

TOWARD CYBER-MANAGEMENT OF WATER RESOURCES AND WATERSHEDS

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Abstract

Recent advances in cyberinfrastructure (CI) (sensors, sensing networks, and numerical models) rapidly are becoming available, and are sufficiently developed, to aid quantifiable understanding of the critical processes that characterize water movement and habitat templates (i.e., geomorphic, water quantity and quality) in watersheds. These advances are enabling water-resource managers to begin establishing high-fidelity, first-principles based, numerical surrogates of actual watershed systems. The term “cyber-management” is used here to describe the integration of techniques for continuous acquisition of accurate field data together with techniques for numerical simulation and decision making. The increased quality and availability of data, along with improved diagnostics, provided by cyber-management can considerably improve the management of watersheds and the water resources they avail. The implementation of cyber-management, however, requires substantial multidisciplinary efforts that presently exceed the resources available at any single institution of research and education. In certain respects too, the U.S. lags developments abroad.

This paper discusses a recent initiative that brings together the complementary expertise and resources of several institutions. By means of research, education and knowledge transfer, the partnership aims to develop and apply cyber-management methods to ensure water-resource sustainability. The initiative is, in its own way, a new model for international

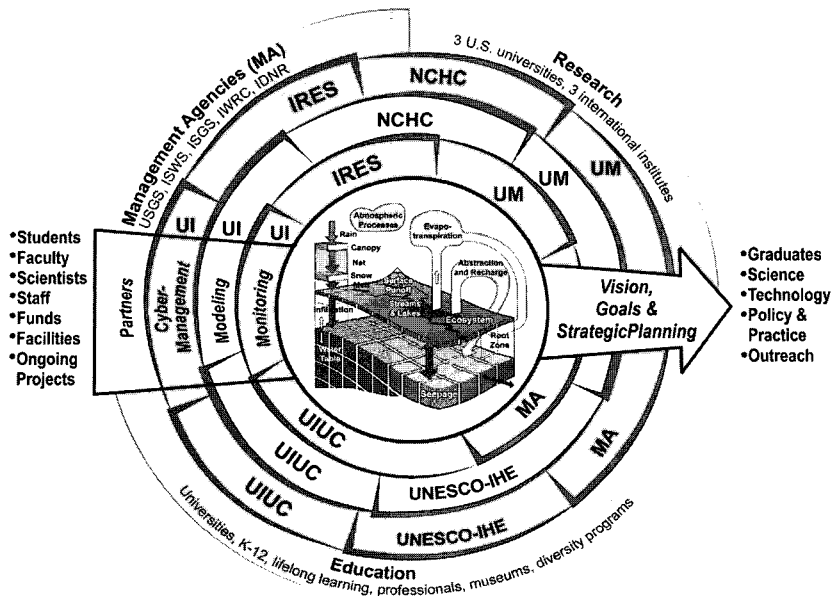


Fig. 1 Partnership synergy

collaboration. It links 2 European, 1 Asian, and 3 U.S. partners. The European partners are the UNESCO-IHE Institute for Water Education and The University of Newcastle-upon-Tyne's Institute for Research on Environment & Sustainability (IRES). UNESCO-IHE is the initiator of hydroinformatics concept and currently it is carrying out intense simulation modeling and information and communication technologies for understanding and solving problems of hydraulics, hydrology and environmental engineering for better management of water-based systems. IRES is a key member of the EuroAqua, a multi-university European partnership venues for hydroinformatics education using traditional and Internet-based programs to cover learning needs associated with water and its use to students around the world. The National Center for High-performance Computing (NCHC) in Taiwan plays a central role in the advancement of grid technologies, high-performance computational models, virtual-imaging, and data-processing. The U.S. partners are University of Iowa (UI), University of Illinois at Urbana Champaign (UIUC), and University of Minnesota (UM). Each of the American universities has formed multi-disciplinary assembly of scientists and engineers to address issues of water resources using an integrated comprehensive approach. The U.S. partners bring together additional multi-university alliances through NSF's Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) and the Collaborative Large-Scale Engineering Analysis Network for Environmental Research (CLEANER) programs. Each U.S. partner is active in international programs of education concerning water. For example, UI, UIUC, and UM participated in an international collaborative project jointly sponsored by the U.S. Department of Education and the European Commission. Since 1997 UI has conducted an International Perspectives in Water Resources Planning course to provide in-depth international experience to students and young professionals interested in water-resource

management.

The immediate goal of the partnership is to establish an international framework for research and education focused on CM for sustainable water resources, doing so by integrating partners' research and education capabilities. The partnership is envisioned to be a long-term undertaking that outreaches to include further participants as it develops. The efforts between the partners entail national and regional agencies conducting water-resource and watershed management. The key areas for partner involvement are illustrated in Figure 1. Though the partnership is limited in number and geographic location, its effort seek to attract the participation of students and professionals around the world through a series of tasks:

Develop and share scientific and technological innovations.

Identify the main knowledge and technology needs.

Use test-bed watersheds in U.S. and overseas to identify the knowledge needed to facilitate cyber-management of water resources and watershed.

Create a comprehensive web-based platform for educating students and professionals.

Undertake collaborations that combine research and education efforts among the partners. The activities include (a) long term (6 to 12 months) and short term (2 to 4 weeks) exchanges of students, faculty, and research professionals, (b) series of workshops and research seminars, and (c) continuous levels of day-to-day interaction focused on specific research and education topics.

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