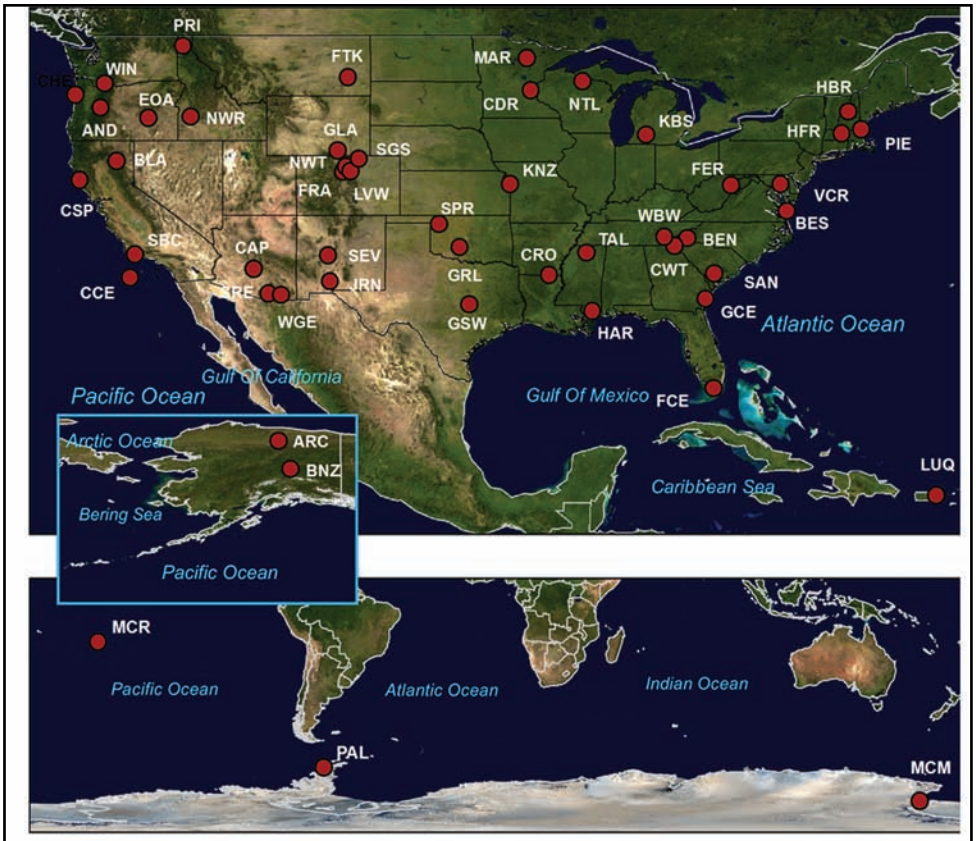
LTER
Network News
Newsletter of the Long Term Ecological Research Network
Vol. 21 No. 1 Spring 2008

EcoTrends Project comes of age

Although it is widely recognized that the Earth's environment is changing, and that long-term data are needed to assess the rate and direction of change, to distinguish directional trends from short-term variability, and to forecast future responses, the accessibility of long-term data beyond the original user has historically been limited. The EcoTrends project, now nearing completion of an important step in its development, is a network-level resource that will allow cross-site and network-wide comparisons that are critical to addressing ecological problems relevant to the LTER Decadal Plan.



Site Abbreviations:

AND: H.J. Andrews Exp. Forest
ARC: Arctic LTER
BEN: Bent Creek Exp. Forest
BES: Baltimore Ecosystem Study LTER
BLA: Blacks Mountain Exp. Forest
BNZ: Bonanza Creek
CAP: Central Arizona – Phoenix Urban LTER
CCE: California Current Ecosystem
CDR: Cedar Creek Natural History Area
CHE: Cascade Head Exp. Forest
CRO: Crossett Exp. Forest
CSP: Caspar Creek Exp. Watershed
CWT: Coweeta Hydrologic Laboratory
EOA: Eastern Oregon Agricultural Research Center
FCE: Florida Coastal Everglades
FER: Fernow Exp. Forest
FRA: Fraser Exp. Forest
FTK: Fort Keogh
GCE: Georgia Coastal Ecosystems
GLA: Glacier Exp. Forest
GRL: Grazinglands Research Laboratory
GSW: Grassland Soil and Water Research Laboratory ARS
HAR: Harrison Exp. Forest
HBR: Hubbard Brook
HFR: Harvard Forest
JRN: Jornada Basin LTER/Jornada Exp. Range
KBS: Kellogg Biological Station
KNZ: Konza Prairie
LUQ: Luquillo Exp. Forest
LVW: Loch Vale Watershed
MAR: Marcell Exp. Forest
MCM: McMurdo Dry Valleys LTER
MCR: Moorea Coral Reef LTER
NTL: Northern Temperate Lakes LTER
NWR: Northwest Watershed Research Center
NWT: Niwot Ridge LTER
PAL: Palmer Station LTER
PIE: Plum Island Ecosystem LTER
PRI: Priest River Exp. Forest
SAN: Santee Exp. Forest
SBC: Santa Barbara Coastal LTER
SEV: Sevilleta LTER
SGS: Shortgrass Steppe LTER
SPR: Southern Plains Range Research Station
SRE: Santa Rita Exp. Range
TAL: Tallahatchie Exp. Forest
VCR: Virginia Coast Reserve LTER
WBW: Walker Branch Watershed
WGE: Walnut Gulch Exp. Watershed
WIN: Wind River Exp. Forest

Figure 1: Sites currently participating in the EcoTrends project.

The EcoTrends Project started in 2004 as a casual conversation between Deb Peters (JRN) and Ariel Lugo (LUQ) about the need for easy access to many long-term data sets to allow cross-site comparisons. This conversation has resulted in the synthesis of more than 1000 datasets from 50 sites—LTER, the US Department of Agriculture (USDA)'s Agricultural Research Service (ARS), the USDA Forest Service, and other agencies—(Fig. 1) that will be available soon on the EcoTrends website (*http://www.ecotrends.info*). Many of these datasets will be included in a book to be submitted for publication in the next few months.

At the core of EcoTrends are two key aspects: (1) a focus on derived data—complicated datasets are condensed into annually, monthly, or seasonally derived values, and (2) attribution to the original data

See "Trends", p. 3

In This Issue

The Network News

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Evaluating performance of the Network Office

The LTER Network Office (LNO) exists primarily to support the objectives of the LTER Network. As the objectives of the LTER Network evolve through the decadal planning process, the support activities of the LNO must also evolve and grow to meet new expectations. To assure that the LNO successfully adapts to evolving Network goals, the LTER Executive Board (EB) conducts an annual evaluation of the performance of the LNO. Part of this evaluation involves a survey that is administered to representatives of the 26 LTER sites.

The survey has undergone considerable change since it was first instituted in 2003. The original survey, developed as part of the LNO Strategic Plan, attempted to gauge site needs while at the same time providing feedback on the performance of the LNO. This year, the EB determined that the survey should focus on performance and eliminate questions on site needs, which will be assessed using other means. In addition, the Board decided that the survey would be administered to three individuals at each LTER site: the lead principal investigator, the information manager, and the graduate student representative. Questions for this year's survey were developed by members of the EB in consultation with the LNO Executive Director. An expert in survey development from the Institute for Public Policy at the University of New Mexico provided suggestions on the survey format.

The survey was administered at the end of April and results discussed by the EB and presented to the Science Council at their May meeting in Baltimore. Below I describe the principal results of the survey and outline how the LNO will respond to these results.

Sixty-four individuals responded to the survey, and all sites had at least one respondent. The largest proportion of responses came from lead PIs (24 of 26 sites), followed by information managers, and graduate student representatives. In response to the statement, "*The general performance of the LNO meets or exceeds my expectations,*" 48 of the 64 respondents answered "Yes"; only three respondents answered "No", while the remaining respondents answered "Don't Know" or skipped the question.

Areas of satisfaction

Several questions elicited strong consensus from respondents that the LNO was performing well on certain tasks:

♦ Respondents indicated that LTER web sites, archives, and data bases maintained by the LNO were available when needed.

♦ Most respondents were "Satisfied" or "Very Satisfied" with the assistance their site had received from LNO staff in the implementation of Ecological Metadata Language.

♦ A strong majority of respondents were "Satisfied" or "Very Satisfied" with the LNO-organized training sessions in which they participated.

♦ Thirty-five respondents felt that the LNO responds to requests for information and assistance in a timely and effective manner; only two respondents disagreed.

♦ A strong majority of respondents were satisfied in the ease of discovering, accessing, and downloading data from Network data sets maintained by the LNO.

♦ A strong majority of respondents was "Satisfied" or "Very Satisfied" with the performance of LNO staff in facilitating research, planning, and governance meetings.

♦ Most respondents were "Satisfied" or "Very Satisfied" with outreach services provided by the LNO including site and network brochures and the Network newsletter.

Areas for improvement

The response to some of the survey questions indicated that the LNO needs to improve its service in certain areas:

♦ Four respondents indicated dissatisfaction with the timeliness or detail of the information they receive about the Network Information System, and 23 respondents answered "Neutral/Don't Know".

♦ Some respondents have had trouble finding information on the results of research, planning, or governance meetings in the LTER document archive.

♦ Seven respondents were dissatisfied with the content or format of the LTER public website—the site used to present information about the LTER Network to other scientists, agencies, students, teachers, and the general public.

♦ Thirteen respondents were "Dissatisfied" or "Very Dissatisfied" with the content and format of the LTER Intranet website–the site used to provide information about LTER activities to LTER scientists and students.

See, p.9

(Trends, continued from p. 1)

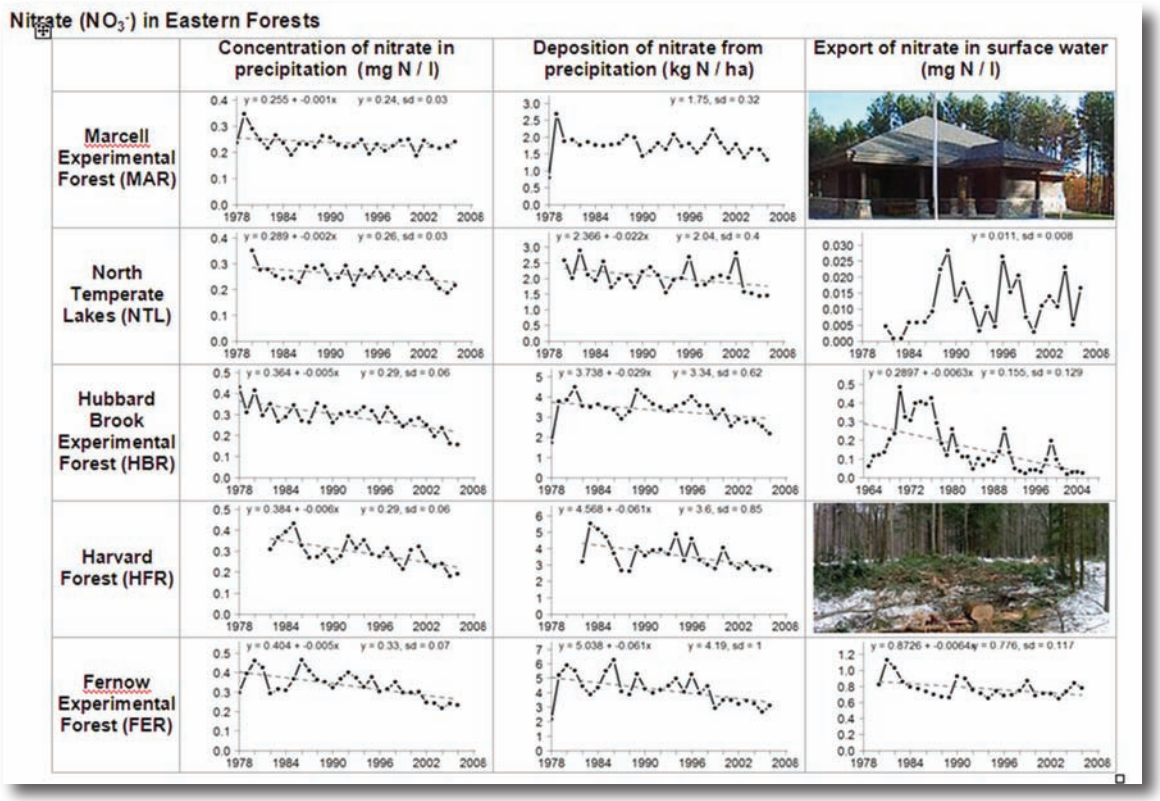


Figure 2. An example page from the Eco-Trends book showing atmospheric nitrate and export of nitrate in surface water for five eastern forest sites.

source. Both the book and the website will be invaluable as the LTER Network continues to develop network-level, synthetic research for the next decade. The project is funded through NSF supplements to Jornada and the LTER Network Office (LNO).

The EcoTrends book illustrates through detailed examples the value and importance of comparing long-term data (in most cases greater than 10 years) from different ecosystems (e.g., forests, grasslands, deserts, freshwater lakes and streams, near coastal marine and estuaries, urban, arctic and Antarctic). It demonstrates the power of a geographically-distributed network of sites in studying long-term phenomena on similar themes (e.g., response to climate and disturbances, patterns through time in biogeochemistry, biotic structure, and human populations). The book is designed to enable users to view patterns in data from many sites, and to easily understand the lessons learned from long-term data (Fig. 2). After a thorough analysis of publishers, the EcoTrends Editorial Committee decided to go with the USDA-ARS—a federal government agency that will promote wide distribution of the book by keeping the costs reasonable and allowing free downloads of its on-line version.

Upon completion the accompanying EcoTrends website will contain all of the derived data in the book and additional datasets with their associated metadata, along with links to the original data sources. Users will be able to search and query the database, create new graphs and combinations of variables, and save graphs and data locally. Future modifications, depending on funding, include the automatic harvesting of data to keep the database up-to-date, and the inclusion of more sites and datasets. Development of the web site has occurred primarily through efforts by Mark Servilla and Duane Costa at the LNO with input from the EcoTrends committee.

The success of this project depends heavily on an active Editorial Committee comprising Scott Collins (SEV), Charles Driscoll (HBR), Peter Groffman (HBR), Morgan Grove (BES), Tim Kratz (NTL), A. Lugo (LUQ), Mark Ohman (CCE), Deb Peters (JRN), and Bob Waide (LNO), interacting closely with the project coordinator Christine Laney (JRN), technical staff at the LNO (Servilla, Costa, James Brunt and Inigo San Gil); members of LTER committees (Ken Ramsey [IMEXEC], Don Henshaw and Wade Sheldon [NISAC], and Charlene d'Avanzo [Education]); site-based Information Managers and scientists; and collaborations with NCEAS (Mark Schildhauer). Chris Boone (BES), Ted Gragson (CWT) and Nicole Rosamilia compiled the human population and economy data for all 23 LTER sites where data were collected. These data currently reside on the Coweeta website (http://coweeta.ecology.uga.edu/trends/catalog_trends_base2.php), and are being incorporated into the EcoTrends website.

The next steps in the project are three-fold: First, we will continue to populate the EcoTrends database. To ensure the quality of the data, the lead Principal Investigator of each LTER site will be sent a file containing the derived data for their site. It will be the responsibility of each site to check the quality of their data prior to its publication and posting. Second, we plan to complete the text and figures for the book within the next few months. At that time, we will request reviews from within the network to ensure a high quality product. Finally, we will continue to promote EcoTrends to broader audiences. For example, the Ecological Society of America has endorsed the EcoTrends project and the two sites now provide links to each other's web pages.

By Debra Peters, JRN

For more information, contact: Debra Peters, Project Leader (debpeter@nmsu.edu) or Christine Laney, Project Coordinator (chrlaney@nmsu.edu).

LTER Decadal Plan

Where are we now?

Members of the LTER Science Council and Executive Board during their Spring 2008 meeting in Baltimore observe research in progress. Photo by John Vande Castle.

In October 2007 the Long Term Ecological Research (LTER) Network submitted to the National Science Foundation (NSF) our decadal plan, in which we laid out goals for the Network in three major areas: research, education, and cyberinfrastructure (www.lternet.edu/dp). The plan's goals are ambitious but realistic, forward-looking, and directed towards taking the Network to the next level of synthetic science. Three years of meetings, workshops, and collaborative writing went into the plan, and its delivery to NSF marked a milestone in providing the larger scientific community our vision of where LTER science is headed.

At the heart of the Plan is the potential for the Network to address important socio-ecological questions crucial for tackling the big ecological issues of today, via the Integrated Science for Society and the Environment (ISSE) framework. In various venues, including the LTER Mini-symposium forum at NSF in February as well as various advisory committees internal and external to the Foundation, we have presented examples of how the ISSE framework can be used to explore human–environment interactions in a wide variety of ecosystems across the Network. From polar to desert, inland to marine, grassland to forest, and urban to agricultural, the framework is proving to be as versatile and robust as originally envisioned.

The network-level multi-site research envisioned in the Decadal Plan will require major resources not now available to Network scientists. We are thus promoting the Plan as part of a larger, ISSE-related initiative that NSF might consider funding as a more general environmental initiative in an upcoming budget year. Such initiatives take years to formulate, and we are working on several fronts to move this forward.

At the LTER Science Council meeting in Baltimore in April, various groups began formulating plans for specific cross-site research proposals within the three topical areas identified in the Plan: land and water use change; climate change, variability, and extreme events; and nutrient mobilization and species introductions. The idea is that proposals for short-term projects might be targeted for existing programs at NSF and elsewhere in anticipation of later opportunities for the larger, long-term opportunities necessary to fully address decadal plan questions. Follow-on workshops, open to all sites, are planned for later this year, and the Network Office renewal proposal has a broad focus on advancing decadal plan goals.

Implementation of the cyberinfrastructure and education plans are also in the works. The Network Information System Advisory Committee (NISAC) is formulating an implementation plan for cyberinfrastructure (CI) that will be compatible with new efforts by NSF to address CI needs across all of the existing and emerging environmental observatories--including LTER, NEON, WATERS, and OOS. A multi-observatory whitepaper from a workshop held this spring should provide a path for implementing LTER goals that are in common with those of other networks.

Development of an implementation plan for education is at an earlier, pre-workshop stage. Roundtable discussions at NSF and Mini-symposium presentations have both provided visibility for the Network's education plans, and provided an opportunity to pursue workshop funding for development of a formal implementation plan. The Network's Education Committee will soon be engaged in this effort. In the meantime groups of individual investigators have submitted short-term proposals for work across multiple sites, similar in scope to proposals envisioned for research efforts, and these sorts of proactive efforts to advance decadal plan goals in the absence of a larger initiative are most welcome.

All in all, we are making expected progress at many levels. And we have reason to be optimistic that incremental progress now will accelerate in the foreseeable future--and thus we need to be well prepared to jump on when the time comes.

By Phil Robertson, LTER Chair, KBS

Call for proposals for LTER Working Groups

The LTER Executive Board announces a call for LTER workshop proposals to advance the Decadal Plan research agenda. The Network has $165,000 available for planning and synthesis activities; priority will be given to proposals with clearly defined products, which might include specific research proposals or synthesis papers, and the likelihood of completion within 6-9 months. Funded projects will be network-level, ISSE-related, and inclusive with respect to the participation of multiple sites. Copies of the Decadal Plan are available at *www.lternet.edu/decadalplan*.

Proposals should be a maximum of two single-spaced pages and should detail the mechanism, goals, participants, timing, and expected products of the planned activity. If all participants are not known, include a statement of how other participants will be selected. Funding is limited to travel and meeting expenses; a separate budget and justification section should detail how funds will be spent. Since the LTER Network Office will fund travel and meeting costs directly, no overhead costs are allowed; cost-sharing is encouraged but not required.

Proposals should be sent to *rwaide@lternet.edu* by July 15, 2008. Decisions will be announced by July 31, 2008. Proposals received after July 15 will be considered subject to the availability of funds.

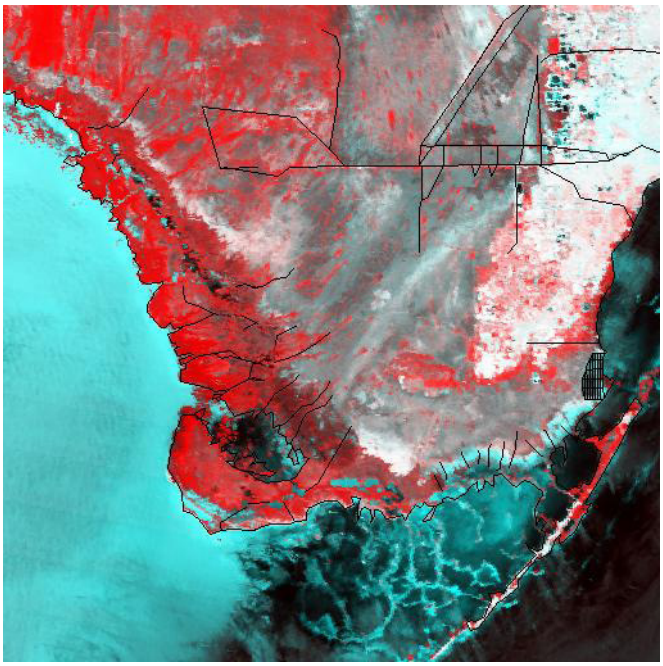
The maximum request that will be considered is $40,000. Proposals at this level would be expected to involve participants from all or close to all LTER sites. Smaller proposals are welcome.

The principal criterion for success will be the degree to which the proposed activities advance the goals of the LTER Decadal Plan research program. Questions about preparation of proposals should be directed to Bob Waide, Executive Director of the Network Office (*rwaide@lternet.edu*, phone 505-277-2649).

LTER sites to get direct broadcast satellite data

A collaboration with the Center for Rapid Environmental Assessment and Terrain Evaluation (CREATE) at the University of New Mexico is providing near real-time satellite data for most LTER sites. The direct readout facilities at CREATE download direct broadcast MODIS data from both the Aqua and Terra satellites.

The significance of the direct broadcast data from CREATE is two-fold: 1) the data can become available less than an hour after a satellite overpass, and 2) the data from a single overpass rather than compositted archive data is more timely. The near real-time data provide information immediately following disturbance events such as hurricanes, storms or fires. Test acquisitions for some LTER sites started in July, 2007, with the remaining sites coming on-line by January of 2008. Currently 22 of the 26 sites are within view of the CREATE satellite antennae and efforts are underway to access direct broadcast data from other receiving stations to cover the rest of the LTER Network.

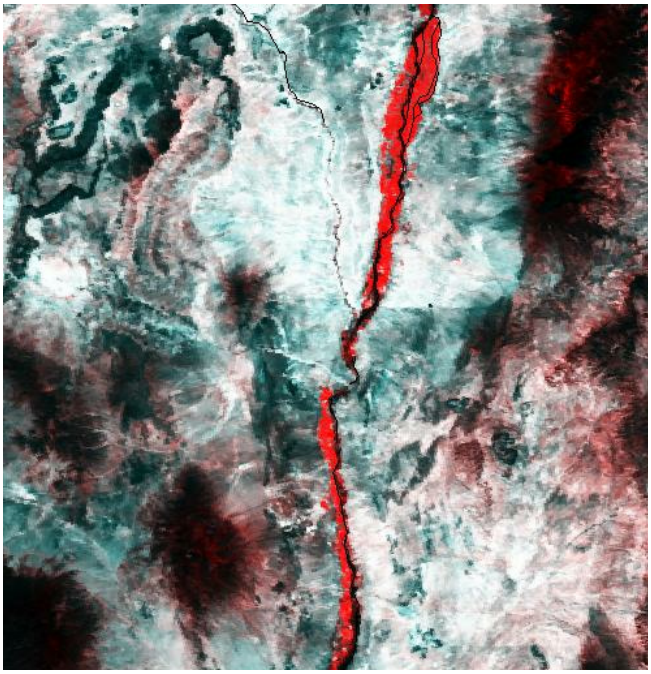


False-color MODIS Satellite image of the Florida Coastal Everglades LTER at 16:19 hrs on 05-06-2008.

How it works

Automated processing extracts MODIS data from the CREATE processing stream for 128 km by 128 km regions encompassing the LTER Network sites. Depending on the MODIS data product, the resolution varies from 250 meters for MODIS bands 1 and 2 and related products such as normalized vegetation indexes (NDVI), 500 meters for MODIS bands 3-7 and related products, and 1000 meters for other MODIS data. Custom data products or different areas can be added based on feedback from LTER site scientists.

Simple JPEG browse images are produced first in the processing and are meant primarily as a reference to see if the data from a satellite overpass are present and acceptable. The second part of data processing produces standard data products such as NDVI, reflectance, or thermal radiance products. All of these products are translated to standard GEOTiff format for input to standard GIS and image processing software such as ENVI, or Erdas/Imagine.



False-color MODIS Satellite image of the Sevilleta LTER at 17:31 hrs on 05-26-2008.

The MODIS products produced by CREATE are similar to the standard data products distributed by NASA's distributed active archive centers (DAAC), except that each product is data from a single satellite overpass rather than aggregated data more commonly acquired from the DAAC such as the 16-day Composite NDVI data product. A disadvantage of the single satellite data is that the satellite look angle and the time of day the image is acquired will influence the quality of data, and the user must consider this in the use of the data.

The data products produced for each of the LTER sites differs for terrestrial and aquatic/coastal sites, with products such as NDVI, fire, and surface temperature produced for terrestrial sites and standard products such as sea surface temperature added to coastal sites. More information and access to the data can be found on the LTER remote sensing/GIS web page at *http://www.lternet.edu/technology/ltergis/* or on the CREATE web site at *http://create.hpc.unm.edu/create/lter.php*

By John Vande Castle, LNO

Factors affecting the success of

Collaboration at a distance

Modern science is increasingly collaborative. But while collaboration has always been a part of science, those who collaborated in the past were often collocated. Today, science needs to be able to take advantage of specialized talent available regardless of location.

However, anyone who has participated in a project where participants are scattered across different locations knows that distance matters (Olson & Olson, 2000). Given that, how can we increase the chance that scientific collaborations across distance will succeed, and what does it mean for a project to be "successful"? These questions motivated a 5-year, NSF-funded investigation known as the Science of Collaboratories (SOC) project. The goal of the SOC project was to define, abstract, and codify the underlying technical and social mechanisms that lead to successful distributed collaborations.

One of the major outcomes of the SOC project is the Theory of Remote Scientific Collaboration (TORSC). TORSC resulted from our attempt to distill basic theoretical issues from the host of best practices and lessons we learned over the course of the SOC project and from literature on computer-mediated communication, organizational behavior, management information systems, and science and technology studies. TORSC proposes a broad set of success measures and analyzes factors that affect those measures. (A forthcoming book from MIT Press entitled Scientific Collaboration on the Internet includes a chapter on TORSC as well as case studies and research findings from investigations of distributed scientific collaborations, including a chapter on LTER coauthored by Bill Michener and Bob Waide.)

Factors that lead to success

Five major clusters of components are important to success: the nature of the work, the amount of common ground among participants, participants' readiness to collaborate, participants' management style and leadership, and technology readiness. The major categories, with the exception of the management issues, were first described in Olson and Olson (2000). We have since identified the key management and decision-making practices that are critical to success and detailed

See "Collaboration", p. 7

Nature of the Work	•**Participants can work somewhat independently from one another.** •The work is **unambiguous**.
Common Ground	•**Previous collaboration(s)** among participants was successful. •Participants share a **common vocabulary**, and if not there is a "dictionary" to help with translations. •Participants share a **common management** or working style.
Collaboration Readiness	•The culture is **naturally collaborative**. •The **goals are aligned** in each sub-community. •Participants have a **motivation** to work together. For example, the participants like working together; there is something in it for everyone; and or the project requires a mix of knowledge and skills. •Participants **trust** each other to be reliable, produce high quality work, and have their best interests at heart.
Management, Planning, & Decision Making	•The **principals** have time to do the work. •There is a **critical mass** of people at each location. •There is a **point person** at each location. •**Management**, **communication**, **knowledge organization**, and **data sharing** plans are in place. Plans have room for **reflection** and **redirection**. •**Leadership** sets culture and develops management plan. •No **legal** or **financial** issues remain such as intellectual property rights.
Technology Readiness	•Collaboration technologies provide the right **functionality**, give **benefit** to the participants, and are **reliable** and **easy to use**. •Participants are **comfortable** with the collaboration technologies. •**Technical support** is available at each location and an overall technical coordinator is in place.

Table 1: Factors that lead to success

(Collaboration, continued from p. 7)

the significant components within these clusters. Table 1 lists the key factors and examples of each. Many of these factors affect collocated collaborations, but are critical to distributed projects.

Forms of success

There are many ways for a distributed collaboration to succeed, and different sets of factors may lead to different kinds of success. TORSC identifies five categories of success: the science itself; science careers; learning and science education; funding and public perception; and the development of new collaborations. For example, a remote collaboration may succeed by encouraging the use of new tools to communicate and coordinate across distance, diversifying the pool of people who become scientists, improving the satisfaction of those in the field, and ultimately, providing revolutionary breakthroughs in both the conduct and outcomes of science.

Conclusion

In TORSC, we have identified the major factors that appear to be important for successful distributed research collaborations. Further research is needed to illuminate the logical connections between the factors, and to identify which factors are the most significant and under what circumstances they apply.

At its core, TORSC states that revolutionary science results when scientists work collectively and diverse points of view are brought to bear on a common problem. Technology then kicks in by allowing more diverse and distant groups of scientists to communicate with each other so that their collective work is coordinated. But major tensions also arise from having large and diverse groups of scientists working together, and the tendency in such groups to have less common ground, lower degrees of trust, and the need for stricter coordination and management. By facing these tensions and focusing on the factors that affect positive outcomes, we expect to see an increase in successful remote collaborations in the future.

Reference

Olson, G. M., and Olson, J. S.. 2000. Distance matters. Human Computer Interaction 15:139–179.

By Ann Zimmerman, Judith S. Olson, Gary M. Olson, and Nathan Bos

Publicizing your research results

The LINX experience

Recently a paper appeared in *Nature* (Mulholland et al. 2008) covering some of the core results of the second phase of the Lotic Intersite Nitrogen Experiment, known as LINX. This large, cross-site study has been funded by NSF and includes a number of LTER sites and investigators. In this article we relate our experience with publicizing the work, which evidently has been successful.

LINX talks and papers synthesizing data from across sites tend to carry large authorship lists and involve multiple institutions. There is a good reason for this: the latest work involved 72 coordinated stream experiments in eight regions across the United States, including Puerto Rico. The LINX experiments were 24-hour stable isotope additions to streams to study nitrogen cycling. Each experiment entailed a carefully coordinated measurement blitz by a team of five to10 people, including senior principal investigators (PIs) on site, followed by months of laboratory work.

We felt that it was critical to work with our home institutions and with the National Science Foundation to publicize the LINX paper, and we did this in the two weeks leading up to the date of publication. The overall LINX group prepared for the publication by drafting a one-page statement to serve as a press release. Every member had a chance to see it and make suggestions, helping avoid the potential confusion that could have resulted if each group did their own pieces in isolation. Individual PIs were free to customize the press release to highlight their own involvement or the context of their research in a particular region. The resulting versions of the release were ready to go as soon as the news embargo was lifted, and the NSF and individual institutions moved speedily to get them into the right hands.

The press releases had to strike a balance between being scientifically newsworthy, yet interesting and relevant to the public. In the LINX case the "broader impacts" of the research were easily conveyed because excessive nitrogen in the environment is widely recognized as a problem and is associated with major environmental issues, such as algal blooms and oxygen depletion in marine coastal waters. It usually helps to mention linkages to issues at the forefront of public debate; in our case the relationship between increasing biofuel crops (corn ethanol), which require greater use of nitrogen fertilizers, and nitrogen loading to streams proved to be one that the press picked up on.

Also crucial to successful publicity was the willingness and accessibility of the PIs to speak with the press. One must pay constant attention to the telephone and email during the first couple of days after the announcement of the paper and respond as soon as possible. Everyone from the media who contacted me for commentary had a deadline measured in hours or even minutes, and their calls or emails always seemed to arrive after normal working hours.

We were pleased with the publicity the paper generated, reaching national popular media such as *Time Magazine* and *US News & World Report*, and winning space in numerous science news media. The news is still spreading through the Internet, as members of the team are still getting requests for comment and more information about the LINX studies from non-governmental organizations in the US and internationally.

Reference

Mulholland, P.J., A.M. Helton, G.C. Poole, R.O. Hall, Jr., S.K. Hamilton, B.J. Peterson, J.L. Tank, L.R. Ashkenas, L.W. Cooper, C.N. Dahm, W.K. Dodds, S. Findlay, S.V. Gregory, N.B. Grimm, S.L. Johnson, W.H. McDowell, J.L. Meyer, H.M. Valett, J.R. Webster, C. Arango, J.J. Beaulieu, M J. Bernot, A.J. Burgin, C. Crenshaw, L. Johnson, B.R. Niederlehner, J.M. O'Brien, J.D. Potter, R.W. Sheibley, D.J. Sobota, and S.M. Thomas. 2008. Stream denitrification across biomes and effects of anthropogenic nitrate loading. Nature 452: 202-205.

By Stephen Hamilton, KBS

Long-Term Soil Observatories team up

Some of society's most important scientific questions have little to do with space travel, human disease, theoretical physics, or new math. Instead, they deal with issues such as the future of Earth's soil.

To promote and expand the world's long-term soil-research base, a workshop at Duke University and the Center for Environmental Farming Systems in North Carolina, USA, in December 2007 established a global network of long-term soil ecosystem (LTSE) studies, several of which have been in continuous operation since the 19th century. Participants at the workshop study soil and ecosystem change in Africa, Asia, Australia, Europe, and the Americas.

The workshop featured the proposition that soil studies spanning decades are key to answering some of the most significant questions faced by humanity today:

- Can soils more than double food production in the next few decades?
- How is soil interacting with the global carbon cycle and climate?
- How can land management minimize its adverse effects on the environment, and improve soil's processing of carbon, nutrients, wastes, toxics, and water?

Top: Map showing the worldwide distribution of LTSE sites (red bubbles). ***Inset***: Drs. Dan Richter, *r*, and Michael Hofmockel, *l*, examine the historic Calhoun Soil Archive. Photo courtesy of LTSE.

Comprehensive research from long-term experiments provide direct observations of soil processes and changes that are evident only after years and decades. The data from these decadal experiments are invaluable for improving the quality of human life and that of the environment.

According to workshop organizer, Dr. Daniel Richter, a professor of soils and ecology at Duke, "Long-term records are key to predicting the weather, air pollution, river floods, and wildlife populations. Similarly, long-term soil observatories need explicit and much greater support not only to improve our rapidly intensifying management of land and water, but also to better manage environmental change."

During the workshop, new results were presented from long-term studies of soil fertility, chemical contamination, crop production increases and declines, greenhouse gas emissions, and water quality—all demonstrating and quantifying soils' susceptibility to change.

Dr. David Powlson of Rothamsted Research in the United Kingdom, a pioneer in long-term soil research, noted that there was great short-term potential for cross-site studies to advance the science of sustainability. Dr. Henry Janzen of the long-running Lethbridge field studies in Alberta, Canada, argued that new long-term studies are needed to meet the growing economic and environmental demands being placed on soils now and in the next few decades.

Participants were particularly concerned about crop declines observed in several long-term experiments. Research on intensively managed rice (an agro-ecosystem that currently feeds more than two billion people) indicates yield declines in several locations attributed to a variety of causes, some of which involve unexpected changes in the soil. More recent studies suggest that adverse climatic changes, such as an increase in night temperature, could be responsible for declining rice and wheat yields.

The participants also decried the poor funding support for long-term soil studies. Many such studies operate without stable institutional support and survive mainly due to the persistence of individual scientists. Several highly productive long-term experiments have been abandoned in recent years, including important studies in Africa and South America.

See "Observatories", p. 20

(LNO Survey, continued from p.2)

Additional issues raised by respondents

Several open-ended questions allowed respondents to bring up points that were not specifically covered by survey questions. The following comments represent the more commonly mentioned ideas:

♦ "We would like to participate in developing/implementing strategies for dealing effectively with the massive streams of data we anticipate from new sensor networks...perhaps the LNO could be more proactive in helping all of us work on these problems effectively."

♦ "… I was not aware that most of this cyberinfrastructure existed until I started taking this survey. Making sure that graduate students know about some of the services available to them would be a good start."

♦ "Further development of the SiteDB concept to provide a uniform view of personnel, publications, databases, and general site information."

♦ "I think LNO is headed in the right direction in providing support to sites for Network synthesis [and] for important IM training workshops… [I hope the LNO will] have funds to continue this activity [and] help the IMs organize … to solve issues like Units and Data Dictionaries."

♦ "It seems that the LTER Grad Student webpage is updated very infrequently, and is not utilized often … if the LNO manages this [information], it would be helpful to figure out how to enhance the usefulness of the website. I also have had difficulties adding new graduate students to the LTER grads listserv."

♦ "Improvements in interfaces for updating personnel lists and bibliographies. Development of web services or other means to automatically update these lists. Right now it seems we are maintaining separately and they are typically out of sync."

♦ "More opportunities for small grants to support directed working groups. We need synthesis of ideas as well as of methods/approaches. Also, opportunities for mini-grants for graduate students for cross-site work would be very beneficial."

♦ "Over the past few years, I have been really satisfied with LNO's services and performance, especially since the hire of Inigo, Mark and Duane. Their work has been outstanding and whenever I've needed assistance, they were able to solve my problems or answer my questions quickly. Thanks for the great job!"

♦ "Additional information management training for graduate students. Working with long-term data … can be a unique experience for grad students and training may not be provided at individual institutions. Working with LTER data and collaborating among sites can be particularly challenging for graduate students due to the short time horizons and challenges in mastering technology related to sharing information across sites. [LNO] could [offer] information management training programs to a few students from each site (new grad students in particular), [e.g.] a three day seminar covering topics such as database management, data archiving, metadata, and analysis of long-term data…"

LNO provides support for training workshops. Above, Mark Servilla (LNO) conducts a training session during a recent workshop. Photo by McOwiti O. Thomas.

♦ "Although I am a graduate student at an LTER site, I haven't felt like I am part of the LTER network since the ASM in 2006. I wasn't able to answer most of the questions on this survey because I was not familiar with their content. It seems that there is not a lot of "networking" happening among the grad students in the LTER, or among grad students and PIs at other sites. I just visited the grad student website and the most recent text is three or four years old. I wonder why some of the visions and mission statements haven't been carried out."

♦ "Overall, it is much easier to find documents in the archive [but] I am still trying to train people to go to the Intranet first [because] documents are much more accessible from there. A document search box on the main index page would be useful. The Google search box does not return the same hits as the box on the document archive page, and this has confused [some] people."

♦ "It would be great if LNO could help get meeting products on-line, distributed, or announced in a timely manner following meetings. Not all groups are very good about getting things out."

The LNO will take all of these ideas into account in prioritizing future activities. Some tasks (e.g., further development of the SiteDB concept, migration of ClimDB and HydroDB to the LNO, development of web services, and revision of the Intranet website) are already in progress and will be given additional emphasis. Other issues, such as the need for additional funds for research working groups and training, are addressed in the LNO renewal proposal and hopefully will be funded in 2009. Some of the suggestions will require new approaches. The LNO will work with the Information Management and the Network Information System Advisory Committees to make sure that timely information about the development of the Network Information System is available to all. LNO staff will contact individual respondents to determine specific problems with the document archive and the webpages, so that fixes can be designed. Our efforts to address this problem since the last survey have apparently not been successful, since significant numbers of people still report problems. We will review all of the working groups we have sponsored and make sure that reports and lists of products are available.

The LNO will continue to work with site representatives to the Graduate Student Committee (GSC) to increase information flow to LTER graduate students and to address other issues raised in this survey. One approach is to add the graduate student representatives to the standard site description (for example, see *http://www.lternet.edu/sites/knz/*), and to ask sites to annually review and update graduate student information. One response to the survey suggested that the GSC could use a mentor to help the committee manage the webpage and interact with sites. The LNO is offering to sponsor an LTER graduate student mixer at the upcoming Ecological Society of America meeting and help the GSC co-chairs plan and execute a program. I will work with the LTER EB to identify ways to address other issues such as training. It is critically important to the LTER Network that graduate students become fully engaged and invested in Network activities.

The LNO is grateful to the people who took the time to complete this year's survey. The results will be very useful in helping us prioritize future activities. Looking ahead, the EB has suggested that the survey be administered every two years instead of annually. In addition, our professional survey consultant strongly recommended that the survey be administered to the entire LTER community. We will work with the Board to continue to improve the survey as well as the services that the LNO provides to the LTER Network and sites.

By Robert B. Waide,
Executive Director, LNO

Looking back, reflecting on the future

The past year, like all odd years, was marked by mid-term site reviews: with 11 visits, this was the largest of the three Long Term Ecological Research (LTER) award cohorts. In contrast, we had six site visits in 2005 and we will have nine in '09. The geographic coverage was also the largest: from the Arctic tundra (ARC) in northern Alaska, to the first review of the Moorea Coral Reef (MCR) in French Polynesia, to the McMurdo Dry Valleys (MCM) in Antarctica, and up the east coast to Plum Island (PIE) in northern Massachusetts and Hubbard Brook (HBR) in northern New Hampshire. And finally, the "biome" coverage was also extensive, including marine, desert, urban, forest, tundra, and coastal sites. In the process, both Henry Gholz and Bob Waide became likely the first people to have visited all 26 LTER sites.

Above: The 2008 MCM review team is led through the "worm farm", Taylor Valley, Antarctica, where Diana Wall and Ross Virginia are manipulating soil temperature using passive chambers in order to understand the effects on soil organisms, mainly nematodes (Photo: Byron Adams). ***Left***: Steve Carpenter (NTL) and Henry Gholz (NSF/BIO) on the "field trip" during the 2008 MCR mid-term review in Moorea, French Polynesia (Photo:Jan Engert). ***Bottom***: The 2008 MCM site review team and NSF Program Officers on the Taylor Glacier, Dry Valleys, Antarctica. Standing, l - r, Joe Vallino (MBL), Peter Groffman (Cary Inst. of Ecos. Studies), Henry Gholz (NSF/BIO), Cyndy Chandler (WHOI), Ed Boyle (MIT), Jim Elser (ASU), and Phil Taylor (NSF/GEO). Sitting: Roberta Marinelli (NSF/OPP). Photo by Cyndy Chandler.

The collective assessments from the review teams certified LTER science, education, information management (IM), outreach, and project management as very healthy. They also revealed the great extent to which the *Integrative Science for Society and Environment* (ISSE) and Decadal Plan for LTER are already influencing the conceptual evolution of the current LTER. Most sites are becoming vested in network-level activities across the review areas, with impressive developments in IM that will be critical in enabling these new activities.

Another keystone event of the year was April's LTER renewal proposal panel for the six sites reviewed in '05. As a result four sites are being recommended for renewal as proposed, one site must file an addendum, and one was placed on a two-year probation with a second renewal proposal to be submitted for the next panel in April 2010.

A landmark for 2008–and for the history of the LTER program–was, of course, the submission of the Decadal Plan in the context of previous submissions and the ISSE's call for a new overarching funding initiative. Both documents have found a receptive and expanding audience across the Foundation. As the general level of interest and discussion concerning environmental science increases across NSF (and across all other Federal Government agencies), it is likely that the more concise and conceptual ISSE document will figure prominently in discussions over the next couple of years. As evidenced by the site review reports, LTER is not standing still, but has taken its strategic plan to heart and is moving down the road of more integrative and networked programming.

In terms of NSF funding for LTER, we were able to support both the core projects as well as provide over $3.2 million in supplementary funding from the LTER program office in the Directorate of Biological Sciences, Division of Environmental Biology (BIO/DEB) and the various other programs that support LTER across the Foundation. The large supplement total was due in part to greater support for social science proposals than in the past from the Social, Behavioral and Economic Science Directorate (SBE). With additional support from the cross-directorate Environmental Research and Education (ERE) Working Group, 15 out of 22 social science requests were supported this year. But the bulk of the funding reflects the commitments from SBE, the Directorate of Geosciences (GEO)/Bio-Oceanography, and the Office of International Science and Engineering (OISE), in joining BIO/LTER to provide advanced funding for the 2009 LTER All-Scientists Meeting. The LTER Network Office can now move ahead to secure meeting facilities at Estes Park, CO, and to plan this important meeting effectively and efficiently. OISE also provided support for nine out of18 request for international supplemental support.

Finally, the rotational movement of program directors at NSF continues apace. We enjoyed having Dan Childers working in the Ecosystem Science Cluster on LTER this past year. But Dan, Jim Raich, and Martyn Caldwell have all now moved on from the Cluster to Arizona State University , Iowa State University and the golden years of retirement (Martyn on June 30), respectively. Todd Crowl from Luquillo LTER followed in Martyn's footsteps from Utah State, and took over June 9 from Dan to work with Henry on LTER and Ecosystems. And Ann Russell has just moved over from Ecology to the Ecosystems Program. So, look for communications over the coming couple of years from Henry and Todd.

By Henry Gholz, NSF/BIO

Alaska fire sparks new research at Arctic LTER

The tundra of the Arctic LTER site, Alaska, sits above hundreds of meters of frozen ground (permafrost). Because of this drainage barrier and low evapotranspiration during the cool, often cloudy summers, the scant summer rainfall keeps the tundra moist. However, in the exceptionally dry summer of 2007 a fire sparked by lightning on July 16 burned 256,000 acres, and continued until the end of September when nearby lakes had already frozen over. This was the largest fire in Alaska in 2007 and by far the largest ever recorded north of the Brooks Range. In the 33 years of research at the site, we recorded only two brief fires covering a few dozen acres.

Unlike the gigantic fires in interior Alaska, tundra fires are driven more by unusual climate conditions than fuel availability. Characteristically, flames creep along burning the low-lying vegetation and peaty soils; there is no tall tree canopy and no firebrands, so natural barriers like streams and rivers easily stop fires.

The Arctic LTER project site is only 23 miles to the southeast of the fire location. There being no roads, the only way to reach this site is by ski plane in the winter and helicopter in the summer. Despite logistical difficulties, the LTER project has decided to describe and analyze the aftermath of this fire because it represents an opportunity to study the effects of a major arctic disturbance at the landscape and whole-catchment scale. The burned area includes multiple first through third order catchments, both with and without lakes, and about half the area is rolling foothills and the other half flat plains. Gus Shaver, of the Marine Biological Laboratory, is leading the fire project.

Above and inset: The Anaktuvuk River fire burning in mid-September 2007 in the foothills region of North Slope Alaska, about 30 miles north of the ARC LTER site at Toolik Lake.

The obvious changes will be to the vegetation. Our observations suggest that if the fire stays on the surface and does not destroy all the organic matter in the upper layers, then some plants will resprout this spring, that is, in late May. A more intense fire will burn away the peat and organic-rich soils and the tundra will take centuries to revegetate. In addition to changes in the plants and soils, there will be large fire-caused differences in the exchange of energy and CO_2 with the atmosphere, and probable changes in the nutrient balance of streams and lakes. The change in the energy balance, caused by changes in surface albedo and insulation by the plant and organic layers, will hasten thawing of the ice inclusions in the permafrost, slumping of soil on hillslopes, and movement of sediments and nutrients into streams and lakes.

The LTER project has obtained Small Grants for Exploratory Research (SGER) funding from the National Science Foundation's Office of Polar Programs for logistics costs and for initial sampling of the fire's impacts. Additional SGER funding will come from the NEON program to test NEON protocols, instrumentation, and remote power setups with a series of flux towers measuring carbon, water, and surface energy balance. Not only will this new project allow a long-term investigation of recovery but will also take advantage of a natural experiment at a very large scale.

By John Hobbie, ARC

Updates from the Andrews Forest

REUs study soil and climate change effects...

In summer 2007, the Andrews Forest LTER Program hosted Research for Undergraduate (REU) students Farm Saechao and Julia Pederson. Saechao, a senior at Oregon State University's (OSU) College of Health and Human Sciences, did her REU project on effects of climate change on rural communities. She worked under the supervision of Brent Steel, Professor in OSU's Department of Political Science. Saechao helped to identify indicators used to assess a community's ability to adapt to changes such as natural disasters. She visited rural communities in Oregon and spoke with city managers about current conditions of their cities and plans for changes. Says Saechao, "After working on this project I feel like graduate school is more of a possibility." Pederson, a senior at OSU in Crop and Soil Science, did an REU project on how mycorrhizal mats contribute to forest soil carbon dioxide production. She worked under the supervision of OSU Forest Science PhD student Claire Philips and OSU Forest Science Professor Barbara Bond. Pederson reported that, "carrying out this experiment to completion was helpful to me as an undergraduate interested in pursuing a career in soil science. I was able to experience a little bit of what it is like to be a graduate student."

By Lina DiGregorio, AND

REU Student, Julia Pedersen (left) and OSU student Priscilla Woolverton, take soil samples at the Andrews Forest. Photo by Claire Phillips.

...others go wireless

REU student, Erin Wyckoff, configuring a soil auto sampler with wireless technology. Photo by Lina DiGregorio.

The science of mountain airsheds in the H.J. Andrews Experimental Forest LTER requires a strong back and a sharp mind—especially when you're lugging a 65-pound golf-cart battery in your backpack.

An interdisciplinary team of Oregon State University students is working to make science easier on the back and on the environment. The three seniors—Drew Smith, Erin Wyckoff and Brian Wilson—spent 10 weeks scaling the steep slopes in the Andrews Forest, pooling their individual expertise in electrical engineering, soil science, and atmospheric science to test and refine a networked wireless and battery-free system for monitoring what OSU's Terra magazine (*http://oregonstate.edu/terra/2007summer/includes/grasping-air.pdf*) calls the "exhaled byproducts of the forest." The students are helping unplug the high-tech sensors that researchers use to measure the ebb and flow of carbon-laden air, connecting them instead through a new generation of ultra-low-power sensing devices that save energy and vastly extend the range of existing equipment in mountainous terrain.

Thanks to their efforts, which is funded by the National Science Foundation REU program, the miles of electric wire that currently snake through the experimental watershed in glistening black tangles may one day be relegated to the dustbin of technology.

For full story, please see: http://oregonstate.edu/terra/2007summer/departments/student-research/cyberforest-unplugged.html

By Lee Sherman, TERRA Magazine, Oregon State University.

FCE LTER website gets new look

Over the past year, the FCE LTER information management system (IMS) team members, Linda Powell and Mike Rugge, redesigned and enhanced the FCE website (*http://fcelter.fiu.edu/*) to better provide the general public and scientific community with the information and tools that are important to each audience. The team unveiled the redesigned website to the public in January 2008. Information in the site is now organized under a series of 'Tabs' and sub-headings that facilitate navigation, and many of the topical choices are represented by graphical icons to draw the audience into the website. The IMS team partnered with a science writer, Sara LaJeunesse, to translate the FCE research introduction and results into a format that is readily understood by general audiences.

The biggest changes to the website can be found under the 'About Us' tab, where we added features that cater to the general public's interest. The section provides an overview of FCE activities and details of the Florida Everglades, such as its history and culture, nature and science, and issues and restoration. Here, visitors can undertake a variety of activities, such as launching a slide show of Dr. Mike Heithaus' Bull Shark tagging field research in the Everglades.

The FCE LTER program is currently organized into five working groups and three cross-cutting themes. The 'Working Group' sub-section under 'FCE Research' blends general and scientific information (under an 'Introduction' written for the public), and abstracts, hypotheses, and findings written for the scientific community. Each working group's introduction explains how the working group's research affects people in South Florida. Users will also find details and links for all personnel, projects, datasets, and publications related to the particular working group.

For the scientific community, the website has many important features, such as a searchable project information, research site locations, personnel, sampling, datasets, and publications that are relationally linked to each project. Many sections have been simplified and made more researcher friendly. For example, the FCE Data section (*http://fcelter.fiu.edu/data/*) has a series of graphical icons that represent different data types and sources. Upon selecting a data type, the user is taken directly to a data source, such as the FCE core datasets, or given a link to an outside data source such as the EcoTrends Project Socioeconomic Catalog. Additionally, the FCE core data can now be searched by themes or using an advanced search process that includes a spatial search component.

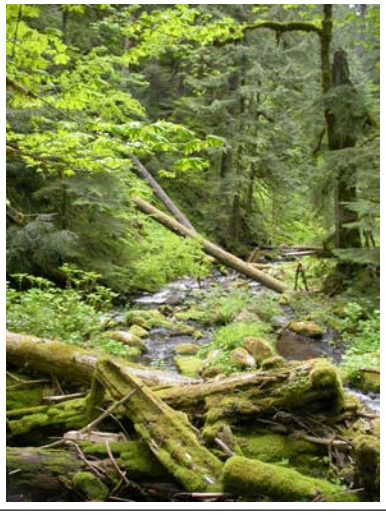
Future website features are expected to include providing a general public section in Spanish and adding a comprehensive section on Everglades modeling to feature model results and provide a user interface for researchers to run model scenarios through the FCE website.

By Linda Powell, Information Manager, FCE

Andrews Forest scientists contribute to LINX paper

Andrews Forest LTER's Sherri Johnson, Linda Ashkenas, Stan Gregory, and Dan Sobota are among coauthors of a new publication in *Nature* entitled "Stream denitrification across biomes and its response to anthropogenic nitrate loading." The publication is a product of the Lotic Intersite Nitrogen Experiment (LINX II) which uses isotopically labeled nitrogen to identify the fate of nitrogen in stream ecosystems flowing through urban, agricultural, and "reference" lands. A key concern of these studies is that land use practices can greatly increase delivery of nitrogen to streams and rivers, with detrimental impacts on water supplies and ecosystems. Synthesizing results from 72 streams in eight regions of the country, the LINX science team found that processes operating in streams can substantially decrease nitrogen loads, but that reduction of the load diminishes with increasing nitrogen concentration. In "healthy" stream ecosystems with low nitrogen concentrations, such as the Andrews Forest, 40 to 60% of the labeled nitrogen is taken up within 500 m of where it entered the stream. Many other papers are underway from this continental-scale study.

By Lina DiGregorio, AND



Mack Creek, which flows through old growth at the Andrews Forest LTER, has been the site of many stream and riparian studies, including LINX, since the early 1970s. Photo by Sherri Johnson.

Graduate students enrich LTER community

In October 2007, Amy Burgin (KBS) transitioned out of her position as LTER graduate student co-chair, and Amber Hardison (VCR) was elected in her place. Amy was a strong leader in the LTER, and during her time as co-chair she helped organize the "2nd LTER Collaborative Graduate Student Symposium" at the 2006 All-Scientists Meeting (ASM) at Estes Park, CO, and co-hosted a post-ASM workshop at KBS in April 2007. We thank Amy for her commitment to facilitating graduate student collaborations within the LTER community.

Meanwhile, John Kominoski (CWT) will serve out his term as LTER graduate student co-chair in May 2008, and will be succeeded by Chelse Prather (LUQ). Nevertheless, John and Chelse will organize an informal LTER graduate student social at the 93rd annual meeting of the Ecological Society of America in Milwaukee, WI, in August 2008. Look for future correspondence about this event, and please join your fellow graduate students to provide feedback, discuss issues, and meet new colleagues.

Student participants at the Graduate Student Symposium during the LTER 2006 All Scientists Meeting. Photo by McOwiti O. Thomas

LTER graduate students conduct diverse research across the globe, volunteer with educational outreach programs, and promote interdisciplinary science within and beyond the LTER community. Below is a snapshot of some graduate student activities and initiatives.

Heidi Geisz (PAL) has just published a paper in Environmental Science and Toxicology entitled "Melting Glaciers: A Probable Source of DDT to the Antarctic Marine Ecosystem". Kristen Gorman, an experienced PAL technician and new graduate student, will spend the better part of six months in the Antarctic this year helping PAL scientists Hugh Ducklow and Matthew Ericson develop a winter investigation of the microbial biology in the Western Antarctic Peninsula.

Graduate students from KBS and Michigan State University (MSU) organized a forum to discuss ways to reach out to other graduate students at the East Lansing campus. These students have identified a need to inform non-LTER graduate students about the opportunities of collaborating with KBS and the LTER Network. To facilitate a stronger connection between KBS and MSU, Uri Levine, a non-LTER graduate student, has been selected as a graduate student co-representative for KBS. Additionally, the GK-12 program at KBS completed its second successful school year by partnering with area rural school districts to enhance ecological literacy in K-12 classrooms. Several KBS graduate students are GK-12 Fellows, including Todd Robinson, Sara Syswerda, and Brook Wilke. Eight new GK-12 Fellows will start in the GK-12 program at KBS this summer.

Nancy Muehllehner (MCR) is studying the plasticity of biomineralization in scleractinian corals in French Polynesia to assess whether morphological plasticity plays a role in the response of the coral species, *Acropora hyacinthus* and *A. pulchra*, to changing carbonate concentrations in seawater. These studies have expanded to include a study of the interacting effects of increased temperature and reduced carbonate in seawater on photosynthesis and calcification in two major reef building species of the Pacific, *Porites rus* and *Pocillopora meandrina*.

Graduate students at NTL sponsored a symposium highlighting graduate student research associated with the eleven LTER focal lakes. Graduate research at NTL spans a range of spatial scales from microbial community response to disturbance, to estimates of secondary production for an entire lake, to human development patterns in a lake-dominated landscape in northern Wisconsin. Research highlights include: mapping ground and surface water flow paths in the Northern Highlands Lake District to explore the effect of aquatic linkages on carbon processing; exploring effects of the invasive aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*) on lakefront property values; and using paleolimnology—the study of past freshwater, saline, and brackish environments—to link the effects of deforestation associated with European settlement on lake eutrophication by examining biological and geochemical pathways by which phosphorus is stored, processed, and released from lake sediments.

The symposium attracted graduate students, faculty, and staff from across the University of Wisconsin–Madison campus and affiliates from the Wisconsin Department of Natural Resources and the United States Geological Survey. Student presenters hailed from seven different departments: the Nelson Institute for Environmental Studies; Civil and Environmental Engineering; Limnology and Marine Science; Zoology; Environmental Chemistry and Technology; Agriculture and Applied Economics; and Geology and Geophysics. The meeting highlighted the cross-disciplinary nature of research conducted by graduate students associated with NTL and brought together social, natural, and physical scientists from all across the campus.

By John Kominoski, CWT

The USA National Phenology Network

A critical tool for enabling adaptive responses to climate change

Phenology is a sensitive measure of climatic variation and change, is relatively simple to record and understand, and is vital to both the scientific and public interest with or without climate change. Integration of spatially-extensive phenological data and models with both short and long-term climatic forecasts offer a powerful and necessary agent for human adaptation to ongoing climate change. However, the predictive potential of phenology requires a new data resource—a national network of integrated phenological observations and the tools to access and analyze them at multiple scales.

The USA National Phenology Network (NPN) is an emerging partnership between federal agencies, the academic community, and the general public to monitor and understand the influence of seasonal cycles on the nation's biological resources. The goal of the NPN (*www.usanpn.org*) is to establish a wall-to-wall science and monitoring initiative focused on phenology, the study of the causes and consequences of life cycle events for individuals and populations of plants and animals.

Periodic plant and animal life cycles driven by seasonal variations in climate set the stage for the dynamics of the ecosystem processes, determine land surface properties, control biosphere-atmosphere interactions, and affect food production, health, conservation, and recreation. Information from phenological research can be used at local to national scales for scientific research, education and outreach, and by stakeholders interested in agriculture, tourism and recreation, human health, and natural resource conservation and management.

A primary goal of the NPN is to enhance the mitigation and adaptation strategies for climate change by building and supporting the first coordinated effort by scientists, naturalists, and the general public to detect and to predict the trajectory of climate change through the accumulation and analysis of daily observations of the natural world. It is intended as a large-scale network of repeated and integrated plant and animal phenological observations, linked with other relevant data sources and the tools to analyze these data at local to national scales. The network will also integrate remote sensing data from satellites with on-the-ground phenological observations by students from educational institutions at all levels, by private citizens and naturalist groups, and by technical staff and volunteers who already take other field measurements across existing environmental networks (Figure 1).

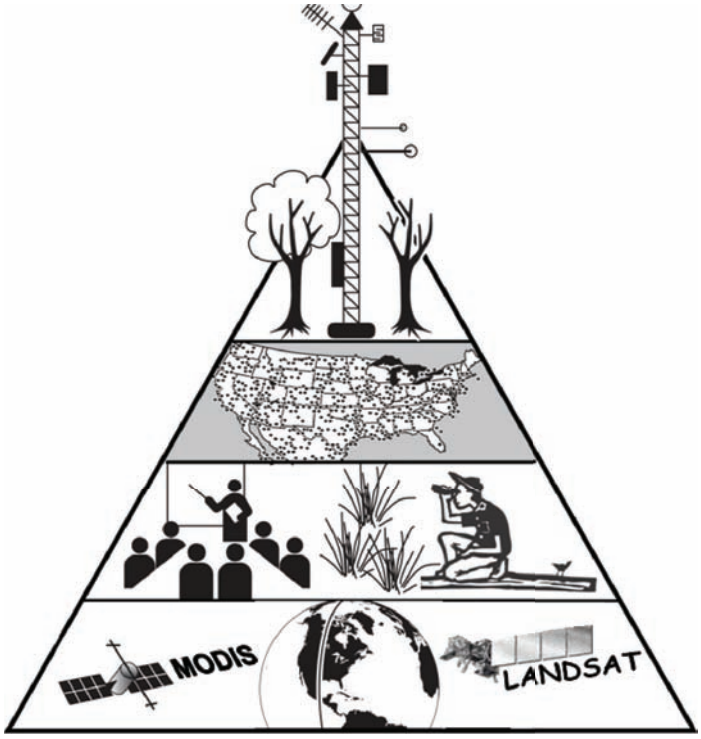


Figure 1: USA-NPN conceptual structure. The USA-NPN consists of four components or tiers, following the "Framework for Environmental Monitoring and Related Research" recommended by the Committee on Environmental and Natural Resources of the National Science and Technology Council. Each tier represents different levels of spatial coverage and related environmental information: 1) Networks of locally intensive sites focused on process studies; 2) Spatially extensive environmental networks focused on standardized observations; 3) Volunteer and education Networks; 4) Remote sensing products that can be assimilated to extend surface observations.

Recent accomplishments include three planning, interdisciplinary workshops in August 2005, October 2006, and August 2007 supported by the National Science Foundation and six other federal agencies, several symposia at national conferences, and a half-million dollar, five-year Research Coordination Network grant from NSF beginning in 2007. The University of Arizona and the U.S. Geological Survey collaborated in 2007 to establish and staff a National Coordination Office (NCO) in Tucson. The NCO is collaborating with the University of Wisconsin-Milwaukee and Oak Ridge National Laboratories to construct a functional data collection system for individual observations, using a common architecture and common database schema. About 200 widely-distributed and common species have been selected for national monitoring, including development and vetting of

See "NPN", p. 16

(NPN, continued from p. 15)

observation protocols. A revised and expanded USA-NPN website will be ready for data entry later in 2008.

The USA-NPN Plant Phenology Program has already registered over 800 individuals who are observing native species and cloned lilacs across 49 states. The program is negotiating memoranda of understanding with federal agencies and environmental networks, including National Park Service Inventory & Monitoring, Organization of Biological Field Stations, the National Ecological Observatory Network and LTER. Planning for regional networks modeled after the national one has advanced quickly in the northeastern U.S. (*www.nerpn.org*), and is in the initial stages in the southeast and southwest. A national campaign to engage private citizens, Project Budburst (*www.budburst.org*), was successfully launched in spring 2007 and expanded in spring 2008 by the University Corporation for Atmospheric Research and other partnerships. UC-Santa Barbara and Virginia Tech University are collaborating to develop curricula in phenology and student-led monitoring and research programs that can be customized for implementation at any university.

As brief as our history may be, NPN values its collaborations with the LTER Network and affiliated scientists, and is fully committed to advancing and strengthening future collaborations. The February 2007 Phenology Workshop is a good example of our successful collaboration. The week-long workshop, supported by the LTER Network Office, brought together researchers to define the state of phenological research across LTER and to provide recommendations to advance the integrative use of phenological data within, across, and beyond LTER sites. A report documenting the results and recommendations of this workshop are posted on the NPN webpage, *www.usanpn.org*.

By Jake F. Weltzin, Executive Director & Mark Losleben, Assistant Director USA NPN National Coordinating Office

Multicultural students gain
Exposure at Harvard Forest

For the last two years, 7th grade students in Lisa Shluger's bilingual science classes at Fuller Middle School in Framingham, MA, have taken on the role of scientists in the field. Every week in the fall and spring they record data from schoolyard trees for the Schoolyard Ecology Program at Harvard Forest. This program connects teachers and students with real science, real scientists, and real issues.

The data students collect at their field site is sent via an electronic spreadsheet to Harvard Forest, where it is published on their website as part of a study called "Buds, Leaves and Global Warming" (*http://harvardforest.fas.harvard.edu/museum/phenology.htm*).

Groups of multicultural (bilingual) students collect data and gain useful exposure with Harvard Forest Phenology study. Photos by Lisa Shluger.

This research is part of a long-term ecological study to find out whether the growing season of leaves in New England is getting longer due to climate change. Through this hands-on research these immigrant students are not only introduced to the concept of climate change, but also get exposed to the local environment, seasons, and wildlife. Students compare these natural resources and processes with examples from their home countries, maintaining pride in their old roots while setting down new ones here.

Ms. Shluger copresented results from the project, including photos of Fuller students, with Harvard Forest Schoolyard Coordinator, Pamela Snow, at this year's annual conference of the Massachusetts Environmental Education Society (MEES). Ms. Shluger plans to continue this study with future classes in order to maintain a data set from which long term patterns in the length of the growing season can be observed.

Meanwhile, the HFR Schoolyard program continued to attract a lot of attention: major newscast in Boston WBZ featured our "Buds, Leaves and Global Warming" Schoolyard Ecology program, with Forest Ecologist/Fisher Museum Director, John O'Keefe and Tewksbury (Mass.) teacher Elaine Senechal's High School class doing the project at their field site; *The Boston Globe* had an article on recent Environmental Education awards given to a number of Mass. schools, including three that feature HFR Schoolyard projects.

By Pam Snow, HFR

Birds of a feather flock together

when adapting to urban environments

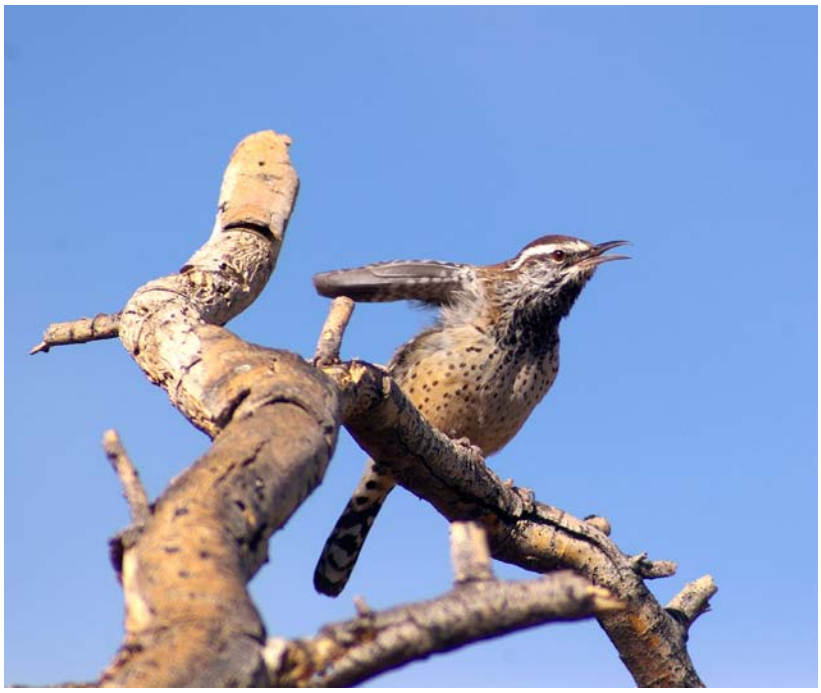
AMHERST, Mass. – Urban areas are the fastest-growing habitat on earth, but little is known about how plants and animals fit themselves into landscapes dominated by humans. Now, LTER researchers from the University of Massachusetts Amherst and Arizona State University (ASU) have shown that birds faced with urban development are a lot like people when choosing a place to live. Some species, including pigeons, thrive in the noise and confusion of city life, others prefer to stay firmly rooted in the country and some are comfortable in both environments.

"Urbanization turns large areas of wild land into cities and suburbs, and has a profound effect on native species, changing where they live and how they interact," says Paige Warren, an urban ecologist at UMass Amherst. "Knowing how these organisms relate to each other and their environment is critical to developing sound conservation strategies." The study focuses on Phoenix, AZ, but Warren expects that similar patterns exist in cities throughout the United States.

Analytical work for the study was done by Jason Walker of ASU. The team also includes Robert Balling, John Briggs and Elizabeth Wenz of ASU and Madhusudan Katti of California State University, Fresno.

Using bird count data taken over a two-year period in Phoenix, and computer models developed for mineral mapping, the team illustrated some striking trends in the distribution of birds over the Phoenix metropolitan area, including surrounding agricultural land and remnants of the Sonoran Desert. Computer models generated maps showing where certain species of birds were likely to live, including the rock dove, or pigeon, the cactus wren and phainopepla, a bird native to the deserts and dry woodlands of the Southwest.

Anyone who has spent time in a major city can probably guess that pigeons showed a marked preference for urban life. "Maps showed that pigeons, a flagship urban species found in cities around the world, adhered strongly to downtown Phoenix," says Warren. "There was a sharp decline in the probability of finding them in the outlying desert and agricultural regions."



Cactus wren preening in Desert Botanical Garden in Phoenix, Arizona. Photo: Eyal Shohut.

According to Warren, pigeons didn't migrate from their wild homes to conquer the big city by themselves. "These birds were taken from the rocky coasts of Malta several hundred years ago and kept as pets in Europe, where they became genetically different from wild pigeons," she says. "Eventually they escaped into cities, where they adapted remarkably well, since they will eat almost anything and are well-suited to live on the sides of buildings."

At the other end of the spectrum was phainopepla, a crested bird native to the desert and dry woodlands that feasts on mistletoe berries and insects caught on the wing. The probability of finding phainopepla in the desert was high, and this species showed no ability to penetrate into the city successfully. Because of this, phainopepla is sensitive to habitat loss from the conversion of desert to farms and developed areas, which has already reduced the number and size of breeding populations.

The cactus wren showed a different distribution, and emerged as an interesting intermediary species. "The cactus wren is usually associated with the desert, since it builds nests in the protection of cacti and other thorny plants," says Warren. "However this native species was able to penetrate the urban ecosystem more successfully than phainopepla, and has been seen nesting in satellite dishes and other man-made structures."

Computer models used in the study proved to be a useful tool to fill in the gaps between the observation sites where bird counts were taken, overcoming the difficulty of predicting where birds will be found in large areas of urban development.

"Usually we can look at the characteristics of a habitat, like food and water availability or types of shelter, and predict whether a certain species would be found there, but urban ecology is a young science, and we don't have a sense of what features an urban habitat should have to support different species," says Warren.

This research was supported by the National Science Foundation, the Central Arizona–Phoenix Long-Term Ecological Research Program and the IGERT Program for Urban Ecology (CAP LTER) at ASU. Bird census data was collected as part of long-term ecological monitoring by the Central Arizona-Phoenix Long Term Ecological Research project.

By Barbara Weiss
University of Massachusetts-Amherst

Metadata for ecological genomics

Last Fall, Inigo San Gil (LNO) attended the 5th Genomics Standards Consortium (GSC) workshop in the United Kingdom to represent LTER and present the Ecological Metadata Language (EML) standard and its potential relationship with the "Minimum Information about a Genome/Metagenome Sequence" (MIGS/MIMS) and its implementation, the Genomic Contextual Data Markup Language (GCDML). Genome sequencing—the ability to decode the DNA base sequences in chromosomes—and its associated science, genomics, and many other "omics" technologies have evolved beyond the original one-dimensional scope of the data.

Nowadays it is common to conduct geo-distributed studies with many ecological variables. The new metadata needed adds to the laboratory pipelines, protocols, and methodology, that were the classical metadata scope captured in some of the *omics* data submissions (NCBI, Genbank, EMBL, Sanger, TIGR). The GSC stakeholders, including the National Genomic clearinghouses and international counterparts, are developing the new standards to gather the necessary metadata.

The adoption of EML as the LTER network standard has been key to building the network's architectures for synthesis that rely on high quality standardized metadata. Since the community's success in adopting a standard depends, among other critical factors, on the tools and trainings developed to use the standard, LTER's significant experience in adopting EML may help GSC to achieve similar success.

Another outcome of the workshop is the possibility of collaboration between LTER and GSC to provide training for GCDML and the associated catalog entry tool, GenCat. LTER is also investigating EML enhancements to better accommodate genomics data, possibly integrating the GCDML schema into EML. Inigo and a number of LTER and genomics community collaborators have published an informational article in the journal OMICS documenting the discussion and interactions. Further collaboration between the GSC and LTER is expected to leverage the efforts in designing a comprehensive metadata standard for genomic and metagenomic data that will benefit the ecological genomics community.

Reference

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LTER hosting environmental informatics conference

The LTER Information Management Committee and LNO join the National Center for Ecological Analysis and Synthesis (NCEAS), NASA, Oak Ridge National Laboratories, PISCO, NBII, and Evergreen State College in hosting "Environmental Information Management Conference 2008" at the University of New Mexico (UNM) September 10-11, 2008. The conference provides a forum for information management practitioners, scientists, and informatics researchers to present and discuss advances in environmental information management, analysis, and modeling. The conference theme is "Managing Sensor Data in Near Real Time," but there will be broad coverage of EIM topics. UNM previously hosted two successful EIM conferences: "Environmental Information Management and Analysis" (May 1993), and "Data and Information Management in the Ecological Sciences" (August 1997). Online registration and lodging information is available at *http://conference.ecoinformatics.org/index.php/eim/eim2008/*.

Shared cyberinfrastructure for earth observing networks

In February, Tim Kratz (NTL), Corinna Gries (CAP), and James Brunt (LNO) attended an invitational workshop organized by the National Science Foundation (NSF) to promote collaboration in cyberinfrastructure (CI) design, implementation, and maintenance between NSF-funded environmental observation networks (EONs) The networks attending included LTER, the National Ecological Observatory Network (NEON), National Phenological Network (USA-NPN), Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI), Water and Environmental Research Systems (WATERS) Network, Arctic Observing Network (AON), Ocean Observatories Inititiative (OOI) and EarthScope. The discussion between the EONs included overall goals and science questions, and the understanding that the CI needed to address those goals and questions. Each observatory gave a short presentation on their science objectives, CI architecture, and challenges. (These presentations are available at the workshop's wiki site, *http://roadrunner.lternet.edu/drupal/*, hosted by the LTER Network Office.) The presentations were followed by group discussions focusing on technology, standards, and the organizational structures

See "Metadata", p. 19)

Don't forget to read DataBits, the Information Managers' newsletter, online at www.lternet.edu.

(Metadata, continued from p.18)

necessary to bring about a shared CI vision, technology, data exchange, and interoperability.

Conference participants identified a wide variety of CI needs which span the existing and developing EONs. Common technological challenges include data accessibility, scalability, and interoperability. For example, participants expressed a need to discover and access stored data quickly, securely, and through an easy-to-use interface. There was also a desire for the CI to scale easily to larger data storage requirements, multiple geographic locations, and more complex data. Recommendations include the development of standard software interfaces, based on data exchange and metadata standards, and identification of services that could be shared and contracted for on the open market.

Participants identified a need for coordination across the EONs driven by common scientific and infrastructure requirements. They also identified increasing communication between the EONs and with the computer science community as a major organizational challenge, and recommended the formation of a federation of EONs to include PIs, Management, and IT participants to coordinate and advance activities of emerging and established scientific EONs.

The proposed Federation of EONs (or FEONs) will define and develop a strategy to provide a common set of standards that allows for interoperability among these developing and legacy observation networks. EONs share many science interests that require common standards and interoperability to enable researchers to easily access data from all EONs.

A workshop report is being prepared to outline the topics discussed and any action items arising from the discussions. A follow up workshop scheduled for May 2008 was to be hosted by the National Center for Atmospheric Research to discuss how the NSF might most effectively craft programs to support the creation and use of new CI capabilities to support environmental research and education over the next decade.

By James Brunt, LNO

NSF gives go ahead to microbial biodiversity survey and inventory

Moorea-water sampling: Professor Alice Alldredge, University of California, Santa Barbara, taking water samples with a Niskin Bottle as part of the water sampling of the Moorea Coral Reef LTER.

The National Science Foundation is funding a microbial biodiversity survey and inventory that will take place across all the major aquatic (marine and freshwater) Long Term Ecological Research (LTER) sites. Known as MIRADA (Microbial Inventory Research Across Diverse Aquatic) LTERs, the biodiversity survey and inventory will take advantage of the aquatic sampling locations that are part of the established LTER network. It will build on existing infrastructure for coordination at the Marine Biological Laboratory (MBL) in Woods Hole, MA, set in place by the Alfred P. Sloan Foundation-supported ocean realm project called the International Census of Marine Microbes (ICoMM).The MBL houses three of the principal investigators from a total of the 13 participating LTERs: John Hobbie (ARC), Chuck Hopkinson (PIE) and Hugh Ducklow (PAL), as well as Mitch Sogin (the lead PI) and Linda Amaral-Zettler, the Secretariat and Education and Outreach lead of ICoMM.

The MIRADA LTERs project will adopt ICoMM's 454-based rDNA tag sequencing strategy that allows extensive sampling of both common and rare microbial species and provides a common metric for integrating studies of microbial diversity across aquatic LTER sites. This strategy will not only enable cross-site comparisons, but also provide valuable baseline data for integrating population structures with ecosystem change, and understanding microbially-mediated trophic dynamics and biogeochemical processes – areas of study already underway at many of the LTERs.

Equally important, the MIRADA project will foster cross-site collaboration between participating LTERs and link into existing outreach efforts established as part of the Schoolyard LTER program. Metrics for charting scientific progress will include 1) production of molecular data for monitoring microbial diversity 2) publication of primary data by the participating LTER partners, and 3) release of data in a variety of formats for the wider community. These data will enable faculty and students to engage in collaborative projects and provide a mechanism to engage undergraduates and graduates students in working with data generated from an LTER location.

As part of a far-reaching outreach effort, MIRADA will coordinate with interested LTERs to develop podcasts that can be used by schools nationally to promote awareness of the importance of biodiversity maintenance, long-term ecological research and earth's ecosystems. This outreach effort will emphasize the participating LTERs in Polar regions (for International Polar Year 2007/2008) during the first year and will base its progress on success in targeting both economically and culturally diverse K-12 audiences.

The project and its products will be an important precursor to the emerging NEON Integrated Science and Education Plan. Participants will be invited to attend a general meeting and will be eligible for support for training their students in bioinformatics analysis of the resulting data. All DNA obtained from this project will be vouchered in collections at the MBL or the Ocean Genome Legacy. All data resulting from this project will be maintained in the MICROBIS database that serves as ICoMM's central database accessible through the ICoMM website. The data will also be linked to the webpages of individual LTER sites.

By Linda Amaral, MBL & McOwiti O. Thomas , LNO

(Observatories, continued from p. 8)

Currently the inventory includes a number of LTER and ILTER sites: Coweeta/USDA Forest Service; Andrews (the Detrital Input, Removal, and Transfer (DIRT) project); Konza; McMurdo; Sevilleta; Luquillo; and the Korean Long-term Ecological Research program at Mt. Jumbong.

The organizers have funding support for five yearly meetings from the National Science Foundation's Research Coordination Network Program and Critical Zone Exploratory Network, the United States Department of Agriculture, and Duke University.

An advanced-format website (*http://ltse.env.duke.edu*) supports the newly established network and connects more than 230 long-term studies with researchers, teachers, and students from around the world. This inventory is a community built ('opt in') list to which anyone (including the public) can post new LTSE sites. We encourage all LTSE studies to register their sites with us.

By Michael Hofmockel, LTSE, Duke University

Calendar

Coming Events of Interest to the LTER Community

JULY 2008

July 11-13: Regional LTER Symposium involving the Sevilleta, Jornada Basin, Central Arizona Phoenix, Niwot Ridge, and Shortgrass Steppe LTER sites. Department of Biology, Castetter Hall, University of New Mexico, Albuquerque, NM. For more information please contact *friggens@sevilleta.unm.edu* or visit *http://www.lternet.edu/meetings/*.

AUGUST 2008

August 17-23: International Long-Term Ecological Research (ILTER) Network Annual Meeting, Congress Centre Academia, Stará Lesná, Slovakia. For more information please contact Julius Oszlanyi (*julius.oszlanyi@savba.sk*).

SEPTEMBER 2008

September 8: LTER Information Management Committee meeting, University of New Mexico (UNM), Albuquerque, NM.

September 10-11: "Environmental Information Management Conference (EIMC), University of New Mexico (UNM), Albuquerque, NM. Theme: "Managing Streaming Sensor Data - Handling Large Quantities of Data in Near Real Time". For more information visit *http://intranet.lternet.edu/im/node/180*

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