

National Ecological Observatory Network (NEON) at Oak Ridge National Laboratory

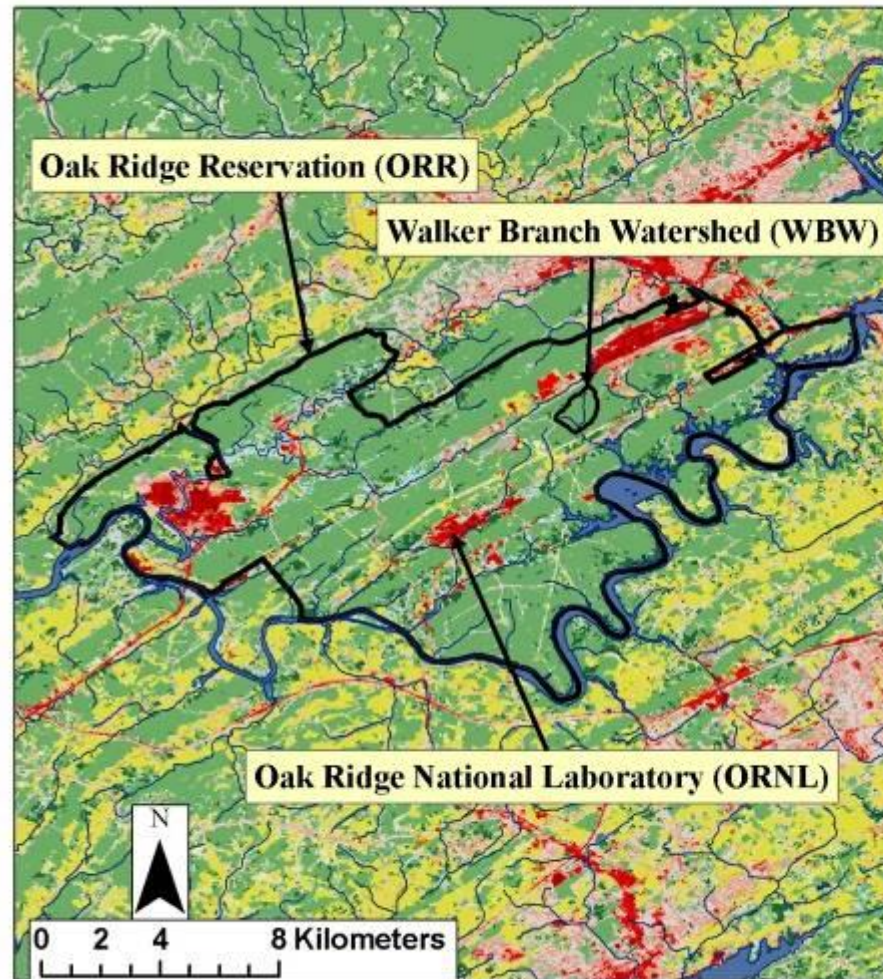


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Walker Branch Watershed

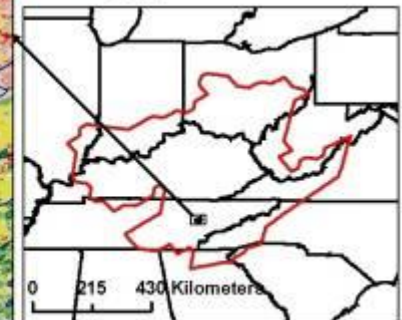
(<http://walkerbranch.ornl.gov/>) will be a core site in a new, large-scale ecological monitoring network known as NEON (<http://www.neoninc.org/>)



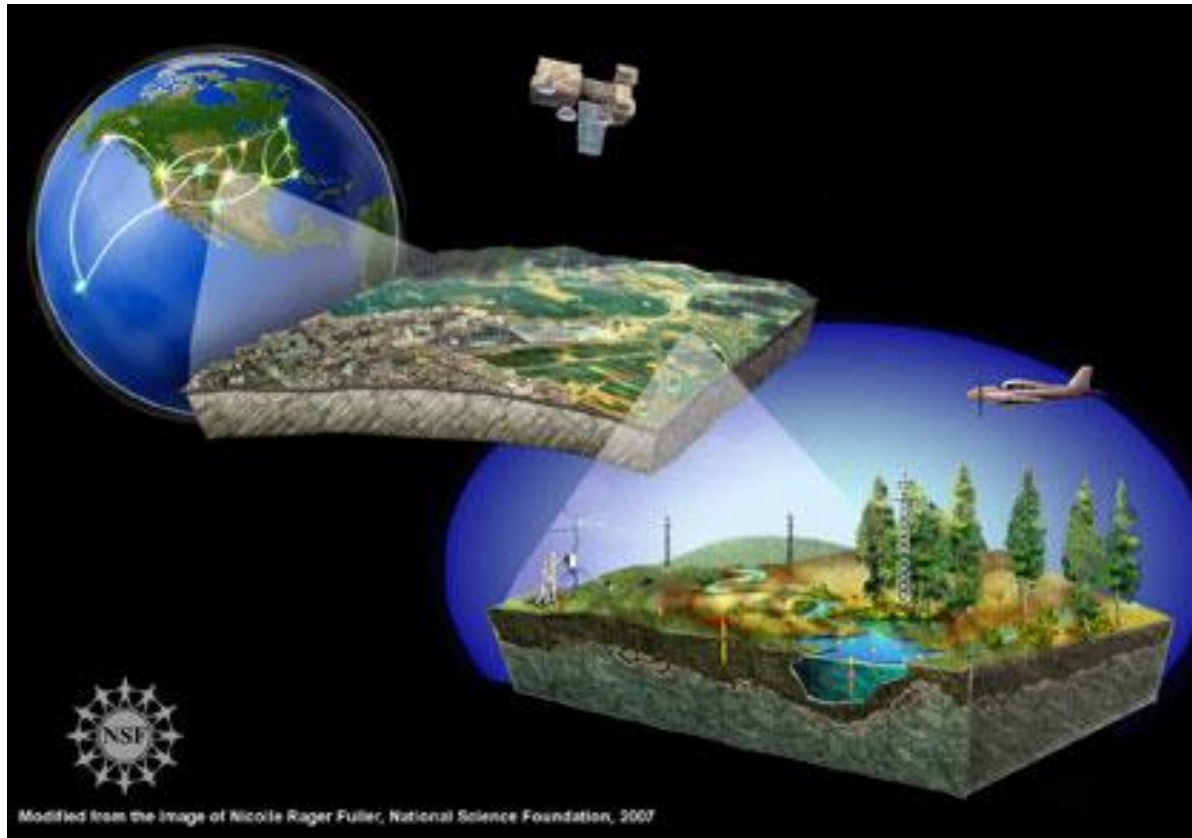
Landcover around Oak Ridge Reservation

Landcover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetland
- Streams



NEON is intended to be a continental-scale observation platform



Recent publications describing NEON:

- Pennisi, E. 2010. A groundbreaking observatory to monitor the environment. *Science* 328: 418-420.
- Keller, M., Schimel, D.S., Hargrove, W.W., and Hoffman, F.M. 2008. A continental strategy for the National Ecological Observatory Network. *Frontiers in Ecology and the Environment* 6: 282-284.

The goal of NEON is to advance our understanding of important processes

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.

NEON science questions encompass multiple organisms and scales

How are ecosystems across the United States affected by changes in climate, land use, and invasive species over time? How do they respond and at what rates?

How do biogeochemistry, biodiversity, hydroecology, and biotic structure and function interact with changes in climate, land use, and invasive species across the nation? How do these feedbacks vary with ecological context and scale over time?

NEON facilities are funded by the National Science Foundation

Phase	Instrumentation/ Measurements	Funding	Timing
Construction	<ul style="list-style-type: none">• Eddy covariance tower for atmosphere-forest gas exchange• Instruments for measuring physical, chemical, and biological conditions in forest, soil, and stream	NSF MREFC Program: ~\$400 M	Construction at likely to begin in 2011
Operation	<ul style="list-style-type: none">• Instrument maintenance• Sample/data collection• Data management• Cyber infrastructure• Education	NSF Biology Directorate: ~\$75 M/year	30-year operation phase

Core sites were chosen in each of 20 NEON Domains based on climate similarity



The Oak Ridge Reservation was chosen as the core wildland site in Domain 7. It is the only DOE site among all core sites.

Walker Branch Watershed will be the primary instrumented site on the ORR



Walker Branch Watershed was chosen because of a of long history of monitoring/experiments (<http://walkerbranch.ornl.gov/>)

Vegetation (periodic surveys begun in 1967, 10-year climate change experiment recently completed)

How are forest biomass and species composition changing over time?

How does seedling recruitment, tree physiology and productivity respond to climate variability and change (precipitation)?

Soil chemistry (decadal surveys begun in 1972)

How is soil chemistry changing over time?

How does soil nutrient availability respond to climate variability (proposed)?

Catchment hydrology (begun in 1967) and chemical budgets (begun in 1989)

How are runoff and ET changing over time (CO₂ effect)?

How are input/output budgets changing with changes in atmospheric deposition and how are these influenced by climate variations?

Stream ecology and biogeochemistry studies (^{32/33}P experiments in 1980's, ¹⁵N experiments in 1997-2005)

How are stream nutrient concentrations influenced by catchment hydrology, forest vegetation phenology, and in-stream uptake and retention?

How does climate and forest vegetation phenology influence stream metabolism?

NEON will include four science components

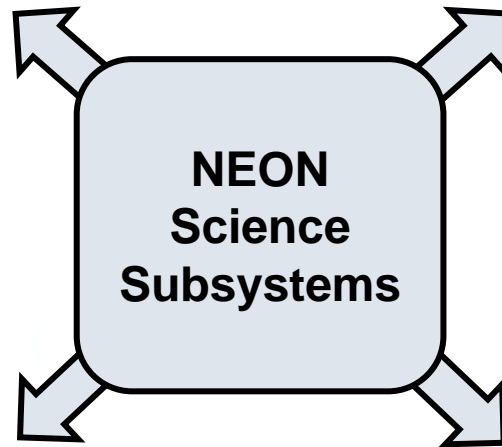
Field
instrumentation

Walker
Branch



Field
sampling

Various
locations
on ORR



Local to
regional
over-flights



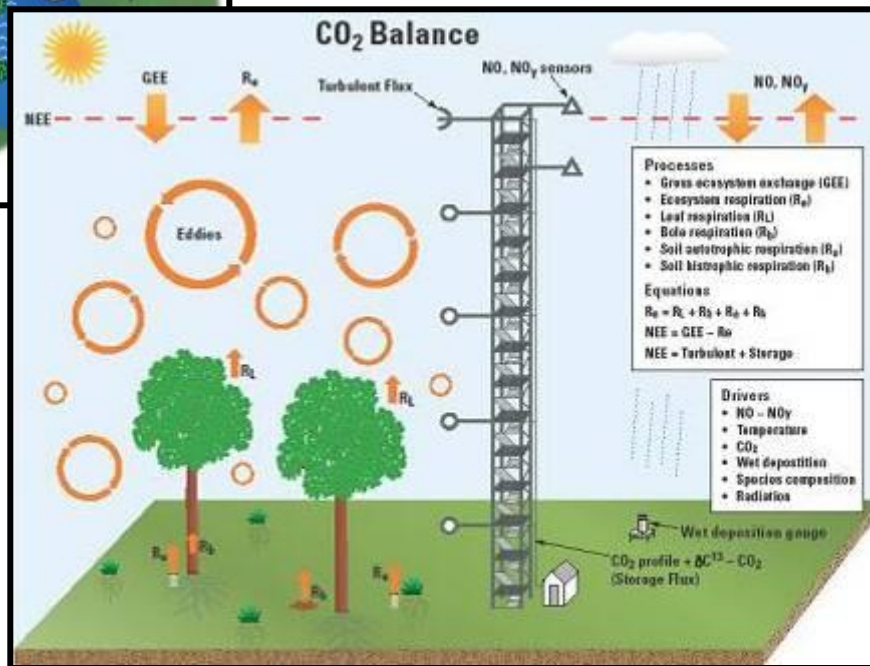
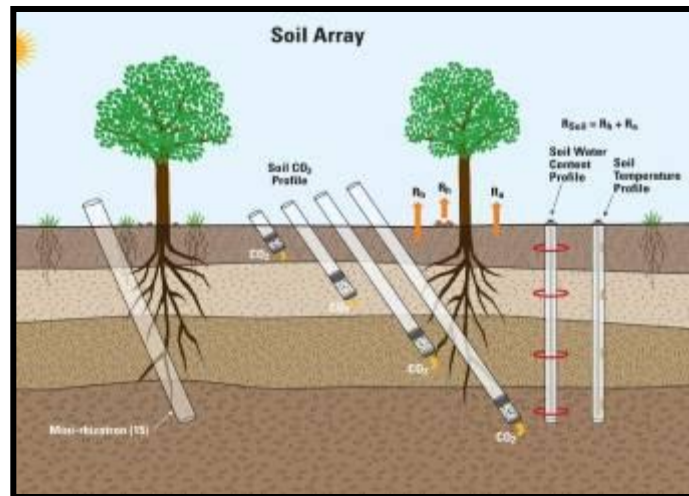
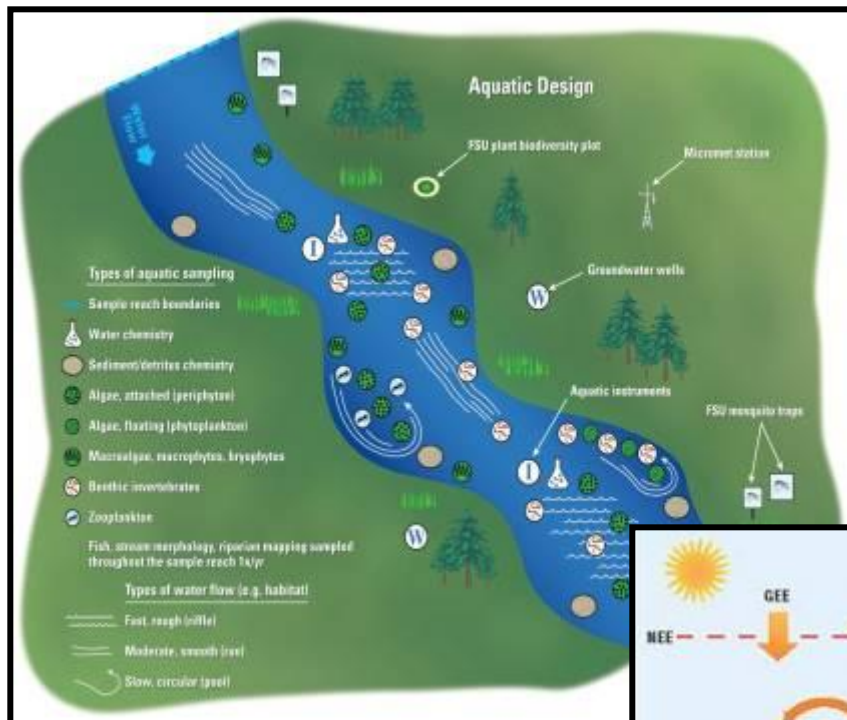
Remote sensing
(aircraft sensors)



Walker
Branch

Stream
experiment

NEON instrumentation (FIU) will monitor climate, soil and stream conditions/processes



NEON field sampling (FSU) tracks changes in organisms, populations, communities

Box 2.3 Fundamental Sentinel Unit Measurements

Field Observation Programs

Aquatic biogeochemistry

- Ground water flow
- Aquatic sediments

Vectors and pathogens

- Mosquito (e.g. West Nile, encephalitis, malaria)
- Deer mouse (e.g. Hanta-virus, Lyme disease)

Phenology

- Standardized lilacs
- Dominant plant species
- First robin nesting

Biodiversity

- Soil microbes
- Ground beetles
- Plants
- Algae
- Aquatic invertebrates
- Fish
- Breeding bird survey



Remote Sensing

Airborne instrument pods

- Hyperspectral
- LiDAR
- Side aperture radar (SAR) interferometry
- Thermal imaging

MODIS satellite

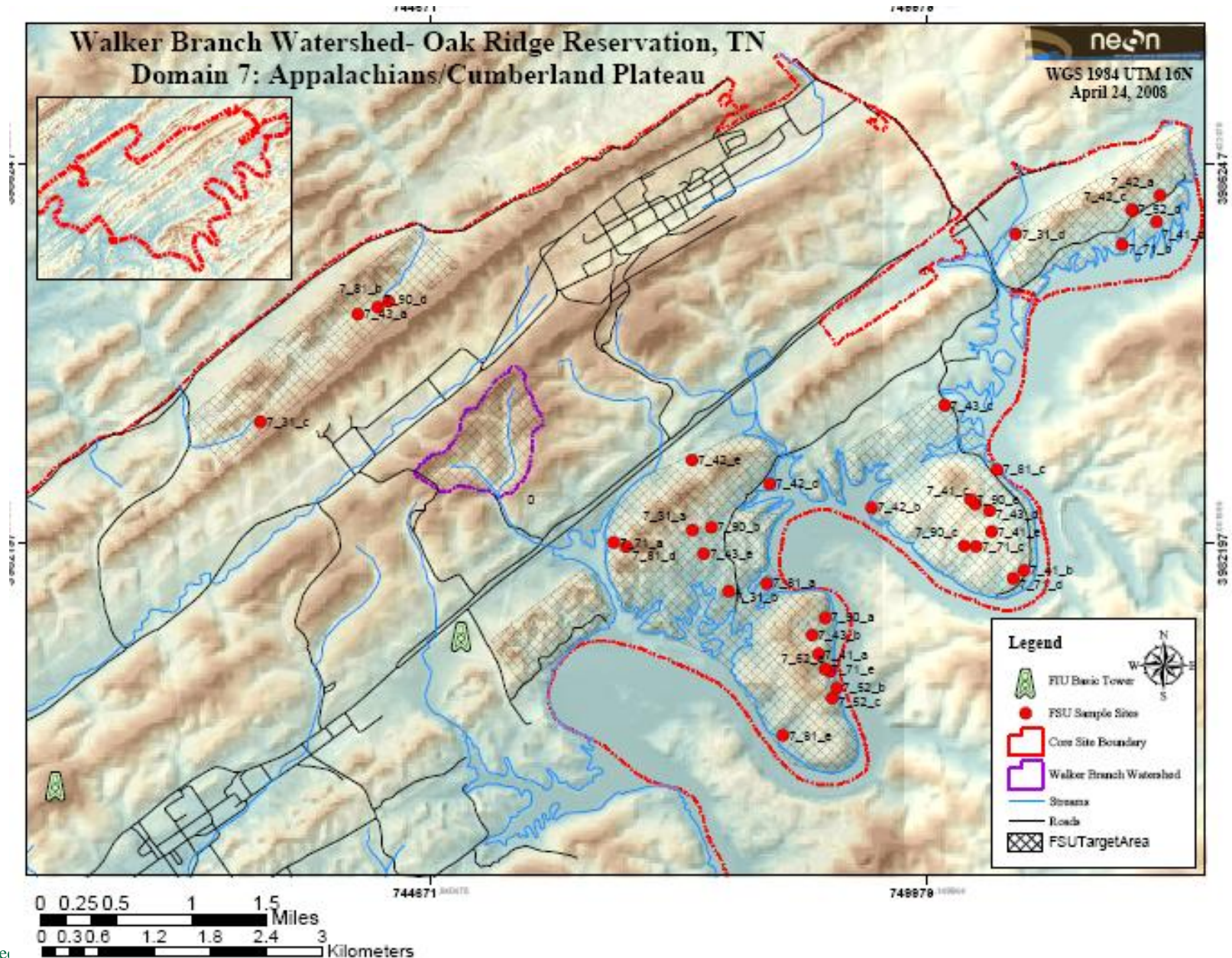
- Land use, land cover
- Primary production



Organism Tracking System

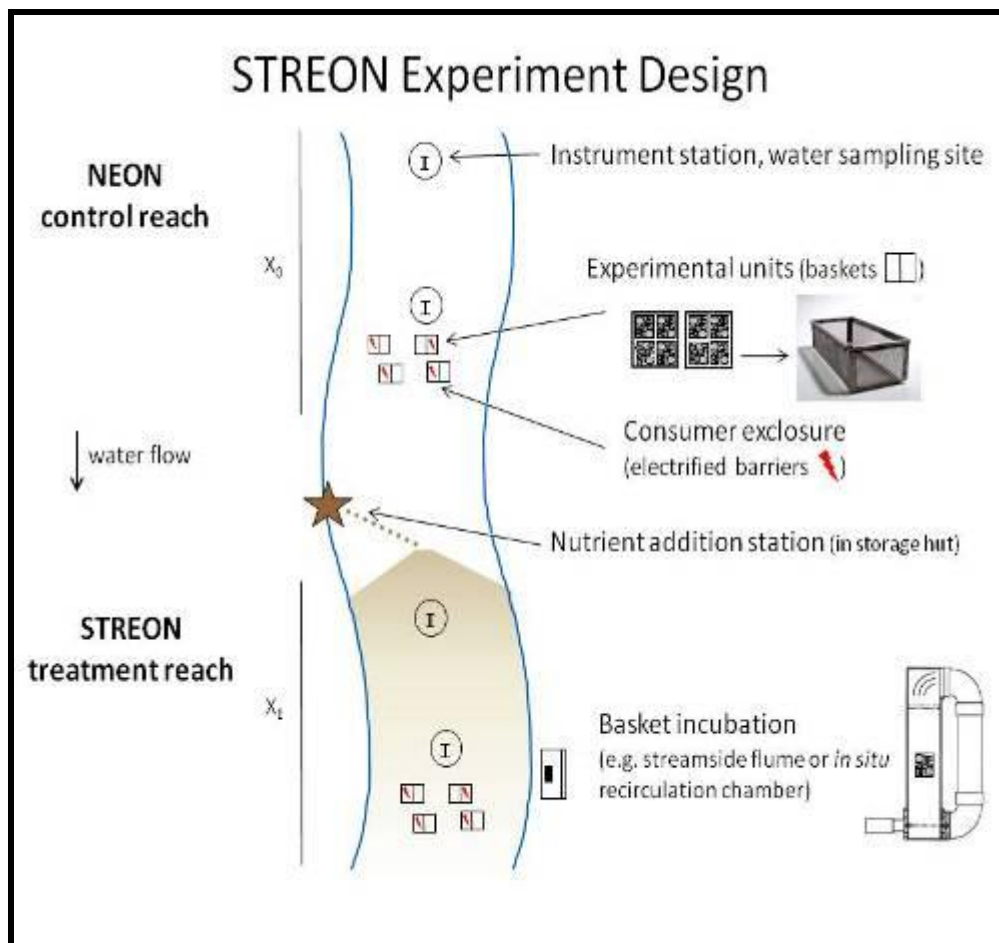
- Deer mouse (*Peromyscus maniculatus*)

Tentative FSU plot locations on ORR



Walker Branch is also one of ten **STREON** sites (**NEON** stream experiments)

- Continuous nutrient (N, P) addition (5× ambient levels)
- Consumer organism exclusion using electric field approach in small plots
- Three years of pre-manipulation measurements
- Response of stream organisms (algae, microbes, macroinvertebrates) and processes (metabolism, nutrient cycling) monitored over a 8-year manipulation period

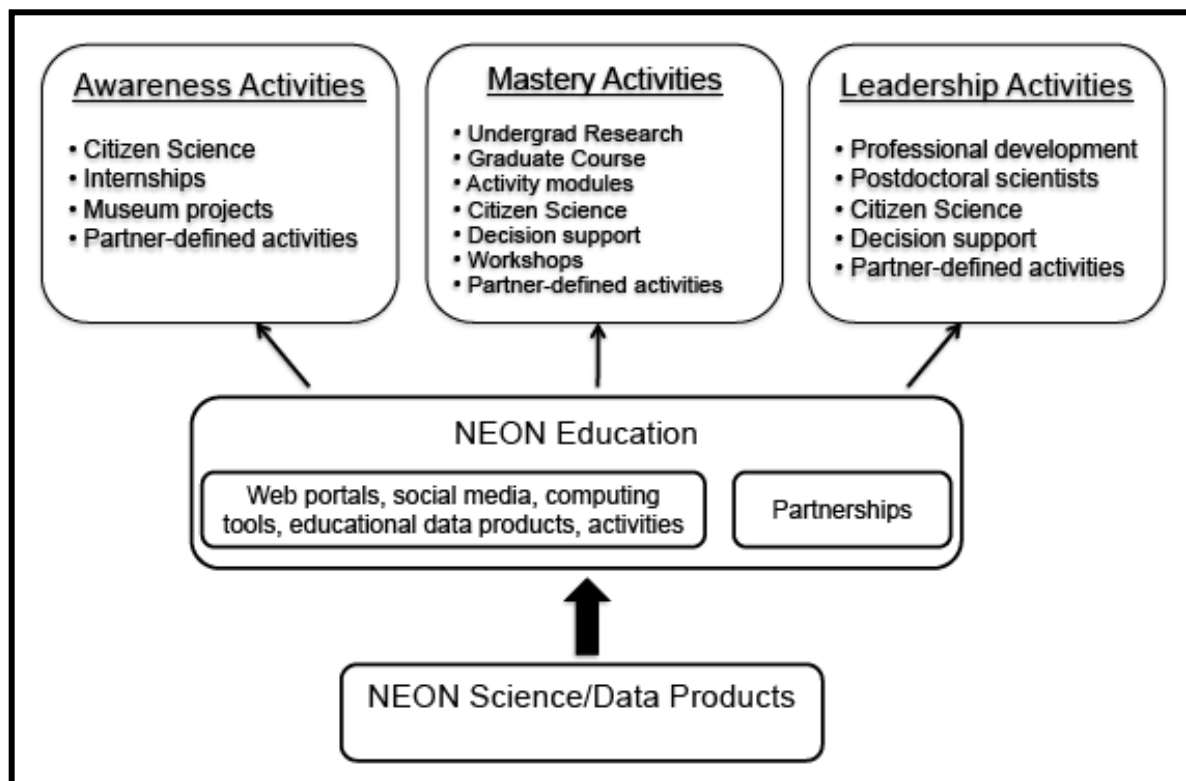


Key NEON data and data products will be posted on the web and publically available

Suite	Data/Data Products
Bioclimate	Temperature Precipitation Humidity Radiation
Biodiversity	Abundance and diversity (insects, fish, birds, plants) Phenology (insects, plants) Microbial function and diversity (functional genes, metagenomes) Bioarchive (all taxa, substrates)
Biogeochemistry	Carbon stocks, fluxes, isotopes Nutrient stocks, fluxes, isotopes Chemical climate (N-deposition, Ozone)
Ecohydrology	Water balance components (storage and flows)
Infectious disease	Disease prevalence (Dengue, Hanta virus, Lyme, West Nile Virus)
Land use and land cover	Remote sensing data (vegetation performance and structure) Geographic data (topography, historical climate, etc.) Statistical data (human geography)

In addition to research, education is a major focus of the NEON network

- NEON program for investigator-initiated research established in NSF Division of Environmental Biology (DEB)
- NEON will have strong education component (all levels) with data and synthesis results available via internet
- Opportunities for planned Oak Ridge Science Camp, local schools and universities



Current facilities and planned NEON instrumentation at Walker Branch Watershed

