

**2006-2007 Learning Technologies Grants Proposal**

**Project Information**

GeoWall for Stereo Visualization in the Geography-Geology Classrooms

Project Title

Dr. Marguerite Madden and Dr. C.P. Lo

Project Director

Geography

Requesting Department

\$14,810

Amount Requested Year 1

\$0

Amount Requested Year 2

Project Director's Signature

**Proposal Endorsement Signatures**

Department Head

Dean

Proposal Abstract (100-word maximum)

This grant will engage undergraduate and graduate Geography and Geology students in the use of innovative stereo viewing technology in the classroom. Consisting of dual projectors controlled by computer software, a special large screen and polarized glasses worn by students, the portable GeoWall permits high definition stereo graphics to be viewed simultaneously by all students. The capability for 3D visualization in Geography-Geology classrooms enhances student learning and understanding in a multitude of subject areas such as physical geography and geology, weather and climate, remote sensing, geomorphology, geographic information science, geovisualization, cartography, earth materials, surface processes, hydrogeology and planetary geology.

## GeoWall for Stereo Visualization in the Geography-Geology Classrooms

UGA Learning Technologies Grant submitted by M. Madden and C.P. Lo

### Section I. Project Description

#### *Nature of the Innovation*

The GeoWall is “A scientific visualization tool for Earth Science research and education by the use of low cost virtual reality visualization devices. The current GeoWall hardware is based on Agave technology developed at the Electronic Visualization Lab, University of Illinois at Chicago” <http://geowall.geo.lsa.umich.edu/intro.html>. It is, essentially, a dual projection system that allows two images taken of the same object or landscape from slightly different angles to be projected simultaneously through linear polarizing filters onto a specially-coated large projection screen (Figure 1). Linked to a computer with a graphics card with two monitor outputs and visualization software (e.g., Electro, OpenGL Based Software, Stereopair Software or WallView), the two image projections will be exactly synchronized to be superimposed on the large screen. Students in the audience wear polarized glasses that separate the view of the two polarized images, left image to the left eye and right image to the right eye. Similar to our normal depth and stereo vision, the brain then fuses the two images and students see a three-dimensional (3D) or stereo view in color.



Figure 1. GeoWall dual projectors and students viewing 3D display  
<http://geowall.geo.lsa.umich.edu/gallery.html>

The GeoWall, developed at the University of Illinois’ Electronic Visualization Laboratory, was designed to broaden the use of scientific visualization tools for Earth Science research and education by the use of low-cost virtual reality visualization devices. The current GeoWall hardware is based on Access grid augmented virtual environment (Agave) technology which appends a low-cost PC-based graphics workstation to an access grid node that can be used to project 3D stereoscopic computer graphics and allow viewers to share 3D content of the display (<http://www.evl.uic.edu/cavern/agave/>).

### *Need/Rationale*

Understanding 3D spatial relationships is a fundamental requirement in many disciplines. Good examples are landforms, clouds and buildings and transportation networks in the urban environment (i.e., urban morphology). It is essential to the study of Earth Sciences including physical geography and geology, weather and climate, geomorphology, Earth materials, surface processes, hydrogeology and planetary geology. Spatial data collection, analysis and display also are fundamental to geographic technologies such as remote sensing, geographic information systems (GIS), geovisualization, cartography, Global Positioning Systems (GPS), geocomputation and spatial modeling. Traditional teaching methods have strongly relied on two-dimensional (2D) representation of images, drawings, maps and profiles. Although most geographers and geologists are trained to understand 3D structures from such representations, the extrapolation requires spatial thinking skills that are difficult to learn and often form a stumbling block for students at the introductory level (<http://geowall.geo.lsa.umich.edu/intro.html>).

### *Relevance of the Project to the unit and University priorities*

Use of a GeoWall for instruction will benefit both the Geography and Geology Departments because it will greatly enhance students' understanding of basic concepts, theories and principles of the Earth's surface, subsurface and atmosphere, as well as geographic technologies and geographic information science (GISci). It is expected that the opportunity for faculty and instructors to illustrate their lectures in 3D will have a tremendous impact on the delivery of their course materials. Engaging students in innovative technology and presenting material in a real-world representation literally adds another dimension to their classroom experience. In this age of computer gaming, portable device video and high definition entertainment, students are exposed to sophisticated graphics and virtual reality everyday. Students are increasingly visual learners and come to the university with a high level of expectation and experience in 3D graphics. It follows that the incorporation of 3D virtual reality technology in traditional lectures and instructional materials will promote student learning and understanding of abstract concepts.

### *Specific Courses Benefiting from the Project-Number of students benefiting from the project:*

The portable GeoWall can be used by both Geography and Geology professors in shared classroom space (Rooms 200B, 200C and 200D) in the Geography-Geology Building. This 3D projection system can be used as an instructional aid in a wide variety of Geography and Geology courses including the following.

### Geography courses and typical enrollment per year:

Undergraduate Geography courses that will directly benefit from use of the Geowall include: GEOG 1111 Introduction to Physical Geography (1250 students), GEOG 1112 Introduction to Weather and Climate (900 students), GEOG 111 Introduction to Landforms (365 students), GEOG 3010 General Geomorphology (40 students), and GEOG 3510 Cartography and Graphics (55 students).

Combined undergraduate and graduate Geography courses that will use the GeoWall include: GEOG 4020/6040 Fluvial Geomorphology (30 students), 4030/6030 Geomorphology and Environmental Change in Karst and Arid Environments (20 students), 4040/6040 Global Environmental Change During the Quaternary (20 students), 4050/6050 The Environment of Egypt (10 students), 4112/6112 Atmospheric Dynamics (15 students), 4140/6140 Satellite Meteorology/Climatology (30 students), 4160/5160 Applied Climatology (10 students), 4220/6240 Plant Geography (25 students), 4290/6290 Neotropical Mountain Geocology (10 students), 4310/6310 Cartographic Design and Reproduction (20 students), 4330/6330 The Use and Interpretation of Aerial Photographs (30 students), 4350/6350 Remote Sensing of Environment (30 students), 4370/6370 Introduction to Geographic Information Systems (100 students), 4375/6375 GIS Applications in Agriculture (10 students), 4410/6410 Cartographic Visualization Methods (20 students), 4470/6470 Geographic Analysis and GIS (15 students), 4730/6730 Geography of China (10 students), 8020 Seminar in Geomorphology (10 students), 8240 Seminar in Geocology (10 students), 8120 Seminar in Climatology (10 students), 8350 Remote Sensing with GIS Applications (15 students), 8450 Geospatial Tools in Landscape Analysis (10 students), 8510 Seminar in Cartography (10 students), and others.

#### Geology courses and typical enrollment per year:

Undergraduate Geology courses that will directly benefit from use of the Geowall include: GEOL 1121 Earth Processes and Environments (1000 students), GEOL 1250 Physical Geology (50 students), GEOL 3010 Earth Materials (20 students), and GEOL 3020 Surficial and Near-Surficial Processes (10 students).

Combined undergraduate and graduate Geography courses that will use the GeoWall include: GEOL 4060/6060 Structural Geology (10 students), GEOL 4170/6170 Hydrology, Geology and Soils of Georgia (cross listed with CRSS, ECOL, ENGR, FORS and GEOG) (30 students), GEOL 4220/6220 Hydrogeology (50 students) and GEOL 4350/6350 Geology of the Planets and Moon (10 students).

In total, approximately 3080 students in Geography and 1180 students in Geology per year may be directly affected by the GeoWall. We assume this technology will have an even greater impact on future geography and geology classes, with some new courses being designed to maximize the utility of 3D color visualizations.

## **Section II. Budget**

### *List Technology, Facilities, and other Resources Requested*

Special equipment and software will be required to install a portable GeoWall system that can be used in the auditorium classrooms of the Geography-Geology building. It is envisioned that the largest classroom will have a large screen mounted on the wall for best stereo viewing. An additional portable screen will allow the technology to be used in the other three classrooms. The dual projectors will be installed in a dual rack that sits on a table top and can be transported, along with the dedicated computer, in different classrooms. Required equipment and software includes:

- Dual DLP projectors (allow polarization)
- Linear polarized filters for the projectors (two)
- Table top projector stacker
- Screen that will preserve the polarization. One to mount in a classroom and one low-cost, portable, front projection screen
- Linear polarization glasses
- Computer with graphics card with two monitor outputs to provide output to left and right projector
- Stereo visualization software such as Electro, OpenGL Based Software, Stereopair Software, WallView

*Itemize all Project Costs*

**LTG Budget**

Based on quote from Tierney Brothers, Inc. (projectorpoint.com) equipment costs include the following.

<b>Item</b>	<b>Quantity</b>	<b>Total Cost</b>	<b>Requested from LTG</b>	<b>Provided by Other Sources</b>
Projectors (3300 Lumen XGA DLP)	2	\$3,798	\$3,798	\$0
Table-top Chief Projector Stacker with Linear Polarized Filter Set and 100 Polarized Glasses	1 (100)	\$1,300	\$1,300	\$0
Stewart Silver 3D Screen with Luxus Fixed Frame 100" Diagonal 60"x80" Wall Mounted	1	\$2,398	\$2,398	\$0
Da-Lite Tripod or Wall Mount Silver Matte 3D Screen 60"x80" Screen	1	\$421	\$421	\$0
Custom Geobrick SFF PC w/Preloaded Software	1	\$2,787	\$2,787	\$0
Replacement Bulbs for Boxlight Projectors	1	\$449	\$449	\$0
Shipping and Handling	1	\$150	\$150	\$0
CRMS Staff support – GISci Technician	2 mo.	\$7,014	\$3,507	\$3,507
<b>TOTALS</b>		\$18,317	\$14,810	\$3,507

*Budget Justification Narration*

The major budget requirements for the GeoWall are: 1) the projectors (\$3,798 for two 3300 lumen projectors); 2) a table-top projector stacker, polarized filters for the projectors and polarized glasses for the students (\$1,300); 3) a mounted screen 60 x 80 inches with a silver

coating (\$2,398); 4) a portable silver-coated screen to use the GeoWall in other classrooms (\$421); and 5) a custom computer with preloaded graphics software (\$2,787). Replacement bulbs will cost \$449 and shipping and handling is \$150.

Partial salary for a technician (1 mo. @ \$3,507 per mo.) from UGA-CRMS to assist in the installation and use of the GeoWall is requested. A month of the technician’s salary will be paid by UGA-CRMS to cover additional devotion to use of the GeoWall during the Spring 2008 semester.

*Timeline for Development of the Project:*

Date (mm/yy)	Objective	Person(s) Responsible
June/July 2007	Installation of mounted screen, table top projection stacker, projectors and computer. GeoWall setup.	Drs. Madden and Lo, CRMS Research Technician part time
August-Dec 2007	Familiarity with the equipment and graphics software. Preparation of stereo displays for Geography and Geology courses. Introduction of the GeoWall to Geography and Geology faculty and students	Drs. Madden and Lo, CRMS Research Technician part time
January-May 2008	Use of the GeoWall in Geography and Geology courses. Demonstrations to other departments and campus units as desired. Evaluation of improved learning through use of the GeoWall.	Drs. Madden and Lo, CRMS Research Technician part time

**Section III. Learning Outcomes and How Resources will be Used**

*Methods for Evaluating the Project and Learning Outcomes*

Evaluating the GeoWall learning experience and outcomes will be accomplished by comparing statistics on grades achieved by students in key Geography and Geology courses before and after use of the GeoWall as an instructional tool. Undergraduate and graduate courses utilizing the GeoWall will be identified and faculty/instructors will be informed of the evaluation process. Comments will be solicited by faculty, instructors and students following the Spring 2008 semester and first use of the GeoWall. A report will include a discussion on the students’ performance and perception of 3D visualization using the GeoWall.

This technology lies at the cutting-edge of educational instruction and will be of interest at professional conferences in Geography, Geology and Education. It is envisioned that an indication of the success of the GeoWall will be discussion of the technology in publications and national/international presentations by the project directors and other interested faculty.

### *Potential Applications in other Academic Areas*

In addition to the related courses noted above, the GeoWall 3D visualization technology is directly related to numerous other academic departments and research units on campus. Once its use in Geography and Geology is established and the project directors are comfortable with the technology, information on its use and the results of the evaluation of its impact on student learning will be distributed to other departments such as Environmental Design, Ecology, Forest Resources, Marine Science, Anthropology, Art and the School of Education.

### **Section IV. Support Plan**

#### *Staffing and Resources to Continue the Initiative Following LTG Funding*

Staff and resources of the UGA Department of Geography's Center for Remote Sensing and Mapping Science (CRMS) will be available to provide technical assistance to support the use of the GeoWall in Geography-Geology. A CRMS Research Technician will be involved in the project from installation to evaluation of outcomes. Other interested faculty in Geography and Geology also will be instructed in the use of the GeoWall to increase the number of individuals who can assist in the demonstration of the technology to other campus departments.