

HYDROLOGY WORKSHOP REPORT

Hydrology workshop - All Scientists Meeting - September 1993.

(Convener: Gordon Grant)

Draft report - Gordon Grant, Carl Bowser

Basic Statistics: The workshop brought together some 56 scientists representing 15 of the LTER sites, other federal agencies (USGS and NPS), other universities, and foreign guests.

Workshop Objectives

- 1) To capitalize on the unique opportunity afforded by the LTER network to advance the basic understanding of interactions between hydrologic and ecologic systems.
- 2) To use the hydrogeologic cycle as an organizing framework around which various important biogeochemical, ecological, and geomorphic processes could be structured.
- 3) To provide a forum that will allow us to look beyond our own sites to explore, compare, and contrast similarities and differences among the sites and to develop the conceptual and analytical tools to make these comparisons.
- 4) To capitalize on the broad range of expertise in hydrologic, biogeochemical, and aqueous geochemical disciplines in a collaborative setting such as the LTER to help to broaden our understanding of hydrologically driven research questions, and to share this collective expertise across sites of varying degrees of recognition of the importance of hydrology in ecosystem science.
- 5) To develop a plan of action to accomplish these objectives.

Proposed Approach - "Ecological Hydrology"

An overall guiding principle of the workshop was to use the hydrogeologic features of sites as an organizing or structuring framework around which important ecological questions could be framed and researched. The detailed understanding of flow and storage of water in ecosystems varies considerably across the LTER sites. Further the flow of water and all its ramifications couple strongly with aqueous solutes, nutrients, and trace gases carried with the water through the system. The flux of nutrients, solutes, and dissolved gases and the dynamics of these aqueous substances is irrevocably tied to the movement of water in all these ecosystems.

To accomplish these objectives we agreed to develop a generalized, conceptual hydrologic model that reflects the various pathways and reservoir of all LTER sites. This framework will be used to help frame important cross-site ecological questions. An initial draft of the hydrologic cycle will be drafted and sent to all LTER sites with the request that they identify the critical pathways and reservoirs applicable to their site. In cases where the draft framework is inadequate individual sites will generate more appropriate cycles that can be used to revise the overall framework. The results will be synthesized into a generalized hydrogeologic model with a collection of sub models that emphasize the strengths of interaction and water reservoirs appropriate to each individual site.

The framework will serve to ordinate or array sites along key gradients that will help test various different cross-site research questions. Several potential controlling processes or conceptual factors were

suggested, among which are:

- 1- Characteristic times of transfer of water and its dissolved substances among various reservoirs (Fluxes and residence times)
- 2- Interannual and seasonal variance in the rates of transfer and storage in the various reservoirs (compartments) of the local ecosystem.
- 3- Precipitation/Potential Evapotranspiration ratio
- 4- Phase changes (e.g., snowmelt, frost, evaporation)
- 5- Relative loading of chemicals (nutrients and solutes) from different compartments of the water system
- 6- Seasonal distribution of precipitation
- 7- Spatial patterns of precipitation
- 8- Effects of biota on the water balance
- 9- Length of the flow path
- 10- Feedback to the local and regional climate

Implementation

- 1- A working group comprised of Gordon Grant (AND), Carl Bowser (NTL), Tim Kratz (NTL), Jill Baron (NPS), George Leavesley (USGS), and Barry Lyons (MCM) will provide leadership..
- 2- Future workshop to develop the hydrogeologic framework necessary to address cross-site, process-oriented questions

Coordinated arrangements with the U.S. Geological Survey.

George Leavesley discussed the USGS hydrologic modeling efforts and offered to provide a set of computational tools to allow sites to gain a better understanding of their own hydrological flow systems. The software (UNIX) based is nearing completion for distribution, and should be available to interested LTER research groups.

Human applications and standards and comparisons

- 1- Water consumptive demands have direct feedback to ecosystems, especially with regard to location, abundance, quality, and conflicting demands for use. Hydrologic budgets and water quality considerations provide a direct link to policy and decision making groups.
- 2- Diverse tools exist to characterize portions of hydrogeologic budgets, and these tools differ widely in the application for specific types of sites (e.g. terrestrial, aquatic). Standardization of procedures, inter comparison and calibration of differing tools are a prime concern and will occupy much of the attention of those working on intersite research in hydrological ecology.

New term: "Ecological Hydrology" - Reflects the concern for the role of hydrologic processes in ecosystem science.