National Ecological Observatory Network

AIRBORNE REMOTE SENSING

FOR A BETTER VIEW OF ECOLOGICAL CHANGE, GET HIGHER.

The NEON Airborne Observation Platform (AOP) is an array of instruments installed into a light aircraft to collect high resolution remote sensing data at low altitude. The resulting open access AOP data fill a critical hole in ecological data collection. Standardized and routine airborne data collection over NEON field sites allows scientists to monitor changes in vegetation patterns and canopy chemistry on a continental scale over an extended time period—providing new insights into how invasive species are spreading and how ecosystem changes impact forest health and their ability to sequester carbon.

The National Science Foundation's National Ecological Observatory Network (NEON) is a continental-scale observation facility operated by Battelle. NEON is designed to collect and provide open data that characterize and quantify complex, rapidly changing ecological processes across the United States. The comprehensive data, spatial extent and remote sensing technology provided by NEON will enable a large and diverse user community to tackle new questions at scales not accessible to previous generations of ecologists.

WHAT WE MEASURE

NEON's AOPs provide high-resolution measurements of numerous physical, biological and biochemical properties. Data from the AOPs build a robust time series of landscape-scale changes in metrics such as vegetation cover and density, canopy chemistry and topography. Measurements include:

- Vegetation cover and dominant vegetation type
- Vegetation structure, including height and Leaf Area Index (LAI)
- Vegetation condition
- Vegetation biochemistry and heterogeneity
- Canopy chemistry (nitrogen index)
- Topography, such as elevation, slope and aspect
- Total biomass
- Vegetation greenness and health (Normalized Difference Vegetation Index [NDVI], Enhanced Vegetation Index [EVI])

These data can be used to derive many key indicators of ecological health and changing ecosystems, including:

- Ecosystem structure
- Ground elevation (Digital Elevation Model [DEM])
- Digital Surface Model (DSM)

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BRIDGING THE GAPS BETWEEN SATELLITE AND SITE-BASED DATA

The AOP is a suite of sensors mounted into a small airplane that includes a hyperspectral imaging spectrometer, a full-waveform and discrete-return Light Detection and Ranging (LiDAR), and a high-resolution Red-Green-Blue (RGB) camera.

The NEON AOP can collect regional data at lower altitudes, yielding data of much higher resolution than a satellite and from broader areas than a handheld instrument could capture. AOP data provide an essential data set to help researchers better understand and compare satellite-derived remote sensing data to ground-collected data. In addition, AOP data may be combined with field-based NEON measurements to estimate ground and atmospheric conditions across sites. Field technicians strategically collect organismal data at individual plots throughout the growing season, and automated instruments continuously collect atmospheric, soil and aquatic data within each field site. Examples of AOP data used in coordination with other NEON measurements include:

- In situ and sensor data combined with AOP measurements to enable scientific study of continental-scale patterns and processes.
- Vegetation indices created at both the native sensor resolution at spectral and spatial resolutions that closely match existing MODIS and Landsat satellite-derived vegetation index products.
- AOP data from other organizations used to fill in gaps between NEON sites or where NEON data do not exist to address ecological questions at regional and continental scales.

COLLECTION AREAS, TIME AND DATA RESOLUTION

Field operators conduct airborne observation surveys annually over NEON terrestrial and aquatic sites, covering a minimum area of 10 by 10 kilometers, including coverage of all field sampling plots and automated instruments and often extending to the surrounding watershed. The average AOP flying altitude of 1,000 meters above ground level provides seamless hyperspectral and gridded LiDAR remote sensing data products at approximately 1-meter spatial resolution and digital photography at approximately 0.25-meter resolution. Flights are scheduled during the growing season, at or close to the time of peak vegetation greenness.

Hyperspectral Imaging Spectrometer

A hyperspectral imaging spectrometer records light energy from the sun that has reflected off the ground. Data from this instrument may be used to characterize vegetation health, species composition and canopy chemistry.

Full Waveform and Discrete Return Light Detection and Ranging (LiDAR)

A LiDAR system uses laser light energy to measure the heights of objects on the ground. Data from a LiDAR system can be used to estimate vegetation height, density and species composition and to map buildings, power lines and other infrastructure.

High-Resolution, Red-Green-Blue (RGB) Camera

A digital camera records light energy that has reflected off the ground in the visible part of the light spectrum, producing high-resolution photographs of the Earth's surface.

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