

“Status of Emerging Environmental Observatories and Opportunities for LTER Collaboration”

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Organizer(s): William Michener (LNO), Todd Crowl - LUQ

Three environmental observatories are in various stages of planning, design and implementation. Each observatory is envisioned as creating significant new infrastructure that will transform associated scientific disciplines. The observatories include: (1) the National Ecological Observatory Network (NEON); (2) the Ocean Observatories Initiative (OOI); and the WATer and Environmental Research Systems Network (WATERS Network) which is being developed by the CLEANER Project Office (Collaborative Large-Scale Engineering Analysis Network for Environmental Research) and CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc.

The workshop was divided into two sessions. The first session, focused on information transfer and included a brief introduction to the workshop by William Michener, followed by updates on the status of each of the three observatories (Elizabeth Blood (NSF), representing NEON; Phil Taylor (NSF), representing OOI; Rick Hooper (CUAHSI), representing WATERS Network).

Brief highlights of the first session:

1. **Introduction.** W. Michener introduced the session with a short summary of what MREFC funding was designed for—i.e., “massive capital investment that will support large teams of researchers to do “transformational” research.” He also discussed the typical time schedule, with specific phases, for an MREFC project.
2. **NEON.** Liz Blood from NSF then described NEON as a “continental”-based program focused on 1) ecological systems that are affected by changes in land use and climate across a range of spatial-temporal scales, and 2) patterns and movement of genes/organisms across the continental and how these affect biodiversity/infectious diseases. She described the importance of continental deployment and instrument design and explained how the Integrated Science and Education Plan emphasized: (i) fixed infrastructure (one tower in each domain), (ii) deployment of movable assets, (iii) experimental infrastructure, and (iv) remote sensing platforms and aircraft and satellite data. Other key issues covered in her presentation:
 - a. The fixed infrastructure includes vertical towers so that suites of instruments can be fixed to sense horizontal parameters including all the appropriate embedded cyberinfrastructure to collect, process as appropriate, and send real time data to a central location. She mentioned that currently there is in excess of 40,000 sensors currently contemplated, and that final design work on the FIU (tower array) is being done at USC-ISI and the SD Supercomputing Center.
 - b. It was emphasized that NSF will have oversight of process and encouraged community participation. She explained the process timeline and the pending Conceptual Design Review in November. The Conceptual Design is part of a 4-part process that includes: (i) Integrated Science and Education Plan; (ii) Conceptual design – or site independent design; (iii) Preliminary design – or site dependent design; and (iv) Final design – or baseline design.
 - c. She then described the RFI focus which is to be released in the next few weeks, to include three parts 1) conceptual proposals of high priority science that will

make use of the infrastructure, 2) experiments that might use the NEON infrastructure, and 3) information about specific sites for infrastructure deployment. The RFI will be due after the first of the year. She indicated that “decision scientists” will be brought in to assist with the evaluation of the RFI responses in January, and that NEON Inc would craft a final document and that the final plan would go to NSF for review. Finally, she expressly commented on the need and process of NEPA and that EA/EIS will be required.

3. **OOI.** Phil Taylor from NSF described ORION/OOI activities. It was explained that OOI is the MREFC component of the ORION initiative. Research themes include: climate variability, ocean food webs, biogeochemical cycles, and coastal ocean dynamics. OOI will likely involve 1) Regional Cabled Observatories including fiber optic cable with power, sensors, and data connectivity, 2) Coastal Observatories, and 3) Global Observatories to look at selected processes on a global scale. Technologically, OOI will collect long-term and high frequency data from sensors, etc. to meet critical needs for data related to episodic and high energetic (storms) events as well as dynamic system processes that change over seconds to decades. He further described ongoing activities including the Monterey Accelerated Research System (MARS) as a test bed for sensors, as well as Neptune and Venus. For more information see <http://www.orionprogram.org>.
4. **WATERS.** Rick Hooper from CUAHSI then described the WATERS initiative and spent significant time on development activities surrounding data collection, presentation, and interface of hydrological data that CUAHSI has been doing recently through the HIS activity. He described steps that WATERS was taking to provide the scientific justification for MREFC funding. WATERS is jointly sponsored by the Geosciences and Engineering Directorates at NSF, and the focus is on human stressed systems. Some of the research goals are to: transcend the uniqueness of place and to reliably predict water quantity and quality anywhere in the Nation, moving from predictions at point to continuous and dynamic fields. Rick pointed out that the RFP for critical zone observatories is out now. More information can be found at <http://www.cuahsi.org>. Also see <http://river.sdsc.edu/HDAS> where a variety of WATERS-relevant data sets are available (e.g., USGS, Ameriflux, NOAA, etc.). The cyberinfrastructure approach is leading to the emergence of digital watersheds as the platform for WATERS.

The second session involved a roundtable discussion with short presentations by LTER scientists that highlight opportunities for collaboration between LTER and one or more of the planned environmental observatories. This was followed by a moderated discussion where we sought additional input from the audience regarding the various ways that LTER can collaborate with the three environmental observatories. Highlights of the presentations include (some of the key points are in **bold**):

- **Phil Robertson:** NEON’s initial site domain-based approach and layout sounded reasonable. He commented that now there is only a wild site backbone and that this freed up resources for creative science, although he expressed some reservation that a wild site may not be possible to locate in all domains. He felt that **most/all LTER sites can collaborate in NEON gradient experiments.**
- **Nancy Grimm:** Nancy thought that there was a “**tremendous opportunity**” to link **observatory networks**—exactly how is up to the community to come up with a plan. Potential linkages include across disciplines, across agencies, and across space through gradient/continental experiments. **Such network linkages will require a change in culture; ecologists need to work as a community and “everyone needs to work**

together.” LTER has a history of big ideas and collaboration, but the rest of our community is not as far advanced.

- **Jill Baron:** described the process whereby USGS is reinventing itself and the seven elements that comprise this reinvention [(1) science for risk and resilience assessment of natural hazards; (2) clarifying the climate record and assessing consequences of change; (3) science for future energy and mineral needs and decisions; (4) understand ecosystems and predicting ecosystem change; (5) quantify the role of environment and wildlife in human health; (6) quantify, forecast, secure freshwater for Americas future; and (7) meeting our information responsibilities]. She felt that **the USGS would depend heavily on NEON to provide the kinds of information that USGS will need to be successful in this reinvention.**
- **James Brunt:** also saw “tremendous opportunities.” He stated that it is **important to assess interoperability of sensors and cyberinfrastructure components among the various networks** to avoid divergent and redundant development efforts. He advanced the idea of **community repositories and the idea of shared cyberinfrastructure costs across the networks.** He felt that legacy data should be included in the design and thought it important to work together to **mediate the heterogeneity of these data and to enhance data integration capabilities.** Reiterating Nancy Grimm’s earlier statements, he expressed concerns that community pressure to work together be kept high and that effecting this change of culture within the community would necessarily involve the integration of socio-technical scientists.
- **Mark Williams:** commented that ecologists have accepted the importance of hydrology but hydrologists have not necessarily accepted the importance of ecology and that these networks **have a large potential for collaboration of ecologists and hydrologists.** He also commented that there is “LTER envy” in the community and that the LTER community needs to be aware of this when dealing with NEON. He saw **great opportunity for NEON infrastructure/LTER experimentation connections, and believes that “once NEON is on the ground, people will come.”**
- **Bruce Hayden:** NSF is the home of environmental observatories and, therefore, **we must fully integrate education into all observatories. It is especially important that we don’t lose people who not at major research universities through this process; diversifying institutions is just as important as diversifying the people component and observatories should be encouraged to bring in smaller four year, community, and Tribal colleges.**

Round-Table Discussion

NEON Question. Some confusion in that NSF wants NEON experiments, etc., but NEON is an infrastructure program?...Liz Blood clarified that MREFC funds buy large equipment and allows researchers to think big, but M&O funding operates the infrastructure AND that R&RA funding will primarily fund the experiments. Research funds will either be set aside for NEON research or funds will be spread across the directorate for funding NEON related science (currently, NSF favors the latter). Research questions will drive the requirements for the infrastructure; input on science questions is useful to help NSF prioritize research funding and also useful in NEON re-scoping if necessary.

NEON Question. Some confusion of NEON Inc.’s role vs. NSF’s role?...Liz Blood responded that NSF is helping NEON Inc. develop the Request for Information and with the merit review of the RFI responses to avoid Conflicts of Interest.

LTERR/NEON Suggestion. It was suggested that at the upcoming AGU meeting that a Town Meeting focused on NEON and the LTER Planning effort be conducted since NEON can act as an enabler of the science plan being developed

Suggestion to 3 Observatories. It was reiterated during the discussion session that there is a critical need for connectivity and interoperability among the observatories and the LTER network...Liz Blood commented that within NSF this point was viewed as critical and, in fact, this is what makes NEON "transformational."...Rick Hooper commented that in addition to the initial capital outlay of funding for the MREFC equipment, that M&O funding may be the real limiting element in the infrastructure equation.

NEON Suggestion. It was reiterated during the discussion that the need to integrate the science with education is important and this connection should be emphasized in the NEON RFI.

Question for the 3 Observatories. The question arose as to why not merge the various observatories?...Liz Blood explained that the total cost and source of funding would curtail this from happening.

Comment for the 3 Observatories. The observation was made that other disciplines generally are more involved with long-term planning and the ecological community generally does not do this to the degree that other disciplines do and that this will require a new cultural change within the community to be able to position the community to take further advantage of MREFC opportunities in the future.

NEON Comment. The observation was made that NEON is a wider program than just LTER, but LTER network has been well represented in the planning process. There remains a need to justify the difference between LTER and NEON. Liz Blood commented that "first group of early adopters of NEON will likely be LTER."

NEON Comment. Need to recognize and bring Mexico and Canada into the picture...Liz Blood responded that NSF recognizes the need to eventually bring international partners into the picture, but right now NEON is complex enough without the added complexity of an international component.

Round-the-Room Ideas for LTER Collaboration with NSF Environmental Observatories:

- LTER and the three Observatories need remote sensing imagery to place their sites into a landscape, regional and continental context. The current satellites are of limited life, and there is a great opportunity for LTER and the Observatories to think through their remote sensing data needs and work towards ensuring that new satellite remote sensing tools meet Observatory and Network needs.
- LTER has been groundbreaking in education, particularly through the Schoolyard LTER Program; there is now an opportunity to bring LTER educators, NEON educators and NSF educators together.
- Standardization of data collection and provision standards, as well as software standards, across networks will be important and LTER could help make that happen. It will also be beneficial to look at other countries in terms of how data are collected and the equipment that is used.

- Nutrient manipulations across the nation (e.g. LINX) are needed in larger rivers; what is missing is the environmental driver information associated with nutrient inputs.
- It is important to integrate 2- and 4-yr schools into the science; possibly include small grant opportunities for graduate and undergraduate student research at Observatories.
- The NSF EPSCOR Program is one mechanism to bring four-year colleges and other small schools into the Observatory picture.
- Modeling and assessment efforts could link the LTER network, NEON, and other Observatory efforts.
- LTER has a reasonably sophisticated shared social sciences component (e.g., CAP, Baltimore) and that might be a way to link LTER and NEON.
- Creation of a Council of Observatory Networks might be very useful to bring the networks together and enhance interoperability.
- NEON should build upon the cyberinfrastructure experiences of LTER.

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