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A new Generation of end-to-end Cyberinfrastructure and Data Services for Earth System Science Education and Research

Mohan K. Ramamurthy (1)

(1) Unidata, University Corporation for Atmospheric Research, (mohan@ucar.edu, P. O. Box. 3000, Boulder, CO 80307 USA, Phone: 303-497-8661, Fax: 303-497-8690)

A revolution is underway in the role played by cyberinfrastructure and data services in the conduct of research and education. We live in an era of an unprecedented data volume from diverse sources, multidisciplinary analysis and synthesis, and active, learner-centered education emphasis. For example, modern remote-sensing systems like hyperspectral satellite instruments generate terabytes of data each day. Environmental problems such as global change and water cycle transcend disciplinary as well as geographic boundaries, and their solution requires integrated earth system science approaches. Contemporary education strategies recommend adopting an Earth system science approach for teaching the geosciences, employing new pedagogical techniques such as enquiry-based learning and hands-on activities. Needless to add, today's education and research enterprise depends heavily on robust, flexible and scalable cyberinfrastructure, especially on the ready availability of quality data and appropriate tools to manipulate and integrate those data.

Fortuitously, rapid advances in computing and communication technologies have also revolutionized how data, tools and services are being incorporated into the teaching and scientific enterprise. The exponential growth in the use of the Internet in education and research, largely due to the advent of the World Wide Web, is by now well documented. On the other hand, how some of the other technological and community trends that have shaped the use of cyberinfrastructure, especially data services, is less well understood. For example, the computing industry is converging on an approach called Web services that enables a standard and yet revolutionary way of building applications and methods to connect and exchange information over the Web. This new

approach, based on XML – a widely accepted format for exchanging data and corresponding semantics over the Internet - enables applications, computer systems, and information processes to work together in a fundamentally different way. Likewise, the advent of digital libraries, grid computing platforms, interoperable frameworks, standards and protocols, open-source software, and community atmospheric models have been important drivers in shaping the use of a new generation of end-to-end cyberinfrastructure for solving some of the most challenging scientific and educational problems.

In this talk, I will present an overview of the scientific, technological, and educational landscape and discuss the how these developments in cyberinfrastructure and data services are enabling new approaches to solving geoscientific problems and advancing student learning.