color printing, and common image manipulation software. Perhaps the primary drawbacks of anaglyph images include visualization problems with primary colors (such as flowers, bright clothing, or blue sky) and distortion factors in large depth-of-field images. However, anaglyphs are more versatile than polarization techniques since they can be printed, displayed on computer screens (such as on websites), or projected with a single projector (as slides or digital images), and red and cyan viewing glasses cost less than polarization glasses and other 3-D viewing alternatives. Anaglyph images are especially well suited for most natural landscapes, such as views dominated by natural earth tones (grays, browns, greens), and they work well for sepia and black and white images (making the conversion of historic stereo photography into anaglyphs easy). We used a simple stereo camera setup incorporating two digital cameras with a rigid base to photograph landscape features in national parks (including arches, caverns, cactus, forests, and coastlines). We also scanned historic stereographic images. Using common digital image manipulation software we created websites featuring anaglyphs of geologic features from national parks. We used the same images for popular 3-D poster displays at the U.S. Geological Survey Open House 2003 in Menlo Park, CA. Anaglyph photography could easily be used in combined educational outdoor activities and laboratory exercises.

ED32B-1199 1330h INVITED POSTER

GeoPad: Innovative Applications of Information Technology in Field Science Education

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A core requirement for most undergraduate degrees in the Earth sciences is a course in field geology, which provides students with training in field science methodologies, including geologic mapping. The University of Michigan Geological Sciences' curriculum includes a seven-week, summer field course, GS-440, based out of the university's Camp Davis Geologic Field Station, near Jackson, WY. Such field-based courses stand to benefit tremendously from recent innovations in Information Technology *IT*, especially in the form of increasing portability, new haptic interfaces for personal computers, and advancements in Geographic Information System *GIS* software. Such innovations are enabling in-the-field, real-time access to powerful data collection, analysis, visualization, and interpretation tools. The benefits of these innovations, however, can only be realized on a broad basis when the IT reaches a level of maturity at which users can easily employ it to enhance their learning experience and scientific activities, rather than the IT itself being a primary focus of the curriculum or a constraint on field activities. The GeoPad represents a combination of these novel technologies that achieves that goal. The GeoPad concept integrates a ruggedized Windows XP TabletPC equipped with wireless networking, a portable GPS receiver, digital camera, microphone-headset, voice-recognition software, GIS, and supporting, digital, geo-referenced data-sets. A key advantage of the GeoPad is enabling field-based usage of visualization software and data focusing on $3D$ geospatial relationships $developedaspartofthecomplementaryGeoWallinitiative$, which provides a powerful new tool for enhancing and facilitating undergraduate field geology education, as demonstrated during the summer 2003 session of GS-440. In addition to an education in field methodologies, students also gain practical experience using IT that they will encounter during their continued educational, research, or professional careers. This approach is immediately applicable to field geology courses elsewhere and indeed to other field-oriented programs $e.g., inbiology, archeology, ecology$, given similar needs.

ED32B-1200 1330h POSTER

Coupling Near-surface Geophysics with Three-Dimensional Geological Model Building for Environmental Investigations

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Investigating the subsurface at scales relevant to environmental remedial investigations can be complicated in areas that have been repeatedly glaciated or complicated by the presence discontinuous frozen ground and fractured bedrock. Ground water flow and contaminant migration pathways are very hard to infer in such heterogeneous aquifers characterized by a complex system of juxtaposed hydrogeological facies. Our investigations have merged using near-surface geophysical surveys with complex three-dimensional geological modeling using EarthVision at various sites in Alaska to assist with better delineating possible groundwater and potential contaminant migration pathways to assist with remedial investigations. These modeling efforts provide a three-dimensional framework to assist with remediation decision-making. Site characterization data were acquired from near-surface seismic refraction tomography, DC resistivity surveys, ground penetrating radar profiles, deep borehole drilling, hydrological modeling, and water quality observations. These data are synthesized to develop a conceptual model of local geology in the context of regional record; the conceptual model is then used as the basis to develop a three-dimensional model of subsurface conditions by modeling the data using EarthVision software.

ED32B-1201 1330h POSTER

The Role of Stereo Projection in Developing an Effective Concluding Earth Science Course

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Remarkably few students enrolled in introductory earth science courses have any intention of continuing in earth science, and for most students, these classes are often the last science course they will take in their academic careers. These students would be better served, if the course was instead designed to be a 'concluding' science course. One that explicitly provided students with the knowledge they need to become more informed citizens in the global community. The University of Minnesota is attempting to develop a national model of an effective 'concluding' earth science course by integrating three essential approaches: use of regional case studies to increase student comprehension; a comprehensive evaluation of students' prior knowledge, misconceptions and post-instructional knowledge that is woven throughout the project; and, an ambitious use of 'GeoWall' stereo projection systems to facilitate the students' use of maps and data sets and level the classroom playing field with regard to spatial conceptualization. In every discipline there are some critical skills or assessments that serve as conscious or unconscious 'gate-keepers' for progress in that field. In earth science, map interpretation is probably the critical restriction curtailing students' ability to access and explore course concepts. So much of our discipline's information is encoded in maps, that students who are not innately predisposed to understanding maps find it difficult to understand much of the course content and methodology. GeoWall stereo projection systems can reduce the efficiency of this 'gate-keeping' process, allowing students of diverse backgrounds and abilities to understand map data and succeed in the course. In doing so, these systems will not only help increase students' scientific literacy, but may also greatly increase the diversity of students who do go on to consider earth science as a potential career.

ED32B-1202 1330h POSTER

Teaching Introductory Mineralogy With the GeoWall

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Mineralogy, like many topics in Earth Sciences, contains inherently three-dimensional topics that are difficult to teach. Concepts such as crystal symmetry and forms, Miller indices, the polymerization of silica tetrahedra and resulting structures of silicate mineral groups, and the interaction of light and minerals are particularly difficult. Two-dimensional diagrams are limited in their effectiveness, and physical models, while effective, are expensive and do not work as well in large class settings. The GeoWall system brings the effectiveness of physical models to the large classroom. In Fall 2003, we will integrate the GeoWall into our introductory mineralogy classes at UCSB using a combination of commercial software, atomic structure models available on the web, and custom content created in-house. The commercial software SHAPE (www.shapesoftware.com) allows users to build and display crystal shapes and their symmetry. Though not designed for the GeoWall, the software's stereopair display mode works perfectly on the system. Using the Chime web browser plug-in (www.mdl.com), computer models of silicate minerals available from the Virtual Museum of Minerals and Molecules (www.soils.umn.eduvirtual_museum) provide an interactive display of silicate mineral structure that illustrates the tetrahedral framework. Again, while not developed for the GeoWall, the Chime plug-in works seamlessly with the GeoWall hardware. 3-D GeoWall images that display light paths through minerals, and reveal relationships between crystal symmetry and optical indicatrix properties, have been developed in-house using a combination of SHAPE and 3D modeling software. The 3-D GeoWall images should convey in an instant these difficult concepts that students historically have struggled to visualize. Initial assessment of the GeoWall's effectiveness as a mineralogy teaching aid at UCSB in Fall 2003 will come from the instructor's impressions and by comparing test scores with classes from previous years.

ED32C MCC: Level 2 Wednesday 1330h

Exploiting the Electronic Media to Communicate Science Posters *(joint with OS, P, C)*

Presiding: **K B Olsen,** Institute for Crustal Studies

ED32C-1203 1330h POSTER

Community Digital Library Requirements for the Southern California Earthquake Center Community Modeling Environment (SCEC/CME)

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A community digital library provides support for ingestion, organization, description, preservation, and access of digital entities. The technologies that traditionally provide these capabilities are digital libraries (ingestion, organization, description), persistent archives (preservation) and data grids (access). We present a design for the SCEC community digital library that incorporates aspects of all three systems. Multiple groups have created integrated environments that sustain large-scale scientific data collections. By examining these projects, the following stages of implementation can be identified:

- Definition of semantic terms to associate with relevant information. This includes definition of uniform content descriptors to describe physical quantities relevant to the scientific discipline, and creation of concept spaces to define how the uniform content descriptors are logically related.
- Organization of digital entities into logical collections that make it simple to browse and manage related material.
- Definition of services that are used to access and manipulate material in the collection.

- Creation of a preservation environment for the long-term management of the collection.

Each community is faced with heterogeneity that is introduced when data is distributed across multiple sites, or when multiple sets of collection semantics are used, and or when multiple scientific sub-disciplines are federated. We will present the relevant standards that simplify the implementation of the SCEC community library, the resource requirements for different types of data sets that drive the implementation, and the digital library processes that the SCEC community library will support. The SCEC community library can be viewed as the set of processing steps that are required to build the appropriate SCEC reference data sets (SCEC approved encoding format, SCEC approved descriptive metadata, SCEC approved collection organization, and SCEC managed storage location). Each digital entity that is ingested into the SCEC community library is processed and validated for conformance to SCEC standards. These steps generate provenance, descriptive, administrative, structural, and behavioral metadata. Using data grid technology, the descriptive metadata can be registered onto a logical name space that is controlled and managed by the SCEC digital library. A version of the SCEC community digital library is being implemented in the Storage Resource Broker. The SRB system provides almost all the features enumerated above. The peer-to-peer federation of metadata catalogs is planned for release in September, 2003. The SRB system is in production use in multiple projects, from high-energy physics, to astronomy, to earth systems science, to bio-informatics. The SCEC community library will be based on the definition of standard metadata attributes, the creation of logical collections within the SRB, the creation of access services, and the demonstration of a preservation environment. The use of the SRB for the SCEC digital library will sustain the expected collection size and collection capabilities.

URL: http://www.sdsc.edu/SCEC/AGU

ED32C-1204 1330h POSTER

Some Programs Should Not Run on Laptops - Providing Programmatic Access to Applications Via Web Services

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Modern laptop computers, and personal computers, can provide capabilities that are, in many ways, comparable to workstations or departmental servers. However, this doesn't mean we should run all computations on our local computers. We have identified several situations in which it preferable to implement our seismological application programs in a distributed, server-based, computing model. In this model, application programs on the user's laptop, or local computer, invoke programs that run on an organizational server, and the results are returned to the invoking system. Situations in which a server-based architecture may be preferred include: (a) a program is written in a language, or written for an operating environment, that is unsupported on the local computer, (b) software libraries or utilities required to execute a program are not available on the users computer, (c) a computational program is physically too large, or computationally too expensive, to run on a users computer, (d) a user community wants to enforce a consistent method of performing a computation by standardizing on a single implementation of a program, and (e) the computational program may require current information, that is not available to all client computers. Until recently, distributed, server-based, computational capabilities were implemented using client/server architectures. In these architectures, client programs were often written in the same language, and they executed in the same computing environment, as the servers. Recently, a new distributed computational model, called Web Services, has been developed. Web Services are based on Internet standards such as XML, SOAP, WDSL, and UDDI. Web Services offer the promise of platform, and language, independent distributed computing. To investigate this new computational model, and to provide useful services to the SCEC Community, we have implemented several computational and utility programs using a Web Service architecture. We have hosted these Web Services as a part of the SCEC Community Modeling Environment (SCEC/CME) ITR Project (http://www.scec.org/cme). We have implemented Web Services for several of the reasons sited previously. For example, we implemented a FORTRAN-based Earthquake Rupture Forecast (ERF) as a Web Service for use by client computers that don't support a FORTRAN runtime environment. We implemented a Generic Mapping Tool (GMT) Web Service for use by systems that don't have local access to GMT. We implemented a Hazard Map Calculator Web Service to execute Hazard calculations that are too computationally intensive to run on a local system. We implemented a Coordinate Conversion Web Service to enforce a standard and consistent method for converting between UTM and Lat/Lon. Our experience developing these services indicates both strengths and weakness in current Web Service technology. Client programs that utilize Web Services typically need network access, a significant disadvantage at times. Programs with simple input and output parameters were the easiest to implement as Web Services, while programs with complex parameter-types required a significant amount of additional development. We also noted that Web services are very data-oriented, and adapting object-oriented software into the Web Service model proved problematic. Also, the Web Service approach of converting data types into XML format for network transmission has significant inefficiencies for some data sets.

URL: http://www.scec.org/cme

ED32C-1205 1330h POSTER

Dynamic Web Expression for Near-real-time Sensor Networks

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As near-real-time sensor grids become more widespread, and processing systems based on them become more powerful, summarizing the raw and derived information products and delivering them to the end user become increasingly important both for ongoing monitoring and as a platform for cross-disciplinary research. We have re-engineered the dbrecenteqs program, which was designed to express real-time earthquake databases into dynamic web pages, with several powerful new technologies. While the application is still most fully developed for seismic data, the infrastructure is extensible (and being extended) to create a real-time information architecture for numerous signal domains. This work provides a practical, lightweight approach suitable for individual seismic and sensor networks, which does not require a full 'web-services' implementation. Nevertheless, the technologies here are extensible to larger applications such as the Storage-Resource-Broker based VORB project. The technologies included in the new system blend real-time relational databases as a focus for processing and data handling; an XML->XSLT architecture as the core of the web mirroring; PHP extensions to Antelope (the environmental monitoring-system context adopted for RoadNET) in order to support complex, user-driven interactivity; and VRML output for expression of information as web-browsable three-dimensional worlds.

URL: http://eqinfo.ucsd.edu/

ED32C-1206 1330h POSTER

Websim3d: A Web-based System for Generation, Storage and Dissemination of Earthquake Ground Motion Simulations.

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Synthetic time histories from large-scale 3D ground motion simulations generally constitute large 'data' sets which typically require 100's of Mbytes or Gbytes of storage capacity. For the same reason, getting access to a researchers simulation output, for example for an earthquake engineer to perform site analysis, or a seismologist to perform seismic hazard analysis, can be a tedious procedure. To circumvent this problem we have developed a web-based "community model" (websim3D) for the generation, storage, and dissemination of ground motion simulation results. Websim3D allows user-friendly and fast access to view and download such simulation results for an earthquake-prone area. The user selects an earthquake scenario from a map of the region, which brings up a map of the area where simulation data is available. Now, by clicking on an arbitrary site location, synthetic seismograms and/or soil parameters for the site can be displayed at fixed or variable scaling and/or downloaded. Websim3D relies on PHP scripts for the dynamic plots of synthetic seismograms and soil profiles. Although not limited to a specific area, we illustrate the community model for simulation results from the Los Angeles basin, Wellington (New Zealand), and Mexico.

URL: http://www.crustal.ucsb.edu/scec/websims/

ED32C-1207 1330h POSTER

Sophisticated Search Capabilities in the ADS Abstract Service

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The ADS provides access to over 940,000 references from astronomy and planetary sciences publications and 1.5 million records from physics publications. It is funded by NASA and provides free access to these references, as well as to 2.4 million scanned pages from the astronomical literature. These include most of the major astronomy and several planetary sciences journals, as well as many historical observatory publications. The references now include the abstracts from all volumes of the Journal of Geophysical Research (JGR) since the beginning of 2002. We get these abstracts on a regular basis. The Kluwer journal Solar Physics has been scanned back to volume 1 and is available through the ADS. We have extracted the reference lists from this and many other journals and included them in the reference and citation database of the ADS. We have recently scanning Earth, Moon and Planets, another Kluwer journal, and will scan other Kluwer journals in the future as well. We plan on extracting references from these journals as well in the near future. The ADS has many sophisticated query features. These allow the user to formulate complex queries. Using results lists to get further information about the selected articles provide the means to quickly find important and relevant articles from the database. Three advanced feedback queries are available from the bottom of the ADS results list (in addition to regular feedback queries already available from the abstract page and from the bottom of the results list): 1. Get reference list for selected articles: This query returns all known references for the selected articles (or for all articles in the first list). The resulting list will be ranked according to how often each article is referred to and will show the most referenced articles in the field of study that created the first list. It presumably shows the most important articles in that field. 2. Get citation list for selected articles: This returns all known articles that cite one or more of the articles in the first list. The resulting list shows the articles that cite the most articles in the first list at the top. The articles with the most citations are presumably the review articles in the field of study that created the first list. 3. Get also-read list for selected articles: This creates a list of articles that were also read by the readers of the articles in the first list. This list will show what articles are currently being read in the field of study of the first list and will give an idea of which articles are currently considered important for this field. Combinations of these second order queries (e.g. first a citation query to get the review articles, then a reference query to get all the references in the review articles) can further enhance the utility of this new capability. These capabilities provide unprecedented search capabilities that allow the scientist to search the literature in ways that have never been available in one system before. The ADS can be accessed at: http://ads.harvard.edu The ADS is funded by NASA Grant NCC5-18.

URL: http://ads.harvard.edu

ED32C-1208 1330h POSTER

Using 3D Glyph Visualization to Explore Real-time Seismic Data on Immersive and High-resolution Display Systems

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The study of time-dependent, three-dimensional natural phenomena like earthquakes can be enhanced with innovative and pertinent 3D computer graphics. Here we display seismic data as 3D glyphs (graphics primitives or symbols with various geometric and color attributes), allowing us to visualize the measured, time-dependent, 3D wave field from an earthquake recorded by a certain seismic network. In addition to providing a powerful state-of-health diagnostic of the seismic network, the graphical result presents an intuitive understanding of the real-time wave field that is hard to achieve with traditional 2D visualization methods. We have named these 3D icons seismoglyphs' to suggest visual objects built from three components of ground motion data (north-south, east-west, vertical) recorded by a seismic sensor. A seismoglyph changes color with time, spanning the spectrum, to indicate when the seismic amplitude is largest. The spatial extent of the glyph indicates the polarization of the wave field as it arrives at the recording station. We compose seismoglyphs using the real time ANZA broadband data (http://www.eqinfo.ucsd.edu) to understand the 3D behavior of a seismic wave field in Southern California. Fifteen seismoglyphs are drawn simultaneously with a 3D topography map of Southern California, as real time data is piped into the graphics software using the Antelope system. At each station location, the seismoglyph evolves with time and this graphical display allows a scientist to observe patterns and anomalies in the data. The display also provides visual clues to indicate wave arrivals and real-time earthquake detection. Future work will involve adding phase detections, network triggers and near real-time 2D surface shaking estimates. The visuals can be displayed in an immersive environment using the passive stereoscopic Geowall (http://www.geowall.org). The stereographic projection allows for a better understanding of attenuation due to distance and earth structure, source directivity and seismic hazard estimation. Wall sized displays like the 3.2 mega pixel CRT projection based Panoram (http://www.siovizcenter.ucsd.edu) and tiled LCD displays such as the Geowall2 can also be used for high-resolution display of the data. This work was started at the Electronic Visualization Laboratory and received funding from the IRIS Consortium and the National Science Foundation.

URL: http://www.eqinfo.ucsd.edu/∼atul/research/seismoglyphs

ED32C-1209 1330h POSTER

The Digital Library for Earth System Education: A Community Integrator

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The rapid changes in the geoscience research environment have prompted educators to request support for their efforts to reform geoscience educational practices. DLESE, the Digital Library for Earth System Education, responds to this request by providing a single point of access to high-quality educational resources for teaching about the Earth as a system. DLESE is supported by the National Science Foundation and is an operational library used by tens of thousands of educators every month. DLESE resources include a variety of media formats, from text-based lesson plans to highly-sophisticated tools for interactive three-dimensional visualization of authentic scientific data. The DLESE community is particularly interested in partnering with scientific researchers to ensure that the tools of practicing scientists become widely available to geoscience educators. Two emerging large-scale scientific efforts, the GEON project and EarthScope, provide compelling illustrations of the potential of these partnerships. Both are cutting-edge, cross-disciplinary projects that use digital tools in a distributed environment to support scientific investigation. Both have also made a deep commitment to use these same tools to support geoscience education, and both are including DLESE as part of that commitment. Our interactive presentation will allow users to discover a variety of educational resources and communication services within the library. We will highlight those library resources and services that take particular advantage of the digital media to support new modes of learning and teaching. For example, annotation tools allow educators to add tips on the most effective way to use a specific resource. Data services will help educators find and use real-time data to illustrate geoscience phenomena. Multi-dimensional visualization tools allow students to interact with authentic student data in inquiry-based learning environment. DLESE will continue to actively collaborate with scientific research efforts to ensure that the practices and tools of the research community also support the needs of geoscience learners and educators.

URL: http://www.dlese.org

ED32C-1210 1330h POSTER

Using News Media Databases (LexisNexis) To Identify Relevant Topics For Introductory Earth Science Classes

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Introductory Earth science courses are undergoing pedagogical changes in universities across the country and are focusing more than ever on the non-science majors. Increasing enrollment of non-science majors in these introductory Earth science courses demands a new look at what is being taught and how the content can be objectively chosen. Assessing the content and effectiveness of these courses requires a quantitative investigation of introductory Earth science topics and their relevance to current issues and concerns. Relevance of Earth science topics can be linked to improved students' attitude toward science and a deeper understanding of concepts. We have used the Internet based national news search-engine LexisNexis Academic Universe (http://www.lexisnexis.org/) to select the occurrence of Earth science terms over the last 12 months, five and ten years both regionally and nationally. This database of term occurrences is being used to examine how Earth sciences have evolved in the news through the last 10 years and is also compared with textbook contents and course syllabi from randomly selected introductory earth science courses across the nation. These data constitute the quantitative foundation for this study and are being used to evaluate the relevance of introductory earth science course content. The relevance of introductory course content and current real-world issues to student attitudes is a crucial factor when considering changes in course curricula and pedagogy. We have examined students' conception of the nature of science and attitudes towards science and learning science using a Likert-scale assessment instrument in the fall 2002 Geology 100 classes at Iowa State University. A pre-test and post-test were administered to see if the students' attitudes changed during the semester using as reference a control group comprised of geoscience undergraduate and graduate students, and faculty. The results of the attitude survey have been analyzed in terms of student demographics and socioeconomic variables (e.g., year in school, gender).

ED32C-1211 1330h POSTER

The Internet as a Platform for Student Presentations

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As the number of students enrolled in colleges and universities across the country increases, both class size and faculty workloads also increase, and individual students slip through wider and wider cracks. Universities are moving toward web-based technology as a way to facilitate student learning in an academic environment that is growing and changing faster than ever. Faculty web pages, hosted by the faculty's own internet provider, by the university, or by national services such as Blackboard or WebCT, are often used to bridge the gap between faculty and students. Typically, faculty web pages are used to post syllabi and announcements, to distribute course notes, and to disseminate student grades, while email replaces office hours as the preferred method of communication. While this use of the internet has already begun to transform course instruction, it represents only the simplest use of a tool that has tremendous potential, both in and out of the classroom. The internet can be used to bring back the element of personalization that is quickly lost as class size continues to grow. Much of the material covered in large introductory science classes is completely new to students, and they have trouble visualizing new concepts and placing them in context. In smaller classes, a solution might be to assign papers or projects to help students become familiar with the new concepts and new ideas. This is neither feasible nor terribly effective in large lecture courses. With the innovative use of web-based technology, student presentations as a method of learning can be reinvented, with greater impact for each student. Additional use of internet-based discussions and chats enables each student to experience many of their classmate's presentations in addition to their own. This use of the web as a media for storage and presentation of student projects is well-liked by students. They are able to work together on projects in large classes otherwise closed to such activity, to learn technology that will help them in their future lives, and ultimately to lose their fear of science through hands-on experience. Though generally a success, it is not without problems, most notably direct plagiarism from other websites. The interactive poster session will include the original website, examples of the best and the worst student presentations, student comments on the whole experience, as well as insights on what to do and not to do in your own course.

ED32C-1212 1330h POSTER

Grid-based Visualization Framework

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Advances in science and engineering have put high demands on tools for high-performance large-scale visual data exploration and analysis. For example, earthquake scientists can now study earthquake phenomena from first principle physics-based simulations. These simulations can generate large amounts of data, possibly high spatial resolution, and long time series. Single-system visualization software running on commodity machines cannot scale up to the large amounts of data generated by these simulations. To address this problem, we propose a flexible and extensible Grid-based visualization framework for time-critical, interactively controlled visual browsing of spatially and temporally large datasets in a Grid environment. Our framework leverages Grid resources for scalable computation and data storage to maintain performance and interactivity with large visualization jobs. Our framework utilizes Globus Toolkit 2.4 components for security (i.e., GSI), resource allocation and management (i.e., DUROC, GRAM) and communication (i.e., Globus-IO) to couple commodity desktops with remote, scalable storage and computational resources in a Grid for interactive data exploration. There are two major components in this framework—Grid Data Transport (GDT) and the Grid Visualization Utility (GVU). GDT provides libraries for performing parallel data filtering and parallel data exchange among Grid resources. GDT allows arbitrary data filtering to be integrated into the system. It also facilitates multi-tiered pipeline topology construction of compute resources and displays. In addition to scientific visualization applications, GDT can be used to support other applications that require parallel processing and parallel transfer of partial ordered independent files, such as file-set transfer. On top of GDT, we have developed the Grid Visualization Utility (GVU), which is designed to assist visualization dataset management, including file formatting, data transport and automatic byte swapping. GVU also supports parameterized data reduction filters such as point sampling with scalar range culling, as well as volume cropping, and down sampling. The GVU framework can be used to facilitate the parallel execution of existing transformation filters, such as the VTK marching cubes isosurface filter, as well as other custom domain-specific filters. Our initial implementation supports remote synthesis of view point independent display lists. This feature allows the local display machine to control the view point for reduced view point latency, and multi-view rendering (e.g., stereo rendering). The poster will provide an architectural design of the Grid-based visualization framework and its components. We will also show a brief demo/movie of our work, and how it is being used to visualize 4D earthquake wave propagation data.

URL: http://www.globus.org

ED32C-1213 1330h POSTER

An Online Module on Rainfall Runoff Processes

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This paper will show an online module designed to provide a comprehensive and quantitative understanding of infiltration and runoff generation processes. This module was developed to fulfill National Weather Service training needs and is targeted at professionals with a college degree in science or engineering, and seniors or graduate students in a hydrologic science or engineering program. No prior knowledge on Rainfall Runoff Processes is required. The module first reviews the mechanisms involved in runoff generation and the pathways water takes moving to streams in different settings. The physical factors at the land surface that affect runoff are presented. This leads into a presentation of soil properties fundamental to the partitioning of water inputs at the earth surface and methods and procedures for the calculation of infiltration at a point. The module guides students through the detailed calculations involved. The module then ends with review of the simulation of runoff generation in hydrologic models such as TOPMODEL and the National Weather Service River Forecast System (NWSRFS). The online material takes advantage of streaming video and slide presentations as well as visualizations and computer animations that focus on key concepts. Substantive supporting material is given in the form of a PDF workbook that serves as a text. There is an online quiz at the end of each chapter designed to reinforce knowledge of the material covered in the section. The module compares answers to the solution and provides feedback. There is also an online final exam accessible once each chapter quiz has been attempted. The material in the early parts of the module is qualitative introducing the terminology and conceptual models involved in describing Rainfall Runoff processes. The latter parts of the module require users to perform quantitative calculations using a spreadsheet program such as Excel or an advanced engineering or scientific calculator. The module may be accessed at http://moose.cee.usu.edu/comet

URL: http://moose.cee.usu.edu/comet

ED32C-1214 1330h POSTER

Data and Visualizations in the Southern California Earthquake Center's Fault Information System

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The Southern California Earthquake Center's Fault Information System (FIS) provides a single point of access to fault-related data and models from multiple databases and datasets. The FIS is built of computer code, metadata and Web interfaces based on Web services technology, which enables queries and data interchange irrespective of computer software or platform. Currently we have working prototypes of programmatic and browser-based access. The first generation FIS may be searched and downloaded live, by automated processes, as well as interactively, by humans using a browser. Users get ascii data in plain text or encoded in XML. Via the Earthquake Information Technology (EIT) Interns (Juve and others, this meeting), we are also testing the effectiveness of querying multiple databases using a fault database ontology. For more than a decade, the California Geological Survey (CGS), SCEC, and the U. S. Geological Survey (USGS) have put considerable, shared resources into compiling and assessing published fault data, then providing the data on the Web. Several databases now exist, with different formats, datasets, purposes, and users, in various stages of completion. When fault databases were first envisioned, the full power of today's internet was not yet recognized, and the databases became the Web equivalents of review papers, where one could read an overview summation of a fault, then copy and paste pertinent data. Today, numerous researchers also require rapid queries and downloads of data. Consequently, the first components of the FIS are MySQL databases that deliver numeric values from earlier, text-based databases. Another essential service provided by the FIS is visualizations of fault representations such as those in SCEC's Community Fault Model. The long term goal is to provide a standardized, open-source, platform-independent visualization technique. Currently, the FIS makes available fault model viewing software for users with access to Matlab or Java3D. The latter is the interactive LA3D software of the SCEC EIT intern team, which will be demonstrated at this session.

URL: http://www.scec.org/FIS

ED32C-1215 1330h POSTER

A Multi-User Model for Effectively Communicating Research Through Electronic Media

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Electronic media have demonstrated potential for data exchange, dissemination of results to other scientists, communication with community interest groups, and education of the general public regarding scientific advances. Few researchers, however, receive training in the skills required to capture the attention of the broad spectrum of Internet users. Because different people assimilate information in different ways, effective communication is best accomplished using an appropriate mix of photographs, graphics, tables, and text. In addition, effective web page design requires a clear, consistent organizational structure, easily-navigated layout, and attention to details such as page printability, downloading time, and minimal page scrolling. One of the strengths of electronic media is that the user can chose an appropriate level of involvement for his or her interest. In designing a web page for the multidisciplinary NSF/EPSCoR "Biocomplexity in Extreme Environments" project, we divided potential users into three categories based on our perception of the level of detail they required: 1) project participants, 2) nonparticipants with technical backgrounds, and 3) the general public. By understanding the needs and expectations of potential viewers, it was possible to present each group with an appropriate balance of visual and textural elements. For example, project participants are often most interested in raw data, which can be effectively presented in tabular format. Non-participants with technical backgrounds are more interested in analyzed data, while a project overview, presented through photographs and graphics with minimal text, will be most effective for communicating with the general public. The completed web page illustrates one solution for effectively communicating with a diverse audience, and provides examples for meeting many of the challenges of web page design.

URL: http://www.uidaho.edu/biogeochemistry

ED32C-1216 1330h POSTER

The Visual Geophysical Exploration Environment: A Multi-dimensional Scientific Visualization

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The Visual Geophysical Exploration Environment (VGEE) is an online learning environment designed to help undergraduate students understand fundamental Earth system science concepts. The guiding principle of the VGEE is the importance of hands-on interaction with scientific visualization and data. The VGEE consists of four elements: 1) an online, inquiry-based curriculum for guiding student exploration; 2) a suite of El Nino-related data sets adapted for student use; 3) a learner-centered interface to a scientific visualization tool; and 4) a set of concept models (interactive tools that help students understand fundamental scientific concepts). There are two key innovations featured in this interactive poster session. One is the integration of concept models and the visualization tool. Concept models are simple, interactive, Java-based illustrations of fundamental physical principles. We developed eight concept models and integrated them into the visualization tool to enable students to probe data. The ability to probe data using a concept model addresses the common problem of transfer: the difficulty students have in applying theoretical knowledge to everyday phenomenon. The other innovation is a visualization environment and data that are discoverable in digital libraries, and installed, configured, and used for investigations over the web. By collaborating with the Integrated Data Viewer developers, we were able to embed a web-launchable visualization tool and access to distributed data sets into the online curricula. The Thematic Real-time Environmental Data Distributed Services (THREDDS) project is working to provide catalogs of datasets that can be used in new VGEE curricula under development. By cataloging this curricula in the Digital Library for Earth System Education (DLESE), learners and educators can discover the data and visualization tool within a framework that guides their use.

URL: http://www.dpc.ucar.edu/vgee/index.htm

ED32C-1217 1330h POSTER

The Challenges and Benefits of Using Computer Technology for Communication and Teaching in the Geosciences

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The advent of the World Wide Web in the early 1990s not only revolutionized the exchange of ideas and information within the scientific community, but also provided educators with a new array of teaching, informational, and promotional tools. Use of computer graphics and animation to explain concepts and processes can stimulate classroom participation and student interest in the geosciences, which has historically attracted students with strong spatial and visualization skills. In today's job market, graduates are expected to have knowledge of computers and the ability to use them for acquiring, processing, and visually analyzing data. Furthermore, in addition to promoting visibility and communication within the scientific community, computer graphics and the Internet can be informative and educational for the general public. Although computer skills are crucial for earth science students and educators, many pitfalls exist in implementing computer technology and web-based resources into research and classroom activities. Learning to use these new tools effectively requires a significant time commitment and careful attention to the source and reliability of the data presented. Furthermore, educators have a responsibility to ensure that students and the public understand the assumptions and limitations of the materials presented, rather than allowing them to be overwhelmed by "gee-whiz" aspects of the technology. We present three examples of computer technology in the earth sciences classroom: 1) a computer animation of water table response to well pumping, 2) a 3-D fly-through animation of a fault controlled valley, and 3) a virtual field trip for an introductory geology class. These examples demonstrate some of the challenges and benefits of these new tools, and encourage educators to expand the responsible use of computer technology for teaching and communicating scientific results to the general public.

URL: http://www.uidaho.edu/~jhinds/Geovisualization.html

ED32C-1218 1330h POSTER

Web Services Provide Access to SCEC Scientific Research Application Software

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Web services offer scientific communities a new paradigm for sharing research codes and communicating results. While there are formal technical definitions of what constitutes a web service, for a user community such as the Southern California Earthquake Center (SCEC), we may conceptually consider a web service to be functionality provided on-demand by an application which is run on a remote computer located elsewhere on the Internet. The value of a web service is that it can (1) run a scientific code without the user needing to install and learn the intricacies of running the code; (2) provide the technical framework which

allows a user's computer to talk to the remote computer which performs the service; (3) provide the computational resources to run the code; and (4) bundle several analysis steps and provide the end results in digital or (post-processed) graphical form. Within an NSF-sponsored ITR project coordinated by SCEC, we are constructing web services using architectural protocols and programming languages (e.g., Java). However, because the SCEC community has a rich pool of scientific research software (written in traditional languages such as C and FORTRAN), we also emphasize making existing scientific codes available by constructing web service frameworks which wrap around and directly run these codes. In doing so we attempt to broaden community usage of these codes. Web service wrapping of a scientific code can be done using a "web servlet" construction or by using a SOAP/WSDL-based framework. This latter approach is widely adopted in IT circles although it is subject to rapid evolution. Our wrapping framework attempts to "honor" the original codes with as little modification as is possible. For versatility we identify three methods of user access: (A) a web-based GUI (written in HTML and/or Java applets); (B) a Linux/OSX/UNIX command line "initiator" utility (shell-scriptable); and (C) direct access from within any Java application (and with the correct API interface from within C++ and/or C/Fortran). This poster presentation will provide descriptions of the following selected web services and their origin as scientific application codes: 3D community velocity models for Southern California, geocoordinate conversions (latitude/longitude to UTM), execution of GMT graphical scripts, data format conversions (Gocad to Matlab format), and implementation of Seismic Hazard Analysis application programs that calculate hazard curve and hazard map data sets.

ED32C-1219 1330h POSTER

Facilitating Communication of Geoscientists' Conceptual Mental Imagery at the U.C.S.B. Educational Multimedia Visualization Center

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Professional geoscientists tend to have specific, elaborate "mental cartoons" that encapsulate their conceptual understandings of earth processes. The computer revolution has made it possible for this mental imagery to be illustrated and animated in ways not previously possible, while the development of the Internet is making it easily shared. The power of this new communication mode for both research communication and for education at all levels and venues is only beginning to be exploited. The Educational Multimedia Visualization Center at U.C.S.B. is devoted to creating conceptual animations and imbedding them in contextual images (maps, photographs, diagrams, etc.) in order to facilitate this revolution in visual communication. Projects are created for both in-house researchers and for visitors to the center. Recent project topics include numerous plate tectonic processes and histories (global, regional, and local), geological histories, volcanic processes and specific volcanic histories, coastal processes, geological manifestations of the ice ages (including the Black Sea flood), formation and trapping of petroleum, and others.

URL: http://emvc.geol.ucsb.edu

ED32C-1220 1330h POSTER

The U.S. Geological Survey Earthquake Hazards Program Website: Summary of Recent and Ongoing Developments

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The U.S. Geological Survey (USGS) Earthquake Hazards Program (EHP) website (http://earthquake.usgs.gov/) focuses on 1) earthquake reporting for informed decisions after an earthquake, 2) hazards information for informed decisions and planning before an earthquake, and 3) the basics of earthquake science to help the users of the information understand what is presented. The majority of website visitors are looking for information about current earthquakes in the U.S. and around the world, and the second most visited portion of the website are the education-related pages. People are eager for information, and they are most interested in "what's in my backyard?" Recent and future web developments are aimed at answering this question, making the information more relevant to users, and enabling users to more quickly and easily find the information they are looking for. Recent and/or current web developments include the new enhanced Recent Global Earthquakes and U.S. Earthquakes webpages, the Earthquake in the News system, the Rapid Accurate Tectonic Summaries (RATS), online Significant Earthquake Summary Posters (ESP's), and the U.S. Quaternary Fault & Fold Database, the details of which are covered individually in greater detail in this or other sessions. Future planned developments include a consistent look across all EHP webpages, an integrated one-stop-shopping earthquake notification (EQMail) subscription webpage, new navigation tabs, and a backend database allowing the user to search for earthquake information across all the various EHP websites (on different webservers) based on a topic or region. Another goal is to eventually allow a user to input their address (Zip Code?) and in return receive all the relevant EHP information (and links to more detailed information) such as closest fault, the last significant nearby earthquake, a local seismicity map, and a local hazard map, for example. This would essentially be a dynamic report based on the entered location. This type of "what's in my backyard?" information would be of great benefit to both various organizations, such as insurance agencies and building contractors, and the general public.

URL: http://earthquake.usgs.gov

ED32C-1221 1330h POSTER

Fiction and scientific communication about volcanoes for the young public

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Since January 2002, I have developed a new type of interactive web site for scientific news and communications about volcanic activities on the Earth and in our solar system. With the help of a small team (including an illustrator) based in GEOTOP at the University of Quebec in Montreal, I have created a monthly French language site on volcanoes including ongoing activity. Our multimedia site www.vickivolka.uqam.ca, combines open-style scientific news, including texts and pictures with scientific explanations. The originality lies in both the content and site structure. The monthly renewals inform the public on volcanic news but also on academic research and scientific experiments that young people can perform at home. We thus link breaking volcanic news with a deeper understanding of the processes and knowledge. Another original aspect is the use of fictional characters (Vicki and Anaky) who present the news and describe their adventures during the volcanic trips (volcanological, geographical, historic contents). Additional sections include interactive functions. Based on the success of this web site (published at the moment in French) - as evidenced notably by numerous primary school visits - we are planning to translate it in English very soon. This mixture of fiction with real world stories and scientific knowledge is an unusual effort by practising researchers and collaborators to strengthen links between the academic world and the general public, especially with children and educators.

ED32C-1222 1330h POSTER

The Electronic Encyclopedia of Earthquakes

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The Electronic Encyclopedia of Earthquakes is a collaborative project of the Southern California Earthquake Center (SCEC), the Consortia of Universities for Research in Earthquake Engineering (CUREE) and the Incorporated Research Institutions for Seismology (IRIS). This digital library organizes earthquake information online as a partner with the NSF-funded National Science, Technology, Engineering and Mathematics (STEM) Digital Library (NSDL) and the Digital Library for Earth System Education (DLESE). When complete, information and resources for over 500 Earth science and engineering topics will be included, with connections to curricular materials useful for teaching Earth Science, engineering, physics and mathematics. Although conceived primarily as an educational resource, the Encyclopedia is also a valuable portal to anyone seeking up-to-date earthquake information and authoritative technical sources. "E3" is a unique collaboration among earthquake scientists and engineers to articulate and document a common knowledge base with a shared terminology and conceptual framework. It is a platform for cross-training scientists and engineers in these complementary fields and will provide a basis for sustained communication and resource-building between major education and outreach activities. For example, the E3 collaborating organizations have leadership roles in the two largest earthquake engineering and earth science projects ever sponsored by NSF: the George E. Brown Network for Earthquake Engineering Simulation (CUREE) and the EarthScope Project (IRIS and SCEC). The E3 vocabulary and definitions are also being connected to a formal ontology under development by the SCEC/ITR project for knowledge management within the SCEC Collaboratory. The E3 development system is now fully operational, 165 entries are in the pipeline, and the development teams are capable of producing 20 new, fully reviewed encyclopedia entries each month. Over the next two years teams will complete 450 entries, which will populate the E3 collection to a level that fully spans earthquake science and engineering. Scientists, engineers, and educators who have suggestions for content to be included in the Encyclopedia can visit www.earthquake.info now to complete the "Suggest a Web Page" form.

URL: http://www.earthquake.info

ED32C-1223 1330h POSTER

Is Your Class a Natural Disaster? It can be... The Real Time Earthquake Education (RTEE) System

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In cooperation with the U.S. Geological Survey (USGS) and its National Earthquake Information Center (NEIC) in Golden, Colorado, we have implemented an autonomous version of the NEIC's real-time earthquake database management and earthquake alert system (Earthworm). This is the same system used professionally by the USGS in its earthquake response operations. Utilizing this system, Penn State University students participating in natural hazard classes receive real-time alerts of worldwide earthquake events on cell phones distributed to the class. The students are then responsible for reacting to actual earthquake events, in real-time, with the same data (or lack thereof) as earthquake professionals. The project was first implemented in Spring 2002, and although it had an initial high intrigue and "coolness" factor, the interest of the students waned with time. Through student feedback, we observed that scientific data presented on its own without an educational context does not foster student learning. In order to maximize the impact of real-time data and the accompanying e-media, the students need to become personally involved. Therefore, in collaboration with the Incorporated Research Institutes of Seismology (IRIS), we have begun to develop an online infrastructure that will help teachers and faculty effectively use real-time earthquake information. The Real-Time Earthquake Education (RTEE) website promotes student learning by integrating inquiry-based education modules with real-time earthquake data. The first module guides the students through an exploration of real-time and historic earthquake datasets to model the most important criteria for determining the potential impact of an earthquake. Having provided the students with content knowledge in the first module, the second module presents a more authentic, open-ended educational experience by setting up an earthquake role-play situation. Through the Earthworm system, we have the ability to "set off" historical earthquakes (ex. the students get alerted, like any other real-time alert, to the 1989 Loma Prieta earthquake). Students are then responsible for going through a series of tasks mimicking real earthquake response teams. Teacher feedback compares students' decisions against the actual decisions of the earthquake professionals, giving student assessment meaning and validity. Additionally, it sets up wonderful post-role-play research projects for students to investigate the complex, long-term impacts of

the historical earthquake. The integration of technology with education is a critical part of the authentic science experience. Telecommunication improvements are making sets of current, robust resources needed for open-ended investigations increasingly available to students. In the RTEE system, the near real-time determination of earthquake information and subsequent delivery of that information to earthquake professionals is a reality that can be shared with students in their classrooms. The specific focus of the RTEE system is to improve the delivery of real-time earthquake education resources to educators and their students. By coupling the Earthworm system with relevant high-quality educational materials, we hope to provide a critical resource for understanding the societal impacts of earthquakes.

URL: http://www.csmate.colostate.edu/staff/whitlock.html

ED32C-1224 1330h POSTER

Enhancing Student Learning in and out of the Classroom with Electronic Teaching and Study Aids Built Around Interactive Groundwater Visualization Software

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Advances in electronic resources allow more realistic student problems, increased student engagement and self learning, and the use of interactive, exploratory learning. We are using a sophisticated yet easy-to-use groundwater modeling and visualization program (Interactive Groundwater, IGW, Li and Liu: www.egr.msu.edu/~lishug/research/igw) to build packages of innovative tools for instructors and students. Equipped with an advanced graphical interface, IGW allows interactive visualization and manipulation of complex, multidimensional subsurface systems including hydrology, contaminant transport and assessment of contaminated sites. Two principle product packages are the Graphical Teaching Aid (GTA) and the Student Learning Exercise (SLE), developed as part of the NSF-supported Virtual Interactive Remediation in the Groundwater Environment (VIRGE). A GTA is a classroom-presentation guide that includes text materials for the instructor as well as supporting electronic IGW files for interactive graphical demonstrations and discussions in the classroom. Text files include a conceptual outline and a list of principles to be examined in the lecture as well as a flexible script punctuated and illustrated throughout by use of IGW as a highly interactive "electronic chalkboard". The thorough text guides the instructor in the effective use of IGW, suggests ideas to engage student interaction, and provides ways to tailor the interactive presentation to student needs. An SLE complements the GTA as an interactive exercise to engage students in discovery learning. As with GTAs, SLEs are designed for specific levels of classes (undergraduate or graduate) and specific populations (non-technical, science, or engineering majors). Text files (background and instruction) and IGW files (for problem visualization, interactive manipulation and solution) are provided. The SLEs include interactive computer-based exercises ranging from introductory investigations to extensive, open-ended investigations comparable to geotechnical exploration projects or engineering design projects.

ED32C-1225 1330h POSTER

EarthEd Online: Open Source Online Software to Support Large Courses

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The purpose of the EarthEd Online software project is to support a modern instructional pedagogy in a large, college level, earth science course. It is an ongoing development project that has evolved in a large general education oceanography course over the last decade. Primary goals for the oceanography course are to support learners in acquiring a knowledge of science process, an appreciation for the relevance of science to society, and basic content knowledge. In order to support these goals, EarthEd incorporates: a) integrated access to various kinds of real earth data (and links to web-based data browsers), b) online discussions, live chat, with integrated graphics editing, linking, and upload, c) online writing, reviewing, and grading, d) online homework assignments, e) on demand grade calculation, and f) instructor grade entry and progress reports. The software was created using Macromedia Director. It is distributed to students on a CDROM and updates are downloaded and installed automatically. Data browsers for plate tectonics relevant data ("Our Dynamic Planet"), a virtual exploration of the East Pacific Rise, the World Ocean Atlas-98, and a fishing simulation game are integrated with the EarthEd software. The system is modular which allows new capabilities, such as new data browsers, to be added. Student reactions to the software are positive overall. They are especially appreciative of the on demand grade computation capability. The online writing, commenting and grading is particularly effective in managing the large number of papers that get submitted. The TA's grade the papers, but the instructor can provide feedback to them as they grade the papers, and a record is maintained of all comments and rubric item grades. Commenting is made easy by simply "dragging" a selection of pre-defined comments into the student's text. Scoring is supported by an integrated scoring rubric. All assignments, rubrics, etc. are configured in text files that are downloaded from the course web server. Students rate the writing assignments as the most effective learning activity in the course. This project is in an evaluation and dissemination phase. An open source model is planned for distribution. For documentation and information about the EarthEd team, see: http://oceanography.geol.ucsb.edu/Collab/software.html

URL: http://oceanography.geol.ucsb.edu/Collab/software.html

ED32C-1226 1330h POSTER

The Prototype Interactive Ground-water Tutor: A New Tool for Computer Assisted Instruction in Secondary and Undergraduate-level Earth and Environmental Science Education

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We have developed and are testing the beta version of a potentially web-based, interactive Java application and accompanying web pages in which students use their knowledge of ground-water flow principles and contaminant transport to solve an environmental disaster. The application simulates movement of a plume from a pipeline break through a shallow alluvial aquifer towards a major river just upstream from a municipal water supply intake. The student plays the role of a consultant hired by the pipeline owner to locate and remediate the plume at a minimum possible cost and time. In the plume-finding phase, students place observation wells on a grid representing the study area and the simulation returns the contaminant concentrations at those locations on the appropriate sample dates. Once students have located the plume, they are able to place pumping and injection wells on the board to begin remediation. The simulation then computes the movement of particles to the pumping wells and returns a cumulative mass curve at each well, along with the total mass recovered. The accompanying web pages provide students with background material on groundwater flow and transport principles, establish the contamination scenario simulated in the application, and emphasize the potential ecological and economic impacts of the contamination. The Tutor promotes national science-education curriculum goals through student role-play using science to solve real-world problems.

ED32C-1227 1330h POSTER

The Windows to the Universe Project: Using the Internet to Support K-12 Science Education

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The World Wide Web can be a powerful tool for reaching the public as well as students and teachers around the world, supporting both formal and informal science education. The Windows to the Universe Project, initiated in 1995, provides a case study of approaches for the use of the web to support earth and space science education and literacy efforts. Through the use of innovative approaches such as easy to use design, multi-level content, and science concepts presented in a broader background context that includes connections to culture and the humanities, Windows to the Universe is an accessible format for individuals of various ages and learning styles. A large global audience regularly uses the web site to learn about earth and space science as well as related humanities content such as myths from around the world. User surveys show that the site has over 4 millions users per year, 65 percent of which are K-12 teachers and students. Approximately 46 percent of users access the site once per week or more. Recently, we have had the opportunity to expand our efforts while we continue to update existing content based on new scientific findings and events. Earth science content on Windows to the Universe is currently growing with a new geology section and development efforts are underway to expand our space weather content with a new curriculum. Educational games allow users to learn about space in a playful context, and an online journaling tool further integrates literacy into the learning experience. In addition, we are currently translating the entire Windows to the Universe web site into Spanish. We have included educators in the project as co-designers from its inception, and by aggressively utilizing and providing professional development opportunities for teachers, the web site is now used in thousands of classrooms around the world. In the past year we have continued to support K-12 educators by adding to our suite of classroom activities and leading professional development workshops and short courses. Core funding for the project is provided from the NASA Office of Space Science Information Technology Research Program, the NASA Earth Science Enterprise Education Program, and the National Science Foundation.

URL: http://www.windows.ucar.edu

ED32C-1228 1330h POSTER

Developing Exhibit-based, Interactive Web Sites to Communicate Science

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New technologies are transforming the Web from a static medium to an interactive environment with tremendous potential for informal education and inquiry-based investigations. ASTC, the trade association of science museums, gave its 2000 innovation award to the Exploratorium's Web page rather than a physical exhibit. The increased power of the Web as an informal learning tool is partly the result of technologies (such as Java, Flash and Shockwave) that allow the development of inquiry-based, interactive experiences. Web site visitors can now "learn science by doing science." This report features two online projects funded by NSF and NASA: MarsQuest Online and the Space Weather Center. TERC, the Space Science Institute, and NASA's Jet Propulsion Laboratory are developing MarsQuest Online, an interactive, exploration-based Web site that extends the reach and scope of the MarsQuest exhibit. The Space Weather Center Web site is based on the Space Weather Center exhibit that was developed in partnership with scientists and educators at NASA/GSFC. Both exhibits represent a tremendous, collaborative effort by scientists, educators, and designers to communicate the essentials of Mars science and space weather to the public. As such, the graphics, text, and story developed for the exhibits represent a valuable resource that will provide the framework and base content for the public site. Given that framework, the Web sites can then expand both the content and audience of the exhibits in key ways. In particular, the sites will 1) extend the reach of the exhibit by making it available online, 2) extend the scope of the exhibit, linking to the latest imagery and results from ground and space-based missions, and 3) provide support and follow-up for the exhibit education programs, while making materials available to more teachers, parents, and museum educators and docents.

URL: http://www.marsquestonline.org

ED32C-1229 1330h POSTER

Planetary Data in Education: Tool Development for Access to the Planetary Data System

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In keeping with NASA's emphasis on "inspiring the next generation of explorers", the Planetary Data System (PDS) has begun work on a new intuitive web interface that will provide easy access to data collected by planetary exploration spacecraft. The ultimate goal of this tool is to allow more citizens and students to become active participants in the exploration of space. The simple interface allows the user to define collections of data based on intuitive search criteria, such as geographic coordinates, feature names (Valles Marineris) and features types (craters). The interface allows the user to download files in numerous image file formats, including JPEG, TIFF, GIF, BMP, PNG and raw pixels. The user can access the collection for subsequent integration with their educational tool or curriculum. In this session we will describe and demonstrate the interface and its capabilities, walk through user scenarios, discuss the relationship of this interface to the PDS access tools and functions developed for the scientific community, and discuss the potential for its utilization in K-14 formal and informal (museums, amateur groups, etc.) settings. The tool discussed in the session is designed to provide a foundation for access to planetary data and test for the basic, broad scope needs of the formal and informal educational communities.

ED32D MCC: 3012 Wednesday 1340h

Education and Outreach Efforts of Major Research Facilities and Organizations I *(joint with OS, P, T, C)*

Presiding: **P G Coble,** College of Marine Science, University of South Florida**; H Gröschel,** Henrike Gröschel

ED32D-01 1340h

The National Center for Atmospheric Research Education and Outreach Program: Successes, Lessons Learned, and the Role of Research Institutions

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The growing consensus that improving science education and public science literacy requires the focused efforts of a wide spectrum of specialists, including scientists, provides the opportunity for national research centers to develop programs that seek to bring their unique science perspectives to educators and the public. At the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, we have developed a multifaceted program for science education and outreach designed to bring our science to these audiences in ways that build on our specialized expertise. Collaboration with scientists internal to NCAR, as well as in the broader University Corporation for Atmospheric Research community, has lead to numerous education and outreach projects that bring the results of funded research projects to the public. Education and outreach activities at NCAR include opportunities to engage with the public in informal as well as more formal settings. Our exhibit and tour program offers topically focused exhibits, interactive activities, and opportunities to learn about the science underway at the laboratory. We hold annual events, providing high-energy science demonstrations and lectures for the public. Our web sites disseminate extensive resources enabling students (K-12 and undergraduate), educators, and the public to learn on their own about our science, supplemented by interactives and hands-on activities. Our professional development programs engage middle and high school educators in standards-based activities and cutting-edge science content that highlights global and climate change topics and modeling in the geosciences. Central to all of these activities is the active participation of lab scientists and staff, whose personal enthusiasm and science expertise enriches the program for our audiences.

URL: http://www.ncar.ucar.edu/eo/

ED32D-02 1355h

Implementing and Supporting Earth Science Curriculum Reform in Secondary Schools

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The American Geological Institute has been actively involved in developing earth science curricula for more thanm 40 years through programs like Earth Science Sourcebook and the Earth Science Curriculum Project. Recently, the AGI was funded by the National Science Foundation to develop curriculum for secondary school (grades 6-12) that would address the Earth science and inquiry content standards of the National Science Education Standards. The EarthComm (high school) and Investigating Earth Systems (middle school) curriculum programs were developed through funding from the National Science Foundation and corporate sponsors of the AGI Foundation, and published for the 2002-2003 schol year. The AGI is now actively involved in developing and refining systems for supporting the professional development of teachers who implement EarthComm and Investigating Earth Systems. The paper presentation will outline how AGI is supporting teachers through a combination of web-based programs, teacher workshops, and DVD and video materials.

URL: http://www.agiweb.org/education/

ED32D-03 1410h

K12 Education Program Lessons Learned at the Center for Earthquake Research and Information

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The Center for Earthquake Research and Information at the University of Memphis has been committed to increasing awareness for Seismic Hazard, Earthquake Engineering, and Earth Science among Mid-America's policy-makers, engineers, emergency managers, the general public, and K-12 teachers and students for nearly three decades. During that time we have learned many lessons related to providing effective education and outreach programs, especially for K-12 students. The lessons learned from these activities may be particularly appropriate for other regions where large earthquakes occur infrequently but have disproportionately high consequence areas due to low attenuation of seismic waves. Effective education programs in these settings must provide a consistent message across many states to a wide variety of socio-economic groups and professional communities through the leveraged resources of various groups and agencies. It is also beneficial to hire and train staff with K-12 teaching experience to work directly K-12 education organizations, and science curriculum coordinators.

URL: http://www.ceri.memphis.edu

ED32D-04 1425h

EARTH (Education and Research: Testing Hypotheses) -Educational Outreach Efforts by the Monterey Bay Aquarium Research Institute (MBARI) and the Monterey Bay Aquarium (MBA).

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Recognizing the need to educate the public about the value of research and help them understand scientific methodology, this collaboration allows us to test new ideas for public outreach and education. One of MBARI's joint projects with MBA, Education and Research: Testing Hypotheses (EARTH) lays new groundwork, providing teachers with means for integrating real-time data with existing educational standards and tested curriculum in an interactive and engaging way. EARTH will use real-time data from the ocean observatory to design and test outreach with the Internet as an interface to scientists, teachers, students, and the public. Several workshops will be held at MBARI in 2002-2004 bringing educators, scientists, and engineers together to develop effective educational practices for access and use of real-time data in preparation for the deployment of benthic observatories. Participants include educators from other research institutions, universities, community colleges, and high schools as well as MBARI and MBA staff. Initial efforts of EARTH target high school and undergraduate students, with the ultimate goal of reaching kindergarten through college. This presentation will focus on the first two years of this project looking at lessons learned, current status, and plans for the future.

URL: http://www.mbari.org/education/earthwksp.htm

ED32D-05 1440h

Southern California Earthquake Center (SCEC) Communication, Education and Outreach Program

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The SCEC Communication, Education, and Outreach Program (CEO) offers student research experiences, web-based education tools, classroom curricula, museum displays, public information brochures, online newsletters, and technical workshops and publications. This year, much progress has been made on the development of the Electronic Encyclopedia of Earthquakes (E3), a collaborative project with CUREE and IRIS. The E3 development system is now fully operational, and 165 entries are in the pipeline. When complete, information and resources for over 500 Earth science and engineering topics will be included, with connections to curricular materials useful for teaching Earth Science, engineering, physics and mathematics. To coordinate activities for the 10-year anniversary of the Northridge Earthquake in 2004 (and beyond), the "Earthquake Country Alliance" is being organized by SCEC CEO to present common messages, to share or promote existing resources, and to develop new activities and products jointly (such as a new version of *Putting Down Roots in Earthquake Country*). The group includes earthquake science and engineering researchers and practicing professionals, preparedness experts, response and recovery officials, news media representatives, and education specialists. A web portal, http://www.earthquakecountry.info, is being developed established with links to web pages and descriptions of other resources and services that the Alliance members provide. Another ongoing strength of SCEC is the Summer Intern program, which now has a year-round counterpart with students working on IT projects at USC. Since Fall 2002, over 32 students have participated in the program, including 7 students working with scientists throughout SCEC, 17 students involved in the USC "Earthquake Information Technology" intern program, and 7 students involved in CEO projects. These and other activities of the SCEC CEO program will be presented, along with lessons learned during program design and implementation.

URL: http://www.scec.org

ED32D-06 1455h

NASA's Learning Technology Project: Developing Educational Tools for the Next Generation of Explorers

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Since 1996, NASA's Learning Technology has pioneered the use of innovative technology toinspire students to pursue careers in STEM(Science, Technology, Engineering and Math.) In the past this has included Web sites like Quest and the Observatorium, webcasts and distance learning courses, and even interactive television broadcasts. Our current focus is on development of several mission oriented software packages, targeted primarily at the middle-school population, but flexible enough to be used by elementary to graduate students. These products include contributions to an open source solar system simulator, a 3D planetary encyclopedia), development of a planetary surface viewer (atlas) and others. Whenever possible these software products are written to be 'open source' and multi-platform, for the widest use and easiest access for developers. Along with the software products, we are developing activities and lesson plans that are tested and used by educators in the classroom. The products are reviewed by professional educators. Together these products constitute the NASA Experential Platform for learning, in which the tools used by the public are similar (and in some respects) the same as those used by professional investigators. Efforts are now underway to incorporate actual MODIS and other real time data uplink capabilities.

URL: http://learn.arc.nasa.gov