The National Ecological Observatory (NEON)

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The goal of NEON is to enable understanding and forecasting of the impacts of climate change, land use change and invasive species on continental-scale ecology by providing infrastructure to support research, education and environmental management in these areas.
Environmental Stressors

Large-scale environmental stressors like climate-change, land-use change, and invasive species impact the nation’s natural, managed, and urban landscapes.

Complex interactions between stressors and impacts

These landscape impacts modify the strength and nature of the stressors through perturbations in land-surface reflectivity, water cycles, nutrient cycles, natural and anthropogenic gaseous emissions, and others.

Landscapes
Overview

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NEON site constellation

NEON airborne platform

Existing satellite platforms

Landscapes
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NEON site constellation

Site-based measurements are used to calibrate and validate airborne measurements, and to produce regional-scale data.

NEON airborne platform

Site-based and airborne measurements are used to calibrate and validate space-borne measurements, and to produce continental-scale data.

Existing satellite platforms

These data are freely web-accessible to support forecasting and decision making across a number of applications, like those stipulated in the Global Earth Observing System of Systems (GEOSS) Societal Benefit Areas:

Disasters  Health  Energy  Climate  Water  Weather  Ecosystems  Agriculture  Biodiversity
The Earth System

(from Earth System Science: An Overview, NASA, 1988)
Field data acquisition, airborne campaigns, Federal partners
Site Schematic

Legend:
- Plant Biodiversity Plots with Traps
- Insect Traps
- Mammal Webs
- Birding Grids
- Mammal Transects
- Ecosystem Productivity Plots

For representation purposes, grid segments represent 1 km². Specific sites will vary in area according to geography and sampling requirements.
Airborne Remote Sensing (AOP)

• Spectroscopy
  – Vegetation biochemical & biophysical properties
  – Cover type & fraction
• LiDAR altimetry
  – Vegetation structure
  – Sub-canopy topography
  – Biomass
• High resolution imagery
  – Land use & land cover
From Data to Information

Field data acquisition, airborne campaigns, Federal partners

Field campaigns to measure key biological indicators

Atmospheric Measurements

Ground Water Measurements

Surface Water Measurements

RTU

LAN

Router

Location Controller

Soil Measurements

Internet
From Data to Information

NEON Cyberinfrastructure

- Data Storage
- Observation and Sample Management (OSM)
- Data Processing (DPMS)
- Science Operations Manager (SOM)
- Data Products
- Portal

- Bioclimate
- Biodiversity
- Biogeochemistry
- Ecohydrology
- Infectious Disease
- Land use and Land Cover
Data

- 20 core wildland sites
- 40 relocatable sites, mostly in managed landscapes
- 36 aquatic sites (all but 2 co-located)
- 10 aquatic experiment sites (of the 36)
- 3 Airborne remote sensing systems
- 542 Level 1 (primary) observations: raw data calibrated into physical, biological or chemical units
- 118 Level 4 (algorithmic) continental-scale data products
- 178 Terabytes of data/year, total
• Basic infrastructure designed around high availability (no data loss) and 30-year sustainability.

• Data infrastructure designed around providing information as well as data.
  – Solution: High level data products, including continental-scale extrapolation, forecasting, innovative informatics for publishing information and data.
From Data to Information

**NEON Cyberinfrastructure**

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- Land use and Land Cover
Applications that utilize NEON data products

- Ecological Forecasting
- Education
- Public Engagement
- Socio-economic analyses
- Decision support for:
  - Climate-change adaptation
  - Climate-change mitigation
  - Resource management
  - Environmental Risk Management
From Data to Information

Education Framework

- **Awareness Activities**: Promote basic knowledge of national-scale ecology and NEON products
- **Mastery Activities**: Deepen understanding of national-scale ecological concepts, advance use of NEON products
- **Leadership Activities**: Transfer knowledge about national-scale ecology and the use and development of NEON products to user communities

NEON Education Interface
- Web portals, social media, computing tools, educational data products, learning experiences
- Partnerships

NEON Information and Infrastructure
NEON Education and Public Engagement

- Educational resources promote science education model that emphasizes the process of science (collecting, analyzing, & interpreting data) through active learning, or “doing science”
- Public engagement strategy reflects societal trends for learning through an increasingly decentralized process and free-choice learning context
- NEON Citizen Science project will serve as a model for transforming science to include public participation (i.e., data collected through Citizen Science efforts)
NEON Educational Products

- **Web Portal**
  - Gateway to NEON
  - Citizen science area
  - Decision-support area
  - Educator area
  - NEON data products area

- **Professional development programs for faculty and teachers**
- **Research and internship opportunities for undergraduates**
- **Competitive field and analysis course for graduate students**
- **NEON museum projects**
- **Postdoctoral research program**
- **Workshops, seminars and courses for scientists and decision makers**
NEON Citizen Science Prototype

- Collaborating with Project BudBurst to develop new tools and resources for participants
- New tools, in the form of widgets, enable users to visualize and analyze data on the web portal
- New resources focus on engaging participants in scientific inquiry beyond collecting data and include interpreting citizen science data in comparison with NEON-like data
81% of respondents had previously heard of NEON and 83% of respondents were interested in using NEON data and resources in the future.
Many respondents appeared to desire more specific details and expressed an interest in data communicated that can be readily used in their work.
Promoting Computational Thinking

• 2009 National Research Council Workshop on Computational Thinking:
  – Use of symbol systems to articulate explicit knowledge
  – Handling and manipulating intangible abstractions for problem solving
  – Comparable to reading, writing, speaking and arithmetic... “basic cognitive abilities that the average person in modern society is expected to possess”.

• NEON’s integrated, context-rich data and information is a valuable resource for the earth sciences community: for both research and education
Preparing the Community to use NEON

• NSF has funded ESA to work with NEON on projects including:
  – Faculty workshop in Washington DC in fall 2008 on the use of continental-scale datasets for undergraduate classes.
  – Faculty workshop at NCEAS in summer 2009 to develop and test web-based activity modules that use large datasets to teach ecological concepts in undergraduate courses, with follow-on workshop for faculty and students in summer 2010.
  – Webinars in 2010 on large-scale ecology open to all.
  – Undergraduate student workshop in November 2010 exposing students to the use of geospatial datasets to explore ecological – socioeconomic connectivity issues in the Chesapeake Bay.
The National Ecological Observatory Network is a project sponsored by the National Science Foundation and managed under cooperative agreement by NEON, Inc.

http://www.neoninc.org