NoRMEO Meeting Minutes
Bozeman, Montana
March 30-31, 2006

March 30th

A) 9:00 Welcome and logistics—Duncan Patten

B) Neon update—Katy Kavanagh
NEON Inc has formed
- Design team has disbanded.
- Neon Inc and governing board.
  - Setting up project office—probably at the University of Virginia?
  - NEON has submitted site design guidelines to NSF.
    - Outline of proposed NEON Infrastructure (March 2006 version) appended (Appendix I)
    - Funding?
- All indications are positive that NSF will forward it to Congress.
  - Investments in Major Research Equipment and Facilities Construction (MREFC) may increase by 26 percent.
  - 600 million for initial infrastructure
- Perhaps 35 million/yr to use NEON platform

Timeline for RFP
- Perhaps June?
- 7-9 months for prospectus preparation
- Workshops for prospectus preparation
- 2-3 district proposals per domain
- Site visits from national team are planned
- Final choice of district within a domain will be made at the national level

Proposed Timeline for NEON funding
- 2007-12 million for national neon center.
- 2008-150 million
- 2009-150 million
- 2010-150 million
- 2011-150 million
- 2112- sites up and running.

Proposed District-level Staffing
- 12 to 15 people: director, assistant director, administrative assistant, 2 IT techs, 2 sensor techs, calibration tech, and 5-7 field scientists/techs for “sentinel unit sampling”.

COREO Update

- May review RFP?
- No word yet…..

Miscellaneous

Dropped from Fall 2005 NEON Infrastructure list:

- No mobile units/platforms
- No canopy cranes
- No radar systems

Now is the time to keep all options open in terms of district locations.

Congress directing NEON to plan for building facilities to house NEON personnel and equipment

- Estimate that will need 4000 to 5000 square feet of space to house staff and equipment.

C) NEON Site Independent Design – March 24, 2006 Presentation—Katy Kavanagh
This is available in the document section of the NEON Inc website - all are encouraged to read it!

D) Input from NoRMEO on the Science and Education Plan–
Experimentation that was highlighted in the plan was too focused.
Papers chosen in support of NEON science plan were not always appropriate or representative of issues.
Very top-down process.

E) Ongoing Agency monitoring efforts and data coordination across a region.
Presentation by Steve Katz, NOAA.
Take home messages:

1. Start coordination and have the paperwork in place before the data is collected and shared.
2. Plan for lengthy and multi-agency permitting process.
3. Be aware of existing monitoring programs
4. Data quality act is of concern
5. Form monitoring programs around questions.
6. Program at EPA that help nest smaller projects inside of a larger scale projects.
7. Data dictionaries in agencies to help communicate findings.
8. Monitoring is justified to demonstrate the money is being spent well.

F) GIS Analysis of Domain done by Sean Finn at USGS in Boise: Presented by Katy Kavanagh
Information well received changes/additions needed:

1. Get analysis done for urban circles and exclude areas outside of the domain (i.e. the Jackson and Coeur d'Alene circles encompass part of adjacent domains in their temp, elev etc… distributions.
2. The temperature distributions for the domain look strange. Mean temperature distribution of the domain seems to be very different relative to urban circles.

3. Expand to include: NPP, LAI
4. Color contrasts are not always evident.
5. Rainfall distributions: amount per month, summer vs. winter precipitation.

G) Site Presentations:
   1. Duncan Patten: Tenderfoot Experimental Forest to Bozeman, The wild and managed in Tenderfoot and Urban in Bozeman.
      a. Suggests considering wild sites as centers in addition to urban sites.
   2. Art McKee: Missoula north to Coram Experimental Forest (and other sites) for wild and managed.
      a. Argued for strong consideration of West ↔ East transect(s) that capitalize on Experimental Forests (e.g. Priest River ↔ Coram ↔ Tenderfoot) to capture maritime to continental environmental gradient and supplement any urban to wild NEON District.

Evening: Discussion of Regional Science questions

Focus on questions that are important here and elsewhere that we can readily address here: (i.e.exurban landuse change, snow pack shifts, water).

Things that are unique of the Northern Rocky Mountains: We have sharp gradients over short distances (i.e. urban to wild, low to high moisture). We have a lot of wildland and entact ecosystsems in the lower 48.

See summary sheet from Andy Hansen.

March 31st:

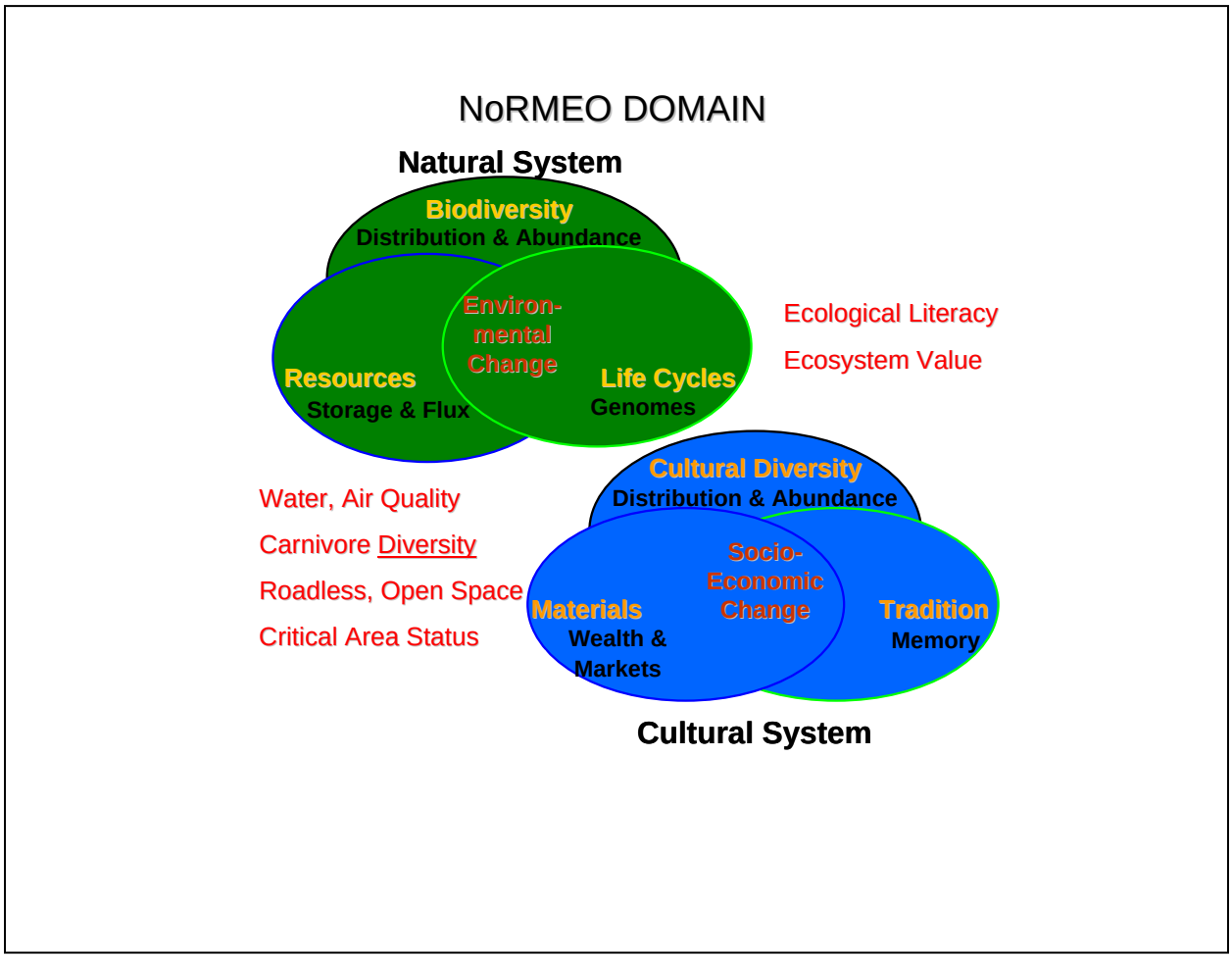
A) 8:30 AM Site Presentations continued.
   1. John Marshall: Couer d'Alene/Post Falls, to Priest River Expt Forest .
   2. Dave Williams, Dan Tinker and Geneva Chong: Jackson, WY toward Yellowstone NP.
   3. Andy Hansen: Bozeman and Greater Yellowstone Ecosystem.

B) Ed Johnson from University of Calgary and the Biological Station presented an outline of research being done at the biological station and expressed an interest in coordinating with work being done as part of NoRMEO and NEON.

C) Ric Hauer presented a framework for discussing the linkages between Natural and Cultural ecosystems in NoRMEO including environmental and socioeconomic changes and their influence on system inputs and outputs. See Figure below:

D) Discussion of where we go from here:
   Next meeting after the RFP date and procedures for submission/review are announced.

   Executive committee will meet via phone conference to determine the time and location of the next meeting.



E) Meeting adjourned at 11:30 AM

Appendix I.

Outline of NEON Infrastructure, March 2006 Version!!!

20 climate **Domains** distributed nationally
Each with a research **District**
Comprised of three **Sites**: Wild, Managed, and Urban
Sites within 200 km (125 mi) distance
Each Site up to 10 km (6 mi) in scale

Each Site must:
Be buffered from influences of disparate land cover and topography
Be suitable for manipulations
Be secure
Contain an instrumentable, low-order watershed

At each Urban to Wild Site:

A. Fundamental Instrument Unit (FIU) consisting of two sensing systems:

1) Four BioMesoNet Towers

- **Three Basic BioMesoNet Towers**
  - Measure many of the key atmospheric and soil properties that can vary in relation to the complexity of landscapes.
    - Air temperature (at 10 m, 1.5 m, 10 cm, 0 cm)
    - Barometric pressure (at 1.5 m)
    - Relative humidity (at 10 m and 1.5 m and 2 other canopy dependent heights)
    - Precipitation (rain and snow liquid equivalent)
    - Wind speed and direction (at 10 m, 1.5 m and 2 other canopy dependent heights)
    - Soil moisture (at -2, -30, and -100 cm)
    - Soil temperature (at -5, -15,and & -30cm)
- **One Advanced BioMesoNet Towers**
  - Include all sensors in the basic tower configuration, plus additional biotic and abiotic sensors:
    - Incoming, reflected, total & diffuse solar radiation (at 1.5 m)
    - Sensible and latent heat and CO2 fluxes
    - CO2 concentration (at 8-10 vertical levels from ground to above
    - canopy)
    - H2O vapor (at 8-10 vertical levels from ground to above canopy)
    - Stable isotopes of C and O in H2O and CO2
    - CO concentration (at 3-5 m)
    - NO, NO2, NOx concentrations
    - O3 concentration (at 3-5 m)
    - Airborne particulates (e.g., pollen, bacteria)

        - Dry deposition of SO4, NO3, NH4, SO2, and HNO3
        - Wet deposition of NH4, NO3, o-PO4, SO4, Cl, Ca, Mg, K, and pH

2) **Environmental sensor arrays** that document environmental diversity across the research site
    - **Climate sensor arrays** complement the BioMesoNet towers and provide nearground measurements of climatic conditions affecting plant growth and biodiversity, biogeochemical cycling of nutrients, and hydrology
    - **Canopy sensor arrays** measure photosynthetically active radiation, air and leaf temperatures, and climatic parameters that affect plant and canopy structure and productivity. Canopy sensor arrays may be deployed with Networked Info Mechanical Systems, robotic instrument platforms that traverse wires suspended through the canopy.
        - Canopy and Climate Sensor Arrays
            - Total, diffuse, and incident photosynthetically active radiation (PAR)
            - Sunshine duration
            - Biological temperature (i.e.,. soil/leaf/canopy surface temperature)
            - Air temperature (at 10 m, 1.5 m, 10 cm, and 0 cm, Climate only)
            - Relative humidity (at 0 m and 1.5 m, Climate only)
            - Precipitation (rain and snow liquid equivalent, Climate only)
    - **Soil sensor arrays** support measurements of root and microbial growth and respiration, soil chemistry, soil temperature, and water content—factors that affect nutrient cycles and plant growth.
        - Root and mycorrhizae phenology
        - Soil respiration (CO2 emission)
        - Soil NO3 concentration
        - Soil O2 concentration
        - Soil pH
        - Soil water potential
        - Soil water volume
        - Soil moisture (measured at multiple depths)
        - Soil temperature (measured at multiple depths)
        - Biological temperature (i.e., soil/leaf/canopy surface temperature)
    - **Aquatic sensor arrays** provide measures of water temperature, nutrients, dissolved gases, turbidity, chlorophyll, and other key indicators of aquatic ecosystem and hydrological function.
        - Groundwater Sensor Array
            - Groundwater level and flow
            - Soil moisture

- Small-Stream Sensor Array
  - Automated water sample collection for chemical, biological, and isotopic measurements
  - Dissolved organic carbon concentration
  - Dissolved gas concentrations: CO2, N2, N2O, CH4, O2
  - Nutrient concentrations: NO3, NH4, PO4, Si
  - pH
  - Oxidation/reduction potential
  - Conductivity
  - Water temperature
  - Turbidity
  - Sediment
  - Chlorophyll
  - Water depth (discharge?)

At each Urban to Wild Site:

B. Fundamental Sentinel Unit (FSU) measures and records observations of ecosystem and organismal responses to climate variation and land-use at each Urban to Wild Site and consists of three types of observations:

1) **Remote sensing** of ecological patterns and processes at regional to national scales, using space- and air-based platforms that include:
   - Airborne instrument pods
     - Hyperspectral
     - LiDAR
     - Side aperture radar (SAR) interferometry
     - Thermal imaging
   - MODIS satellite
     - Land use, land cover
     - Primary production
2) **Tracking of animal movements** within NEON sites using an organism tracking system focusing on deer mice.
3) **Direct, field-based observations of organisms** using a variety of approaches:
   - **Biodiversity program** supports observations of changes in biodiversity of species and functional groups that have rapid population turnover rates. Opportunities for partnerships with the Nation's museums and collections.
     - **Location of Biodiversity Sampling Stations Relative to Towers**
       Biodiversity sampling plots and various sensor arrays should be co-located to provide the greatest interrelationship of the data streams, associated with, but, physically separated to avoid damage to the sampling plots.
       - **Plants** sampled in modular quadrats that can be scaled and adapted to the dominant vegetation at each site.
       - **Soil microbes** 1x1 m soil pit at each station, three loci per pit to sample biodiversity of soil microbes, as well as soil plots outside of plant plots.
       - **Ground beetles** five pitfall traps will be located adjacent to the vegetation plots, for a total of 60 pitfall traps.

        - **Fish** sample at four habitats along a 300-m reach downstream of the gaging station.
        - **Algae** four replicates dispersed over the 300-m distance where fish are sampled.
        - **Aquatic invertebrates** same spatial array as algae, with flow measurements taken at the same time as invertebrate samples.
        - **Breeding birds** censuses conducted in variable-radius sample plots, co-located with other biodiversity sampling. In addition, road transects will be established to follow the protocols of the North American Breeding Bird Survey (BBS).
    - **Phenology program** records the seasonal progression of critical biological processes and the timing of ecological events. A citizen-science program is envisioned, incorporated into the US National Phenology Network via a partnership with the United States Geological Survey.
        - Standardized lilacs
        - Dominant plant species
        - First robin nesting
    - **Pathogen monitoring program** provides an opportunity to partner with the Centers for Disease Control in tracking mosquito-borne pathogens and deer mouse-borne pathogens. Mosquitoes and deer mice will be sampled twice yearly, tested for the presence of known pathogens and archived for subsequent testing.
        - Mosquitoes
        - Deer mice
    - **Soil biogeochemistry sampling program** Soil cores collected twice per year will enable scientists to 1) develop a long-term record of organic matter accumulation, and 2) analyzed and archived to provide an historical record of past environmental and climatic conditions.

Deployment of Senor Arrays/FSU Sampling

A. Clusters of sensor arrays are deployed to measure the spatial heterogeneity of each of the three Sites (***envisioned as an instrumented watershed***) within the Domain's District.
B. The clusters are associated with the four towers (one advanced, three basic) within each watershed:
    1) The advanced tower is located centrally within the Site watershed.
    2) Basic towers are deployed in areas to represent the heterogeneity of the Site (arrayed across the largest gradient of variation within the Site).
C. A gaging station is located at the base of the instrumented watershed, and aquatic samples are arrayed downstream from that point.
D. One of the four sensor clusters is located near the outlet of the watershed, while the other three are positioned in upland settings. Each cluster includes a tower and one or more sampling stations.

Collections/Archiving

FSU samples will be cataloged and archived for future studies. Samples will be archived in redundant biocollection facilities to ensure long-term preservation. A central curation facility for soil, water, and tissue samples will also be constructed to supplement the biocollection facilities.

Genomics
Genomic analyses will be outsourced to genomics facilities that provide standard molecular genetics laboratory infrastructure and support sequencing, fragment analysis, gene expression mapping, proteomics, and metabolomics.

Stable Isotope Analyses
Stable isotope analyses will be outsourced to facilities with the capacity for analyzing stable isotope ratios of hydrogen, carbon, nitrogen, oxygen, and sulfur in materials sampled from aquatic, terrestrial, and atmospheric environments.

Concluding notes -- disconnect

Much of the discussion of placement of NEON field sampling stations has been described the terrestrial-aquatic interface component of NEON as focusing on first order watersheds. And, the text of the current NEON documents continues to call the "watershed" at each of the Sites within the District a first-order watershed.

The diagrams used for illustrative purposes, however, show a much larger area (up to 100 km^2) within which the four towers and associated sampling arrays are distributed with streams feeding down to the gaging station where the fish sampling would be done. Few regions of the country have fish in first-order streams so there's some apparent confusion of terms. It appears that NEON will actually be placing field stations within an area that for most parts of the country will be closer to a large second- low third-order stream.