To: Participants - LTER All-Scientist meeting

From: Bill Lauenroth

Date: September 10, 1990

Subject: Agenda for the workshop on using simulation models in cross-site analyses.

This is the workshop on September 29 identified as cross-site analysis of models on the sign-up sheet. The pessimistic objective for the workshop is to generate discussions about using simulation models as tools in cross-site anslyses. The optimistic objective is to generate discussions about how to extend the current group of cross-site analysis projects to include new sites and new questions. The format will use short presentations of current activities as vehicles to generate discussions about new projects.

10-10:10am Introduction of the workshop and objectives

10:10-10:10:40 Analysis of grassland ecosystems
Individual-based model (STEPPE) Debra Coffin
Holistic model (CENTURY) Bill Parton

10:40-11:10 Analysis of forest ecosystems
Holistic model (GEM) Gus Shaver
Individual-based model (ZELIG) Dean Urban

11:10-noon Discussion

Stream Processes Workshop at LTER All Scientist Meeting
September 1990
Judy Meyer, organizer

About 40 people gathered to discuss what we considered burning questions in stream ecology and whether the network offered a series of sites to use in answering these questions. Four action items arose from these discussions, and from the smaller working groups that were organized during the discussion.

1) Catalog of streams at LTER sites.

When designing a research project, one often needs sites with particular attributes, e.g. low or high alkalinity, pH, gradient, etc. We felt that a catalog listing basic attributes of the streams at each site would serve the needs of individual researchers, stimulate and facilitate intersite research, and stimulate researchers outside LTER to use our network of sites to answer their questions. A small working group (Judy Meyer, Stuart Findlay, Cathy Tate, Donna D'Angelo, Mack Oswood, Liz Blood and Dale Toetz) met and developed a short questionaire that will be sent to the sites with streams. Judy Meyer and Stuart Findlay will compile these data and make copies available to all interested people (including the network office!).

2) Symposium at NABS meeting in May 1991.

During the workshop discussion we began describing the conceptual basis of stream research at our sites; but it soon became apparent that even at 5 min./ site this would consume all our available time, so we dropped it. Yet if we are going to function as a network, we have to know what is going on at the other sites, so Judy Meyer (with help from Cliff Dahm, program chairman for NABS) will put together a session at the NABS meeting that will allow each site 20 minutes to describe their stream program. This session will serve not only to inform ourselves, but also to let the outside world hear about opportunities for research at LTER sites. We also plan a half day workshop for LTER scientists at that meeting to discuss plans for intersite projects and comparisons.

3) Working group on interfaces.

One of the burning questions we identified was the role of interfaces in controlling stream processess, particularly the riparian and hyporheic interfaces. A group organized by Cliff Dahm got together to discuss new methodologies and to compare what research each site was doing in this area. This is a topic we will pursue further at the workshop at NABS in May.

4) Macroinvertebrate control of leaf decomposition in streams.

A subset of the larger group met later in the meeting to plan an intersite experiment to determine if there are latitudinal gradients in macroinvertebrate control of leaf decomposition in streams. The group was composed of Judy Meyer, Stuart Findlay, Julie Hamrock, Cathy Tate, Mark Oswood, John Bryant, Alan Covich, Donna D'Angelo, and Fred Benfield. Although we were able to plan most aspects of the experiment, a good method for excluding macroinvertebrates needs to be developed. Judy Meyer has an idea she will pursue with the aid of a SGER grant (hopefully). When a suitable method is developed, a proposal to use this method to address the question of latitudinal gradients in macroinvertebrate control of leaf decomposition will be developed.

Draft, Decomposition Workshop Proceedings
LTER All Scientists Meeting
September 25-30, Estes Park, Colorado

(Draft sent to Jerry Melillo, from Mark Harmon. Not yet sent out to group.)

summary prepared by Stephen C. Hart

The initial discussion centered around a description of the intersite fine litter decomposition experiment. This study was designed at a workshop held in Wood's Hole in 1989. The experiment is currently being installed in the field at 17 LTER sites, and four others (21 total). The experiment will have a 10-year study duration and be sampled annually except for tropical sites where faster decomposition will require a three-month sampling interval. Nine standard litters (6 leaf, 3 "fine" root) are being placed at each site; these species vary in N and lignin content (a graph showing this was handed out). The concept of using "wildcard" species to check the results from the for standard litter discussed and has been incorporated into the design. Wooden dowels (same for all sites) are also being placed in the soil at each site to get an idea of site effects on woody debris decomposition.

The discussion then turned to general character of a proposal to be send to Ecosystems NSF December 1990 panel. Of particular concern was how all the participants would get credit for their contribution. After discussion following the workshop, it seemed reasonable that only a few (three-four) investigators would actually submit the proposal. However, all the participants would be identified as part of the research team. A suggested name for the team was the Decomposition Intersite Experiment (DIE). All suggestions for names are welcome. Harmon stressed that only one primary contact should be identified for each site (so-called designated hitter). All participants, present and potential were asked to send a letter to Mark Harmon once a rough proposal draft is received the affirms participants plans tocollaborate over the long haul.

Funding will be sought to run the experiment, cover the costs of sample processing and chemical analysis and hold a workshop for the first five years of the experiment. A preliminary estimate of costs, excluding workshops, run 30-40 k/year. Some expressed doubt the experiment could be held down to these levels, therefore a detailed budget needs to be developed. None-the-less, participants agreed in principle to the notion that each site would provide support to harvest the samples, and provide background data and that the only costs to be recovered will be those of chemical analysis, data management, etc not currently covered.

A rough schedule for the preparation of the proposal was discussed. A rough draft will be sent out to all participants by mid-November, and a final draft will be prepared by the first week of December. A small workshop involving the modeling aspects of the proposal will be held at Wood's Hole in November.

Another group concern was data sharing and authorship. The following guidelines were discussed: 1) Each site will receive the data for their site and has priority on this data for one year after receipt from the central data bank at Oregon State University. 2) Small groups of sites will be free to publish smaller syntheses, a good example may be the tropical sites which will have work completed prior to the other sites. 3) Team syntheses papers using all the data were planned to summarize findings one, five, and 10 years.

Although 21 sites are involved, there was concern that some major situations are currently not represented. Addition of six-seven new sites would be possible with additional funding. Other sites to be proposed for establishment in the future included: 1) Dry tropical (Ariel Lugo, Puerto Rico), 2) Tropical Cloud Forest (Nalini Nadkarni, Costa Rica), 3) tropical grassland, 4) tropical seasonal dry forest (Joe Wright, Panama), 5) mixed-conifer with Mediterranean Climate (Steve Hart, Sierra Nevada), 6) cold desert (Jim MacMahon, Utah), 7) subalpine forest (Jill Baron, Colorado), and 8) cold temperate rainforest (Paul Alaback, Juneau, Alaska). Addition of wetland sites was also discussed, but these concerns may be addressed by the stream decomposition experiment also being planned by Judy Meyer, et al.

As with the original workshop at Wood's Hole it was decided that most wet chemical analyses would be made at one central laboratory. The location of this laboratory is uncertain at this time. Although the methods of analyses need to be explicitly worked out the following parameters will be measured: total

Kjeldahl nitrogen and phosporus; polar and non-polar extractives; cellulose and lignin; and ash. Samples of all materials will be non-destructively sampled for nitrogen, cellulose, and lignin content using near IR reflectance system being developed by John Aber. These measurements will be calibrated using the wet chemical information. Additional analyses suggested were total S, cations, and carbon. A need to permanently archives samples somewhere was noted as not all potential analyses can be run, or even thought of at this time. Tom Siccama offered to use the JARS system at Hubbard Brook, if no other home could be found.

In addition to analysis of the litter itself, some of the models will require knowledge of the nutrient (particularly nitrogen) availability at the sites. A resin core system was suggested as a system that would be inexpensive and that would yield useful information integrated over a period as long as one year.

The idea that short-term litter dynamics study be included in the experimental design was suggested. However, this received little support from the group. Sites with particular interest in this area were encouraged to develop their own studies.

Finally the need to decide what climate indices to use for characterizing sites was discussed. It was clear that mean annual values would not distinguish seasonally distinct climates. A related concern was the degree MET stations would be located near each of the four replicate litterbag sites. If they are not then how do we "correct" for the other locations? Do we assume all four replicates have same microclimate as measured at the single MET station?

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CANOPY STUDIES WORKSHOP
LTER All Scientists Meeting
YMCA of the Rockies, Estes Park, Colorado
September 25-30, 1990

The forest canopy is recognized as an extremely important component of a forest both in terms of ecosystem processes and biological diversity. Development of forest canopy access systems is one of the twelve Action Items outlined in the 1990's Global Change Action Plan. The Canopy Studies Workshop was organized during the All Scientists Meeting to respond to the growing interest of LTER scientists in canopy studies, especially in gaining access to the canopy.

The overall goal of the workshop was to initiate discussion on within- and outside-LTER network needs for canopy measurements and research. The canopy studies workshop brought together a diverse group of scientists from eleven sites to discuss issues concerning canopy studies. The discussion was based on the following outline:

A. Importance of canopy studies - what questions should/can be addressed in the canopy?

B. Ongoing LTER (and other) efforts - what questions are currently being addressed?

C. Canopy access techniques, including proposed canopy crane

There was full discussion by participants and a number of useful suggestions shared. Consensus was reached on the following:

A. Canopy studies make up an important part of understanding long-term phenomena in ecosystems. A dearth of quantitative data exists because of the difficulty of access and lack of a strong statistical basis for rigorous sampling and analyses. Important areas of canopy study include the following: 1) development of sampling protocol and analyses; 2) staging within-canopy micrometeorological studies, including measurement of gaseous, dry and wet deposition; 3) documenting diversity and behavior of canopy biota; 4) measuring tree architecture; and 5) validating canopy structure from remote sensing data.

B. Specific studies being carried out (or planned/desired for the future) by the scientists present at the workshop include: 1) photosynthesis studies in the canopy; 2) vertical stratification of animals, including their distribution and behavior; 3) validating canopy structure from remote sensing data; 4) canopy structure and light extinction in the "air column" of the canopy; 5) analyzing the role of epiphytes in forest nutrient cycles; and 6) mapping tree structure with surveying and computer graphics techniques.

C. To date, access to the canopy has been accomplished with a variety of techniques: free-climbing, single-rope techniques, towers, scaffolds, and in one case (the Smithsonian in Panama) with a small construction crane. It was noted that most of these techniques provide only limited access to the canopy and severely limit the amount of data that can be taken. For example, single-rope techniques, which are relatively inexpensive and safe, do not provide access to the outer branches or upper crowns of most trees.

The possibility of using a construction crane was discussed extensively. Jerry Franklin reported that he has mustered considerable support from Congress for the idea of installing large construction cranes in forests. Capability to substantially increase canopy studies would result, including the ability to: 1) lift heavy instrumentation to the canopy such as IRGAs for process-oriented research; 2) reside for long periods of time in the canopy for long-term observations of animal behavior and certain phenological phenomena; 3) provide total access to the trees and the three-dimensional volume of the whole forest; 4) provide access for those individuals who may not otherwise be physically able to get into the canopy; and 5) provide good "publicity" for fund-raising for forest canopy and other research. The drawbacks are that cranes are extremely expensive ($1.2 million to install and operate one machine), somewhat destructive to the immediate area of installation, and require considerable infrastructure to maintain. We will look towards the example of the Smithsonian crane (contact = Dave Correll) to evaluate feasibility, costs, and benefits.

D. The Workshop provided valuable contacts for future collaboration and highlighted the diverse interests, geographical locations, forest ecosystem types, and research questions that relate to the canopy. Further communication among the participants and other LTER and outside researchers was encouraged.

- Nalini M. Nadkarni, Chairperson
The Marie Selby Botanical Gardens
811 South Palm Avenue
Sarasota, Florida 34236

List of Participants
CANOPY STUDIES WORKSHOP

NAME	SITE/INSTITUTION
D. Arthur Sampson	C.S.U. Department of Forest & Wood Science
Doug Reagan	Luquillo LTER
Larry Woolbright	Luquillo LTER
Fairley Barnes	Los Alamos Research Park
Ariel Lugo	Luquillo LTER
Keith Van Cleve	Bonanza LTER
John Yarie	BCEF LTER
Art McKee	HJ Andrews LTER
Dave Correll	Smithsonian
Merrill Kaufman	USDA FS Rocky Mtn Station, Fort Collins
Robert Edmonds	University of Washington
Robert Pierce	Hubbard Brook LTER
Jerry Franklin	University of Washington, LTER Office
Nalini M. Nadkarni	Marie Selby Botanical Gardens

Workshop Report on Modeling Forest-Stream Interactions
LTER All-Scientists Meeting, 28 Sept. 1990

H. McKellar

The workshop participants outlined four main zones of a forested watershed which must be conceptually and quantitatively linked with respect to hydrology and biogeochemistry in order to effectively model the dynamics of forest-stream interactions. These are (1) the watershed vegetation, (2), the upland soils and groundwater, (3) the interface zones between uplands and streams (ie. riparian and hyporheic zones), and (4) the stream channel.

All agreed that the hydrologic coupling of these zones represents an important, yet difficult, component of any modeling effort. A considerable number of models currently exist for simulating aspects of watershed hydrology. Some models specifically discussed included HSPF, ILWAS, TOPMOD, IHDN, PROSPER, PRMS, and OPUS. However, none of these models was considered entirely adequate for addressing the specific time, space, and process dimensions of forest-stream interactions. Therefore, combining the most appropriate components of existing models was discussed as a possible approach. A specific example mentioned was the combination of PROSPER (with its rigorous treatment of evapotranspiration) with PRMS (with its variable time-step capability for simulating processes over the hydrograph time scale). Attention was brought to a particularly useful document for evaluating and comparing the strengths of many existing hydrology models;

> van der Heijde *et al.* 1988. Groundwater modeling: an overview and status report. GWMI 88-10, The Groundwater Modeling Institute, Butler University, Indianapolis, Indiana 46208.

We also discussed approaches to interpreting nutrient chemistry and solute transport in evaluating the major biotic and geochemical transformations from hillside to stream. Although empirical relationships may suggest the relative importance of specific processes of nutrient and organic matter processing at different soil depths and lateral positions along the hillside, emphasis was placed on direct measurement of specific processes (i.e., nitrogen fixation, denitrification, nitrification, decomposition, etc) for deriving rate parameters in forest-stream interaction models.

The hydrology and biogeochemistry of the riparian and hyporheic zones was discussed as especially complex and less well understood at present, although several sites are providing new information which could be incorporated into developing models.

The roles of riparian vegetation in transmitting light and exporting woody material was discussed as a key component of forest-stream interactions, determining hydrologic and biotic characteristics of the stream ecosystem.

Much specific information was exchanged during the workshop and considerable discussion in smaller groups continued afterwards. We felt that individual investigator collaborations were well served and sufficient interest exists for convening additional working groups at future LTER meetings.

Workshop on Modeling Forest Stream Interactions
List of Participants

Name	Organization
Peter Homann	Cedar Creek
Sherri Johnson	Luquillo
John Elder	N. Temperate Lakes
Mark MacKenzie	N. Temperate Lakes
Mark Oswood	Bonanza Creek
Andy Hansen	Andrews
Nel Caine	Niwot Ridge
Jim Schindler	NSF
George Leavesley	USGS
Dean Urban	Virginia Coast Res.
David Weinstein	Hubbard Brook
Rob Striegl	USGS
Carl White	Sevilleta
Stuart Findlay	Hubbard Brook
Cliff Dahm	Sevilleta
Liz Blood	North Inlet
Alan Covich	Luquillo
Bob Gardner	North Inlet
Fred Sklar	North Inlet
Judy Meyer	Coweeta
Wayne Swank	Coweeta
Win Everham	Luquillo
Breck Bowden	HBR
Fred Swanson	Andrews
Donna D'Angelo	Andrews

United States Department of Agriculture
Forest Service
Southeastern Station
Coweeta Hydrologic Laboratory
999 Coweeta Lab Road
Otto, NC 28763

Reply To: 1360 (4040)

Date: October 4, 1990

Dr. Jerry Franklin
College of Forest Resources AR-10
University of Washington
Seattle, Washington 98195

Dear Jerry:

Enclosed is a summary of the Atmospheric Chemistry workshop and a list of participants. A copy has been sent to each participant, site principal investigator, and to Josh Schimel. I think our efforts were productive and there was helpful discussion, particularly by investigators from programs external to LTER. Many of the network investigators with expertise on this topic attended the soil warming session which was held at the same time as the chemistry session. However, they were present at the trace gas exchange workshop and identified the same needs as our group. I believe they will recommend action relative to Items 2-4 in my report.

In the meantime, I am willing to pursue Item 1. I think this will be an important contribution as a network and would be used within a site, across sites, and with other programs. I am particularly excited about showcasing linkages between near-ground atmospheric measurements and ecological phenomena. I also feel we need quick turnaround on this effort to capitalize on some of the emerging programs. We need to communicate some of our capabilities!

I think Bill Munger and I can handle the job with cooperation from the key people at the sites, and we do not need another workshop for this effort. I have discussed the document with our editor, Bob Blankenfield, and he has checked on printing costs. We could produce a good quality publication of 60-70 manuscript pages (2,500 copies) for less than $3,500.

If you and/or the executive committee feel this would be worthwhile as a network effort, where do I go from here?

Sincerely,

WAYNE T. SWANK
Project Leader

Enclosure

cc: Caroline Bledsole

Atmospheric Chemistry Workshop
LTER All Scientists Meeting
YMCA of the Rockies, Estes Park, Colorado
September 25-30, 1990

The workshop was held on September 27 from 1030 to 1200 hours with 25 participants in attendance (list enclosed). The overall goal of the workshop was to initiate discussion on network needs related to atmospheric chemistry measurements and research. The three objectives offered for discussion were:

1. Discuss interest in preparing summary document that characterize atmospheric chemistry measurements and background data at LTER sites.

2. Discuss need for establishing protocols for different levels of network monitoring relative to ecological processes.

3. Discuss development of funding and other programs to fill gaps.

There was full discussion by participants and a number of useful suggestions. Consensus was reached on the following actions and/or needs.

1. We should proceed to develop a network document on atmospheric chemistry which is comprised of (a) an inventory of atmospheric chemistry measured at each site, method of measurement or collection, number of locations for measurement, duration of record, and participation in ongoing networks (NADP, NDDN, Mountain Cloud, etc.), and (b) demonstrated illustrations of linkages between atmospheric chemistry and biological/ecological phenomena based on past or current site research, including a list of relevant publications. This would be site specific, summarized examples provided by site investigators. Wayne Swank (Coweeta) will provide the lead responsibility in collaboration with Bill Munger (Harvard Forest) in compiling and editing the document. A rapid turnaround is needed and the Southeastern Forest Experiment Station has offered to publish the document and provide 2,500 copies for less than $3,500.

2. A workshop is needed to synthesize trends, patterns, similarities, and differences in atmospheric chemistry across network sites. This should include wet, particulate, and gaseous atmospheric constituents.

3. Several working sessions are needed to develop standard methods and protocols for atmospheric chemistry across the network at several different levels of complexity similar to the climatic measurement protocols. Emphasis should be placed on those parameters considered to be of greatest ecological importance. This document would be of general ecological interest as noted at the Snowbird ESA meeting. Recommendations could lead to an NSF network supplement for atmospheric chemistry equipment and operation.

4. Network leadership is needed to establish linkages with other institutions, organizations, and programs conducting near-ground atmospheric chemistry measurements. This leadership could then communicate opportunities to sites for followup. For example, apparently NADP will be melded with EMAP. What

are the opportunities for sites currently without a NADP station to enter the program? Who should be contacted to negotiate how LTER sites might be included if they so desire? Also, NCAR is developing a monitoring program and is interested in LTER as potential sites. How do the sites communicate their interests and capabilities in such a program?

Many of these same topics and needs were discussed in the Trace Gas Exchange workshop and some specific actions were identified. Thus, I have asked Josh Schimel to transmit a copy of their report to you.

WAYNE T. SWANK, Chairman

BRUCE HAINES, Recorder

From: DR PHILIP BACON, ITE MERLEWOOD, UK 9-OCT-1990 01:10
To: JFRANKLIN
Subj: Publications of LTER 'Regional Prediction' theme in Ecological Modelling

Dr J Franklin, LTER, Washington.

Dear Dr Franklin,

LTER Meeting, Estes Park.

First may I thank you for your hospitality at the LTER meeting last week, which I found both enjoyable and instructive. I have sent a report ot Bill Heal, and hope that a fruitful coopoeration will develop between LTER and the proposed UK Environmental Change Network of sites (ECN). I have asked Bill to keep you/LTER as fully informed of ECN proposals and developments as he can.

Following our lunchtime discussion of the final day, I have followed up both my suggestion of a 'system' to facilitate matching questions to relevant models and data and of publishing a few 'collected papers' of the LTER meeting in 'Ecological Modelling'.

Descriptions of Models and Data.

As I agreed I spoke to both Rudolph Nottrott and Bill Lauenroth about this idea. Both felt it worth persuing initially: I think they both felt it would be difficult to automate; my aim is more towards devising a system run by 'human experts' with the knowledge-based tools of 'expert systems' as an aid to those experts; we agreed such a half-way house migh be feasible, and trying to devise it would be very informative. Accordingly I have written a few pages outlining what I have in mind. This is presently being typed. When it is ready I will send copies to Rudolph and Bill Lauenroth, and also to Bill Heal as such a system could be more useful to an international network than the existing LTER network of close colleagues.

Publication of 'theme papers' from the Estes Park meeting.

I have now spoken to Prof Jorgensen (chief Editor, Ecological Modelling) who was indeed enthusiastic about a collection of papers exploring the theme of using modelling linked to GIS techniques to predict on a regional rather than a local scale. He would be keen to consider a set of linked papers to appear together as one or two issues of the journal (bound together; each issue is about 80 pages, so he envisages 80 to 160 pages). Most articles in the journal have some 20 pages, so we should be looking for 4 to 8 key papers.

During our discussion you suggested the following as key contributors:

Indy Burke (Bill Lauenroth) Central Plains study: CPR/Konza

John Aber Havard Forest: regional predictions.

You also mentioned Jim Dawes and Bob Woodmanze, although not the topics they could contribute (and they didn't speak at the meeting so I couldn't discern topics).

From the more limited perspective of the papers and workshop contributions at Estes Park I found two talks informative on that theme:

William Schlesinger, Jordana . Desertification Modelling

Phil Robertson, Kellogg LTER . Below ground processes (modelling and spatial auto-correlation of parameters).

and brief presentations in Bill Lauenroth's workshop on 'Cross-Site Analyses', namely:

grasslands (CENTUARY model)
forests (ZEILEG model)
tundra & forest soils (GEM model)

unfortunately I was unable to get those speakers names as I had to leave early to meet you.

Could I ask you and/or Bill Lauenroth also, to indicate which of these speakers and topics you feel would best represent the current 'state of the art of regional prediction within LTER' and also give a broad over-view of the various approaches being used? I could then write to those potential contributors asking them to supply abstracts if they were interested, and make a final decision on the basis of those. I may also ask a statistical colleague in the UK to offer a short paper of the strengths and pitfalls of GIS techniques in such predictive processes.

Prof Jorgensen asked if I would write an introduction to this set of papers, assuming it is produced. I would prefer to do this jointly with you (or a nominated colleague) as although I understand the theme I want the papers to emphasise (local models of simple processes made reasonable on a wide scale by parameterisation to local driving variables by GIS/data-base techniques) I do not have enough background knowledge of LTER to set the scene properly.

with kind regards,

Yours sincerely,

Dr P J Bacon

cc Prof Jorgensen, Editor, Ecological Modelling.
Prof Lauenroth, Modelling Group, LTER
Prof Heal ITE/NERC ECN.

Dr S Buckland MLURI Statistics

Rudolph Nottrott LTER

SELBY GARDENS

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October 23, 1990

TO: Canopy studies workshop participants
FROM: Nalini Nadkarni
RE: Workshop proceedings

I very much enjoyed meeting you and getting together with you during our workshop at the All Scientists Meeting in Colorado last month. Attached is a report summarizing the workshop. If you have further suggestions or ideas about what we discussed, please get in touch with me.

Thank you for your interest.

SUMMARY: WORKSHOP ON HYDROLOGY AND BIOGEOCHEMICAL MODELLING

by Gordon Grant, H.J. Andrews LTER

The wide range of hydrologic and biogeochemical systems represented by the LTER network and related sites was the subject of the workshop on "Hydrology and Biogeochemical Cycling" chaired by Gordon Grant and Nel Caine at the LTER All-Scientists meeting. The workshop attracted over 50 participants from 15 LTER sites, the U.S. Geological Survey, National Park Service, and several other institutions. Objectives for this workshop included sharing information about the direction and scope of current work in this area among the various sites, informing participants of related activities in other agencies, and exploring opportunities for future collaborative or intersite work.

Hydrologic features and flowpaths at LTER sites span a considerable range of types and spatial and temporal scales. Major hydrologic landforms represented in the network include lakes, marshes, estuaries, ephemeral washes, intermittent streams, perennial channels, and small rivers. Sites vary in terms of the relative proportion of flow following surface or subsurface pathways, and the sequence of flowpaths within a site. For example, the North Lakes site is characterized by lakes interconnected by groundwater seepage and surface water flow while the Andrews site exhibits a sequence of shallow subsurface and deep groundwater flow to streams which, in turn, provide recharge to valley bottom aquifers. While in most sites, flowpaths are gravitationally driven and thus unidirectional, some coastal sites (i.e. Northern Inlet) have bidirectional fluxes driven by tidal fluctuations. Different sequences of flowpaths provide different opportunities for interaction among water, vegetation and soils which is then reflected in the water chemistry.

Spatial and temporal scales of interest vary widely between sites, ranging from plot scale studies of storm response and diurnal variations in soil moisture to landscape-level studies of trends in lake chemistry or rainfall-runoff relationships extending over several decades.

These differences highlighted one common theme expressed in a 'roll call' of hydrology and biogeochemistry research activities by site: an interest in characterizing flow pathways, particulary exchanges between different landforms. Other common themes were: controls on movement and transformation of elements (water, sediment, nutrients, organics), particularly the degree of coupling between hydrologic and biogeochemical phenomena; the role of disturbance in modifying flow paths and fluxes; and the importance of viewing flow phenomena within a broader landscape context.

The importance of the LTER Network within the larger physical and biogeochemical science community was emphasized in a presentation by George Leavesley, a U.S. Geological Survey hydrologist involved with the Survey's WEBB (Water, Energy, and Biogeochemical Budgets) program. This program, which is part of the the Survey's in-house Global Change initiative, is designed to fund process-level studies relevant to climate change. Two LTER sites (NTL and LUQ) were among the five WEBB sites chosen in FY 91 and four additional LTER sites (CWT, AND, KNZ, and BNZ) will be among those considered for funding in FY 92. WEBB clearly demonstrates the growing recognition of the role of LTER sites as key areas for interagency, interdisciplinary research into the biological and physical implications of global change.

There are exciting opportunities for intersite work in this area; in fact it was suggested that understanding hydrologic and biogeochemical processes is one of the major themes linking all LTER sites. Several topics for future activities were proposed. These included an examination of the relative importance and degree of interaction between landuse and climate imposed changes in hydrologic regime (one hypothesis suggested that inland sites would be more susceptible to landuse-imposed changes than marine sites because they lack an ocean to buffer climatic variation). Interest was also expressed in an intersite comparison of streamflow generation processes, particularly the interaction between groundwater and surface water. The importance of linked biogeochemical and hydrologic studies, particularly those using isotopes and tracers, was emphasized by several participants.

One suggestion to advance these proposals was to hold a workshop to develop alternative conceptions of flow generation and pathways in several different sites. This might lead to an actual modelling exercise to compare the response of different sites to scenarios of changing climate and landuse. This approach would fit in well with the work of Leavesley and his colleagues to develop a common framework for hydrologic modelling. An ad hoc working group is looking into possibilities to hold such a workshop in the next year or so.

A final take home message from this workshop was the importance of developing links between the biological and physical science communities. At one level, this might include joint symposia co-sponsored by groups such as ESA and AGU, linked computer networks, and increased visibility of the LTER network as a forum for interdisciplinary work. At a more fundamental level, it means working towards lessening the discipline-centrism among ourselves, within universities and in funding agencies.

LTER ALL-SCIENTISTS MEETING
INVASION WORKING GROUP

A meeting of scientists interested in species invasions was held September 28,1990, chaired by John J. Magnuson, NTL. Eighteen people attended (address list enclosed). Representatives were present from AND, ARC, BNZ, CDR, CPR, HFR, KNZ, LUQ, NTL, and VCR, as well as from Savannah River, the Idaho DOE Park, and the NERC in Great Britain. In initial discussions we found that several discrete subgroups were involved; some were interested in the natural process of invasion as a part of succession while others were concerned with invasion of established systems by non-native species. Several were interested in the intentional introduction of new species as part of management strategy.

The classic questions of invasion theory, - what makes a good invader, what makes a system invasible, how does the system respond to invasion - were briefly discussed. Magnuson suggested that at this first meeting our most important job was to identify ways in which action in the context of the LTER network could improve efforts to answer these questions. It is clear that an important contribution possible with intersite cooperation would be in comparing the invasion process across a variety of biomes. The list-making approach to invader and invasibility characteristics has shown that these tend to be quite taxon-specific; a successful plant invader is not the same as a successful fish. But inter-site comparisons might reveal more general principles, particularly in areas such as the importance of disturbance in invasion and the role of scale in the match between invader and community. The response of the ecosystem to invasion is another area where comparison will be useful. It was pointed out that the removal of a species was in many ways similar to the addition; extirpations as well as invasions should be examined. A further area for cooperation is at the landscape level, with consideration of corridors/linkages both facilitating invasion and changing in response to it. The problem of genetically engineered organisms also was raised; this is an issue that may focus increased attention on invasion studies in the future. It was agreed that an important goal should be to produce guidelines that could be used as a basis for decision making about new/introduced/invading species.

Several specific actions were agreed upon. First, we will ask the LTER sites to prepare a list of invading and of extirpated species for each site. This effort will estimate the magnitude of the problem, identify possible areas of cooperative study, and focus attention on issue of non-native species and encourage sites to develop policy concerning them. A committee was formed to work on this project: Don Kaufman (KNZ), Jack Lattin (AND), Don Hazlett (CPR), and Ann McLain (NTL).

Second, we would like to organize a symposium on invasion for the Ecological Society of America meeting in August 1992, to be held in Hawaii. As a warm-up for that symposium we will attempt to organize a contributed paper group for the ESA meeting in 1991 in San Antonio. A committee was formed to work on this action: John Magnuson (NTL), Don Kaufman (KNZ), Jon Evans (VCR), and Mark McGinley (CDR).

We discussed the idea of holding an Invasions Workshop. Magnuson suggested that this issue may not be quite ready for a full-scale workshop. Jon Evans suggested that a workshop dealing specifically with succession might be a good idea. He pointed out that this is an area of interface between ecosystem and population studies. He may attempt to organize something along these lines. Tim Reynolds said that Park-Net is organizing a biodiversity workshop this next spring; we may be able to get more information out on that. There were suggestions that we ask for a bulletin board for the invasion group; no specific action was taken there.

Participants in the meeting seemed to feel that simply identifying other LTER scientists with similar interest had been a positive benefit. We hope that publishing these minutes and address list will help us all stay in touch and move forward on the proposed actions.

John J. Magnuson
Ann S. McLain

LTER INVASION WORKING GROUP

Name/Address	One Interest
Phyllis Adams (BNZ LTER) USDA Forest Service Institute of Northern Forestry 308 Tanana Drive Fairbanks, AK 99775-5500 (907) 474-3318	rates and direction of succession
Philip Bacon Institute of Terrestrial Ecology Natural Environment Res. Council, U.K. Banchory Research Station, Hill of Brathens Glassel, Banchory Aberdeen AB34BY, SCOTLAND, UK 03302-3434, 031-445-4343	exotic invasions into extensively modified environments
Jesus D. Chinea (LUQ LTER) USDA Forest Service Institute of Tropical Forestry Call Box 25000 Rio Piedras PR 00928-2500 (809) 765-7210	properties of an invading species
Jonathan Evans (VCR LTER) Dept. of Environmental Sciences University of Virginia Charlottesville VA 22903 (804) 924-0552	invasibility of habitat controls on populations succession
Donald Hazlett (CPR LTER) Range Science Department Colorado State University Fort Collins CO 80523 (303) 897-2210	biodiversity distribution relative invasibility
John Heuer Savannah River Ecology Lab Drawer E Aiken SC 29802 (803) 725-2472	response of native predator to invading species
David Hill (NTL LTER) Center for Limnology University of Wisconsin 680 N. Park Street Madison WI 53706 (608) 262-2573	global change connection

Don Kaufman (KNZ LTER)
Division of Biology
Kansas State University
Ackert Hall
Manhattan KS 66506
(913) 532-6622

extirpations as negative invasion

Jack Lattin (AND LTER)
Systematic Entomology Lab
Oregon State University
3200 Jefferson Way
Corvallis OR 97331
(503) 737-2116

possible effect of climate change on invasibility

Ariel Lugo (LUQ LTER)
Institute of Tropical Forestry
Call Box 25000
Rio Piedras PR 00928-2500
(809) 766-5335

possible use of exotics in management

John J. Magnuson (NTL LTER)
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University of Wisconsin-Madison
680 N. Park Street
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properties of invasion-prone habitats

Mary Martin (HFR LTER)
Complex Systems Research Center/SERB
University of New Hampshire
Durham NH 03824
(603) 862-4098

problem invasions

Mark McGinley (CDR LTER)
Ecology, Evolution, & Behavior
University of Minnesota
109 Zoology Building
Minneapolis MN 55455
(612) 625-5131

characteristics of invader/colonists
old field succession

Ann McLain (NTL LTER)
Center for Limnology
University of Wisconsin
680 N. Park Street
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(608) 262-2573

system response to invasions

Tim Reynolds
Idaho National Environmental
Research Park
U.S. Department of Energy
785 DOE Place
Idaho Falls, ID 83402-4149
(208) 528-2311

problem invasions by exotics
relationship to fire

Donald Schell (ARC LTER)
Institute of Marine Science
University of Alaska
Fairbanks AK 99775-1760
(907) 474-7115

how does succession affect
ecosystem properties

Les Viereck (BNZ LTER)
USDA Forest Service
Institute of Northern Forestry
308 Tanana Drive
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(907) 474-3324

primary and secondary succession
pioneer species

Lawrence Walker (LUQ LTER)
Biology Department
University of Puerto Rico
PO Box 21491
San Juan PR 00931-1491
(809) 758-4523

primary succession as series
of invasions

Environmental Remote Sensing Center
Institute for Environmental Studies
UNIVERSITY OF WISCONSIN – MADISON

1225 WEST DAYTON STREET, MADISON, WI 53706. TELEPHONE: 608-262-1585
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December 13, 1990

Stephanie Martin
LTER Network Office
College of Forest Resources AR-10
University of Washington
Seattle, WA 98195

Dear Stephanie:

The following is the All Scientist Meeting workshop report for the GIS Modeling Working Group. Please forgive my tardiness in getting this to you but it is one of those things that fell between the cracks.

The objectives of the group were to:

1. Stimulate a discussion on what is modeling as the term relates to GIS and ecology.
2. Discuss importance of scale and how a GIS can address the scale issue.
3. Discuss methods for linking ecological models with GIS
4. Discuss regional digital databases (state, federal, etc) and how to access them.
5. Provide a forum in which individuals could become acquainted with research currently being conducted in the realm of GIS and modeling and for people to identify individuals with similar interests.

The working group consisted of approximately 90 people with a wide variety of backgrounds and interests. Members ranged from being highly literate to completely illiterate in GIS and/or modeling in general. As such, it was difficult to get into very many detailed discussions or develop detailed plans for future research.

The following topics were brought up for discussion by the group:

1. What is modeling?
2. How does on link GIS and process models?
3. What do individuals want to get out of a GIS?
4. Scale issues
5. Using a GIS to improve sampling design
6. What are the basic questions related to GIS and regional data bases?
7. Importance of focusing on GIS and how it relates to science

I would say that the most important end product of this working group was that people were able communicate their ideas with others. I feel the interaction between process modelers and those skilled in GIS will lead to some exciting research activities. I think this interaction will become even more useful as we continue to deal with regional to global issues.

Attached are notes that were taken at the working group by John Porter and his ever handy portable PC. I am in his debt for taking these notes. They are a lot more extensive than the ones I produced.

Sincerely,

Mark MacKenzie
North Temperate Lakes

GIS/Modeling Working Group

A. Objectives
   1. Different scales for GIS
   2. What is modeling?
   3. Linking models with GIS
   4. Regional databases (federal, state)

B. What is modeling?
   1. Non-GIS
      a) evolution of forest models
         1) gap models
         2) spatially explicit models that can be reconciled with GIS
      b) model of process
   2. GIS
      a) use programs built into GIS
      b) look at individual areas--combining data layers
         1) overlay
         2) weighing
         3) mathematical operations
      c) in principle any process model that generates x,y, and z parameters can be used in a GIS using surfacing programs etc.--spatial component is important

C. Linking GIS and process models?
   1. understanding data structures for process models--needed to link GIS and process models
   2. problems: GIS emphasizes two dimensions where more would be very useful (time, elevation) would be good to add

D. What do you want to get out of GIS?
   1. insect ecologist
      a) surfacing - spatial analysis of data
   2. process modeler
      a) initialization of process model
      b) display of model output
   3. need to do more than just Input/Output--take advantage of spatial analysis techniques
      a) some find I/O enough
   4. GIS <-> spatial modeling <- modeling pattern
   5. two things make GIS and model link
      a) GIS can simply be place to store spatially explicit data
      b) spatial context
      c) spatially explicit transfers

6. GIS can provide more refined forcing functions for models
    a) problems with running models
        1) FORICO model run in grid cells with differences in sunlight, but biomass was invariant
7. we seem to be assuming that GIS is data manager--it really will be only a component of my DM system which much also include non-spatial components
    a) DM capabilities still very limited
    b) no one is really trying to do this--most sites use relatively low-level archival storage
        1) GIS systems provide ways to exchange data between systems
    c) management of large storage of GIS also a problem
8. In soviet GIS found that relatively small number of pixels (12%) needed to characterize landscapes. Intercorrelations also allow minimization of input information
    a) need to be careful about being selective about the information that you need to input
    b) can get from other sources--eg. USGS--buy in bulk

E. Questions
1. Querying databases
2. How many pixels must my model generate before I can contour
    a) resampling/minimization
    b) may be able to use geostatistics to decide--needs more development
3. sharing information

F. Scales
1. need to make decision--non-trivial to rescale
2. hierarchy of scales
    a) there are standard scales that could be used
    b) often take scale by default from input medium (eg, SPOT images at 20m)
3. difficult to interpolate for missing pixels--need better tools--vector format will allow better rescaling
    a) Geoease - allows kriging to produce "full" array for input. Available free from Denver EPA
        1) good but complex
    b) Surfer - good simple package
    c) RPA - similar to ERDAS interpolation programs
4. Are there appropriate scales? We will start to see them defined by the systems
    a) different sites may have different scales
5. Overlaying hard to overlay characteristics (eg. movements over topography)--want patterns of association
    a) how do you link various tiers of hierarchy?
        1) are there scale independent variables?
        2) statistical tests can be applied
        3) recent issue of landscape ecology
            a> hierarchy of scales depends on scales of dominant processes
6. Scale is more complex than we have yet realized--it goes beyond pixel size
    a) scale of data set description may not be the scale of the data
    b) need to make sure that tool doesn't mislead in questions of scale

G. Using a GIS for improving sampling design
1. use calibration and test set
2. geostatistics and semivariograms
3. Hubbard Brook uses Tin to create multivariable classes to define sampling groups

H. What are basic questions related to GIS and regional databases?
   1. generalization--how do you derive variables for process models based on regional models--eg. coming up with soil chemistry based on soil map requires many assumptions
   2. How much does space matter? Many models don't assume that adjacent points affect one another. Can use null model approach to test.
   3. How to link between sites with diverse landscapes
      a) tools measure at different scales
      b) remote sensing provides relatively fixed scales
   4. How do we put confidence levels on the maps?
      a) level of confidence gets separated from maps over time
      b) algorithms
      c) there are discrete sampling statistics that can be used to provide confidence levels
      d) need to get information from geographical groups
      e) overlaying maps can compound errors--error propagation
   5. Temporal phenomena hard to deal with especially seasonal change
   6. LTER data management would like to talk with people about
      a) integrating GIS into DM systems
      b) developing GIS documentation standards

I. Need to focus on using GIS for science

J. What will be done in other working group? The one this afternoon will discuss site capabilities and research at sites. GISWorld has good review of current systems,