Storing, Managing and Delivering of 3D data

Paul Gabriel[1], Jan Gietzel[1], Prof. Helmut Schaeben[2]
1 GiGa infosystems
2 TU Bergakademie Freiberg

Abstract

In a spatial data infrastructure an uncomplicated but secured access to the data is tremendous. A webportal can help to overcome the limitations that emerge from the use of highly sophisticated and platform dependent software packages. Latest internet technologies allow to port applications from the desktop to the web browsers. Using WebGL technology makes it possible to visualize 3D geomodels in real time and lets the user interact with the model. Combining this approach with a check in and check out system makes a distributed editing of the data possible. The 3D content can be embedded into 2D Map applications that show the power of 3D mapping with the tools of 2D web map platforms.

The software "Geosciences in Space and Time" (GST) shows how this techniques are applicable in the daily work and how to enhance the cooperation, teaming and compatibility when working with 3D geological models.

Keywords: Data management, team work, storage, 2D and 3D interaction, presentation.

Introduction

When tremendous and excessive resource models are created more people and different teams become involved. This may also include the usages of different software for structural modelling, predictive modelling and ground water modelling to mention just a few applications. The integration of different people demands the usage of a generic storage system (Görne 2003; Pouliot 2009). Within the context of the EU Project ProMine the TU Bergakademie Freiberg has developed a data model and prototypical software which enables its users to profit from a centralized data store in 3D modelling. The company GiGa infosystems turned the prototype in a full-featured software that is supporting the 3D infrastructure of the EU Project GeoMol by publishing and deploying 3D models of the project partners. The core benefits of the software alongside of the example of the modelling process of an ore deposit will be shown with the focus on how the software will support the modeller's daily work.

In addition a centralized model store for 3D data simplifies data management tasks such as the organization and investigation of models for follow up or similar projects that is often accompanied with traditionally time consuming data transformations.

1. Geosciences in Space and Time – GST

Based on experiences of 3D modeling and long term discussion with geologists we found specific problems which are addressed by almost all geologists involved in computer aided 3D modeling. Thus we are working on a data model which is capable of overcoming issues that are faced by the modeller's daily work: Such issues are for example the handling of large datasets which occur either during creation of either wider areas on a country scale or models of reservoirs with a decent spatial resolution. Also these models involve a group of modellers working on different parts of the models at the same time. Mostly these modellers are based in different location. The involvement of several modellers usually brings up a heterogeneous software pool. Much time is therefore spent on conversion processes.

Using the approaches supplied by e.g. a database management system like multiuser access, multi version concurrency control (MVCC), high availability makes it possible to design a system, which can overcome the pitfalls of a file based storage approach.

The software based on the data model of the ProMine project is called Geosciences in Space and Time or GST. It enables the user to combine geoscientific 3D modelling and store it in a centralized database independently from the modelling software. With its components GST aims towards a Spatial Data Infrastructure (SDI) for 3D Models. It also allows querying a model of an ore deposit e.g. for the areas with

the highest degree of a certain mineralization. That is not the only reason why geological surveys in Europe are using GST.
Through the central data store many users can access the data simultaneously. This means that not just colleagues from one particular institution but also colleagues from other institutions can be involved in order to comment or even contribute to the models.
Furthermore 3D data can be combined with traditional 2D map platforms and so enrich the 2D GIS platforms with content of the 3D modeling.

1.1. General Architecture

In order to keep the data within the companies and institutes that produce and work with them our software used a basic 3 tier architecture. The first layer stores all the data and manages the models. It can be either accessed directly or via a web service. Thus it is secured that only people who are allowed are able to view data and edit data. This is done with second layer. The third layer is able to present the model or just parts of it to others. This presentation layer can be implemented either in a modelling environment such as gOcad, Petrel or Move or a simple web browser can be used to display the data.

1.2. Compatibility

Many of the ore deposits today do not stop at particular borders of countries. Thus the compatibility between several coordinate reference systems (CRS) has to be ensured by the modelling environment. Usually these steps are getting done manually and consume a lot of time which might be better used to understand the overall model. A central data stored keeps track of the used CRS and transforms the data on-the-fly into the needed systems.
Another time crucial process when working with several software is the compatibility amongst them. To get a complex geologic structural model into a groundwater simulation software might take days or even weeks. This process can be automated in such way that the underlying data is transformed in to a more generic approach and can be outputted in the right format on the user's request.

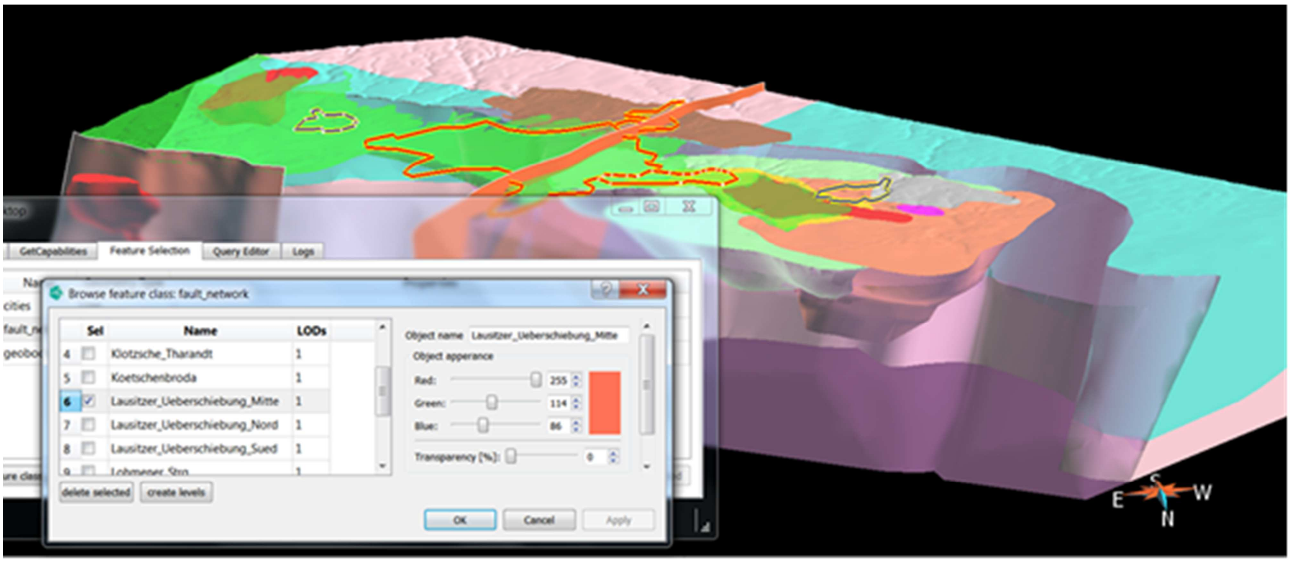

Figure 1 : Direct integration of the GST Client in the 3D environment let's a team work on deposit models simultaneously.

1.3. Seamless Tiles

While modelling large areas or small areas with a high spatial resolution you might reach the physical boundaries of your workstation in terms of memory or graphic power. Sometimes you need to work with several modellers at the same time on different parts of the model.

Using the common approach of a file based storage many of these things can achieved by splitting the work area in several parts and synchronising every steps manually.
Technologies like databases are capable of letting different users work on partial data at the same model but they lack the ability to handle 3D models coming from geology and they lack the ability to handle complex data structures which mainly occur within such 3D models.
Thus GST combines the advantages of a database and overcomes the disadvantages that arise from a file based storage. The system allows to check out areas or whole models, letting the users work in parallel. They can update the model and the system takes care, that the model is kept consistent. This makes the daily modelling process easier and faster.

1.4. History Management

In order to be able to track changes within a multi user environment version management systems like Subversion or Git have been developed. These systems store each change within a new version. Thus it is possible to revert changes to a specific version if they are not applicable or include errors.
Such approaches are useful for 3D modelling as well. So the users can track the changes of their models over the time and may also conclude new knowledge from the creation process of the model.
This includes a storage of the users and timestamps as well as the storage of the new version without duplicating the data in order to avoid redundancy.

1.5. Presentation

Another essential point when working in the field of geology is the inclusion of third party opinions. Today's modelling software is hardly capable of providing an easy to use and yet compatible presentation layer. On the other hand new technologies like WebGL allow everyone with a modern web browser to see and use 3D models out of the box. 3D models can seize the memory of the client machine quickly. In contrast 2D is transporting less information but can be widely consumed. These techniques can be combined to use the advantages of both:
Users can define an area on the 2D map where they want to see the 3D model in a real time view as subset of the original model. The service generates a model of this requested area which will be presented to the user in real time via WebGL (see). Furthermore showing the extent of the 3D models on the 2D maps is an informative tool to visualize the 3D mapping extent. The new tool for the map application allows generating sections, boreholes and slicing maps. These information is directly derived from the 3D model in the database (see Figure 2Presenting 3D content embedded in widely used 2D map applications allows to design powerful information systems. (see next figure)). A service interface allows a generation of reports in standard formats like SVG, PNG and PDF – ready to be attached to documents, publications, (automatic) reports, etc.
This technique shows the strength of map platforms when they are enriched by content of the geological 3D modelling.

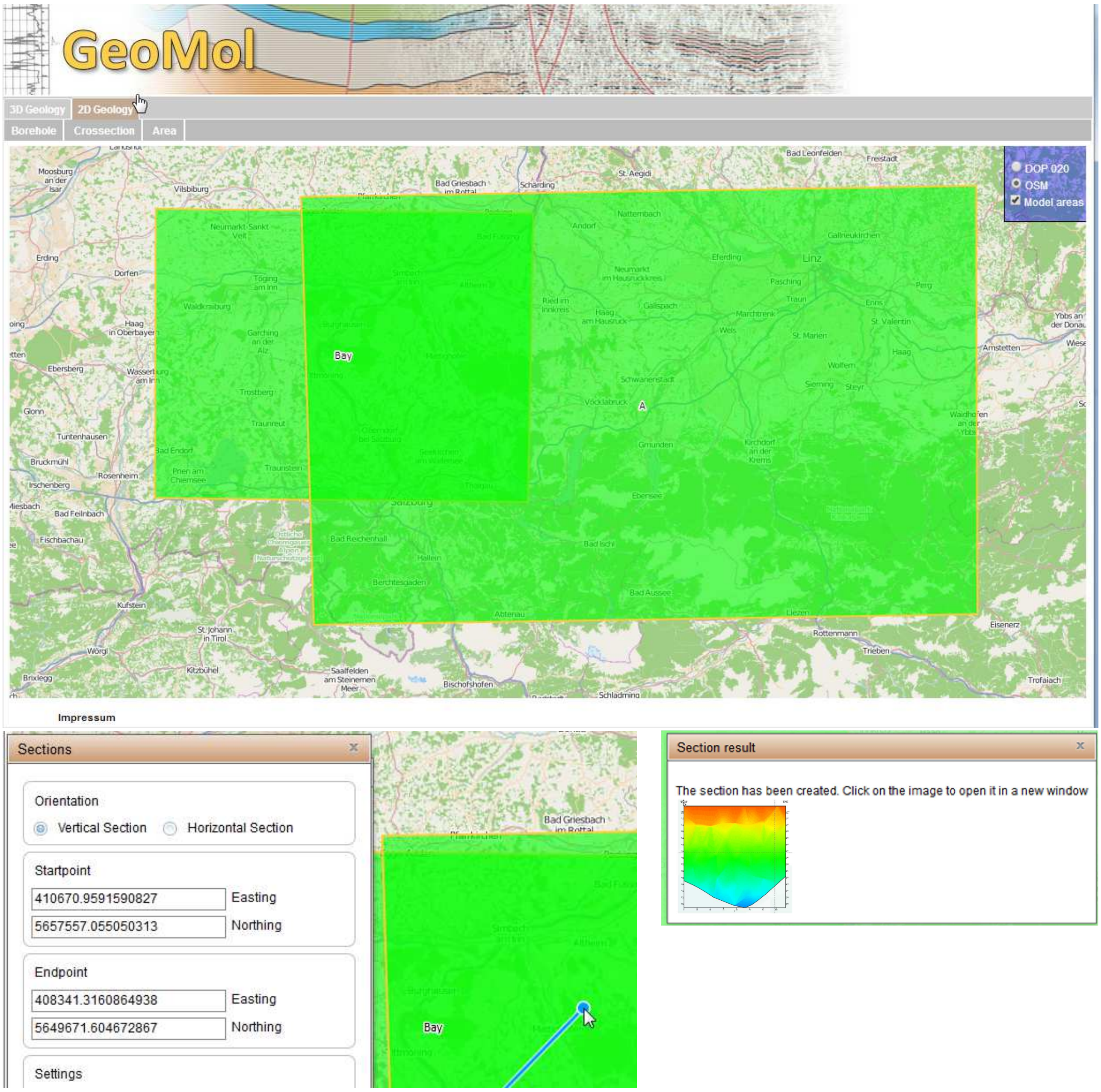

Figure 2 Presenting 3D content embedded in widely used 2D map applications allows to design powerful information systems. (see next figure)

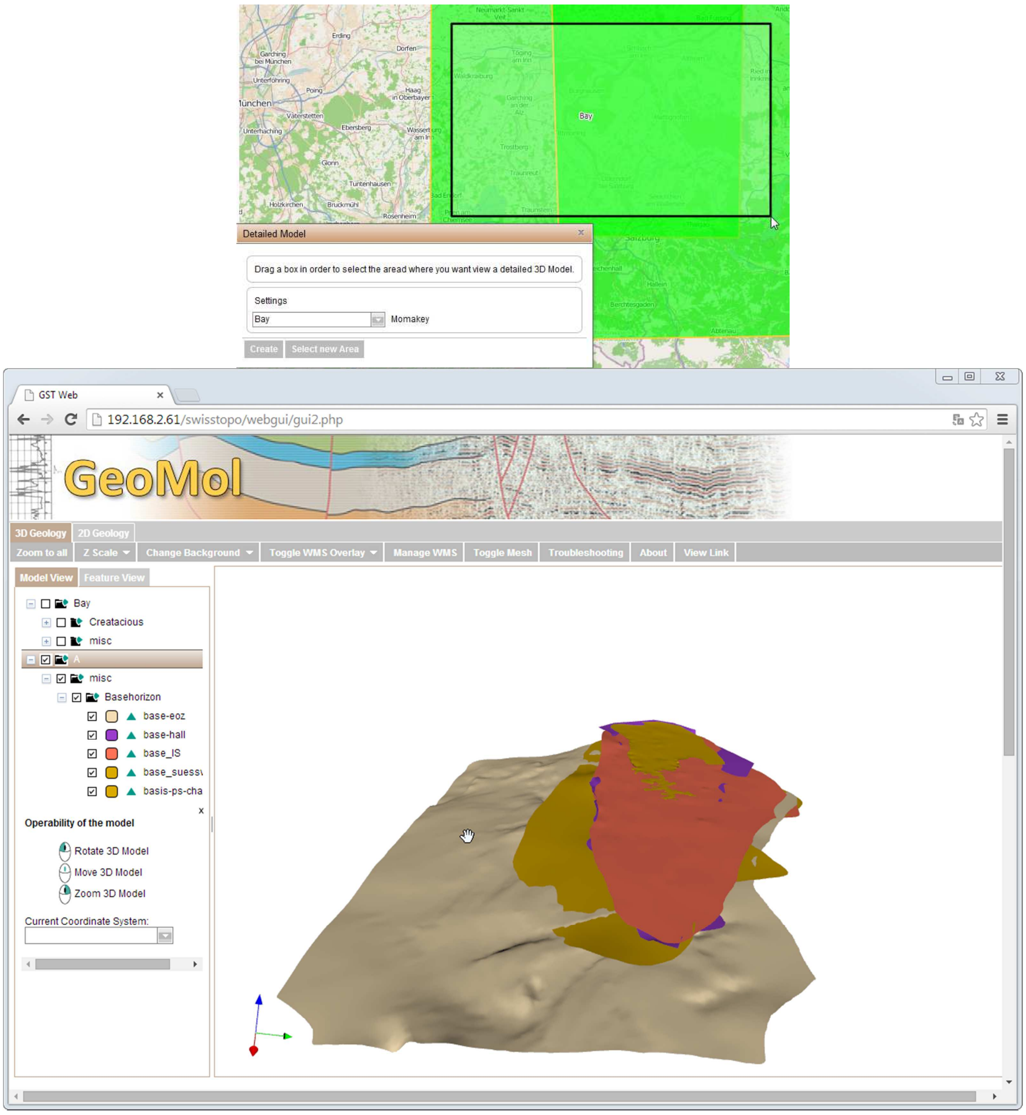

Figure 3 3D models can be inspected direct in 3D next to the 2D map application. To lower the memory consumption for huge models (when displaying) it is good to use the tool that allows inspecting subset of complex 3D models.

2. Acknowledgements

GeoMol is funded by the Alpine Space Programme as a part of the European Territorial Cooperation 2007-2013. It features a joint effort of partners from Austria, France, Germany, Italy, Slovenia and Switzerland to assess subsurface potentials of the Alpine Foreland Basins for sustainable planning and use of natural resources.

References

Görne S, Krentz O, Horna F, Block C, Hübschmann M (2003) 3D-Modellierung mit Gocad auf dem Weg zur routinemaßigen Anwendung im LfUG. 57. Berg- und Hüttenmännischer Tag. http://www.umwelt.sachsen.de/umwelt/download/geologie/57BHT.pdf [Online, 2013.02.22]

Pouliot J, Badard T, Desgagné E, Bédard K, Thomas V (2009) Development of a Web Geological Feature Server (WGFS) for sharing and querying of 3D objects. Developments in 3d geo-information sciences