife.com/). The sequence data can be obtained by following the links from the NEON data portal, or by directly querying NEON data sets on the BOLD server. From the NEON portal, the link "BOLD Project: Small Mammal sequences DNA barcode" redirects to a page on the BOLD public data portal for the queried data. This is a dynamic link and will automatically update based on the user query.

Design Description

Up to 240 ear punches will be collected from each target and opportunistic species per site per year. These tissues will be preserved in an appropriate tissue vial and up to 95 tissue samples per domain will be shipped to an external lab. DNA will be extracted and target sequences amplified via PCR. Barcodes of cytochrome oxidase I will be generated per specimen.

DP1.00042.001 Snow depth and understory phenology images

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Stardot NetCam SC CAM-SEC5IR-B

Coverage

All terrestrial core and relocatable sites; camera is positioned at the bottom of each site's tower.

Description

Camera images of snow depth relative to mounted/calibrated depth stakes when snow is present; images used to track understory phenology when possible (see NEON.DOM.SITE.DP1.00033).

Abstract

Phenology is the study of reoccurring life cycle events that are driven by environmental factors (Morrisette et al., 2009). The timing of these events is driven by both short- and long-term variability in climate and is therefore valuable in understanding the effects of climate change (Richardson et al., 2006). Automated repeat digital images of plant canopies provide data for the extraction of indices (e.g. green chromatic coordinate (gcc)) that can be used to quantify changes in phenological events over time (Sonnentag et al., 2011).

NEON has deployed a Stardot NetCam at the bottom of all terrestrial core and re-locatable towers to study below-canopy phenology and snow depth. Over time, these images can be used to detect seasonal changes in understory vegetation (e.g., onset of leaf growth and senescence). The camera will also capture images of snowdepth stakes. Images are sent to and processed by PhenoCam, a cooperative network that archives and distributes imagery and derived data products from digital cameras deployed at research sites across North America and around the world. NEON's phenocam images are available for viewing and downloading from the PhenoCam Gallery, along with images and data from other phenocam sites across the world.

Design Description

NEON has deployed a Stardot NetCam at the bottom of all terrestrial core and re-locatable towers to study above-canopy phenology and snow depth. Every 15 minutes each camera captures back-to-back RGB and IR images separated by 30 seconds.

DP1.10008.001

Soil chemical properties (Distributed initial characterization)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Soil chemical properties of a soil core that was sampled by the NRCS as part of initial site characterization activities at the NEON site. Data are reported by horizon for the top 1m of the soil profile. Also see distributed periodic and megapit soil data.

Abstract

This data product contains quality-controlled, native sampling resolution chemistry data from soils measured during the course of an initial soil characterization effort at each NEON site. This effort is executed by the Soil Science Division of the Natural Resources Conservation Service (NRCS), in partnership with the USDA Agriculture Research Service (ARS). Queries for this data product will return soil chemistry data on a per horizon basis. Associated with these data are soil pedon descriptions and narrative summary documents, which place the plot-level data into site-level context. These documents can be found in the NEON Document Library, in the folder Soil Characterization Summaries > Distributed plots.

Design Description

At each site, up to 4 Tower and 30 Distributed plots are sampled, with number of plots determined by NRCS based on site variability and number of soil map units present. In most Distributed base plots, a single 1 m x 1 m x 1 m soil pit is excavated. In Tower plots and sites where pit sampling is not permitted, several 10 cm diameter, 1 m deep cores are collected from within a 1 m x 1 m square (where possible). Upon excavating a pit or collecting cores, NRCS describes the profile and all major horizons, assesses coarse fragment volumes, collects bulk density samples (most often by the clod method), then collects enough material to conduct all laboratory analyses. Field sampling and descriptions follow the methods outlined in the NRCS Field Book for Describing and Sampling Soils, version 3.0. Laboratory analyses are conducted at the Kellogg Soil Survey Laboratory in Lincoln, Nebraska following the standard operating procedures outlined in the Soil Survey Laboratory Methods Manual, Report No. 42, Version 5, 2014.

DP1.10078.001 Soil chemical properties (Distributed periodic)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites with sufficient soil depths to enable sampling.

Description

Soil chemistry from the top 30 cm of the profile from periodic soil core collections. Data are reported by horizon (mineral vs. organic). See initial characterization and megapit products for additional soil data.

Abstract

Total organic carbon and total nitrogen concentrations in surface soils sampled from NEON plots. Soils are sampled by horizon type (organic or mineral) to a maximum depth of 30 cm. For additional details, see protocol NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling and science design NEON.DOC.000906: TOS Science Design for Terrestrial Biogeochemistry. Queries for this data product will return elemental data only. For stable isotope data measured concurrently with concentrations, see Soil stable isotopes (Distributed periodic) data product. For field metadata associated with these samples, see Soil physical properties (Distributed periodic) data product.

Design Description

Three pre-determined, randomly assigned locations are selected for each soil sampling event at each of 10 plots distributed throughout a site. Every five to ten years, these soil samples, collected during the period of historic peak greenness, are analyzed for carbon and nitrogen concentrations. The same soil samples are used to generate several other biogeochemical and microbial data products - see related data products section for a complete list.

DP1.00097.001 Soil chemical properties (Megapit)

Subsystem

Terrestrial Instrument System (TIS)

Coverage

Soil chemical properties are measured at one temporary soil pit at each terrestrial site.

Description

Total content of a range of chemical elements, pH, and electrical conductivity in the <= 2 mm soil fraction for each soil horizon. Data were derived from a sampling location expected to be representative of the area where the Instrumented Soil Plots per site are located and were collected once during site construction. Also see distributed soil data products.

Abstract

Soil chemical properties are measured by horizon from a single temporary soil pit at each terrestrial site at depths of up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Soil properties affect the movement of soil water and nutrients through the soil profile and their availability to plants and soil organisms. In addition, these properties relate to the storage and accessibility of nutrients in the soil and influence biogeochemical cycling rates. The sampling location is expected to be representative of the NEON sensor-based soil plots and this sampling activity is expected to occur once at each NEON terrestrial site. Additional soil samples collected from the same soil pit are archived in the NEON Megapit Soil Archive and are available upon request.

Design Description

The soil chemical properties (megapit) data product is available at each terrestrial site. The soil pit location was chosen to be representative of the sensor-based soil plots based on soil type, vegetation and topography, as well as being accessible by a backhoe and outside the main measurement zone of other sensors. The soil pit is usually within a few hundred meters of the sensor-based soil plots and NEON tower. Soil samples were collected by soil horizon up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites).

DP1.00095.001 Soil CO2 concentration

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Vaisala - GMP343

Coverage

Soil CO2 concentration is measured in all five instrumented soil plots at each terrestrial site.

Description

CO2 concentration in soil air at various depth below the soil surface starting at 2 cm. Data are from all five Instrumented Soil Plots per site and presented as 1-minute and 30-minute averages.

Abstract

CO2 concentrations are measured at different depths in the soil to allow the gradient method to be used to estimate soil CO2 efflux rates when combined with other NEON data products. Soil CO2 efflux is an important component of the carbon cycle because it is one of the largest exchanges of carbon between terrestrial ecosystems and the atmosphere. In addition, since the vast majority of soil CO2 is produced by microbial, root and soil faunal respiration, soil CO2 efflux is an indicator of total soil biological activity. CO2 concentrations are measured in all five Instrumented soil plots per terrestrial site and at various depths below the soil surface starting at approximately 2 cm and data are presented as 1-minute and 30-minute averages. CO2 sensors at different depths within a soil plot are typically located within 1 m horizontally of one another. The CO2 concentration of soil air is measured at three depths within each plot, starting at approximately 2 cm.

Design Description

When possible the plots were arranged in a transect with the first plot approximately 15-40 m from the tower in the expected dominant airshed. The middle of airshed was used as the transect vector and plot spacing was based on the distance required for surface soil temperature and moisture measurements to be spatially independent at the 1 hectare scale during site characterization (capped at approximately 40 m due to logistical constraints). Soil plots were microsited as necessary to avoid obstacles (e.g., boulders, streams, and paths) and more compact plot layouts were used at small sites. The CO2 concentration of soil air is measured at three depths within each plot, starting at approximately 2 cm. The depths of the two deeper sensors vary among sites and were chosen based on megapit soil horizon data (NEON.DP1.00097), expected soil CO2 concentration, and ecosystem type (see NEON.DOC.003146).

DP4.50036.001 Soil CO2 flux - MDP sensor

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Flux of carbon dioxide from the soil surface. Generated only by the mobile deployment platforms (MDP); for soil CO2 concentration at NEON towers see NEON.DOM.SITE.DP1.00095.

Abstract

NA

Design Description

NA

DP1.00040.001 Soil heat flux plate

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Hukseflux HFP01SC: Self-Calibrating Heat Flux Sensor

Coverage

Soil heat flux is measured at all of NEON's soil plots at terrestrial sites.

Description

The amount of thermal energy moving by conduction across an area of soil in a unit of time. Measured as part of the soil array.

Abstract

Soil heat flux is the amount of thermal energy that moves by conduction across an area of soil in a unit of time and usually expressed in Watts per square meter. This data product represents the soil heat flux at the locations of the heat flux plates, 0.08 m below the soil surface. It is reported as 1-minute mean measurements and 30-minute mean values.

Design Description

The soil heat flux data product is available at all NEON TIS sites. At each site, soil heat flux sensors are distributed within three of the five soil plots within the TIS soil array. The sensor is installed at depth of 0.08 m below the soil surface.

DP1.10080.001 Soil inorganic nitrogen pools and transformations

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Soil inorganic nitrogen concentrations and rates of net nitrogen mineralization and net nitrification from the top 30 cm of the profile. Data are reported by horizon (organic vs. mineral) within a soil core.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's measurement of soil inorganic nitrogen (N) pools and net N transformation rates. Soils are sampled by horizon type (organic or mineral) to a maximum depth of 30 cm. For additional details, see protocol NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling. Queries for this data product will return laboratory metadata and results of chemical analyses. For field metadata associated with these samples, see the Soil physical properties (Distributed periodic) data product.

Design Description

Sampling occurs once every five years at a site. During 'on' years, sampling takes place 1-3 times, dependent on growing season length. All sites are sampled during the periodic of historic peak greenness, and most are also sampled during seasonal transitions aimed at capturing a range of temporal dynamics. For each sampling event, three pre-determined, randomly assigned locations are selected within each of 10 plots distributed throughout a site. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Two cores are collected - one is transported to the laboratory for immediate extraction in potassium chloride and analysis of ammonium and nitrate, while the other is put in a covered core or plastic bag and replaced in the soil borehole, then removed one to four weeks later and processed in the same way. To calculate net N mineralization, the final and initial masses of ammonium plus nitrate per unit dry soil (or nitrate only for net nitrification calculations) must be differenced, and a rate of production (usually per day) can be calculated by dividing the difference by the incubation time.

DP1.10104.001 Soil microbe biomass

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Quantitative abundance of total microbes in soil samples

Abstract

This data product contains the quality-controlled laboratory data and metadata for microbial biomass derived from soil microbial sampling. Microbial biomass is measured by phospholipid fatty acid (PLFA) analysis, in which a set of microbial lipid biomarkers is extracted and quantified using Gas Chromatography-Mass Spectrometry (GS-MS). For additional details about sampling methods and design, see NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling; and NEON.DOC.000908vA: TOS Science Design for Terrestrial Microbial Diversity.

Design Description

Three pre-determined, randomly assigned locations are selected for each sampling event within each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Sampling occurs at each site once every five years, with a frequency of one to three times within the sampling year (depending on length of growing season), with all sites sampling during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Bulk samples are homogenized in the field. A subset of the soil is either sieved (mineral soils), or picked of coarse debris such as rocks, roots and organic material (organic soils) and 5-10g are transferred to sterile containers. The samples are frozen and shipped on dry ice to an analytical facility, where freeze-drying, sample preparation and GC-MS analysis is performed.

DP1.10081.001 Soil microbe community composition

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Counts and relative abundances of archaeal, bacterial, and fungal taxa observed in soil microbial communities

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON's soil bacterial, archaeal, and fungal community composition analysis derived from soil microbial sampling. Taxon tables are derived from the 16S and ITS marker gene sequencing data product, NEON.DP1.10108. Taxonomic data are generated for sequence data using standard bioinformatics software. For additional details about sampling methods and design, see NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling; and science design NEON.DOC.000908vA: TOS Science Design for Terrestrial Microbial Diversity.

Design Description

Three pre-determined, randomly assigned locations are selected for each sampling event within each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Soil sampling occurs once (sites with short growing seasons) to three times a year (sites with longer growing seasons), with all sites sampled during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Subsamples of homogenized soil (rocks, roots and organic debris removed) from each of the 3 sampling locations are stored in sterile containers, frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and high-throughput sequence analysis using primer sets targeting the small subunit of the ribosomal RNA gene. Quality-filtered sequence data are processed bioinformatically and taxon tables are generated.

DP1.10109.001 Soil microbe group abundances

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Counts and relative abundances of marker genes from total archaea, bacteria, and fungi observed by qPCR in soil microbial communities

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON's soil bacterial, archaeal, and fungal group abundances analysis, which are derived from soil microbial sampling. Group abundances are quantified via qPCR on frozen, field-collected soils. For additional details, see protocol NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling; and science design NEON.DOC.000908vA: TOS Science Design for Terrestrial Microbial Diversity.

Design Description

Three predetermined, randomly assigned locations are selected for each sampling event within each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Soil sampling occurs once (sites with short growing seasons) to three times a year (sites with longer growing seasons), will all sites sampling during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Subsamples of homogenized soil (rocks, roots and organic debris removed) from each of the 3 sampling locations are stored in sterile containers, frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and qPCR analysis using primer sets targeting the small subunit of the ribosomal RNA gene.

DP1.10108.001 Soil microbe marker gene sequences

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

DNA sequence data from ribosomal RNA marker genes from soil samples

Abstract

This data product contains the quality-controlled laboratory metadata and 16S and ITS marker gene sequences derived from NEON's soil microbial sampling. For additional details, see NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling and NEON.DOC.000908: TOS Science Design for Terrestrial Microbial Diversity.

Queries for this data product return a downloadable data package with laboratory methods and DNA extraction, PCR amplification, and sequencing metadata for samples from the queried sites and date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository. Sequence data may also be obtained by querying NEON data sets at the NCBI Sequence Read Archive (NCBI SRA) and the European Bioinformatics Institute (EMBL-EBI).

Design Description

Three pre-determined, randomly assigned locations are selected for each sampling event within each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Soil sampling occurs once (sites with short growing seasons) to three times a year (sites with longer growing seasons), with all sites sampled during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Subsamples of homogenized soil (rocks, roots and organic debris removed) from each of the 3 sampling locations are stored in sterile containers, frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and high-throughput sequence analysis using primer sets targeting the small subunit of the ribosomal RNA gene. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.10107.001 Soil microbe metagenome sequences

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Metagenomic sequence data from soil samples

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's shotgun metagenomics sequences derived from soil microbial sampling. Typically, measurements are done on plot-level composite samples and represent up to 3 randomly selected sampling locations within a plot. For additional details, see protocol NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling; and science design NEON.DOC.000908vA: TOS Science Design for Terrestrial Microbial Diversity. Queries for this data product will return metadata tables that include laboratory methods and results from DNA extraction, sample preparation, and DNA sequencing for samples from the specified sites and within the specified date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository.

Design Description

Three pre-determined, randomly assigned locations are selected for each sampling event within each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Soil metagenomics sampling occurs annually during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. Subsamples of homogenized soil (rocks, roots and organic debris removed) from each of the 3 sampling locations are combined to form a plot-level composite sample that is used for metagenomics analysis. Samples are frozen on dry ice and shipped to an analytical facility for DNA extraction, sample preparation and shotgun metagenomic sequencing. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.10047.001

Soil physical properties (Distributed initial characterization)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites.

Description

Soil physical properties of a soil core that was sampled by the NRCS as part of initial site characterization activities at the NEON site. Data are reported by horizon for the top 1m of the soil profile. Also see distributed periodic and megapit soil data.

Abstract

This data product contains quality-controlled, native sampling resolution taxonomic and physical data from soils measured during the course of an initial soil characterization effort at each NEON site. This effort is executed by the Soil Science Division of the Natural Resources Conservation Service (NRCS), in partnership with the USDA Agriculture Research Service (ARS). Queries for this data product will return field collection, bulk density, and particle size distribution data on a per horizon basis. Associated with these data are soil pedon descriptions and narrative summary documents, which place the plot-level data into site-level context. These documents can be found in the NEON Document Library, in the folder Soil Characterization Summaries > Distributed plots.

Design Description

At each site, up to 4 Tower and 30 Distributed plots are sampled, with number of plots determined by NRCS based on site variability and number of soil map units present. In most Distributed base plots, a single 1 m x 1 m x 1 m soil pit is excavated. In Tower plots and sites where pit sampling is not permitted, several 10 cm diameter, 1 m deep cores are collected from within a 1 m x 1 m square (where possible). Upon excavating a pit or collecting cores, NRCS describes the profile and all major horizons, assesses coarse fragment volumes, collects bulk density samples (most often by the clod method), then collects enough material to conduct all laboratory analyses. Field sampling and descriptions follow the methods outlined in the NRCS Field Book for Describing and Sampling Soils, version 3.0. Laboratory analyses are conducted at the Kellogg Soil Survey Laboratory in Lincoln, Nebraska following the standard operating procedures outlined in the Soil Survey Laboratory Methods Manual, Report No. 42, Version 5, 2014.

DP1.10086.001 Soil physical properties (Distributed periodic)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites with sufficient soil depths to enable sampling.

Description

Soil physical properties from the top 30 cm of the profile from periodic soil core collections. Data are reported by horizon (mineral vs. organic). See initial characterization and megapit products for additional soil data.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's soil sampling, pH, and moisture measurements. Samples collected as part of this product are also used for microbial and biogeochemical measurements; those data can be found in associated data products.

Soil is defined as the upper layer of the earth's surface where plants grow and consists of decomposing organic material and inorganic particles such as clay and rock. Soils are sampled by horizon type (organic or mineral) to a maximum depth of 30cm. For additional details, see NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling; NEON.DOC.000906: TOS Science Design for Terrestrial Biogeochemistry; and NEON.DOC.000908: TOS Science Design for Terrestrial Microbial Diversity. Queries for this data product will return field collection, pH, and moisture data with collection dates within the months of the specified date range. This data product provides primary field and laboratory metadata that can be associated with soil microbial data products, soil chemistry and stable isotope data products, and soil nitrogen transformations data products. See related data products section for the complete list.

Design Description

Three pre-determined, randomly assigned locations are selected for each sampling event at each of 10 plots distributed throughout a site; sampling locations within a plot are not re-sampled. Soil sampling occurs 1-3 times per year depending on analysis type and length of growing season, with each site always sampled during the historic peak in vegetation greenness. Soil samples are collected to a maximum depth of 30 cm, with organic and mineral soils sampled separately. The type of device used to collect soils varies based on local soil types and seasonal conditions and is recorded for each sample. In-situ soil temperature is measured, soil samples are homogenized in the field, and subsamples used for microbial analyses are immediately frozen on dry ice. Gravimetric soil moisture and soil pH analyses are conducted at field laboratories, following the methods outlined in Robertson et al. (1999). Every five-ten years, peak greenness subsamples are analyzed for carbon and nitrogen concentrations and stable isotopes. Every five years, net nitrogen transformation rates are measured on fresh and field-incubated soil cores by measuring inorganic nitrogen concentrations on soils extracted in a potassium chloride solution.

DP1.00096.001 Soil physical properties (Megapit)

Subsystem

Terrestrial Instrument System (TIS)

Coverage

Soil physical properties are measured at one temporary soil pit at each terrestrial site

Description

Soil taxonomy, horizon names, horizon depths, as well as soil bulk density, porosity, texture (sand, silt, and clay content) in the <= 2 mm soil fraction for each soil horizon. Data were derived from a sampling location expected to be representative of the area where the Instrumented Soil Plots per site are located and were collected once during site construction. Also see distributed soil data products.

Abstract

Soil physical properties are measured by horizon from a single temporary soil pit at each terrestrial site at depths of up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Soil properties affect the movement of soil water and nutrients through the soil profile and their availability to plants and soil organisms. In addition, these properties affect the movement of heat and gases into and out of the soil. The sampling location is expected to be representative of the NEON sensor-based soil plots and this sampling activity is expected to occur once at each NEON terrestrial site. Additional soil samples collected from the same soil pit are archived in the NEON Megapit Soil Archive and are available upon request.

Design Description

The soil physical properties (megapit) data product is available at each terrestrial site. The soil pit location was chosen to be representative of the sensor-based soil plots based on soil type, vegetation and topography, as well as being accessible by a backhoe and outside the main measurement zone of other sensors. The soil pit is usually within a few hundred meters of the sensor-based soil plots and NEON tower. Soil samples were collected by soil horizon up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites).

DP1.10100.001 Soil stable isotopes (Distributed periodic)

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites with sufficient soil depths to enable sampling.

Description

Soil stable isotope values from the top 30 cm of the profile from periodic soil core collections. Data are reported by horizon (mineral vs. organic). See initial characterization and megapit products for additional soil data.

Abstract

Stable isotope content of total organic carbon and total nitrogen pools in surface soils sampled from NEON plots. Soils are sampled by horizon type (organic or mineral) to a maximum depth of 30 cm. For additional details, see protocol NEON.DOC.014048: TOS Protocol and Procedure for Soil Biogeochemical and Microbial Sampling and science design NEON.DOC.000906: TOS Science Design for Terrestrial Biogeochemistry. Queries for this data product will return isotope data only. For concentration data measured concurrently with stable isotopes, see Soil chemical properties (Distributed periodic) data product. For field metadata associated with these samples, see Soil physical properties (Distributed periodic) data product.

Design Description

Three pre-determined, randomly assigned locations are selected for each soil sampling event at each of 10 plots distributed throughout a site. Every five-ten years, these soil samples, collected during the period of historic peak greenness, are analyzed for the stable isotope content of total organic carbon and total nitrogen pools. The same soil samples are used to generate several other biogeochemical as well as microbial data products - see related data products section for a complete list.

DP1.00041.001 Soil temperature

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Thermometrics - Climate RTD 100-ohm Probe

Coverage

Soil temperature is measured in all five instrumented soil plots at each terrestrial site.

Description

Temperature of the soil at various depth below the soil surface from 2 cm up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Data are from all five Instrumented Soil Plots per site and presented as 1-minute and 30-minute averages.

Abstract

Soil temperature is measured at various depths below the soil surface from approximately 2 cm up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Soil temperature influences the rate of biogeochemical cycling, decomposition, and root and soil biota activity. In addition, soil temperature can impact the hydrologic cycle since it controls whether soil water is in a liquid or solid state. Measurements are made in vertical profiles consisting of up to nine depths in all five instrumented soil plots at each terrestrial site, and presented as 1-minute and 30-minute averages.

Design Description

When possible the soil plots were arranged in a transect with the first plot approximately 15-40 m from the tower in the expected dominant airshed. The middle of airshed was used as the transect vector and plot spacing was based on the distance required for surface soil temperature and moisture measurements to be spatially independent at the 1 hectare scale during site characterization (capped at approximately 40 m due to logistical constraints). Soil plots were microsited as necessary to avoid obstacles (e.g., boulders, streams, and paths) and more compact plot layouts were used at small sites. Soil temperature is measured at up to nine depths within each plot, with the mid-point of the shallowest sensors at approximately 2, 6, 16, and 26 cm. Depths for deeper sensors vary among sites and are based on megapit soil horizon data (NEON.DP1.00097) and depth to restrictive feature (see NEON.DOC.003146).

DP1.00094.001 Soil water content and water salinity

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Sentek - EnviroSCAN TriSCAN

Coverage

Soil water content and an index of salinity are measured in all five instrumented soil plots at each terrestrial site.

Description

Soil volumetric water content and an index of salinity at various depth below the soil surface from 2 cm up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Data are from all five Instrumented Soil Plots per site and presented as 1-minute and 30-minute averages.

Abstract

Soil volumetric water content and an index of soil water ion content (salinity) are measured at various depths below the soil surface from approximately 2 cm up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Soil moisture is an important component of the hydrologic cycle and is the dominant source of water for most plants and soil organisms making it a key indicator of drought. In addition, soil moisture status influences the severity of flooding and temperature extremes, as well as physical, chemical and biological processes in the soil. Measurements are made in vertical profiles consisting of up to eight depths in all five instrumented soil plots at each terrestrial site, and presented as 1-minute and 30-minute averages.

Design Description

When possible the soil plots were arranged in a transect with the first plot approximately 15-40 m from the tower in the expected dominant airshed. The middle of airshed was used as the transect vector and plot spacing was based on the distance required for surface soil temperature and moisture measurements to be spatially independent at the 1 hectare scale during site characterization (capped at approximately 40 m due to logistical constraints). Soil plots were microsited as necessary to avoid obstacles (e.g., boulders, streams, and paths) and more compact plot layouts were used at small sites. Soil moisture and salinity index are measured at up to eight depths within each plot, with the mid-point of the shallowest sensors at approximately 6, 16, and 26 cm. Depths for deeper sensors vary among sites and are based on megapit soil horizon data (NEON.DP1.00097) and depth to restrictive feature (see NEON.DOC.003146).

DP1.20015.001 Specific conductivity in groundwater

Subsystem

Aquatic Instrument System (AIS)

Sensor

In-Situ, inc. - Aqua TROLL 200

Coverage

These data are collected in the fall and spring at all NEON aquatic sites except for MCRA, CUPE, and TECR where there are no groundwater wells.

Description

In situ sensor-based measurements of specific conductance of groundwater in wells

Abstract

Specific conductance is a proxy for the level of total dissolved solids of the groundwater as well as related to the redox potential. Conductivity may also be used as a tracer of distinct water masses for understanding flow. NEON measurements of groundwater conductivity at high temporal resolution. Up to eight wells (and as low as three) are available per aquatic site. From NEON groundwater elevation measurements, the magnitude and direction of groundwater flow can be calculated, which may be coupled to better understand the exchange between groundwater and surface water. This data product includes continuous quality-controlled groundwater temperature captured every 5 minute and reported as 5-minute instantaneous measurements and 30-minute averages.

Design Description

Multiple groundwater wells per aquatic site are installed in triangular arrays where local features allow. Specific conductance of groundwater is measured in an site-specific array designed to capture shallow groundwater flow and exchange with the surface water feature at the site.

DP1.00043.001 Spectral sun photometer - calibrated sky radiances

Subsystem

Terrestrial Instrument System (TIS)

Sensor

CIMEL Electronique - CE318N-EBS9

Coverage

Data are collected for a select subset of NEON terrestrial sites. Sensors are located on the southeast-most corner of the tower top.

Description

Calibrated Sky Radiances; includes Almucantar Radiance Data and Principal Plane Radiance Data.

Abstract

Sun photometer measurements of the direct (collimated) solar radiation provide information to calculate the columnar aerosol optical depth (AOD). AOD can then be used to compute columnar water vapor (Precipitable Water) and estimate the aerosol size using the Angstrom parameter relationship, and derive other inversion data products. Data from NEON's sun photometers are uploaded daily to NASA's Aerosol Robotic Network (AERONET) program, where they are checked for quality and processed. AERONET produces numerous data products in addition to the Spectral Sun Photometer - Calibrated Sky Radiances data product, including Aerosol Optical Depth and Total Column Water Vapor. Clicking on a link below will open to an AERONET webpage providing a data download service for the selected NEON site. To discover more AERONET-generated data products as well as graphing and reporting tools, visit the AERONET Data Display Interface and click on your site of interest in the list.

Design Description

The raw data collected by sensor will be sent to AERONET directly. This data product is the results of the AERONET data process.

DP1.30006.001

Spectrometer orthorectified surface directional reflectance - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Surface reflectance (0-1 unitless, scaled by 10,000) computed from the NEON Imaging Spectrometer using ATCOR4r is orthorectified and output onto a fixed, uniform spatial grid using nearest-neighbor resampling. Fixed spatial grid is based on the native spatial resolution which is driven by the aircraft altitude; data are provided by flightline.

Abstract

The NEON AOP surface directional reflectance data product is an orthorectified (UTM projection) hyperspectral raster product. It is distributed in an open HDF5 format including all 426 bands from the NEON Imaging Spectrometer. It is a calibrated and atmospherically corrected product distributed as scaled reflectance. It includes many QA and ancillary rasters used as inputs to ATCOR for atmospheric correction as well as outputs from ATCOR for diagnostic purposes. L1 reflectance is distributed by original flight line with one HDF5 file per flight line including the reflectance data and all metadata and ancillary data.

Design Description

The Level 1 orthorectified at-sensor radiance data product is distributed in in an open HDF5 data format in UTM projection and ITRF00 datum. Each file contains all 426 radiance bands for a single flight line as well as many QA and ancillary rasters and datasets.

DP3.30006.001

Spectrometer orthorectified surface directional reflectance - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Orthorectified Surface reflectance (0-1 unitless, scaled by 10,000) computed from the NEON Imaging Spectrometer (NIS) per pixel; data are orthorectified and output onto a fixed, uniform spatial grid using nearest-neighbor resampling (tbr). Level 1 flight lines over a given site are mosaicked into single product; spatial resolution is 1m.

Abstract

The NEON AOP surface directional reflectance data product is an orthorectified (UTM projection) hyperspectral raster product. It is distributed in an open HDF5 format including all 426 bands from the NEON Imaging Spectrometer. It is a calibrated and atmospherically corrected product distributed as scaled reflectance. It includes many QA and ancillary rasters used as inputs to ATCOR for atmospheric correction as well as outputs from ATCOR for diagnostic purposes. L3 reflectance is distributed in 1 km by 1 km tiles with one HDF5 file per tile including the reflectance data and all metadata and ancillary data. The mosaic is created using the most-nadir pixels from the flight lines covering the tile.

Design Description

The Level 3 orthorectified surface directional reflectance data product is distributed in in an open HDF5 data format in UTM projection and ITRF00 datum. Each file contains all 426 reflectance bands for a single 1 km by 1 km tile as well as many QA and ancillary rasters and datasets both used in and produced by ATCOR reflectance processing as well as a map of from which flight line each mosaic pixel is taken.

DP1.30008.001

Spectrometer orthrorectified at-sensor radiance - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Calibrated radiance in units of uW/cm^2-sr-nm as measured by the NEON Imaging Spectrometer is orthorectified and output onto a fixed, uniform spatial grid using nearest-neighbor resampling. Fixed spatial grid is based on the native spatial resolution which is driven by the aircraft altitude; data are provided by flightline.

Abstract

The NEON AOP at-sensor radiance data product is a calibrated, orthorectified (UTM projection) hyperspectral raster product. It is distributed in an open HDF5 format including all 426 bands from the NEON Imaging Spectrometer. It includes many QA and ancillary rasters required for atmospheric correction. L1 radiance is distributed by original flight line with one HDF5 file per flight line including the radiance data and all metadata and ancillary data.

Design Description

The Level 1 orthorectified at-sensor radiance data product is distributed in in an open HDF5 data format in UTM projection and ITRF00 datum. Each file contains all 426 radiance bands for a single flight line as well as many QA and ancillary rasters and datasets.

DP1.20276.001 Stable isotope concentrations in groundwater

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected in the fall and spring at all NEON aquatic sites except for MCRA, CUPE, and TECR where there are no groundwater wells.

Description

Grab samples for stable isotopes of water in groundwater

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's stable isotope concentrations in groundwater sampling protocol. Water samples are sent to external facilities for analysis to determine 18O/16O and 2H/1H water isotope ratios. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Stable Isotope Sampling in Surface and Ground Waters (NEON.DOC.001886).

Design Description

The aquatic stable isotope sampling protocol is completed in conjunction with the water chemistry protocol. Groundwater is sampled twice per year at NEON aquatic sites from permanently installed groundwater wells. There are up to eight wells at each site; currently four are sampled for water chemistry and isotopes. For more information see [NEON.DOC.001886]((http://data.neonscience.org/api/v0/documents/NEON.DOC.001886vE).

DP1.00038.001 Stable isotope concentrations in precipitation

Subsystem

Terrestrial Instrument System (TIS)

Sensor

N- Con Systems Company Wet Deposition Collector, Manufacture Model No: NEON 00-127-7

Coverage

Measured at select NEON terrestrial and aquatic sites.

Description

Stable isotope ratios of 18O and 2H in precipitation water

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's stable isotope concentrations in wet deposition protocol. Deuterium and oxygen-18 concentrations are measured in precipitation samples.

Design Description

Hydrogen and oxygen stable isotope concentrations are sampled in conjunction with wet deposition chemistry (DP1.00013.001). Samples are collected in a climate controlled wet deposition collector located at the tower top of terrestrial sites, and at the meteorologic tower of select aquatic sites. The automated assembly detects precipitation with an optical sensor and opens to collect wet deposition during all rain events. Every two weeks samples are retrieved, filtered, and sent for analysis.

DP1.20206.001 Stable isotope concentrations in surface waters

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, non-wadeable rivers, and lakes).

Description

Grab samples for stable isotope chemistry including water and organic matter, in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's stable isotope concentrations in surface water sampling protocol. Filters containing suspended particulate organic matter (POM) are sent to external facilities for analysis to determine 15N/14N and 13C/12C isotope ratios. Water samples are sent to external facilities for analysis to determine 18O/12O and 2H/1H water isotope ratios. For additional details on NEON field and laboratory protocols, see the AOS Protocol and Procedure: Stable Isotope Sampling in Surface and Ground Waters (NEON.DOC.001886.

Design Description

The aquatic stable isotope sampling protocol is completed in conjunction with the water chemistry and dissolved gas protocol. Grab samples of surface water at NEON aquatic sites are collected in streams 26 times per year and 12 times per year in lakes. In streams, 12 samples are collected at regular intervals during the sampling season, while the remaining 14 are collected on an irregular basis to capture major flow events. In lakes, samples are collected approximately monthly and to capture ice-on and ice-off events. For more information see [NEON.DOC.001886]((http://data.neonscience.org/api/v0/documents/NEON.DOC.001886vE).

DP4.00130.001 Stream discharge

Subsystem

Aquatic Instrument System (AIS)

Sensor

Level TROLL 500

Coverage

This data product is measured at NEON aquatic wadeable stream and river sites.

Description

Continuous measurements of stream discharge calculated from a stage-discharge rating curve and sensor-based measurements of water surface elevation.

Abstract

This data product describes the volume of water flowing through a stream or river cross-section during a given period of time. For each NEON stream or river site, site-specific stage-discharge rating curve equations are derived from point observations of gauge height and discharge. Continuous sensor measurements of surface water pressure are used to derive water column height. The rating curve equations are applied to water column height to derive continuous stream discharge.

Design Description

NEON calculates continuous stream discharge in all rivers and wadeable stream sites within the Observatory. Stream discharge data are calculated using pressure of surface water L0 data (DP0.20016; the raw, level 0 inputs used to calculate Elevation of surface water, DP1.20016), stream discharge rating curve data (DP4.00133), gauge height data (DP1.20267.001) and geolocation information. Continuous discharge data are reported once per minute.

DP1.20048.001 Stream discharge field collection

Subsystem

Aquatic Observation System (AOS)

Sensor

HACH FH950

Coverage

These data are collected in aquatic wadeable streams and rivers.

Description

Discharge measurements from field-based surveys

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's stream discharge field collection protocol. Individual discharge measurements are conducted by means of surveys that occur in wadeable streams and rivers along permanently benchmarked cross-sections at NEON aquatic sites. During discharge measurements the waterbody is divided into lateral sub-sections (of which there are typically 20-25 per cross-section). Within each subsection, an instantaneous velocity magnitude is obtained and transformed to a volumetric discharge magnitude by applying the velocity across the full subsection area. Total stream discharge is then calculated by a flowmeter (in wadeable streams) or an acoustic doppler current profiler (in rivers), which sums the discrete volumetric discharges for each subsection. Further details with regards to wadeable streams can be found in NEON.DOC.001085 AOS Protocol and Procedure: Stream Discharge. A protocol for river discharge is forthcoming.

Design Description

Stream discharge is measured in all wadeable stream and river sites. At each site, field collection measurements are made 26 times per year until a valid stage-discharge relationship, i.e. rating curve, is developed. Once a relationship has been established, measurements will be made 12 times per year to verify the rating curve and identify when a new stage-discharge relationship may need to be developed. The stream discharge field collections will be planned to capture the range of discharge values for a particular stream. At some sites this may mean relatively evenly timed surveys, e.g. every two weeks during stage-discharge relationship development, while at others the surveys may be concentrated during variable-flow times of year, e.g. spring snow-melt, with less frequent surveys during baseflow times of year.

DP4.00133.001 Stream discharge rating curve

Subsystem

Aquatic Instrument System (AIS)

Coverage

This data product is measured at NEON aquatic wadeable stream and river sites.

Description

Rating curve generated from manual wading surveys of stream discharge. Used to calculate continuous measurements of stream discharge.

Abstract

This data product provides parameters that describe the relationship between staff gauge readings and stream discharge measurements. The parameters provided are the coefficients defining an exponential curve, and are derived from manually measured discharge and staff gauge readings by a Bayesian model. Rating curve parameters published in this product are used together with sensor measurements of surface water pressure to calculate the continuous stream discharge data product (DP4.00130). Data users should refer to the user guide for stream discharge rating curve (NEON_ratingCurve_userGuide_vA) for more detailed information on the algorithm used to develop a rating curve.

Design Description

Stage discharge rating curves are developed and evaluated annually for each site at the end of each water year (October 1-September 30). Throughout the year, up to 26 staff gauge and stream discharge measurements are made at each NEON stream or river site. These readings, along with hydrologically relevant morphological information from the stream morphology map (DP4.00131) and NEON geolocation database are used to fit a relationship between staff gauge measurements and discharge for each site. The parameters generated from the rating curve are used to calculate continuous stream discharge (DP4.00130) using an exponential fit. For additional details on NEON field staff gauge readings and discharge measurements, see the AOS Protocol and Procedure: Stream Discharge (NEON.DOC.001085vE).

DP4.00131.001 Stream morphology map

Subsystem

Aquatic Observation System (AOS)

Sensor

Hilti POS 180 robotic total station

Coverage

Geomorphology surveys are conducted at NEON aquatic wadeable stream sites.

Description

Map showing the morphology of streams. These maps denote topography of the stream basin as well as location of the thalweg, coarse woody debris, gravel/sand bars, and other features of interest.

Abstract

The wadeable stream morphology data product provides raw survey data, maps, shapefiles, and metric tables that quantify stream channel geomorphology and bed composition and delineates biological habitats within the aquatic reach boundaries (approximately 1,000 meters in stream length) of wadeable streams at NEON aquatic sites. Raw survey data is collected with high-resolution total station survey equipment at each NEON wadeable stream site. Survey maps and channel metrics are produced and calculated using raw survey data (Level 0) that are geo-referenced to a global coordinate system (Level 4). Geomorphology surveys are conducted at each site once every five years or immediately following a storm event deemed to have significantly altered stream morphology within the aquatic reach. Geomorphology surveys conducted immediately after a stochastic event will assess event magnitude by quantifying changes in channel geometry, bed composition, and biological habitat. For further details see NEON.DOC.003162vB AOS Protocol and Procedure: Wadeable Stream Morphology.

Design Description

Geomorphology surveys encapsulate the entirety of the aquatic reach, which at most NEON sites is equivalent to approximately 1,000 meters in stream length. A raw survey data file includes each of the individually mapped points collected by the total station during the geomorphology survey. Each point contains a Northing, Easting, and elevation coordinate relative to fixed benchmarks installed at the downstream extent of the reach (where the surveys typically begin). Mapped points are distributed at a high resolution (typically less than 1m) throughout the extent of the aquatic reach. Points are mapped along the main channel to capture thalweg (or the deepest part of the stream) elevation, along the edge of water to capture wetted width, and along select transects that run perpendicular to the channel in order to capture cross-sectional area. Additional points are collected at stream features that locally influence fluvial processes (i.e. large woody debris jams, mid-channel bars, etc.). Northing, Easting, and elevation data contained in raw survey files are relative to a local Cartesian coordinate plane (X, Y, and Z, respectively) defined by the fixed benchmark used to orient the total station at the beginning of the survey. Fixed benchmark locations are globally referenced (WGS 84 reference coordinate system) and locally projected (UTM Zone xNorth) using global positioning instrumentation to an accuracy of 10-30 centimeters of elevation. The degree of additional uncertainty associated with each survey will vary and is dependent on operator error, site-specific conditions, and environmental factors. Uncertainty associated with each survey is included within the data product package. During post-processing, GPS data is utilized to convert Northing and Easting values to latitude and longitude and elevation values to meters above mean sea level. All geo-referenced survey data is considered Level 4.

DP4.00001.001 Summary weather statistics

Subsystem

Terrestrial Instrument System (TIS)

Coverage

Summary weather statistics are generated for each Core terrestrial site in all 20 of NEON's domains.

Description

Present summary statistics for biometeorological variables for NEON weather stations at core TIS sites. Statistics will include means, standard deviations, maxima, and minima for periods of days, months, and years. Engineering-grade product only.

Abstract

The data products used for computing summary weather statistics represent fundamental meteorological parameters and are commonly monitored by many meteorological networks (e.g., USCRN, SCAN, etc.). Summaries of these meteorologic parameters are useful for understanding trends and changes in weather patterns.

Design Description

Summary weather statistics are be generated from Level 1 (L1) data products at NEON core sites. The L1 data products used to generate summary weather statistics are 2D wind speed (DP1.00001.001), Triple aspirated air temperature (DP1.00003.001), Barometric pressure (DP1.00004.001), Primary precipitation (DP1.00006.001), Shortwave radiation (primary pyranometer) (DP1.00022.001), and Relative humidity (DP1.00098.001). The means, minima, maxima, variances, and standard errors of the mean are reported for the finest temporal resolution of each data product. For Primary precipitation, only precipitation totals are reported.

DP1.20138.001 Surface water microbe cell count

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Cell counts from surface water microbial collection in lakes, wadeable streams, and non-wadeable streams

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's Surface water microbe cell count sample collection. Field samples are collected using a sterilized grab sampler in the water column of wadeable streams, rivers, and lakes in conjunction with standard recurrent surface water chemistry samples. Cell count field samples are collected 12 times per year in streams and 6 times per year in lakes and rivers, and are collected year-round unless ice cover is too thick to allow sampling. Samples are preserved in the field and shipped to a contractacting lab for analysis. For additional details, see NEON.DOC.003044: AOS Protocol and Procedure: Aquatic Microbial Sampling and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Surface water cell count samples are collected at the same time and location as surface water chemistry samples once per month in wadeable streams (12 times per year) and every-other month in lakes and rivers (6 times per year). In wadeable streams, cell count samples are collected near the downstream S2 sensor location. In lakes, cell count samples are collected near the the buoy, inlet, and outlet sensors, and sampling depth(s) is dependent on lake stratification. In rivers, cell count samples are collected near the buoy sensor. Samples are collected using a grab sampler, typically a sterilized 4 gallon jug in streams and a Kemmerer sampler in lakes. Samples are preserved with 1% formaldehyde in the field, and sent to an external facility for cell count analysis using propidium iodide (PI) staining and epifluorescence microscopy. Cell counts are enumerated using image analysis software.

DP1.20141.001 Surface water microbe community composition

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Counts and relative abundances of archaeal, bacterial, and fungal taxa observed in surface water microbial communities in lakes, non-wadeable streams, and wadeable streams

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON bacterial, archaeal, and fungal community composition data derived from surface water microbial sampling in lakes, and wadeable and non-wadeable streams. Taxon tables are derived from the 16S and ITS marker gene sequencing data product, NEON.DP1.20282. Taxonomic data are generated from quality-filtered sequence data using standard bioinformatics software. For additional details about sampling methods and design, see NEON.DOC.003044: AOS Protocol and Procedure: Aquatic Microbial Sampling; and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Surface water microbial genetic samples are collected at the same time and location as surface water chemistry samples once per month in wadeable streams (12 times per year) and every-other month in lakes and rivers (6 times per year). In wadeable streams, microbial genetic samples are collected near the downstream S2 sensor location. In lakes, microbial genetic samples are collected near the the buoy, inlet, and outlet sensors, and sampling depth(s) is dependent on lake stratification. In rivers, microbial genetic samples are collected near the buoy sensor.

DP1.20278.001 Surface water microbe group abundances

Subsystem

Aquatic Observation System (AOS)

Coverage

Measured at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Counts and relative abundances of marker genes from total archaea, bacteria, and fungi observed by qPCR in surface water microbial communities

Abstract

This data product contains the quality-controlled laboratory data and metadata for NEON's surface water bacterial, archaeal and fungal group abundances analysis, which are derived from surface water microbial sampling. Surface water grab samples are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. For additional details, see protocol NEON.DOC.003044 AOS Protocol and Procedure: Aquatic Microbial Sampling and science design NEON.DOC.001152 NEON Aquatic Sampling Strategy.

Design Description

Surface water samples for microbial molecular analyses are collected at the same time and location as surface water chemistry samples once per month in wadeable streams (12 times per year) and every-other month in lakes and rivers (6 times per year). In wadeable streams, microbe samples are collected near the downstream S2 sensor location. In lakes, samples are collected near the the buoy, inlet, and outlet sensors, and sampling depth(s) is dependent on lake stratification. In rivers, samples for microbial analysis are collected near the buoy sensor. The filters are frozen on dry ice in the field and shipped to an analytical facility for DNA extraction, sample preparation and qPCR analysis using primer sets targeting the small subunit of the ribosomal RNA gene. Laboratory data are passed through the NEON automated ingest process for QC testing and acceptance, and then are published on the NEON data portal.

DP1.20282.001 Surface water microbe marker gene sequences

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON lake and non-wadeable stream sites.

Description

DNA sequence data from ribosomal RNA marker genes from surface water samples

Abstract

This data product contains the quality-controlled laboratory metadata and 16S and ITS marker gene sequences derived from NEON's surface water microbial sampling. For details about the methods and design, see AOS Protocol and Procedure: Aquatic Microbial Sampling (NEON.DOC.003044) and NEON Aquatic Sampling Strategy (NEON.DOC.001152).

Queries for this data product return a downloadable data package with laboratory methods and DNA extraction, PCR amplification, and sequencing metadata for samples from the queried sites and date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository. Sequence data may also be obtained by querying NEON data sets at the NCBI Sequence Read Archive (NCBI SRA) and the European Bioinformatics Institute (EMBL-EBI).

Design Description

Surface water microbe samples are collected at the same time and location as surface water cell count samples and surface water chemistry samples once per month in wadeable streams (12 times per year) and every-other month in lakes and rivers (6 times per year). In wadeable streams, surface water microbe samples are collected near the downstream S2 sensor location. In lakes, microbial samples are collected near the the buoy, inlet, and outlet sensors, and sampling depth(s) is dependent on lake stratification. In rivers, microbial samples are collected near the buoy sensor. Water samples are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. Frozen samples are shipped to an analytical facility for DNA extraction, sample preparation and high-throughput sequence analysis using primer sets targeting the ribosomal RNA gene. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.20281.001 Surface water microbe metagenome sequences

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic sites (wadeable streams, lakes, and non-wadeable streams).

Description

Metagenomic sequence data from surface water samples

Abstract

This data product contains the quality-controlled laboratory metadata and QA results for NEON's shotgun metagenomic sequences derived from surface water microbial sampling. Surface water grab samples are filtered on 0.22 um Sterivex capsule filters, capped and flash-frozen in the field. For additional details, see protocol [NEON.DOC.003044vB] (http://data.neonscience.org/api/v0/documents/NEON.DOC.003044vB): AOS Protocol and Procedure for Aquatic Microbial Sampling. Queries for this data product will return metadata tables that include field observations and measurements, laboratory methods, and results from DNA extraction, sample preparation, and sequencing for samples from the specified sites and within the specified date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository.

Design Description

Surface water metagenomic samples are collected at the same time and location as surface water chemistry samples once per month in wadeable streams (12 times per year) and every-other month in lakes and rivers (6 times per year). In wadeable streams, samples are collected near the downstream S2 sensor location. In lakes, samples are collected near the the buoy, inlet, and outlet sensors, and sampling depth(s) is dependent on lake stratification. In rivers, samples are collected near the buoy sensor. The filters are frozen on dry ice in the field, and later are shipped on dry ice to an analytical facility for DNA extraction, sample preparation and shotgun metagenomic sequencing. Laboratory metadata are then delivered to NEON for QC testing and acceptance, and then are formatted for upload to public sequence repositories.

DP1.20053.001 Temperature (PRT) in surface water

Subsystem

Aquatic Instrument System (AIS)

Sensor

Thermometrics – R032-00000048

Coverage

All wadeable stream sites monitor stream water temperature at both the upstream and downstream sensor set locations.

Description

Surface water temperature, available as one-, five-, and thirty-minute averages, measured by a platinum resistance thermometer at the sensor location in lakes, wadeable and non-wadeable streams

Abstract

This data product contains quality-controlled continuous surface water temperature readings from a sensor within each of NEON's wade-able stream sensor sets.

Design Description

Surface water temperature ismeasured using a platinum resistance thermometer that acquires resistance readingsat 1 Hz. NEON coverts the raw resistancedata product into temperature and reports at1 minute intervals.

DP1.20264.001 Temperature at specific depth in surface water

Subsystem

Aquatic Instrument System (AIS)

Sensor

Precision Measurement Engineering Inc. - T-Chain RS 232/485

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Sensor based measurements of water temperature in lake and river sites. Temperature is measured at specific depths by a fixed-length buoy-mounted array of temperature sensors.

Abstract

Temperature at specific depths on buoys is measured every minute and is reported as 1-minute instantaneous measurements and 30-minute mean values. A temperature chain with between 3 and 10 thermistors (depending on lake depth) is affixed from the buoy at the water surface. The shallowest thermistor is located at 5 cm below the water surface. Deeper thermistors have their depth published with the data and vary for each lake or river.

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.20217.001 Temperature of groundwater

Subsystem

Aquatic Instrument System (AIS)

Sensor

In-Situ, Inc. - Aqua TROLL 200

Coverage

These data are collected in the fall and spring at all NEON aquatic sites except for MCRA, CUPE, and TECR where there are no groundwater wells.

Description

Sensor based measurement of groundwater temperature in each well.

Abstract

Groundwater plays an important role in modulating temperature of surface water, which is critical to habitat quality and ecosystem function. NEON measures groundwater temperature at high temporal resolution. Three to eight wells are available per aquatic site. From NEON groundwater elevation measurements, the magnitude and direction of groundwater flow can be calculated, which will help to inform the heat flux between groundwater and surface water. This data product includes continuous quality-controlled groundwater temperature captured every 5 minutes and are reported as 5-minute instantaneous measurements and 30-minute averages.

Design Description

Multiple groundwater wells per aquatic site are installed in triangular arrays where local features allow. Temperature of groundwater is measured in a site-specific array designed to capture shallow groundwater flow and exchange with the surface water feature at the site.

DP2.00024.001 Temperature rate of change

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield

Coverage

These data are collected at all NEON terrestrial sites.

Description

Time rate of change of temperature (storage component only) over 30 minutes at each measurement level along the vertical tower profile. Gap-filling is not applicable. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product is the temporally interpolated temperature data (time rate of change for temperature) at the 30 minute time scale at different measurement levels on the tower. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Single Aspirated Air Temperature (SAAT) and Triple Aspirated Air Temperature assembly (TRAAT) assemblies are deployed at tower sites. SAAT assemblies are located on each boom arm below the top of the tower while TRAAT assemblies are located on the top level of the tower infrastructure.

DP3.00008.001 Temperature rate of change profile

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield

Coverage

These data are collected at all NEON terrestrial sites.

Description

Time rate of change of temperature (storage component only) over 30 min, spatially interpolated along the vertical tower profile. This data product is bundled into DP4.00200, Bundled data products - eddy covariance, and is not available as a stand-alone download.

Abstract

This data product contains spatially interpolated temperature data at a 0.1 m vertical interval based on the 30 minute time rate of change for temperature at different measurement levels on the tower. The data are delivered with the Bundled data products - eddy covariance data product (DP4.00200.001).

Design Description

Single Aspirated Air Temperature (SAAT) and Triple Aspirated Air Temperature assembly (TRAAT) assemblies are deployed at tower sites. SAAT assemblies are located on each boom arm below the top of the tower while TRAAT assemblies are located on the top level of the tower infrastructure.

DP2.00004.001 Temporally interpolated biological temperature

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e., to gap fill missing data) biological temperature (i.e. surface temperature) measured via IR temperature sensors located in the soil array and at multiple heights on the tower infrastructure.

Abstract

NA

Design Description

NA

DP2.00016.001 Temporally interpolated PAR-line

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e., to gap fill missing data) Photosynthetically Active Radiation (PAR). Observations are made by sensors at the soil surface covering a one meter length.

Abstract

NA

Design Description

NA

DP2.00005.001

Temporally interpolated photosynthetically active radiation

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e., to gap fill missing data) Photosynthetically Active Radiation (PAR). Observations are made by sensors located at multiple heights on the tower infrastructure and a single sensor located on the aquatic meteorology station.

Abstract

NA

Design Description

NA

DP2.00020.001

Temporally interpolated shortwave and longwave radiation (net radiometer)

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e., to gap fill missing data) net radiation that is composed of incoming and outgoing shortwave and longwave radiation. These data products are available as one- and thirty-minute averages from sensors located on the TIS tower and located on the aquatic meteorology station.

Abstract

NA

Design Description

NA

DP2.00006.001 Temporally interpolated soil temperature

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e., to gap fill missing data) soil temperature at various depth below the soil surface from 2 cm up to 200 cm at non-permafrost sites (up to 300 cm at Alaskan sites). Data are from all five Instrumented Soil Plots per site and presented as 1-minute and 30-minute averages.

Abstract

NA

Design Description

NA

DP2.00023.001 Temporally interpolated triple aspirated tower temperature

Subsystem

Terrestrial Instrument System (TIS)

Coverage

NA

Description

Temporally interpolated (i.e. to gap fill missing data) air temperature, derived from triplicate 1 Hz temperature observations. Observations are made by sensors located at the top of the tower infrastructure. Temperature observations are made by three platinum resistance thermometers, which are housed together in a fan aspirated shield to reduce radiative biases.

Abstract

NA

Design Description

NA

DP1.10092.001 Tick-borne pathogen status

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Presence/absence of a pathogen in each single tick sample

Abstract

This data product contains the quality-controlled, native sampling resolution data derived from NEON's tick pathogen testing. Products resulting from this sampling include results of testing individual ticks collected during NEON tick sampling for pathogen presence/absence. See NEON Product Ticks sampled using drag cloths (DP1.10093.001) for data on the abundance and diversity of ticks collected at NEON sites. Following collection, tick samples are sent to a professional taxonomist where ticks are identified to species and sex. A subset of postively-identified nymphal ticks are tested for the presence of viral and protozoan pathogens. For additional details see science design NEON.DOC.000911: TOS Science Design for Vectors and Pathogens.

Design Description

A set of up to 130 individual ticks per site per year are selected for pathogen testing. Ixodes scapularis and Ixodes pacificus nymphs are targeted for testing of Anaplasma phagocytophilum, Babesia microti, Borrelia burgdorferi, Borrelia miyamotoi, and other Borrelia species. Nymphs in the genera Dermacentor and Amblyomma are targeted for testing of Francisella tularensis and Rickettsia species.

DP1.10093.001 Ticks sampled using drag cloths

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at NEON terrestrial sites.

Description

Abundance and density of ticks collected by drag and/or flag sampling (by species and/or lifestage)

Abstract

This data product contains the quality-controlled, native sampling resolution data from Tick and Tick-Borne Pathogen Sampling protocol. Tick abundance and diversity are sampled at regular intervals by NEON field technicians at core and relocatable sites using drag or flag sampling techniques. For additional details on protocol, see the TOS Protocol and Procedure: Tick and Tick-Borne Pathogen Sampling. Following collection, samples are sent to a professional taxonomist where ticks are identified to species and lifestage and/or sex. Identified ticks are then processed for pathogen analysis or preserved for final archiving. Products resulting from this sampling and processing include records of when ticks were sampled and the taxonomic and abundance data of ticks captured. For additional details, see protocol NEON.DOC.014045: TOS Protocol and Procedure: Tick and Tick-Borne Pathogen Sampling and science design NEON.DOC.000911: TOS Science Design for Vectors and Pathogens.

Design Description

During the growing season, sampling is conducted every three weeks at sites where ticks have previously been detected and every six weeks elsewhere. Sampling also occurs only if the high temperature on two consecutive days prior to planned sampling exceeds 0°C.

DP2.30016.001 Total biomass map - spectrometer - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Mass of all above ground organic matter per unit area at particular time; estimate of biomass derived from correlation with NDVI and LAI parameters; data are provided by flightline data are provided by flightline at equivalent resolution to spectrometer orthorectified surface directional reflectance.

Abstract

The NEON AOP Total Biomass data product is an orthorectified (UTM projection) raster product derived from NEON AOP Imaging Spectrometer (NIS) reflectance data. Biomass is an important layer in models and measurements involving climate, landscape ecology, and the carbon cycle. Remotely sensed estimates of biomass are important links between ground based biomass measurements and models operating at landscape, regional, or global scales. The biomass product is distributed in GeoTIFF format with each file containing the biomass raster for a single flight line.

Design Description

The Level 2 biomass data product is distributed in GeoTIFF format in UTM projection and ITRF00 datum. Each file contains the biomass raster for a single flight line.

DP3.30016.001 Total biomass map - spectrometer - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

Mass of all aboveground organic matter per unit area at particular time; estimate of biomass derived from correlation with NDVI and LAI parameters; mosaicked from the total biomass level 2 product onto a spatially uniform grid at 1 m spatial resolution and provided as 1 km by 1 km tiles.

Abstract

The NEON AOP Total Biomass data product is an orthorectified (UTM projection) raster product derived from NEON AOP Imaging Spectrometer (NIS) reflectance data. Biomass is an important layer in models and measurements involving climate, landscape ecology, and the carbon cycle. Remotely sensed estimates of biomass are important links between ground based biomass measurements and models operating at landscape, regional, or global scales. The Level 3 mosaic biomass product is distributed in 1 km by 1 km tiles in GeoTIFF format with each file containing the biomass raster for a single tile. The mosaic is created using the most-nadir pixel values from the single flight line biomass products intersecting the tile.

Design Description

The Level 3 biomass data product is distributed in GeoTIFF format in UTM projection and ITRF00 datum. Each file contains the biomass for a single 1 km by 1 km tile. The mosaic is created using the most-nadir pixel values from the single flight line biomass products intersecting the tile.

DP1.00003.001 Triple aspirated air temperature

Subsystem

Terrestrial Instrument System (TIS)

Sensor

Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield

Coverage

These data are collected at all NEON terrestrial sites.

Description

Air temperature, available as one- and thirty-minute averages derived from triplicate 1 Hz temperature observations. Observations are made by sensors located at the top of the tower infrastructure. Temperature observations are made by three platinum resistance thermometers, which are housed together in a fan aspirated shield to reduce radiative biases.

Abstract

Triple aspirated air temperature measurements, available as one- and thirty-minute averages of 1 Hz observations. Temperature is one of the most fundamental physical measurements. It is a primary driving factor for countless physical, chemical, and biological processes. The triple aspirated sensor assembly comprises three individual Platinum Resistance Thermometers (PRTs) housed within an aspirated shield.

Design Description

The Triple Aspirated Air Temperature assembly is deployed at core and relocatable tower sites. It is located on the top level of the tower infrastructure.

DP2.30026.001 Vegetation indices - spectrometer - flightline

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

NDVI - Normalized ratio of NIR and IR bands; characterizes the "red edge" in vegetation spectra. SAVI - Normalized ratio of 850 nm and 650 nm bands with gain and offset factors to minimize soil contribution in result; primary input to LAI product. EVI - Normalized ratio of NIR and IR bans (red edge characterization); includes Blue channel for better aerosol characterization. Data are provided by flightline; additional indices will be assessed and added to this product

Abstract

The Vegetation Indices data product is a family of 4 spectral indices: NDVI, EVI, ARVI, and SAVI. These indices use regions of vegetation reflectance spectra known to be indicators of vegetation health, vegetation health in high LAI areas, vegetation health in lush and/or humid regions, and vegetation health in mixed soil and vegetation landcover areas, respectively. The indices are derived from NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) data collected in North-South oriented flight lines to reduce BRDF effects. These data are processed to orthorectified directional surface reflectance and then processed to the indices. L2 Vegetation Indices are distributed in the original North/South flight lines and are packaged as a zip file containg one GeoTIFF for each index. The Level 2 vegetation indices are distributed in their original North-South flight lines.

Design Description

The Level 2 Vegetation Indices product is distributed as a Zip file containing one GeoTIFF file for each vegetation index raster for a single flight line. Each GeoTIFF is in UTM projection and ITRF00 datum.

DP3.30026.001 Vegetation indices - spectrometer - mosaic

Subsystem

Airborne Observation Platform (AOP)

Sensor

NEON Airborne Observation Platform (AOP) Imaging Spectrometer (NIS) - NASA/JPL AVIRIS-NG

Coverage

NEON AOP data are planned for yearly collects at all NEON sites at 90% of maximum greenness or greater. Coverage is planned to include at least 95% of NIS Tower Airshed area as well as at least 80% of a minimum 10km x 10 km box around that. All acquisitions are subject to change due to weather conditions as well as program planning changes.

Description

NDVI - Normalized ratio of NIR and IR bands; characterizes the "red edge" in vegetation spectra. SAVI - Normalized ratio of 850 nm and 650 nm bands with gain and offset factors to minimize soil contribution in result; primary input to LAI product. EVI - Normalized ratio of NIR and IR bans (red edge characterization); includes Blue channel for better aerosol characterization. Level 2 products derived from individual flight lines over a given site are mosaiced into single product; spatial resolution is 1m.

Abstract

The Vegetation Indices data product is a family of 4 spectral indices: NDVI, EVI, ARVI, and SAVI. These indices use regions of vegetation reflectance spectra known to be indicators of vegetation health, vegetation health in high LAI areas, vegetation health in lush and/or humid regions, and vegetation health in mixed soil and vegetation landcover areas, respectively. L3 Vegetation Indices are distributed in 1 km square tiles with 1 m pixels whose values are taken from the most-nadir pixel from the original flight line collections.

Design Description

The Level 3 biomass data product is distributed in GeoTIFF format in UTM projection and ITRF00 datum. Each file contains the biomass for a single 1 km by 1 km tile. The mosaic is created using the most-nadir pixel values from the single flight line biomass products intersecting the tile.

DP1.20288.001 Water quality

Subsystem

Aquatic Instrument System (AIS)

Sensor

YSI EXO2 Multiparameter Sonde; YSI EXO turbidity sensor; YSI EXO total algae PC sensor; YSI EXO pH sensor; YSI EXOdissolved oxygen sensor; YSI EXO fDOm sensor; YSI EXO conductivity and temperature sensor; YSI EXO central wiper

Coverage

S1 (upstream) and S2 (downstream) sensor sets are at all wadeable stream sites within NEON. Buoys are deployed at alllake and large river sites within NEON.

Description

In situ sensor-based specific conductivity, concentration of chlorophyll a, dissolved oxygen content, fDOM concentration, pH, and turbidity, available as one-, five-, and thirty-minute averages in surface water of lakes, wadeable streams, and non-wadeable streams.

Abstract

Water quality is measured once per minute at stream sensor sets and once per 5 minutes on buoys at lake and river sites. It is reported as 1- or 5-minute instantaneous measurements.

Design Description

The water quality sondes are deployed at stream sensor sets and lake and river buoys. At stream sites, the sondes are affixed to a post at a static depth relative to the stream bottom. The upstream sensor set #1 (S1) collects specific conductance, dissolved oxygen, pH, chlorophyll, and turbidity, but no fDOM. The downstream sensor set #2 (S2) collects specific conductance, dissolved oxygen, pH, chlorophyll, turbidity and fDOM. The buoy-deployed multisondes collect specific conductance, dissolved oxygen, pH, chlorophyll, turbidity, fDOM, and depth. At all but the Flint River, GA (FLNT) buoys, the water quality multisonde is fixed to a profiling winch to collect data from multiple depths every 4 hours and from 0.5 m parked depth when not profiling. Due to the high velocity of the Flint River, there are two sondes. One is deployed at a fixed depth of 0.5 m below the water surface and one monitors waterpumped from two depths, which are reported with the data.

DP1.00013.001 Wet deposition chemical analysis

Subsystem

Terrestrial Instrument System (TIS)

Sensor

N- Con Systems Company Wet Deposition Collector, Manufacture Model No: NEON 00-127-7

Coverage

Measured at select NEON terrestrial and aquatics sites.

Description

Total dissolved chemical ion concentrations of SO4 2-, NO3-, Cl-, Br-, NH4+, PO4 3-, Ca2+, Mg2+, K+, Na+, and pH/Conductivity in precipitation water; collected at TIS and AIS sites.

Abstract

This data product contains the quality-controlled, native sampling resolution data from NEON's wet deposition protocol. Major ion concentrations, pH, and conductivity are measured in precipitation samples.

Design Description

Wet deposition chemistry is sampled in conjunction with stable isotope concentration in precipitation (DP1.00038.001). Samples are collected in a climate controlled wet deposition collector located at the tower top of terrestrial sites, and at the meteorologic tower of select aquatic sites. The automated assembly detects precipitation with an optical sensor and opens to collect wet deposition during all rain events. Every two weeks samples are retrieved, filtered, and sent for analysis.

DP1.20059.001 Windspeed and direction above water on-buoy

Subsystem

Aquatic Instrument System (AIS)

Sensor

RM Young 05108-45 Wind Monitor-HD Alpine; Honeywell HMR 3330

Coverage

Buoys will be deployed at alllake and large river sites within NEON.

Description

Wind speed and direction; observations are made by 2-D sonic anemometer sensors located on lake and river buoys.

Abstract

Wind speed and direction on buoys are measured 11 times per minute and reported as 2- and 30-minute mean values. The buoy wind sensor, and therefore data processing, is different than other wind sensors at aquatic met stations and on the terrestrial tower.

Design Description

The buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets or terrestrial towers. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

DP1.10098.001 Woody plant vegetation structure

Subsystem

Terrestrial Observation System (TOS)

Coverage

These data are collected at all NEON terrestrial sites at which qualifying smaller woody individuals (individuals with DBH $<$ 10 cm) are present at 10% cover or greater, or when larger individuals (individuals with DBH $\geq$ 10 cm) are present in 10% or more of designated plots . Functionally, sampling occurs at forested sites, and sites with shrub/scrub vegetation.

Description

Structure measurements, including height, canopy diameter, and stem diameter, as well as mapped position of individual woody plants

Abstract

This data product contains the quality-controlled, native sampling resolution data from in-situ measurements of live and standing dead woody individuals and shrub groups, from all terrestrial NEON sites with qualifying woody vegetation. The exact measurements collected per individual depend on growth form, and these measurements are focused on enabling biomass and productivity estimation, estimation of shrub volume and biomass, and calibration / validation of multiple NEON airborne remote-sensing data products. In general, comparatively large individuals that are visible to remote-sensing instruments are mapped, tagged and measured, and other smaller individuals are tagged and measured but not mapped. Smaller individuals may be subsampled according to a nested subplot approach in order to standardize the per plot sampling effort. Structure and mapping data are reported per individual per plot; sampling metadata, such as per growth form sampling area, are reported per plot. For additional details, see protocol NEON.DOC.000987vG: TOS Protocol and Procedure: Measurement of Vegetation Structure, and Science Design NEON.DOC.000914: TOS Science Design for Plant Biomass, Productivity and Leaf Area Index.

Design Description

Woody Plant Vegetation Structure data are collected from distributed and/or tower plots. Each distributed plot is then sampled if at least one tree with DBH $\geq$ 10 cm is present, or if trees with DBH $\geq$ 10 cm are absent, distributed Plots are sampled if smaller woody individuals constitute $\geq$ 10% cover of the plot. Tower plots are sampled if at least one tree with DBH $\geq$ 10 cm is present in $\geq$ 10% of Tower Plots, or if smaller woody individuals constitute $\geq$ 10% of cover averaged across all Tower Plots. Within a plot, all individuals with DBH $\geq$ 10 cm are mapped and measured throughout the plot sampling area. Individuals with DBH $<$ 10 cm may be mapped if they are visible to airborne remote-sensing instruments, and if stem density thresholds are met, individuals with DBH $<$ 10 cm may be measured within nested subplots in order to standardize sampling effort across plots.

At relatively mesic sites, distributed Plots are sampled every 3 years, and a minimum of n=5 tower plots are sampled annually. At continental cold and/or dry sites, distributed plots and tower plots are sampled every 3 years. At boreal sites in Alaska, distributed and tower plots are sampled every 6 years, and relocatable sites are sampled a minimum of 3 time points. At sites with seasonal senescence, the onset of sampling in a given year is triggered by senescence of canopy or understory individuals, and must be completed before growth begins the following season. At sites with no distinct season, sampling begins within $\pm$ 2 weeks of the same date, and must be completed within 4 months of onset. See NEON.DOC.000987 for more details.

DP1.20219.001 Zooplankton collection

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic lake sites.

Description

Collection of zooplankton from water column samples in lakes

Abstract

This data product contains the quality-controlled, native sampling resolution data and metadata from NEON's aquatic zooplankton collection protocol, as well as associated taxonomic, morphometric, and count analyses data provided by a contracted lab. Field samples are collected in the water column of lakes using the most appropriate sampler (vertical tow net or Schindler trap) for the depth of water, preserved in ethanol in the field, and shipped to a contracting lab for analysis. For additional details, see NEON.DOC.001194 AOS Protocol and Procedure: Zooplankton Sampling in Lakes and NEON.DOC.001152: NEON Aquatic Sampling Strategy.

Design Description

Zooplankton samples are collected three times per year at lake sites during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using either a tow net (water deeper than 4 m) or a Schindler-Patalas trap (water shallower than 4 m) depending on the depth at the sampling location. Samples are collected near the NEON profiling buoy as well as the inlet and outlet sensor sets. Samples are preserved in ethanol in the field and shipped to a taxonomy lab for sorting and identification, including count of each taxon, summary length and width measurement for each taxon per sample (to nearest mm) and identification to lowest practical taxon (genus or species).

DP1.20221.001 Zooplankton DNA barcode

Subsystem

Aquatic Observation System (AOS)

Coverage

These data are collected at all NEON aquatic lake sites.

Description

CO1 DNA sequences of the zooplankton community

Abstract

This data product contains the quality-controlled, native sampling resolution data and metadata from NEON's aquatic zooplankton DNA sampling protocol, as well as associated metadata provided by a contracted lab. Field samples are collected in the water column of lakes using the most appropriate sampler (vertical tow net or Schindler trap) for the depth of water at the same time and location as morphological taxonomy samples, preserved in ethanol in the field, and shipped to a contracting lab for processing and sequencing. For additional details, see AOS Protocol and Procedure: Zooplankton Sampling in Lakes (NEON.DOC.001194) and NEON Aquatic Sampling Strategy (NEON.DOC.001152).

Queries for this data product return a downloadable data package with laboratory methods and DNA extraction, PCR amplification, and sequencing metadata for samples from the queried sites and date range. The actual sequence data are publicly available and may be queried on the Metagenomics Rapid Annotation using Subsystem Technology (MG-RAST) server. There may be lags between publication of metadata on the NEON data portal and availability of sequence data on the public sequence repository. Sequence data may also be obtained by querying NEON data sets at the NCBI Sequence Read Archive (NCBI SRA) and the European Bioinformatics Institute (EMBL-EBI).

Design Description

Zooplankton DNA samples are collected three times per year at lake sites during aquatic biology bout windows, roughly in spring, summer, and fall. Samples are collected using either a tow net (water deeper than 4 m) or a Schindler-Patalas trap (water shallower than 4 m) depending on the depth at the sampling location. Samples are collected near the NEON profiling buoy as well as the inlet and outlet sensor sets. Samples are preserved in ethanol in the field and shipped to an external facility for homogenization and high-throughput sequencing (metabarcoding).