Minutes of the LTER Executive Board Meeting
Arlington, VA
March 7-9 2007


1.      Introductions and attendees (Waide)

The meeting was called to order by John Magnuson at 9:10 am.

Attendees included all members of the Executive Board (except Phil Robertson, Morgan Grove, and Berry Lyons) as well as Henry Gholz, Phil Taylor, Penny Firth, and Alan Tessier from NSF and Peter Arzberger from the LTER National Advisory Board.

2. Announcements.

John Magnuson discussed feedback that he had received regarding EB letters to the Chairs of standing committees.

Bob Waide asked for changes or corrections to the minutes from the January 23rd, 2007 videoconference.  Only one correction was suggested, to delete "B. The meeting is adjourned" from the minutes.

John Magnuson requested additions or changes to the agenda.  None were forthcoming.

3. ISSE update (Scott Collins)

After introductions, Scott Collins provided an overview of the LTER Planning Process.  John Magnuson discussed the new governance structure of the LTER Network.

The ISSE document was submitted to Henry Gholz along with a cover letter on 26 Feb 2007. The document then flew around the BIO administration before Henry could talk to people.  Confusion arose because some at NSF were expecting an LTER Strategic Plan.  However, as we explained to BIO Administrators, the LTER strategy includes several concrete products: ISSE, a cyberinfrastructure review and plan, an education plan, TRENDS, new governance structure, and a detailed research plan.  TRENDS and the detailed research plan are still being completed.  In the meantime the ISSE document has been submitted to people at ASLO, ESA, AAEA, ERF, USSEE, AERC, and USFS for endorsements to be sent to NSF.

4. Conversations with Henry Gholz, Penny Firth, and Phil Taylor (Waide)

Questions for Penny:

What are unique fundamental theoretical advances that this proposal can make?
Will these be in the forthcoming LTER strategic plan?
What is LTER's unique role in this in this or any other construct?
Concerned that there is a separate cyberinfrastructure plan.
Are you guys really doing a strategic plan?
Do not include budget number in the research plan.

5. Discuss what we report to the National Advisory Board on the 8th in the afternoon.  (Magnuson & Collins)

Magnuson led a discussion of the organization of presentations to the NAB  We decided to give the NAB a more detailed report on the progress of the planning grant than what we did with NSF people.  We will emphasize our response to the recommendations contained in the last NAB report.  We will begin with an overview of the history of the activity and anticipated products.  We will emphasize that core elements of the planning activity were endorsed and supported by 10- and 20-yr reviews. Planning activities are explicitly designed as an add-on to existing activities. We are not abandoning the existing network and its goals. Barbara Benson will be on speaker phone to talk about cyberinfrastructure, and Magnuson will do Governance.  We will produce an overhead showing the relationship of elements in the LTER planning process. We ended with a discussion of the points that we want the NAB to consider.

We continued with a discussion of the questions that might come up in discussions with NSF.  The following questions were discussed.

How do we incorporate theory into our planning activity?

A discussion ensued about the meaning of theory in ecology, existing ecological theories, the implicit presence of theory in our planning diagrams, the importance of generality and prediction in developing theory, and the existence of two different approaches to developing theory.

What's the distinction between NEON/ORION and LTER?

LTER is an ongoing research program motivated by theory and research questions; NEON is an infrastructural program making measurements, some of which will be useful to LTER science.

When do you know when the research proposed under ISSE is done?

What is the timeline and what are the milestones?

Getting funded
Incorporation of social sciences

Working collectively across network to develop synthesis
Training the next generation of scientists

<u>Are you going to propose new LTER sites and what is the rationale for those new sites?</u>

We will propose new sites if we believe the research plan requires them.

6. Strategic planning items not in the ISSE or planning grant (Waide)

Waide led a discussion of additional planning elements that might be developed for the final planning document to be submitted to NSF. The discussion revolved around 10 areas that he had previously raised as potential topics for additional planning. After discussion, the EB decided to approach this issue by creating a series of ad hoc committees that would outline sections to be written for the planning document. Five topics were scheduled to be addressed for the May EB meeting. These were (with committee membership in parenthesis):

<u>Growth</u>  (Robertson, Collins, Peters)
<u>Communication and Outreach</u> (McOwiti, Elser, Andrews, ???)
<u>Increasing Diversity</u> (Grove, Johnson, Ohman)
<u>Facilitating Synthesis</u> (Magnuson, Waide, Groffman)
<u>External Relations</u> (Reed, Lyons, Hopkinson)

Five other topics will be addressed after the May EB meeting:

<u>Training</u> (Henshaw, Hopkinson)
<u>Technology</u> (Henshaw, Reed, Lyons)
<u>Funding</u> (Groffman, Ohman, Johnson)
<u>Metrics for evaluating LTER (TBD)</u>
<u>Informing Government</u> (Robertson, Collins, Grove)

From Mark Ohman:  While both the ISSE and the Cyberinfrastructure planning documents draw attention to the need to archive, curate, and provide access to electronic data, there is a parallel need for archives of physical samples which has not yet been articulated.  Properly archived physical samples of organisms (plankton, birds, insects, fish, plants, etc.), soils, sediments, and water, are of great importance for documenting the state of ecological systems at specific points in time.  In many cases it is of paramount importance to have voucher collections so that taxonomic identifications can be verified at a later date. Reference samples for trace metal, stable isotope, and other analytical chemical analyses are similarly important.  Specimen collections also permit genetic changes over time to be documented.  Numerous examples exist of the advent of new technologies which were not available at the time of specimen collection, but which can be applied retrospectively to properly archived samples in order to reconstruct temporal changes in organisms and associated ecosystems.  We

expect such specimen collections, in addition to electronic data archives, to be a valuable resource as well as an important legacy of the LTER research sites.

Planning for future network activities should include consideration of appropriate storage facilities for specimen collections as well as the construction of remotely queriable digital databases of specimen holdings.  Storage facilities in some cases need to be temperature- and humidity-controlled.  Compact mobile shelving is a very space-efficient means of archiving materials so that they can be readily accessed.  Physical bar coding of samples is often an efficient means to track inventories and usage.  Digital databases permit efficient management of collection holdings and provide a means for off-site users to canvas the resources available for cross-site comparative analysis of specimen-based materials.

7. Governance of the LTER planning grant (delayed discussion).

8. LNO Survey. (Groffman and Hopkinson)

The Executive Board (EB) is required to conduct an annual evaluation of the LTER network office (LNO).  The primary instrument for this evaluation over the past several years has been a survey that was developed by the LNO with assistance from a professional survey developer.  The purpose of the survey is to assess the performance of the LNO in providing services to the sites (and outside organizations) and to identify where additional help can be provided to the sites.  Groffman and Hopkinson spent some time reviewing the survey and presented a series of recommendations to the EB for improving the survey that were supported by the EB:

1. As the survey is to assess the delivery of services, it is essential that the sites know what those services are. The LNO should find mechanisms to better inform the sites of services provided by the office.  The EB recommended that Waide summarize LNO services at the various LTER sites all-scientists meetings, as he has done at several sites.  The EB also recommended that a listing and description of provided services be readily found on the LTER Network web page.
2. The LNO, perhaps again in consultation with a professional, should revisit the questions in the survey to be sure that they are focused on specific things that the LNO does.  Many of the questions are vague and it is not clear if the intent is to evaluate specific activities that the LNO does, or if the questions are based on suggestions made in previous surveys.  An example of some good questions is the list of questions about "outreach forums" in section V of the current survey.  The key here would be to get the questions more focused

on specific activities to make the survey more useful without making it more time consuming.

3. Questions should specifically indicate if the service/activity being mentioned is a response to a suggestion from a previous survey.
4. The response options should include something that allows us to assess awareness of the different services. Something like "I am not aware of this service."
5. We should provide more guidance about whom/how the survey should be filled out by the sites. There is concern that there is a lot of variability in the way that the surveys are handled by the sites and this reduces the value of the results. We suggest that the survey should be sent out by the Chair of the EB with the suggestion that it be filled out by the site Principal Investigator, the site Information Manager and perhaps one or two other interested participants.

For 2007, we used the same survey as last year, and the results will be evaluated at our meeting in Portland. The LNO should try to have a revised survey for the EB to consider by October 1, 2007.

Magnuson and Waide will work with comments from Hopkinson and Groffman to revise survey. Evaluation of LNO will take place on May 16

9. Plan the May Science Council Meeting (Robertson and Magnuson)

Format for the May SC meeting was discussed and consensus is to balance as best as possible the needs of the Ecological Services Workshop (planned for the day prior to the SC), NISAC (planned for the 2 days prior to SC), EB (planned for day prior to SC), Trends workshop (at SC), the Planning Grant Writing Team workshop (at SC), PAL and MCM science overviews (at SC), and the annual Business meeting (at SC). John, Bob, and Phil will work with Scott Collins, Steve Carpenter, and Deb Peters to work out an agreeable balance for working sessions; the main challenge is overlapping memberships of various groups.

10. Conversations with NSF persons about NEON and OOI - Liz Blood and Phil Taylor (Johnson)

NSF sponsored Observatories and LTER Network

Phil Taylor, Program director of NSF's biological oceanography program, shared recent news about ORION (Ocean Research Interactive Observatory Networks Program) that is part of the Ocean Observatory Network (OOI).

From the NSF web page: "A high priority within the Division of Ocean Sciences (OCE) at NSF is the development of technologies to support in situ observing systems to investigate ocean processes at appropriate temporal and spatial scales and to deploy these observatories at optimal locations to facilitate this

research.  Primary goal of this program is the development of technologies that will enable advances in the understanding of benthic boundary layer processes. The ORION program was established by NSF to operate and manage existing and future ocean observing sites, some of which will be constructed by the MREFC Ocean Observatories Initiative (OOI). The ORION Program will coordinate the science driving the construction of this OOI research observatory network as well as the operation and maintenance of the infrastructure; development of instrumentation and mobile platforms and their incorporation into the observatory network; and planning, coordination, and implementation of educational and public outreach activities.  Background information about the OOI and ORION Program is available at www.orionprogram.org."

Coastal Scale Observatories were reduced: Pioneer Array reduced, West Coast Endurance Array reduced to Pacific Northwest Array and East Coast Endurance Array omitted. No LTER sites have affiliation with these arrays presently

## 11. Discussions of NEON (Johnson)

Liz Blood, Program director, DBI, provided updates about NEON.
"NEON is conceived as a continent-wide research platform designed to extend the understanding of the biosphere to regional and continental scales. NEON will be a "shared use" research platform of geographically distributed field and laboratory research infrastructure connected via cyberinfrastructure into a continental-scale research instrument.  Status: NEON continues to develop its construction and operations plan in anticipation of construction commencing in FY 2007."

Major Research Equipment and Facilities Construction (NSF-MREFC) funds be used. Core sites have been chosen following RFI that went out last fall.  Themes are being developed for cross-site comparisons.  NSF will review progress of NEON, Inc toward meeting goals in May 2007. http://www.neoninc.org/

## 12. Athens Meeting Agenda (Robertson)

A tentative agenda for the April planning grant meeting in Athens has been worked out by John, Scott, and Phil and was discussed.  Two thematic breakout sessions will include the 7 themes identified as common from the feedback loops created by sites prior to the February STF planning group meeting (suburbanization/exurbanization; trophic structure, biodiversity, and invasive species; storms, large oscillations, and climate feedbacks; water availability, flooding, and sea level change; aquatic and marine/coastal eutrophication; working lands; and loss of the cryosphere).

## 13. Revisions of bylaws (Magnuson)

The new bylaws have worked very well, but we have not been able to follow them to the letter.  Some items should likely be updated and made more realistic. The Executive Board decided by consensus that modifications to the bylaws at this time were premature and that another year or two of experience with them should precede submission of recommended changes to the Science Council. Below I provide some comments on a few parts of the bylaws that may need modification after a bit more experience is gained.

Items that should perhaps be changed based on our experience since May 2006 include:

Article VII, Section 1.  General.  Annual committee reviews by the Executive Board are likely too frequent. Perhaps a two-year committee report and review process would be more workable and appropriate. In the meantime we could request a report from the committees at a two-year interval to see if that worked. The deadline for the last committee reports was approximately in October 2006. So perhaps spring 2008 would work? Alternatively we could request reports at 1-year intervals but only do a detailed review biennially.

Article V, Section 3 EB meetings. We have been unable to get the minutes of our Executive Board completed and approved within the 2-week window in the bylaws. This rapid turnaround has utility, but is difficult practically. We should continue to shoot for two weeks and push ourselves to meet such a deadline. Let's see what another year of experience reveals.

Article IV, Section 2.1 Chairperson. We chose an ad hoc nominating committee for the election of Chair of the Science Council and Executive Board at the Cedar Creek Science Council Meeting in May 2006. This worked very well and was well within the powers of the Science Council to form ad hoc committees as needed. However, the nominees were not funneled through the Executive Director of LTER Network Office and the Science Council to the ad hoc Nominating Committee for our Sept 2006 election. The committee solicited individuals to put their names in the ring – this is probably a realistic requirement. Thus, we have no record of the nominees and the list was reduced entirely by the ad hoc nominating committee. Vitae of the final two candidates were circulated to the Science Council immediately prior to the election. Seems as though we should expect the nominating committee to reduce the number to two or three persons to be voted on by the Science Council but that the entire list of nominees should be part of the record and solicited by some sort of general inquiry by the LNO director. I doubt that it is necessary to send vitae of all nominees to the entire Science Council. We may need to think this process through more thoroughly prior to the next election of chair.

Article IV, Section 3.  Meetings.  The science themes and scientific for the annual Science Council meetings. While this works at a general level, I found that the carry through to the next science council meeting and deviations from what the

Science Council approved a year earlier needed to be modified and shaped by the Chair.  We may want to recognize that in the bylaws as it would be rather awkward to get approval by the Science Council between meetings. Such changes could be at the discretion and judgment of the chair in consultation with the Executive Board and LNO Director.

Article VIII.  National Advisory Board.  The National Advisory Board (NAB) has become more active and wishes to meet at least annually. They have made a request to meet more often to review key documents at appropriate times, e.g., the strategic plan prior to our submission of it by September 30, 2007 to NSF. This raises several issues regarding the function of the NAB. Is it evolving towards becoming a review board or governing board rather than an arms length advisory board?  Meeting twice per year has both budget consequences and governance  implications. NAB meetings would be twice as frequent as the annual Science Council meetings and equal to the number of face-to-face meetings specified in the bylaws for the Executive Board. We should think about the implications of the evolution of the NAB.


14. Cyber Infrastructure Survey (Henshaw information item)

The results from the 2007 LTER Site Cyberinfrastructure (CI) Assessment Survey are now available on the LTER technology website under "New Items" at: http://www.lternet.edu/technology/.  These are the summarized raw results from the survey that was recently filled out by the LTER information managers in February-March.  All 26 sites participated in the survey.  John Vande Castle will be writing a summary report comparing this survey with the CI survey from 2005.


15. Cyberinfrastructure (CI) planning grant and strategic plan

The CI-Core Team (Brunt, Benson, Porter, Vande Castle, Henshaw) funded from a CI  planning grant is near completion of the CI strategic plan. Barbara Benson presented the CI planning process and the strategic initiatives that are included in the CI strategic plan to the NAB on 8 March. The goal is a completion date of May 1 for the strategic plan, with the CI-Core handing the document to the LTER NISAC for the future development of a CI implementation plan.  Comments from the broader community, specifically groups associated with this planning effort, will be solicited and included in an appendix to the final strategic plan.

EB discussion:

Peter Groffman (EB) shared several comments with the EB on the CI strategic plan:
- There should be an LTER-wide discussion of the LTER CI strategic plan and that buy-in from the broader community is essential

- Will NEON help solve some of the strategic initiative problems?  We want to avoid redundancy of effort with products that may emerge from NEON or the broader community.
- Is returned value vs. effort on CI development cost effective?  Certainly products such as the LTER metacat stemming from EML development is a valuable product, but will future effort and increases in CI capacity bring cost effective rewards.
- The Trends project is seen as a real CI test bed for LTER data integration.
- The importance and need for sample archives was stressed by Mark Ohman and a section on sample archives will be added to the CI strategic plan.

16. Trends (Peters)

An update was provided by Peters on the Trends project. A recent trends editorial committee meeting was held in Las Cruces that helped clarify the format of the book and the individual graphs. A short draft of the book was presented that was also given to Jim Collins, Penny Firth, and Henry Gholz. We are in negotiations with Peter Prescott at Oxford University Press and expect to sign a contract soon. The book is expected to be submitted to Oxford by late summer 2007. The web page is also under development. Henry notified Peters that he approved the Trends supplement request so we should receive the money soon. No amounts were given by Henry, although we are assuming he funded the entire amount supported by the LTER EB (ca. $150,000 JRN; $100,000 LNO).

17. IM, GIS, Remote Sensing, Technology, Climate. (Henshaw)

**Background:** The potential broadening of the focus of the Information Management Committee (IMC) to include the activities of the GIS/RS working group and Technology Committee was discussed in a directors' meeting at the LNO.  The LNO discussion of "reinventing" or merging of IMC with other committees was stimulated in light of 1) the suggestion from the IM committee to create a separate GIS/RS committee, and 2) the discussion within the EB about the possibility of eliminating or combining the Technology and Climate Committees. The goal of the LNO internal discussion was to examine ways in which the function of the various committees could be maintained even if the committees themselves were abolished by the EB.  It was driven in part by several factors including the considerable overlap of focus and participants among some of the standing committees, the availability of resources to meet, the new availability of videoconferencing tools, recent dips in activity in several committees, and the perception that the different committees were working independently rather than interactively. The LNO discussion considered that this broader committee focus would better allow for achievement of integrative science as put forth in the ISSE, and allow for coordination of activities across these groups. Thoughts from this discussion were conveyed to the IMExec (IM

Executive Committee) during a conference call in December, 2006 and to the Executive Board during a VTC in January, 2007.

Building on ideas generated from this LNO discussion, the IMExec Committee considered potential scenarios for combining and governing the IM, GIS/RS, and Technology committees (Albuquerque, 13-14 February 2007) and considered ways in which the annual IMC meeting could be reorganized to accommodate this broader focus and participation. The IMExec received considerable feedback after presenting this discussion summary to the entire IMC email list, an inclusive list of LTER information managers and related specialists and interested scientists. While the feedback on the proposed merging and governance of these committees was highly variable, there was considerable interest in better incorporating spatial data management and improving collaboration with spatial data specialists, particularly in continuing and evolving the efforts of the GIS/RS working group. The GIS/RS working group is an LTER ad hoc group primarily focused on GIS data management.  This group was self-organized at the 2000 ASM, and has used subsequent ASM meetings and a meeting at the SDSC to begin to draft spatial data standards for LTER, survey LTER sites on GIS capabilities, and plan future workshop activities.

**IMExec summary:**
The EB IM representative (Henshaw) presented the following IMExec summary of committee reorganization:
- The Information Management Committee (IMC) would expand to include the GIS/RS working group and the Technology committee, and would be open to the addition of other people and areas of interest as necessary (e.g., social science, climate).
- The IMExec steering committee for the IMC would continue to guide the broader committee and would assure that a member from each of these new groups is represented on IMExec.
- GIS/RS and Technology would become standing working groups within the IMC and continue to advance projects/products in the proven self-organizing working group style.
- The annual IMC meeting would include one IM per site and representatives for GIS/RS and technology with interests pertaining to information management in those areas (plus invited guests from the larger eco-informatics community).
- The IMC meeting would be restructured to assure efficient information exchange in a larger group while at the same time being open to new eco-informatics challenges (e.g. three days with separate working groups (workshops or symposia), presentations, panel discussions, posters and demonstrations, and business meeting).  An annual meeting is preferred.

**Discussion bullets:**
The success of the Information Management Committee (IMC) in developing standards, assuring minimum standard installations at all sites, and the valuable

role in training and informing new site information managers of LTER is not in dispute.

With regard to the establishment of GIS/RS as a standing committee: Formal committees should not be established without a specific intended purpose, and the EB is generally interested in downsizing committees.  The ASM is the major mechanism for broadening group interaction. Should science drive the need for a standing GIS/RS Committee, the proposal for establishment should come from site PIs. The EB does not see the need for establishing an independent GIS/RS committee and suggests that issues related to management of spatial data would best be handled within the context of the IMC.

With regard to the continuation of Technology as a standing committee: The Technology Committee report suggested that Technology be merged with the IM or another committee to reduce the redundancy of effort.  The EB questioned the need for continuation of Technology as a standing network-level committee; however the critical importance of new sensor arrays and sensor technology is recognized. Consideration of new sensor technology issues including managing and quality assurance of sensor streaming data should be a part of the IMC responsibility, and is the primary technology that should be actively addressed by the IMC. The LNO will assume other former technology committee responsibilities.

The IMC should plan to assume these additional responsibilities. The resolution of governance issues and meeting format should be resolved by the IMC.  There is no need to present the new organizational structure to the EB for approval, but the details of any reorganization should be provided in the next annual report.

Neither of the motions passed by the EB mentions nor requires larger meetings, although the addition of some GIS/RS capability is certainly implied. The caveat to holding broader and more inclusive IMC meetings is available funding. The IMC should determine whether additional funds would be required for the larger meetings, and if so these funds would need to be requested from LNO. Currently, there is a fixed annual budget for the IM/IMExec Committees (currently $32K). Potentially, the IMC can take responsibility for allocation of this funding for meeting use within the constraints provided by the LNO.

The use of videoteleconferencing (vtc) in lieu of actual travel or more expensive teleconferences is encouraged. The LNO will set up sessions as needed (e.g., IMExec, spatial data working group, etc.). Plans to acquire and provide vtc equipment to all sites is under discussion.

PI participation at annual IMC meetings is considered important to staying in better communication with science issues. The notion of a specific theme (e.g., GIS issues) for the IMC meeting was well received. Regular annual meetings are considered important.

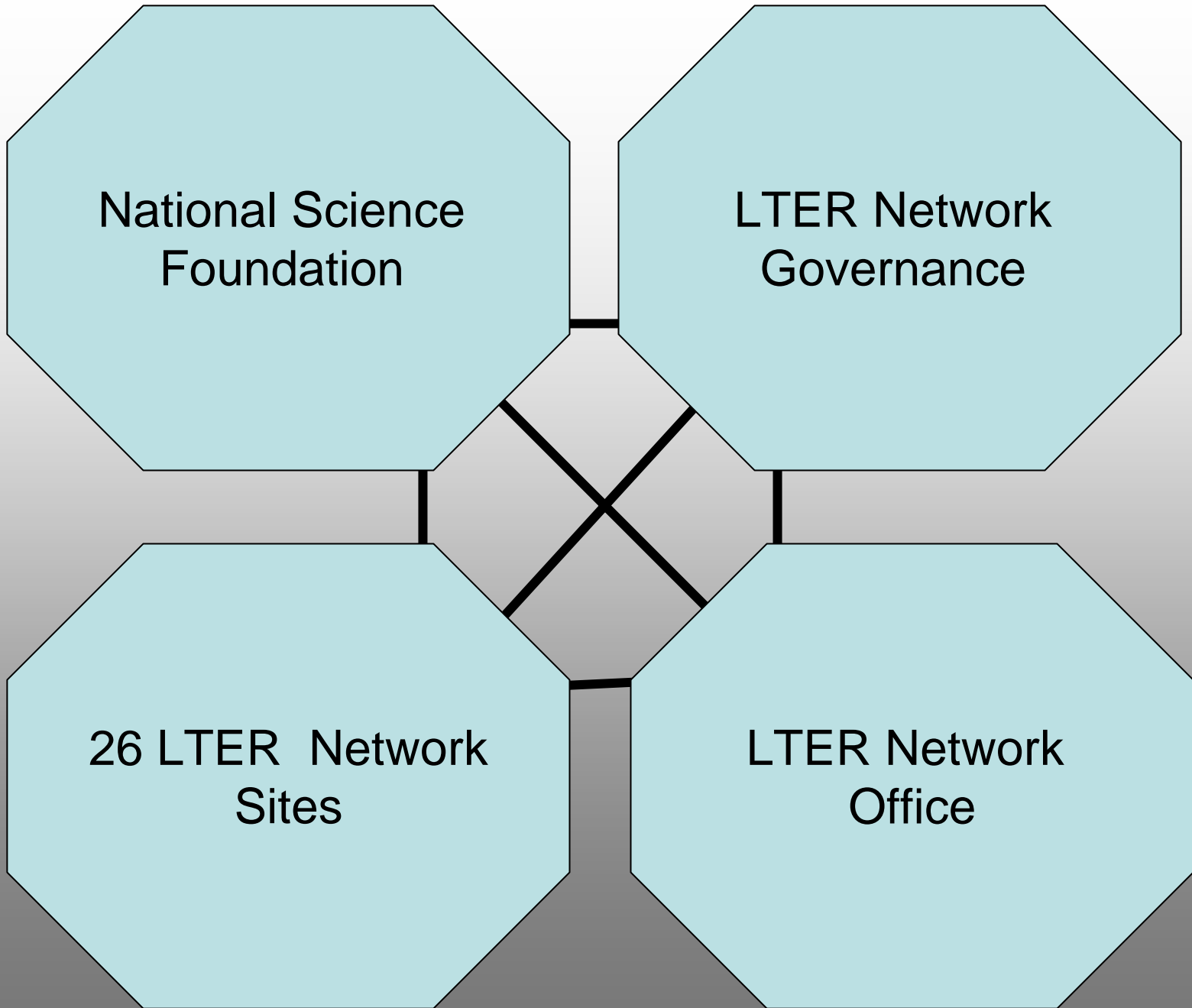**The following motions were passed unanimously (6-0)**

**Motion:** Move that responsibilities of the IM Committee will include spatial data and data from sensor networks, and the IM Committee will self-organize to accomplish this.

**Motion:** Move that the Technology committee be disbanded and that former Technology Committee duties will be assumed by the LNO when needed, such as to assess technology needs, etc.


18. Next steps for the planning grant.  (Scott Collins)

19.  Report from Waide sabbatical

Bob Waide gave a brief report on the outcome of his three-month sabbatical, which was spent in Puerto Rico interacting with scientists from the Luquillo LTER site.  The primary objective of these interactions was to re-start efforts to complete the Luquillo volume for the Oxford series.  Waide completed a co-authored chapter for this book, read and edited all other chapters, and stimulated decisions regarding the completion of the book.  The outcome of these efforts was the submission of the first five chapters of the book for friendly review, with the other three chapters to follow shortly.  Completion of the book is anticipated before the end of 2007.

National Science Foundation
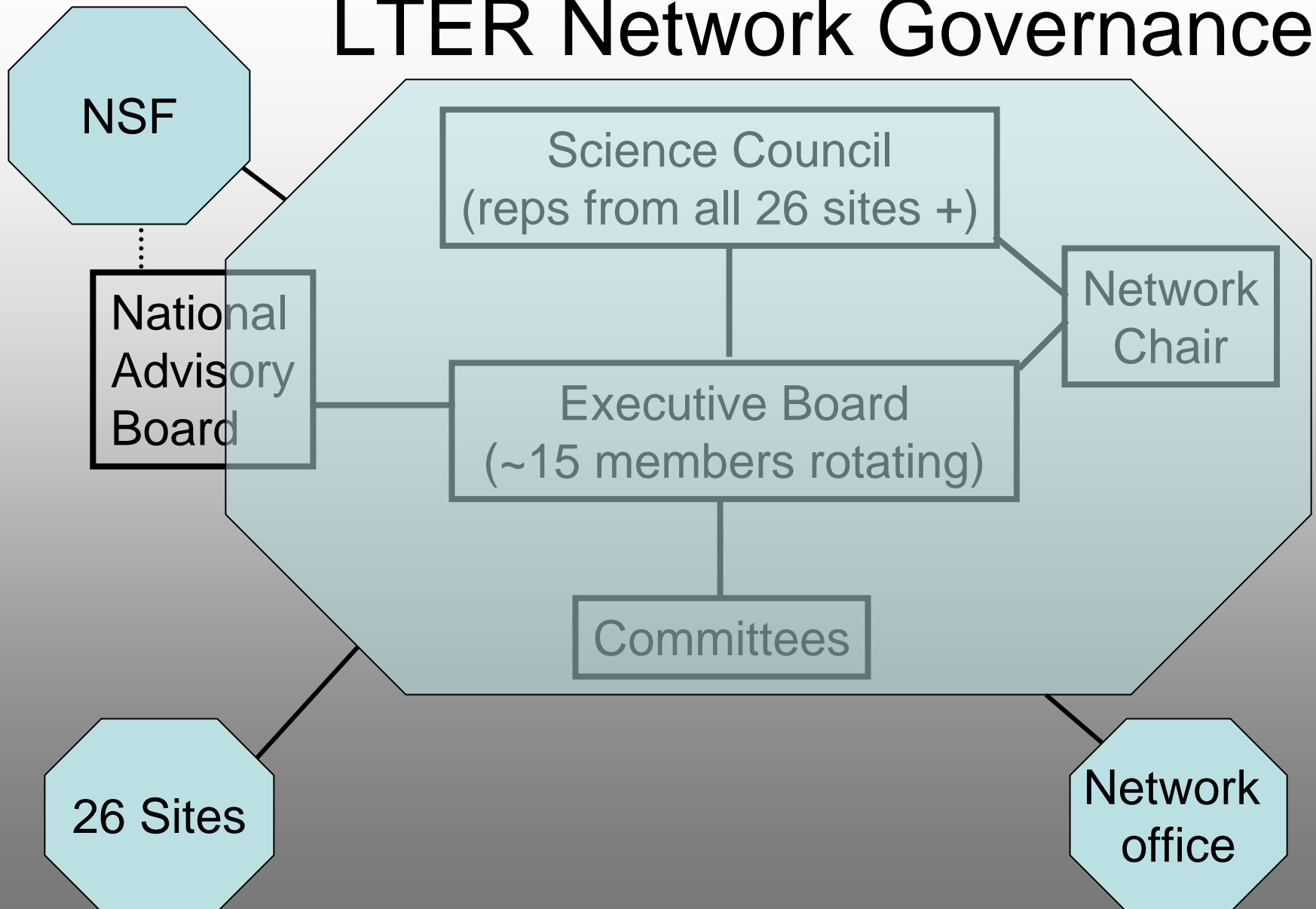
LTER Network Governance

26 LTER Network Sites

LTER Network Office

NSF March 9, 2007

# LTER Planning Grant

**To produce LTER**

**Strategic Plan for Long-term, Intersite Transdisciplinary Science**

Research

Cyber-infrastructure

Education

Larger Context ISSE

Governance

Trends Project
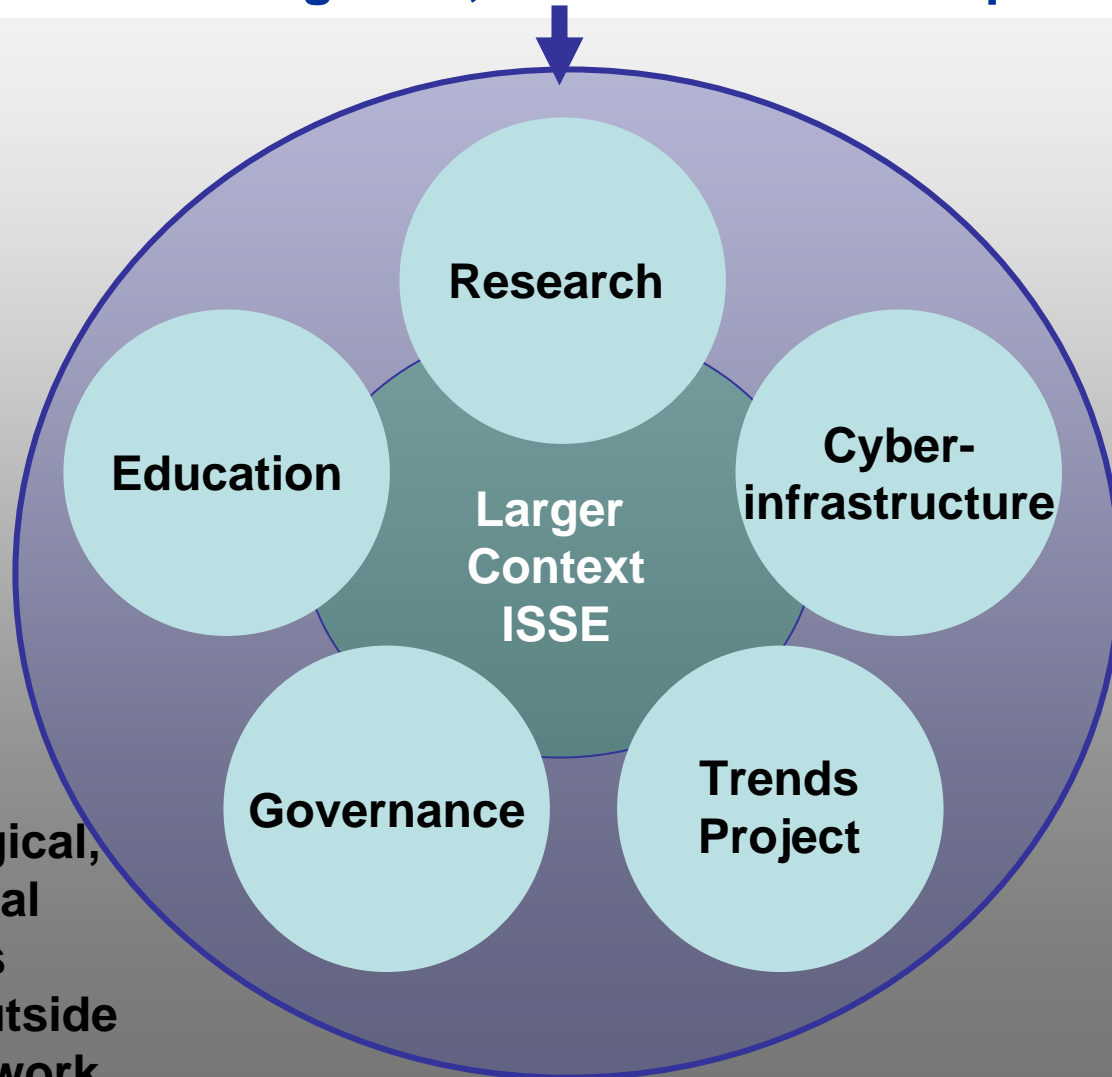
**Involved social, ecological, and physical scientists from in and outside the LTER network**

# LTER Network Governance



NSF

Science Council
(reps from all 26 sites +)

Network
Chair

National
Advisory
Board

Executive Board
(~15 members rotating)

Committees
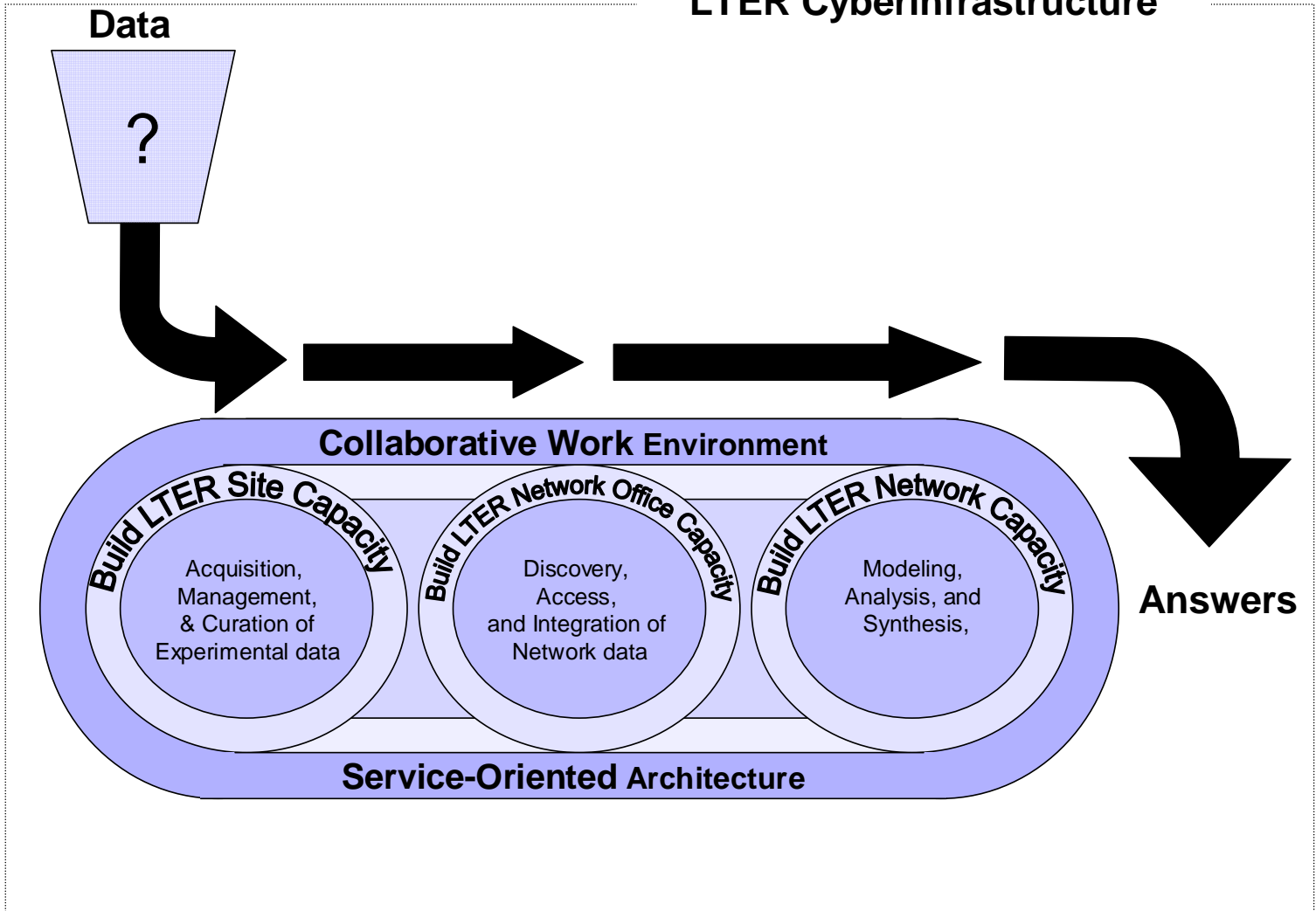
26 Sites

Network
office

NSF March 9, 2007

# Cyberinfrastructure Planning within the LTER Network Planning Grant

**Barbara Benson**
**James Brunt**
**Don Henshaw**
**John Porter**
**John Vande Castle**

# LTER Cyberinfrastructure Strategic Plan
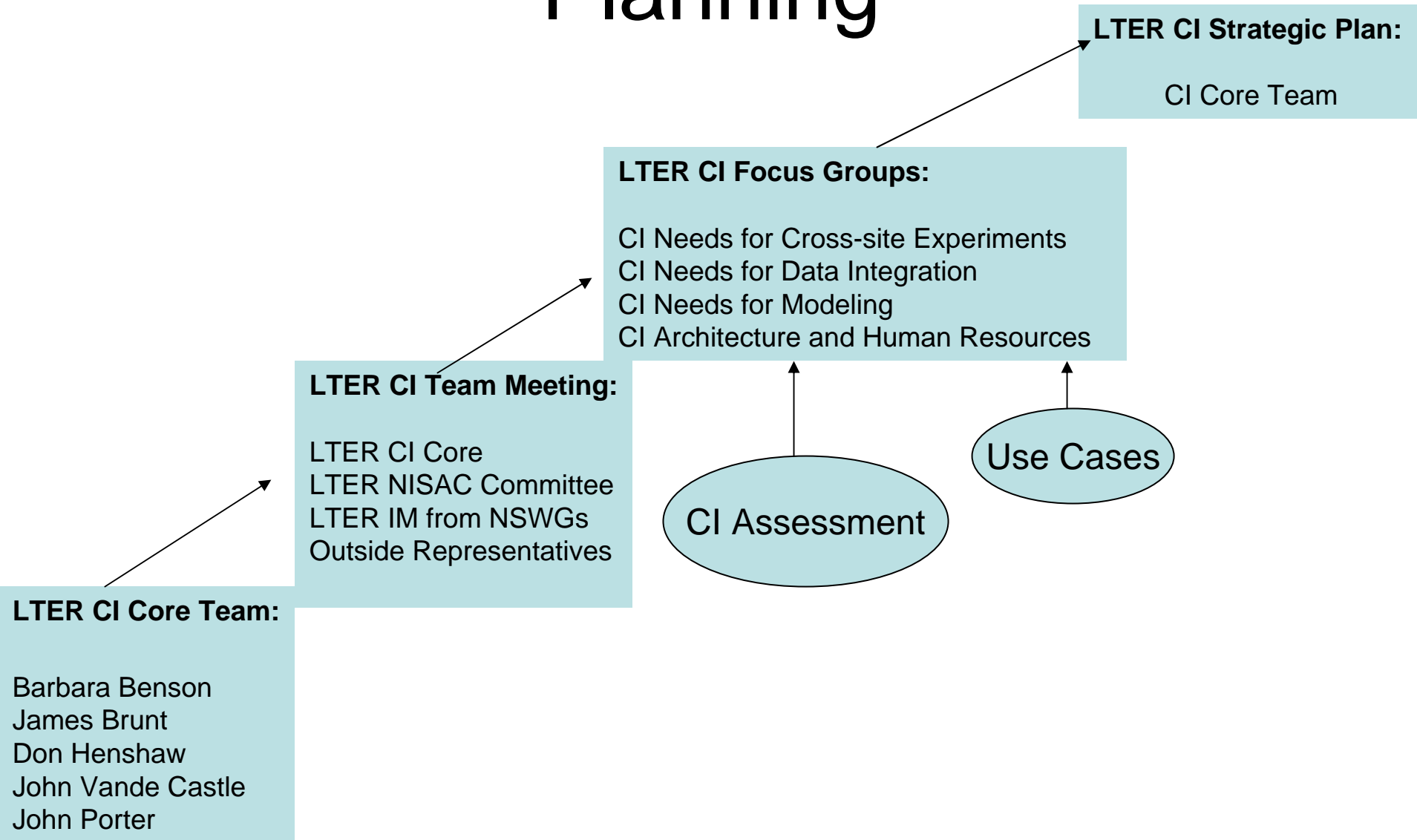
# Cyberinfrastructure (CI) Planning Process

- engaged computer and information scientists to address the new integrative challenges presented by the expanding spatial, temporal and interdisciplinary scope of LTER network science

- provided cross-fertilization between LTER CI planning and that of other concurrent efforts within and beyond the ecological science community

# LTER Cyberinfrastructure Planning

**LTER CI Strategic Plan:**

CI Core Team

**LTER CI Focus Groups:**

CI Needs for Cross-site Experiments
CI Needs for Data Integration
CI Needs for Modeling
CI Architecture and Human Resources

**LTER CI Team Meeting:**

LTER CI Core
LTER NISAC Committee
LTER IM from NSWGs
Outside Representatives

Use Cases

CI Assessment

**LTER CI Core Team:**

Barbara Benson
James Brunt
Don Henshaw
John Vande Castle
John Porter

# LTER Affiliated Groups in LTER CI Planning

- **CI-Core**:  Barbara Benson, James Brunt, Don Henshaw, John Porter and John Vande Castle

- **LTER Information Managers**:  Corinna Gries, Kristin Vanderbilt, Karen Baker, Ken Ramsey, Jonathan Walsh, Don Henshaw, Barbara Benson, John Porter

- **LTER Network Information System Advisory Committee (NISAC)**: Barbara Benson, Emery Boose, James Brunt, Stuart Gage, Mark Harmon, Don Henshaw, Tim Kratz, Peter McCartney, William Michener, Debra Peters, Robin Ross, Mark Servilla, John Vande Castle, Robert Waide

- **LTER Principal Investigators**: Stuart Gage, Mark Harmon, Tim Kratz, Debra Peters, Robin Ross, Paul Hanson, Hank Shugart

# Associated Groups in LTER CI Planning

- **Chaitan Baru (GEON/SDSC, NEON)**
- **Kai Lin (GEON)**
- **Bryan Beecher (UM/ICPSR)**
- **Mark Schildhaur (NCEAS)**
- **Chris Jones (PISCO)**
- **Mandy Lane, Herbert Schentz (ALTER-Net)**
- **Bob Cook, Tim Rhyne (ORNL/NASA)**
- **Peter Cornillon, Nathan Potter (OPeNDAP/OGC)**
- **Mark Stromberg (OBFS)**
- **David Maidment (CUAHSI)**
- **Mike Freeman (NBII/NCSA)**
- **Gordon Bonan (NCAR)**
- **George Hurtt (UNH EOS)**
- **Peter Franks (SIO/CCE LTER)**
- **Jennifer Eakins (SIO IGPP, RoadNet)**
- **Michael Piasecki  (Drexel OWL, CUAHSI)**
- **Patrick Mulholland (ORNL/ESD – LINX)**
- **Michael Hamilton (CENS/James Reserve, NEON)**
- **Shawn Bowers (DAKS/UCSD)**

# Strategic Initiatives to Develop LTER Cyberinfrastructure

# The Glue That Holds It All Together
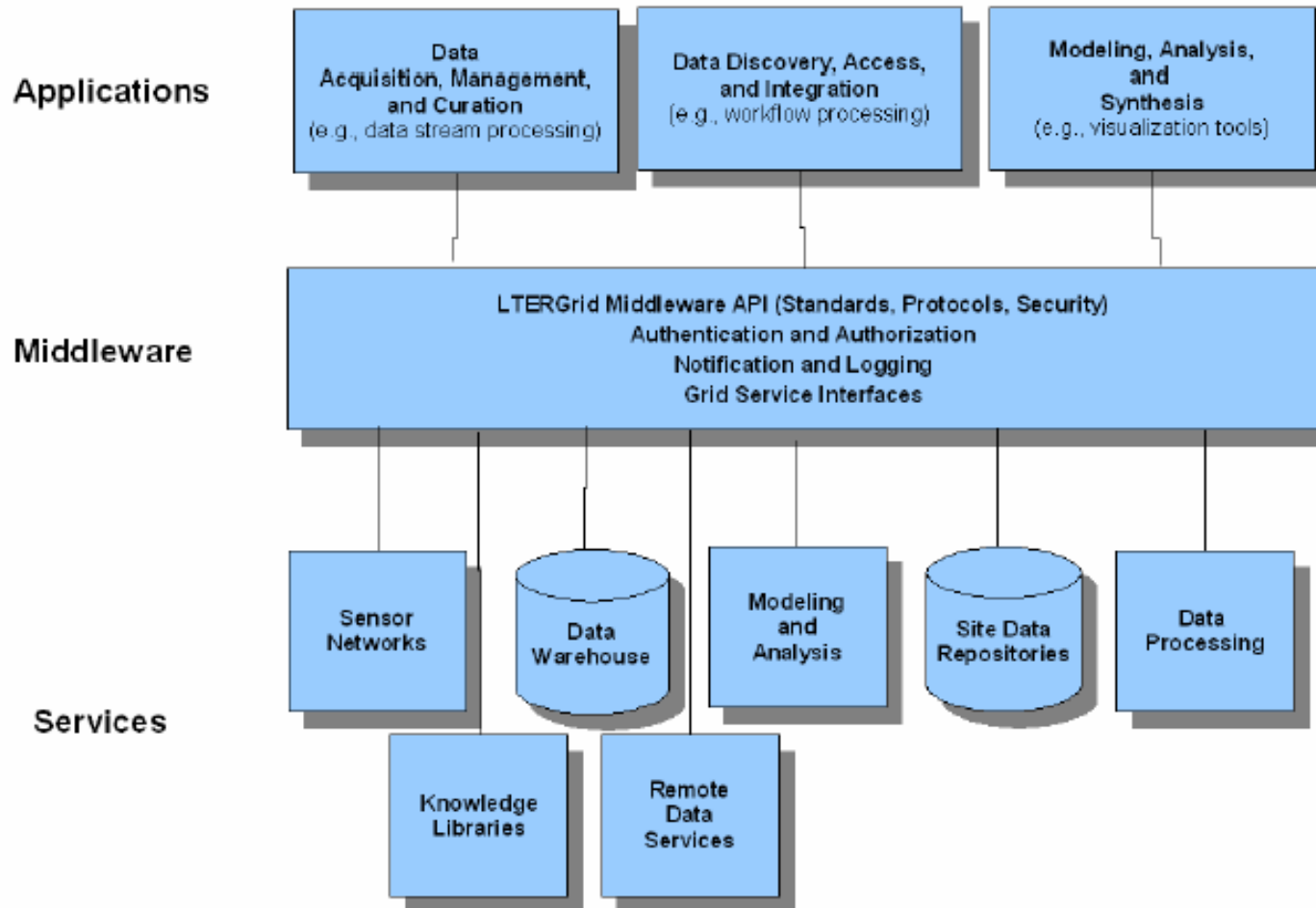


Build community-based services and service-oriented architecture (SOA)

# grid-based services envisioned for the LTER CI

- Will provide data services that ensure secure and efficient access to data stored in site data repositories and computational services for numerically demanding analyses and models, for large-scale multi-site experiments that include sensor networks, satellite sensors, and high performance computing, all through a secure, fault-tolerant, and seamless process

- will require prototyping community integration through a grid "Point-of-Presence" (PoP) model that will provide an interface between the LTER resources and other resources interconnected to the LTER Grid via an Internet2/National Lambda Rail connection

# required resources and partnerships

- Support for key partners to work collaboratively with LTER sites and the LTER Network Office in developing and providing community-based services (e.g., NCEAS)

- Support for integrative software developers and programmers at the LTER Network Office

- Support for LTER site participation in development, deployment, and use of community services

Increase CI capacity for data acquisition, management, and curation

Sevilleta LTER

# challenges

Data collected and managed at LTER sites form the foundation for science at the site, muti-site and network levels.

- New integrative science will demand ready access to online, fully documented data across sites.

- Embedded sensor networks using wireless technologies provide data at new temporal and spatial scales and constitute a new capacity for generating data.

- Maximizing the throughput of high quality data from field collection to secure storage to centralized access portals is a necessary requirement for supporting synthetic and integrative science.

# required resources

- site staffing to support a network information system and maximize throughput of high quality data, may include network administrators, information managers, programmers,sensor technicians, cross-trained specialists in satellite, sensor, and spatial data
- site computing technology to implement persistent data services, such as hardware, mass storage, software, and sensors
- LTER Network Office staffing to coordinate development and deployment of standards and web services for site data delivery and site staffing for implementation of services and standards.
- training site and Network Office staff in new technology

**searchable data catalogs**

**multi-site experimental data**

**post-collection data integration**

**ongoing value-added data products**
**ClimDB**
**Trends website**

Increase CI capacity for data discovery, access, and integration

# approach for enhanced data discovery, access and integration

- Will require development of innovative prototype systems utilizing data warehousing and distributed query systems
- Needs to be linked to research in applying knowledge representation and semantic mediation approaches to harmonizing heterogeneous data

# required resources

- LNO staffing to design, prototype, and implement a network information system to integrate site data services
- Site resources to implement wrappers for site data to conform to specified global schemas necessary for single point of access architecture to LTER site data for specified sets of queries
- LNO staffing to provide analytical and technical support for sites in implementing network standards and for the network in utilizing the network information system
- Funding for collaborative research and working groups on mediating data heterogeneity through knowledge representation and ontology development
- Equipping the LNO to develop and deploy the network information system – may require adding persistent computation infrastructure in the form of mass storage, computing resources
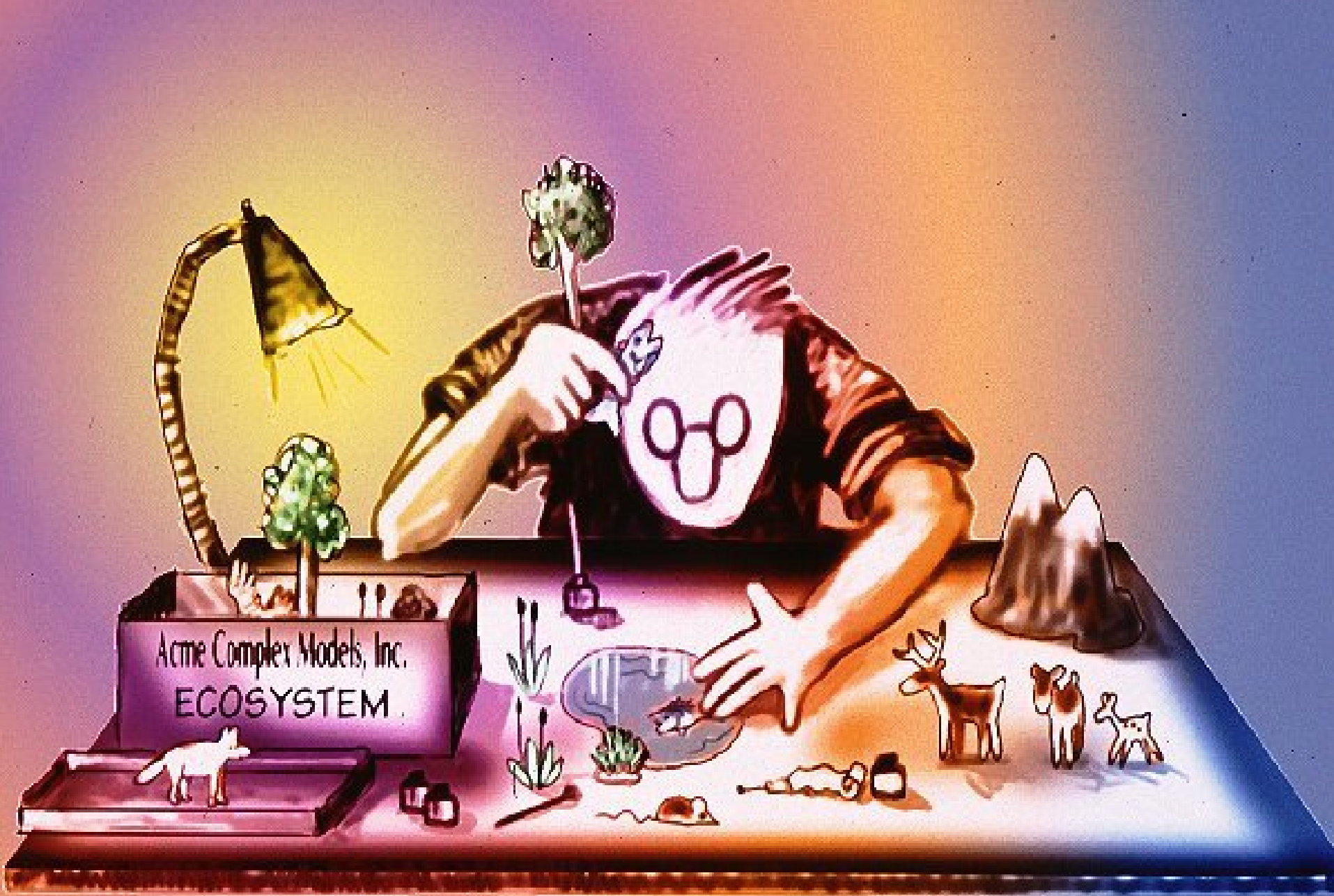
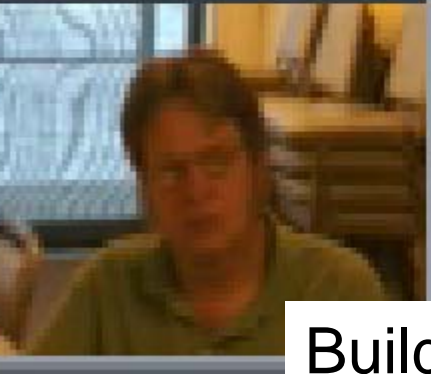Build CI capacity for increased modeling and analysis activities

# approach for increased modeling and analysis capacity

Goal: organize and direct computational support of analysis and modeling related activities and identify and collaborate on the development and integration of new analytical tools.

- Scalable computing resources
- Advanced analytical environments
- Community-based repository for environmental data products and models

# required resources

- Staffing (e.g., programmers, software developers) and increased funding for scientists both at individual sites and at a centralized location that focuses on network-level analysis and modeling activities

- Access to computing services including new hardware technologies, high performance computers, parallel processors, and high storage and high throughput capacity

- Funding for collaboration on software development, including visualization tools, software to link models with different programming languages and the multiple control of linked models, data- and model-based management tools, and network-wide site licenses

- Equipping the LNO to develop and deploy a persistent archive of data and models –may require adding persistent computation infrastructure in the form of mass storage and computing resources

Build capacity for increasing collaboration

# approach to facilitating the increased need for research collaboration

- procuring and deploying video-conferencing and network technology for immediate use

-  codeveloping and deploying a framework for collaborative work environments

-  the development and deployment of analytical tools within that framework

-  collaboration with socio-technical scientists in order to build effective frameworks and learn from our efforts.

# required resources

- Staffing for software development and programming of collaborative work environments
- Funding for procurement of video-conferencing technology
- Staffing for software development of integrated analytical tools
- Funding for procurement of enhanced network infrastructures

Integrating CI into socio-ecological research, education, and training

# Approach to training

- Provide training in new technologies and methods to information managers and technical professionals who are engaged in data acquisition and management at LTER sites
- Provide training in the use of advanced informatics tools to natural and social science students and scientists who are engaged in LTER research
- Maintain a cross-trained cadre of information managers who can be quickly deployed with a standard curricula and training materials for working with LTER colleagues and collaborators
- Develop educational materials tailored to video-teleconferencing, web-based seminars, distance learning, and other paths by which informatics training for can be conducted remotely

# CI development for education/outreach

- Distance learning technology (e.g., webcasts, linking classrooms, etc.), used routinely in undergraduate and research settings must address issues of insufficient infrastructure and technical expertise in the K-12 environment .

- Research databases must be tailored to achieve pedagogical goals and must work with educational technology infrastructure.

- Embedded resources, such as guides to support student inquiry, interactive learning components, and more engaging graphic interfaces would support the learning community.

- Tools and databases for educational research would help to integrate the science education research community.

# next steps

- Implementation plan to be developed by the Network Information System Advisory Committee
  - Will include timeline and budget estimates
  - A subcommittee is working on site requirements.