

The NSF's National Ecological Observatory Network has 47 terrestrial field sites. Locations are representative of terrestrial features and habitats typical of regions across the United States within each NEON Domain and near to NEON's 34 freshwater aquatic field sites whenever feasible.

## Data Collection Systems at Terrestrial Sites

Automated instruments • Observational Sampling • Airborne Remote Sensing

NEON data products are open access and can be used in conjunction with one another because they're gathered in close proximity to each other at a site. The data are also comparable among field sites so researchers can study connections and patterns across ecosystems, and then develop models to forecast environmental change locally, regionally and at a continental scale.

### Types Of Data Collected At Terrestrial And Aquatic Field Sites

1. A flux tower collects atmospheric data at terrestrial sites.
2. Primary precipitation is measured using a Double Fence Intercomparison Reference.
3. Sampling plots are located within, and outside of the tower footprint.
4. Automated instruments collect soil data at terrestrial sites.
5. Field scientists collect organismal data from select plants, animals, pathogens, and microbes.
6. A meteorological station collects atmospheric data at aquatic sites.
7. The Airborne Observation Platform (AOP) flies over most sites annually to collect remote sensing data.
8. Surface water and depth profile data are collected in streams, rivers, and lakes.
9. Groundwater wells capture changes in groundwater elevation, temperature, and specific conductance.
10. Buoy stations at lake sites collect data about surface water quality.

## TERRESTRIAL OBSERVATIONAL SAMPLING

Sampling plots are established within the flux tower airshed, as well as throughout the dominant land cover/vegetation types identified at each field site. All data and archival samples collected are open access.



### Soils & Soil Microbes

- Soil physical properties (Distributed initial characterization)
- Soil physical properties (Distributed periodic)
- Soil microbe biomass
- Soil microbe community composition
- Soil microbe group abundances

### Terrestrial Plants

- Plant phenology observations
- Plant presence and percent cover
- Digital hemispheric photos of plot vegetation
- Herbaceous clip harvest
- Litterfall and fine woody debris sampling
- Non-herbaceous perennial vegetation structure
- Root sampling (Megapit)
- Root sampling tower plots
- Woody plant vegetation structure
- Coarse downed wood bulk density sampling
- Coarse downed wood log survey

### Ticks, Mosquitoes and Ground Beetles

- Ticks sampled using drag cloths
- Mosquitoes sampled from CO<sub>2</sub> traps
- Ground beetles sampled from pitfall traps

### Birds & Small Mammals

- Breeding landbird point counts
- Small mammal box trapping

### Pathogens

- Rodent-borne pathogen status
- Tick-borne pathogen status
- Mosquito-borne pathogen status

### DNA & Meta-Barcode Sequences

- Small mammal DNA barcodes
- Mosquito DNA barcodes
- Ground beetle DNA barcodes
- Soil microbe marker genes
- Soil microbe metagenomes

### Biogeochemical

- Soil chemical properties (Distributed initial characterization)
- Soil chemical properties (Distributed periodic)
- Soil inorganic nitrogen pools and transformations
- Soil stable isotopes (Distributed periodic)
- Plant foliar physical and chemical properties
- Plant foliar stable isotopes
- Litter chemical properties
- Litter stable isotopes
- Root chemical properties
- Root stable isotopes

### Soil Plot Sensors

NEON installs an array of five soil plots within or near the flux tower's footprint and in the locally dominant (1 km<sup>2</sup> scale) soil type of each terrestrial field site. Soil plots are typically spaced up to 40 m apart.

- 1 Photosynthetically Active Radiation (PAR) LI-COR LI-191-01 Quantum Line Sensor **1 sec**
- 2 Net-shortwave & net-longwave radiation, & biological temperature Hukseflux NRO1 Net Radiometer **1 sec**
- 3 Precipitation/Throughfall \* Met One 372 tipping bucket (non-heated) (excludes short-stature sites) **0.5 sec**
- 4 CO<sub>2</sub> concentrations Vaisala - GMP343 diffusion model **0.1 sec**
- 5 Soil Temperature Thermometrics - Climate RTD 100-ohm Probe **0.1 sec**
- 6 Soil moisture and salinity Sentek - EnviroSCAN TrISCANe **0.1 sec**
- 7 Soil heat flux Hukseflux - HFPOISC **0.1 sec**
- 8 Relative humidity Vaisala HUMICAP humidity & temperature probe - HMP 155 **1 sec**

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## Meteorological Measurements at Terrestrial and Aquatic NEON Sites

Measurement & Data Product	Sensor	TERRESTRIAL SITES (frequency/location)			AQUATIC SITES (frequency/location)	
		Tower Top	Lower Levels	Soil Array	On Bank Met Station	Above Water Met Station
Shortwave radiation (primary pyranometer)	Kipp and Zonen CMP22 Pyranometer	1 sec (core sites)	⊘	⊘	⊘	⊘
Shortwave radiation (direct and diffuse pyranometer)	Delta-T Devices SPNI Sunshine Pyranometer	1 sec	⊘	⊘	⊘	⊘
Shortwave and longwave radiation (net radiometer)	Hukseflux NRO1 Net Radiometer	1 sec	⊘	1 sec (only longwave)	1 sec	30 sec
Photosynthetically Active Radiation (PAR)	Kipp & Zonen PQS 1 PAR Quantum Sensor (additional downward-facing)	1 sec	1 sec	⊘	1 sec	30 sec
Photosynthetically Active Radiation (PAR) - quantum line	Licor LI-191-01 Quantum Line Sensor	⊘	⊘	1 sec	⊘	⊘
Spectral sun photometer - calibrated sky radiances	CIMEL Electronique - CE318N-EBS9	15 min	⊘	⊘	⊘	⊘
Air temperature	Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield (triplet probes in tower top shield)	1 sec	1 sec	⊘	1 sec	1 min
IR biological temperature	Apogee SI-111 infrared (IR) temperature sensor	⊘	1 sec	1 sec	⊘	⊘
Relative humidity	Vaisala HUMICAP Humidity and Temperature Probe - HMP 155	1 sec	⊘	1 sec	1 sec	1 min
Barometric pressure	Vaisala - BAROCAP Digital Barometer PTB330	⊘	1 sec	⊘	1 sec	1 min
Primary precipitation Double Fence Intercomparison Reference (DFIR)	Belfort AEPG II 600M weighing gauge	0.1 sec (20 sites)			0.1 sec (4 sites)	
Secondary precipitation	Met One 372 tipping bucket (non-heated) and 379 tipping bucket (heated)	On event (37 sites)	⊘	⊘	On event (6 sites)	⊘
Throughfall precipitation	Met One 372 tipping bucket (non-heated)	⊘	⊘	On event	⊘	⊘
2D wind speed and direction	Gill - Wind Observer II; Extreme Weather Wind Observer; RM Young 05108-45 Wind Monitor-HD Alpine (buoy); Honeywell HMR 3330 (buoy)	⊘	1 sec	⊘	1 sec	-4 sec
3D wind speed, direction and sonic temperature	Campbell Scientific. CSAT-3 3-D Sonic Anemometer	20 sec	⊘	⊘	⊘	⊘
3D wind attitude and motion reference	Xsens North America Inc. MTI-300-2A5G4 Attitude Heading Reference System	40 sec	⊘	⊘	⊘	⊘
CO <sub>2</sub> and H <sub>2</sub> O concentration & flux	LI-COR LI7200 or LI7200RS	20 sec	⊘	⊘	⊘	⊘
CO <sub>2</sub> and H <sub>2</sub> O concentration & flux (storage/profile)	LI-COR LI840A or LI 850	1 sec	1 sec	⊘	⊘	⊘
CO <sub>2</sub> atmospheric isotopes (storage/profile)	PICARRO - G213H-i isotopic CO <sub>2</sub> analyzer	1 sec	1 sec	⊘	⊘	⊘
H <sub>2</sub> O atmospheric isotopes (storage/profile)	PICARRO - I2130-i isotopic H <sub>2</sub> O analyzer	1 sec (21 sites)	1 sec (21 sites)	⊘	⊘	⊘
Wet deposition chemistry and precipitation isotopes	N- Con Systems Company Wet Deposition Collector, Manufacture Model No: NEON 00-127-7	2 wks (37 sites)	⊘	⊘	2 wks (6 sites)	⊘
Phenology images	Startod NetCam SC CAM-SEC5IR-B	15 min	15 min	⊘	15 min	

Additional measurements only at D10 & D13 terrestrial sites (MOAB, ONAQ, NIWO, RMNP, STER, CPER): Dust and particulate size distribution (TSI DustTrak model: 8533EP): 1 sec

## AIRBORNE REMOTE SENSING SURVEYS

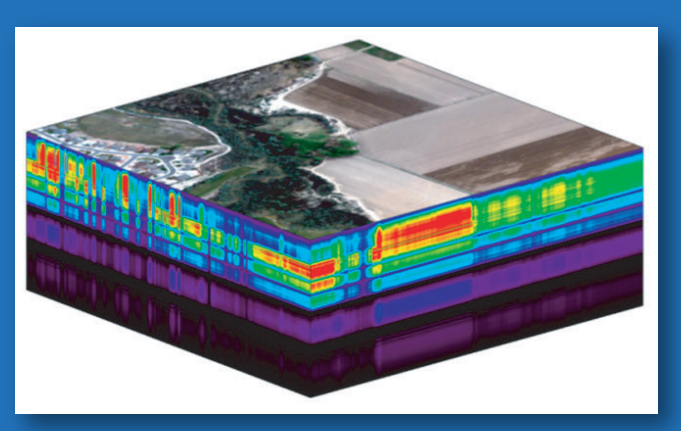
A NEON Airborne Observation Platform (AOP) is an array of instruments installed into a light aircraft to collect high resolution remote sensing data.

Collection of AOP data is synchronized with data collected on the ground at each site and takes place at peak greenness for each field site. Instruments include a discrete and waveform lidar, a hyperspectral imaging spectrometer, and a high resolution digital camera.

All data are open access. NEON has three AOPs that are used to capture data over NEON field sites and collect research-specific flight campaign data requested by the community.



Above: a point cloud from the lidar system.



Above: a hyperspectral cube from the spectrometer.



Left: an ortho-rectified and mosaicked aerial photo.