

Data Product	Sensor	Frequency / Averaging Period	Use Case
2D wind speed and direction profile	Gill Wind Observer II	1 Hz averaged to 1 and 30 minutes	Vertical profiles of wind velocities provide information on how well the atmosphere mixes with the ecosystem canopy.
3D wind attitude and motion reference	Xsens MTI-300-2A5G4 Attitude Heading Reference System	40 Hz averaged to 1 and 30 minutes	Used to correct 3D wind data from CSAT3 for motion of the boom in windy conditions. Usually only used for 3D wind measurements on buoys, ships, and aircraft.
3D wind speed, direction and sonic temperature	Cambell Scientific CSAT3	20 Hz averaged to 1 and 30 minutes	Provides vertical wind measurements used to calculate eddy covariance fluxes. Measures air temperature for calculating sensible heat flux.
Atmospheric CO ₂ isotopes	Picarro G2131	1 Hz averaged to 6 and 30 minutes	Stable carbon isotopes can provide information about CO ₂ source and can be used to partition the net flux into components of photosynthesis and respiration.
Atmospheric H ₂ O isotopes	Picarro L2130	1 Hz averaged to 9 and 30 minutes	Stable isotopes in water vapor provide information about the source of atmospheric water vapor and can be used to partition water fluxes into evaporation and transpiration.
Carbon dioxide flux	LiCor LI7200 Infra-red gas analyzer, LiCor LI-840/850 Infra-red gas analyzer, Cambell Scientific CSAT3	30 minutes	Provides net ecosystem exchange of CO ₂ , which is driven by uptake of CO ₂ from photosynthesis and release of CO ₂ from respiration.
CH ₄ Concentration	Picarro G2131	0.1 Hz averaged to 9 and 30 minutes	CH ₄ concentration profiles can be used to calculate a gradient flux of CH ₄ and characterize methane concentration changes with tower height.

CO2 concentration profile	LiCor LI-840/850 Infra-red gas analyzer	1 Hz averaged to 2 and 30 minutes	Used to calculate the storage term component of CO2 fluxes. Measures changes in CO2 within the canopy, e.g. higher concentrations at the surface at night due to respiration.
CO2 concentration - turbulent	LiCor LI7200 Infra-red gas analyzer	20 Hz averaged to 1 and 30 minutes	Provides high frequency CO2 data at the tower top for eddy covariance flux calculation.
CO2 concentration rate of change	LiCor LI-840/850 Infra-red gas analyzer	30 minutes	CO2 rate of change is gap filled to provide a continuous dataset at each tower measurement level. This is a precursor to calculating the CO2 flux storage term.
CO2 concentration rate of change profile	LiCor LI-840/850 Infra-red gas analyzer	30 minutes	CO2 rate of change is interpolated to height increments of 0.1 m. This is a precursor to calculating the CO2 flux storage term.
Dust and particulate size distribution	TSI DustTrak 8533EP	1 Hz averaged to 1 and 30 minutes	Provides atmospheric particulate matter concentrations that can be related to sources such as dust transport, wildfire smoke, or pollution. This data product has been recently discontinued.
Flux footprint characteristics	Cambell Scientific CSAT3	30 minutes	The flux footprint is the modeled upwind area contributing to the measured fluxes.
H2O concentration profile	LiCor LI-840/850 Infra-red gas analyzer	1 Hz averaged to 2 and 30 minutes	Concentration profile used to calculate storage term component of H2O fluxes.
H2O concentration - turbulent	LiCor LI7200 Infra-red gas analyzer	20 Hz averaged to 1 and 30 minutes	Provides high frequency H2O data at the tower top for eddy covariance flux calculation.
H2O concentration rate of change	LiCor LI-840/850 Infra-red gas analyzer	30 minutes	H2O rate of change is gap filled to provide a continuous dataset at each tower measurement level. This is a precursor to calculating the H2O flux storage term.
H2O concentration rate of change profile	LiCor LI-840/850 Infra-red gas analyzer	30 minutes	H2O rate of change interpolated to height increments of 0.1 m. This is a precursor to calculating the H2O flux storage term.

IR biological temperature	Apogee SI-111 infrared (IR) temperature sensor	1 Hz averaged to 1 and 30 minutes	Leaf temperature and available photosynthetically active radiation control plant biochemical processes. IR biological temperature can be used to calculate canopy stomatal conductance.
Latent heat flux	LiCor LI7200 Infra-red gas analyzer; LiCor LI-840/850 Infra-red gas analyzer; Cambell Scientific CSAT3	30 minutes	Latent heat flux is an important term in ecosystem energy balance closure. With a unit conversion this can be expressed as evapotranspiration to understand how much water the ecosystem loses to the atmosphere.
Momentum flux	Cambell Scientific CSAT3	30 minutes	Provides friction velocity data which is used to filter the other flux data (sensible heat, latent heat, CO ₂) to exclude time periods with insufficient turbulence.
Phenology images	Stardot NetCam SC	15 minutes	RGB and IR images are used to track changes in greenness of vegetation in the camera field of view. Can also be used to infer other phenological information such as flowering (if flowers are large enough) and any other changes.
Photosynthetically active radiation	Kipp & Zonen PQS 1 PAR Quantum Sensor	1 Hz averaged to 1 and 30 minutes	Provides the amount of solar radiation in wavelengths useful for photosynthesis at each level of the tower profile. Can be used along with carbon flux data to calculate light response curves and understand how carbon uptake varies with light availability.
Photosynthetically active radiation (quantum line)	Licor LI-191-01 Quantum Line Sensor	1 Hz averaged to 1 and 30 minutes	Measures a spatial average of photosynthetically active radiation at the soil surface, which is more representative of overall light availability when measuring under a tree canopy.
Precipitation (weighing gauge)	Belfort AEPG II 600M weighing gauge	1 and 24 hours	Precipitation measurement adjacent to the tower within a double-fence intercomparison reference to minimize wind influence on measurements. Used to understand water availability in an ecosystem.

Precipitation (tipping bucket)	Met One 372 tipping bucket	1 and 30 minutes	Precipitation measurement at the tower top and in the soil plots under tree canopy (throughfall precipitation). Used to understand water availability in an ecosystem.
Relative humidity	Vaisala HUMICAP Humidity and Temperature Probe - HMP 155	1 Hz averaged to 1 and 30 minutes	Relative humidity measured on the tower and soil plot, and aquatic meteorological station. Can be used to calculate vapor pressure deficit (along with temperature and barometric pressure) to understand how drying air is to plants.
Sensible heat flux	LiCor LI7200 Infra-red gas analyzer; LiCor LI-840/850 Infra-red gas analyzer; Cambell Scientific CSAT3, Thermometrics Climate RTD 100 Ω Probe	30 minutes	Sensible heat flux is an important component of ecosystem energy balance, measuring the amount of outgoing energy in the form of sensible heat. This is often used in combination with latent heat flux to understand how much energy is lost from an ecosystem by sensible or latent heat. For example, before leaf out in the spring, a deciduous forest will have a higher sensible heat flux than later in the season when energy is lost through transpiration.
Shortwave and longwave radiation (net radiation)	Hukseflux NR01 Net Radiometer	1 Hz averaged to 1 and 30 minutes	Net radiation is the balance between incoming and outgoing shortwave and longwave radiation. This data product provides observations of incoming shortwave, outgoing shortwave, incoming longwave, and outgoing longwave radiation and is important for understanding ecosystem energy balance.
Shortwave radiation	Delta-T Devices SPN1 Sunshine Pyranometer	1 Hz averaged to 1 and 30 minutes	Measures incoming shortwave solar radiation to the ecosystem.
Air temperature profile	Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan	1 Hz averaged to 1 and 30 minutes	Provides air temperature at various levels on the flux tower. These data are used to calculate to sensible heat flux storage term.

	aspirated radiation shield		
Snow depth and understory phenology images	Stardot NetCam SC	15 minutes	Images at the flux tower base with vertical rulers in the field of view can be used to calculate snow depth or characterize understory phenology.
Soil CO ₂ concentration profile	Vaisala GMP343	0.1 Hz averaged to 1 and 30 minutes	CO ₂ profiles in soil are used to calculate soil CO ₂ efflux to quantify soil respiration
Soil heat flux	Hukseflux HFP01SC: Self-Calibrating Heat Flux Sensor	0.1 Hz averaged to 1 and 30 minutes	Soil heat flux measures how much energy is being stored in and lost from the soil, which is an important term for calculating ecosystem energy balance.
Soil temperature profile	Thermometrics Climate RTD 100-ohm Probe	1 Hz averaged to 1 and 30 minutes	Soil temperature data are used to understand biogeochemical cycling in the soil (e.g. decomposition and nitrogen mineralization rates), suitability of the soil to different soil microorganisms, and permafrost stability
Soil water content and water salinity profile	Sentek EnviroSCAN TriSCAN	0.1 Hz averaged to 1 and 30 minutes	Measures soil water content available for plants and microbes at various depths from the surface to 200 cm (300 cm in Alaska).
Calibrated Sky Radiances	CIMEL Electronique - CE318N-EBS9	NA (raw data sent directly to AERONET)	Measures ground-based remote sensing of aerosol optical depth (how much sunlight is blocked by particles in the atmosphere). Data are processed by NASA AERONET.
Temperature rate of change	Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield	30 minutes	Temperature rate of change is a precursor to calculating the sensible heat flux storage term.
Temperature rate of change profile	Thermometrics Climate RTD	30 minutes	Temperature rate of change interpolated to height increments of 0.1 m. This is a

	100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield		precursor to calculating the sensible heat flux storage term.
Tower top air temperature	Thermometrics Climate RTD 100 Ω Probe, housed within a Met One 076B fan aspirated radiation shield	1 Hz averaged to 1 and 30 minutes	Provides the most accurate temperature measurement at the site, with three redundant temperature probes inside an aspirated housing.
Air temperature and barometric pressure above water on-buoy	Vaisala HUMICAP Humidity and Temperature Probe - HMP 155	1 Hz averaged to 1 and 30 minutes	Barometric pressure, or atmospheric pressure, is a major determinant of rates of chemical diffusion from the air to water surface.
Continuous discharge	In-Situ, Inc. - Level TROLL 500	1 minute	Stream discharge, the velocity of water moving across a cross-sectional area, is the most important physical control on stream environments. Discharge provides information to researchers on nutrient flux calculations, biogeochemical cycling, invertebrate drift, timing of runoff, sediment transport, as well as watershed water use, infiltration and retention.
Elevation of groundwater	In-Situ, Inc. - Aqua TROLL 200	1 Hz averaged to 1 and 30 minutes	Informs important linkages and feedbacks between groundwater and surface water in streams, rivers, and lakes.
Elevation of surface water	In-Situ, Inc. - Level TROLL 500	1 Hz averaged to 1 and 30 minutes	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.

Land-water interface images	Stardot NetCam SC	15 minutes	RGB and IR images of the lake, river, or stream riparian vegetation and stream surface taken from an automated camera. Photos may be used for understanding interactions between terrestrial vegetation and aquatic ecosystems or qualitative estimates of snow cover, riparian characteristics, or weather.
Nitrate in surface water	Seabird - SUNA V2 UV nitrate sensor	Mean value from 20 measurements made during a sampling burst every 15 minutes	Used to understand nutrient dynamics. While nutrients are essential for growth, excessive nutrients can create algal blooms leading to hypoxic and anoxic conditions, ultimately decreasing habitat quality.
Photosynthetically active radiation at water surface	Kipp & Zonen - PQS1	1 Hz averaged to 1 and 30 minutes	Measures the amount of light available for photosynthesis above the water surface.
Photosynthetically active radiation below water surface	LI-COR LI-192A	1 Hz averaged to 1 and 30 minutes	Continually measuring above and below-water PAR enables understanding spatial variation within and among sites, as well as temporal variation ranging from seasonal changes to trends in long-term datasets.
Shortwave and longwave radiation above water on-buoy	Hukseflux NR01 Net Radiometer	Measured twice per minute and averaged to 1 and 30 minutes	Net radiation is one component that determines water temperature and plays a role in regulating biogeochemical cycles.
Temperature of groundwater	Aqua TROLL 200	5-minute instantaneous measurements and 30-minute averages	Used to understand the relative influence of subsurface water on the temperature of surface water at NEON aquatic sites.
Surface water temperature	Thermometrics -- R032-00000048	1 Hz averaged to 1, 5, and 30 minutes	Water temperature is an important variable in stream and lake ecosystems. Biological factors including growth, production, life history, and community structure are strongly affected by water temperature.

Water quality	YSI EXO2 Multiparameter Sonde; YSI EXO turbidity sensor; YSI EXO total algae PC sensor; YSI EXO pH sensor; YSI EXO dissolved oxygen sensor; YSI EXO fDOM sensor; YSI EXO conductivity and temperature sensor; YSI EXO central wiper	1-min measurements in wadeable stream sites and 5-min measurements in lake and river sites	This data product provides in-situ, sensor-based measurements of specific conductance, dissolved oxygen, pH, turbidity, fluorescent dissolved organic matter (fDOM) and chlorophyll-a. Use cases differ for each parameter. Examples are: chlorophyll levels in lakes and streams can change in close association with environmental factors, such as precipitation, nutrient loading, or light availability, as well as biological factors such as predation, while conductivity is a useful indicator of groundwater inputs, catchment geology and human activity (i.e. herbicides, pesticides, fertilizer, road salt, human and animal waste) within the watershed.
Windspeed and direction above water on-buoy	RM Young 05108-45 Wind Monitor-HD Alpine; Honeywell HMR 3330	11 times per minute and reported as 2- and 30-minute averages	Wind across the surface of a lake influences gas exchange and is one mechanism by which lake water mixes and overturns.
Water temperature and conductivity in lakes	Onset HOBO U24-001; In-Situ, Inc. - Level TROLL 400	20-minute or 30-minute values	Measurements of water temperature and conductivity in lakes from a subsurface moored array of sensors is used to understand how temperature and conductivity change with depth, which influence lake stratification and turnover.
Temperature at specific depth in surface water	Precision Measurement Engineering Inc. - T-Chain RS 232/485	1-minute instantaneous measurements and 30-minute averages	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.