Geological 3D model visualization in Cave settings, challenges and limitations

Gerold Zeilinger, Andreas Bergner, Lutz Ehlert, Matthias Ohrnberger, and Manfred R. Strecker

University of Potsdam, Institute of Earth and Environmental Science, Potsdam/Golm, Germany

Introduction

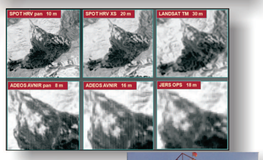
During the last decade new developments in visualization hardware and software with geoscience applications have improved our ability to portray complex data in a user-friendly manner. This technology provides new avenues for innovative research operations and teaching efforts with multi-sourced data sets spanning the 3D arrangement of geological structures and seismicity to the distribution of rainfall, runoff and surface processes. Since October 2010 a 3-sided virtual reality Cave has been operative at the Institute of Environmental and Earth Sciences at Potsdam University.

Data

The available projection technique allows the combination of diverse spatiotemporal data. The data are based in general on following methods:

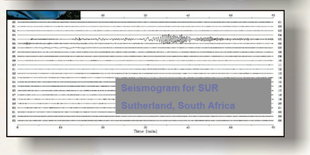
Field

Remote Sensing



Drillings

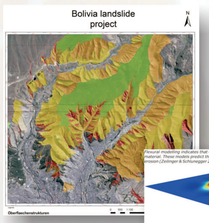
Seismics



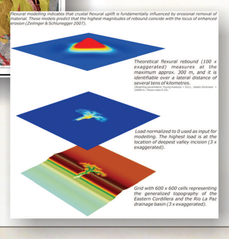
Laser Scanning

http://www.riegl.com/nc/products/terrestrial-scanning/gallery/

Sampling & Analysis



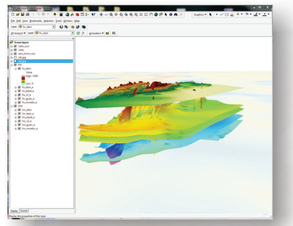
Model



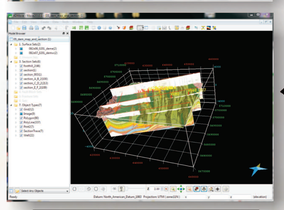
Desktop Application

Key for usability are (1) a fast and smooth data/model transfer from standard geological software (e.g. Visit, MOVE, PETREL, ArcGIS) to the 3-dimensional visualization in order to avoid time consuming data transformation to highly specified visualization software, and (2) the capability to modify models directly within the visualization cluster by the user with the familiar standard software.

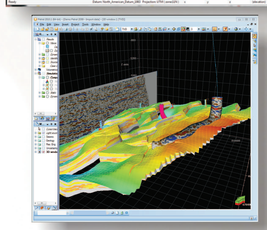
ArcScene



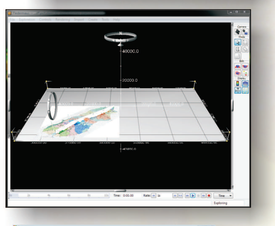
Move



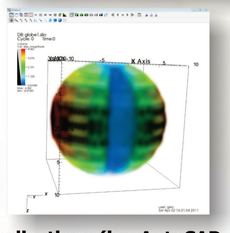
Petrel



Fledermaus



VisIt



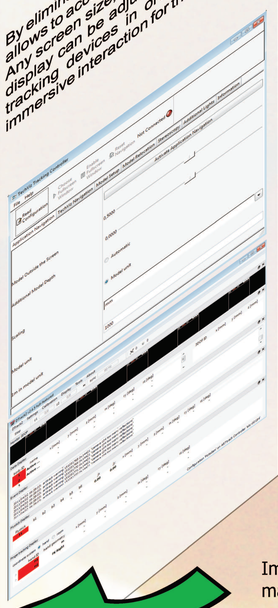
... and more applications (i.e. AutoCAD, LPS)

Middleware

The use of standard software in a Cave setting is achieved with TechViz, a software that distributes the OpenGL signal through single rendering nodes to the different sides of the Cave.

Full TechViz XL System

By eliminating the converting process, it allows to accelerate the visualization. Any screen size, any kind of immersive display can be adjusted and used with tracking devices in order to allow an immersive interaction for the user.



Immediate possibility of discussing and manipulating models.

3D Cave

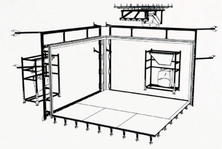
Design

The 3 sided Cave comprises:

- 2 Screens in 90°-angle (backprojection)
- 1 Floorprojection (frontprojection)
- each 3.84m x 2.40m (width x height)

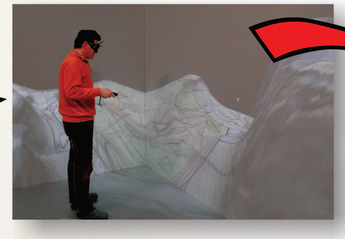
3 Projectors Barco NW - 12

- Resolution 1920x1200px (WUXGA)
- 12ooo Ansi Lumen
- Data link over DVI, RGBHV, VGA
- Control over Ethernet



Stereo

The applied 3D stereo technology is Active Stereo for small groups (up to five persons) and Active Infitec for groups of up to ten persons. The advantages of Active Stereo are color brilliance and high contrast. Using the Active Stereo mode with several persons in the Cave shielding of the synchronization signal between the emitters and the goggles occur and sporadically results in distorted 3-dimensional impressions. The passive goggle system "Active Infitec" provides less contrast in the display, but provides an undistorted 3 dimensional impression for several viewers standing in the Cave. This system is therefore the preferred stereo mode for teaching purposes.



Cluster

3 Workstations each for one Screen: Intel Xeon X5550, 12 GB memory, NVIDIA Quadro FX 5800

1 Controlworkstation : 2 x Intel Xeon X5550, 24 GB memory, NVIDIA Quadroplex D2200

OS: Win7, XP, RHEL

Tracking

Users are tracked with an ART head-, flightstick- and finger-tracking system.

A.R.T.-Trackingsystem

- optical Trackingsystem
- six cameras
- Input devices: Flystick 3, Fingertracking

Sound and Control

Denon 7.1 Receiver

Teufel 7.1 Soundsystem

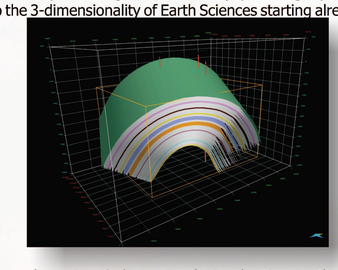
Crestron, touch panel control system

Concept of use

Already during the initial planning and setup phase of the installation, the focus was on the usability for research and teaching.

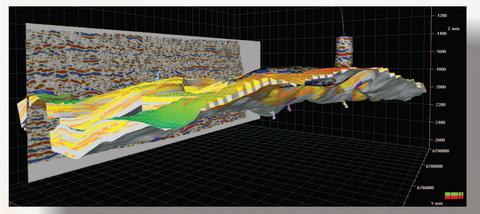
Teaching

Our experience with this system as a teaching tool is excellent. Student feedback emphasized the improved visual recognition of complex structures compared to classical 2D figures. This very important aspect will ultimately lead to an increase of 3-dimensional visualization covering many geologically relevant structures and patterns (e.g. crystal lattice, fossil shapes, seismic cubes, phase diagrams, folds etc.), providing a profound introduction into the 3-dimensionality of Earth Sciences starting already at the BSc level.



Research

In the research realm using 3-dimensional visualization in the Cave provides improved and much faster recognition of complex structures and offers the immediate possibility of discussing and manipulating models during discussions with peers. A successful utilization of this system by many researchers requires, however that the familiarization with the technical and management aspects is brief in order to attract frequent users that can implement and visualize own data/models. The user will use familiar software for display and manipulation, while the software organizing the display signal in the Cave works in the background.



Experimental

New interaction and display tools, including software, should be established. First collaborations with different institutes with strong geo-informatic expertise are already ongoing.

Collaboration

This facility, which is open to industry and academic partners, is an integrative part of PROGRESS, the Potsdam Research Cluster for Georisk Analysis, Environmental Change and Sustainability.

PROGRESS
Potsdam Research Cluster for Georisk Analysis, Environmental Change and Sustainability

Video Conferencing

The 3D facility is enhanced by video conferencing tools and desktop management tools like Barco's XDS. It is planned to integrate the 3D lab into the Virtual Campus program at the Institute for Earth and Environmental Science at Potsdam University in order to promote online teaching.

Conclusion

Without doubt, virtual reality is an excellent tool for visualizing, researching and teaching geological data/models and complex spatial relationships that will ultimately lead to frequent use in education, research and decision making. It forms an enhancement to field based research and teaching methods.