

# Vision of Cyberinfrastructure for End-to-End Environmental Explorations (C4E4)

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**Abstract:** Holistic approaches are needed for understanding and addressing a wide range of environmental issues that require multidisciplinary studies of complex and interlocking systems. The writers' vision of a cyberinfrastructure for end-to-end environmental exploration (C4E4) that combines data and modeling tools in an integrated environment across different spatial and temporal scales is presented. The overall goal behind C4E4 is to enable a broad environmental research and remediation community to address the challenges of environmental data management and integration in real-world settings. The St. Joseph Watershed in northern Indiana is chosen as a test bed in this effort. The C4E4 framework will allow researchers to combine heterogeneous data resources with state-of-the-art modeling and visualization tools through a user-friendly web portal. By engaging TeraGrid resources, C4E4 will have the computational resources to store, manipulate, and query large data sets, thereby facilitating new science. C4E4 will serve as a prototype, and provide valuable experience for scaling up to larger observatories at the national level. This paper presents the writers' vision and goals, initial efforts, and briefly describes how C4E4 can benefit the environmental community.

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## Introduction

The quality of our land, air, and water resources is under unprecedented pressures as a result of human activity. Many current vital questions in environmental sciences cannot be answered without conducting comprehensive studies based on data from various sources in hydrologic, atmospheric, agricultural sciences, and other related disciplines. As a result, an urgent need exists for the design and development of an enabling data infrastructure that helps integrate various data sources and tools, and provides easy access to researchers from multiple research communities. According to the National Science Foundation-(NSF) sponsored report on cyberinfrastructure (CI):

“Environmental research and education are characterized by a

number of attributes that make cyberinfrastructure especially important for this field of scientific endeavor. Many environmental research activities are observationally oriented, rely on the integration and analysis of many kinds of data, and are highly collaborative and interdisciplinary. Much of the relevant data needs to be geospatially indexed and referenced, and there is a host of currently noninteroperable data formats and data manipulation approaches. Spatial scales vary from microns to thousands of kilometers; time scales range from microseconds (for some fast photochemical reactions) to centuries or millennia (for paleoclimate and Earth evolution studies); and data types range from written records and physical samples to long-term instrumental data or simulation model outputs.” (NCAR 2003)

This paper presents an approach adopted by a group of inves-

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