

# **COST Short Term Scientific Mission (STSM) TU1206-17520**

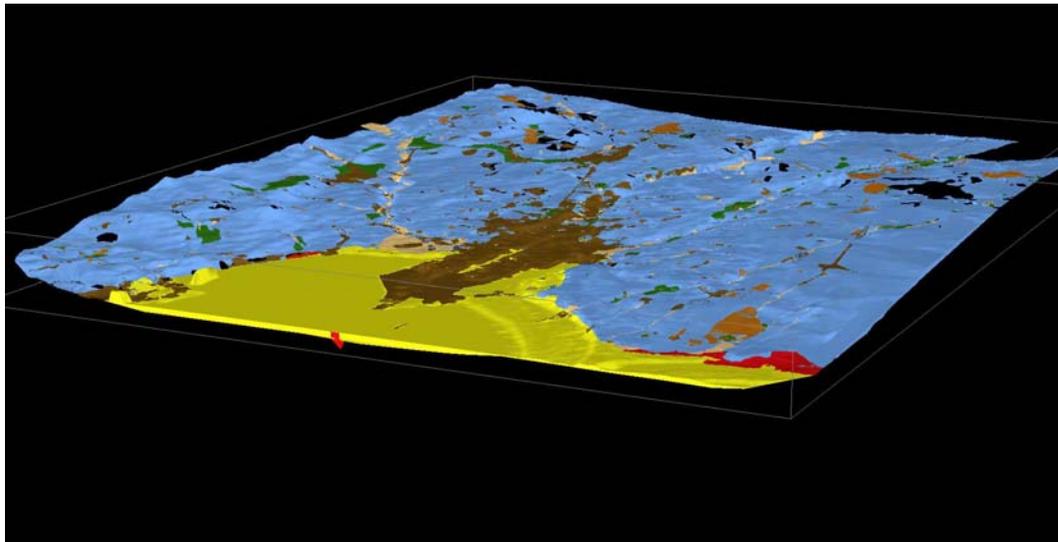
## **3D subsurface modelling using Gocad**

### **STSM Report to COST MC Chair**

*Data preparation, data management, creation and delivery of 3D geological models in Gocad*

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**STSM Host: Mike McCormac (BGS Edinburgh UK)**



## Contents

Acknowledgements.....	3
1.STSM rationale and purpose.....	4
2. Work carried out within the STSM.....	5
3. Lessons learnt from BGS in best practise in 3D modelling .....	6
4. Future collaboration .....	8
5. Summary .....	9
6. STSM Host institution approval/sign-off .....	10

## **Acknowledgements**

A number of individuals have contributed to this short-term scientific mission (STSM), and made the STSM a very valuable collaboration between the Geological Survey of Ireland (GSI) and the British Geological Survey (BGS).

Particular thanks go to Mr Mike McCormac and Diarmad Campbell at the BGS for hosting the STSM, together with other staff of the geological survey.

Finally, the author thanks the COST Action for offering the opportunity granted by the STSM programme and for the financial contribution to the collaboration.

## **1. STSM rationale and purpose**

### **Rationale**

Urban geology is becoming increasingly important and it is vital that the subsurface is well known to provide sufficient information to help in any issues that could arise in urban areas.

GSI has been a member of the GSI3D Research Consortium for the last few years and has been using GSI3D to create 3D models of the Quaternary of Dublin and Cork. When GSI attempted to model Bedrock using the same software it was clear that GSI3D wasn't able to do it.

All those reasons in conjunction with the ceasing of the GSI3D Research Consortium in 2015 forced GSI to look for alternatives to continue with the 3D modelling.

### **Aim and purpose**

The aim and purpose of this STSM was to learn the basics of 3D modelling and data delivery using Gocad in order for GSI to progress in the 3D modelling. As BGS has been using Gocad for many years and they have developed best practice and many 3D models, it felt right to propose this STSM in conjunction with them.

## 2. Work carried out within the STSM

The STSM involved a 5 day visit of the STSM applicant (Beatriz Mozo Lopez) to the BGS from the 31<sup>st</sup> of March 2014 to the 4<sup>th</sup> of April 2014.

During those five days, Mike McCormac (BGS) explained the different aspects of 3D modelling with Gocad.

The main topics of the STSM were:

Days 1 and 2:

- Basic setup and operational overview of the Gocad modelling application
- Gocad data/object types, input/output file formats and geological feature “housekeeping”
- Structure, properties and applicability of different types of 3D models
- Gathering and preparation of typical data sets for input to the 3D modelling process
- Best practice methodologies for 3D models creation, using both manual and semi-automated Gocad “Structural Workflow” utilities
- Editing tools, model refinement, model merging and quality control protocols

Days 3 and 4:

- Creation of the different types of geo-cellular 3D grids and population with petrophysical properties
- Property manipulation with the Gocad calculator and region editor utilities
- Geometric and stochastic property modelling, volumetrics
- Integration of wells and well logs
- Modelling complex folded/thrust terrains and intrusive bodies
- Presenting 3D models to the outside world

Days 4 and 5

- Working through recently created models especially the Glasgow (Clyde Catchment) Quaternary and faulted bedrock models and offshore reservoir models

Also, during the five days, I have access to a computer in which I was able to practice with the software after the introductory sessions with Mike McCormac.

### 3. Lessons learnt from BGS in best practise in 3D modelling

The lessons learnt can be divided in the following topics:

- **Data preparation and data manipulation**

It is a time consuming process but it is essential to avoid problems when modelling.

Some of the common problems are:

- Data not loaded as they are not in the right format
- Data plotted in different locations as they have different coordinate systems
- DTM files too big causing Gocad to shut down

- **Modelling process**

The use of the semi-automatic “Structural Workflows” has proved very useful as it indicates you the necessary steps to create the model.

Manual editing is always necessary to constrain the model and remove edges.

The cross section tool is also very powerful and it is especially useful when there is no other data available than geological maps.

- **Data delivery**

Data delivery is one of the great challenges as the potential users of those models in an urban environment are not familiar with geological information so it needs to be delivered in a way that they can understand.

Models can be delivered in 3DPdf format, ASCII, ArcGis grids, or other applications like Geodando which is a free 3D viewer for the visualization and querying of 3D models that has being developed especially for Gocad objects (Fig1.).

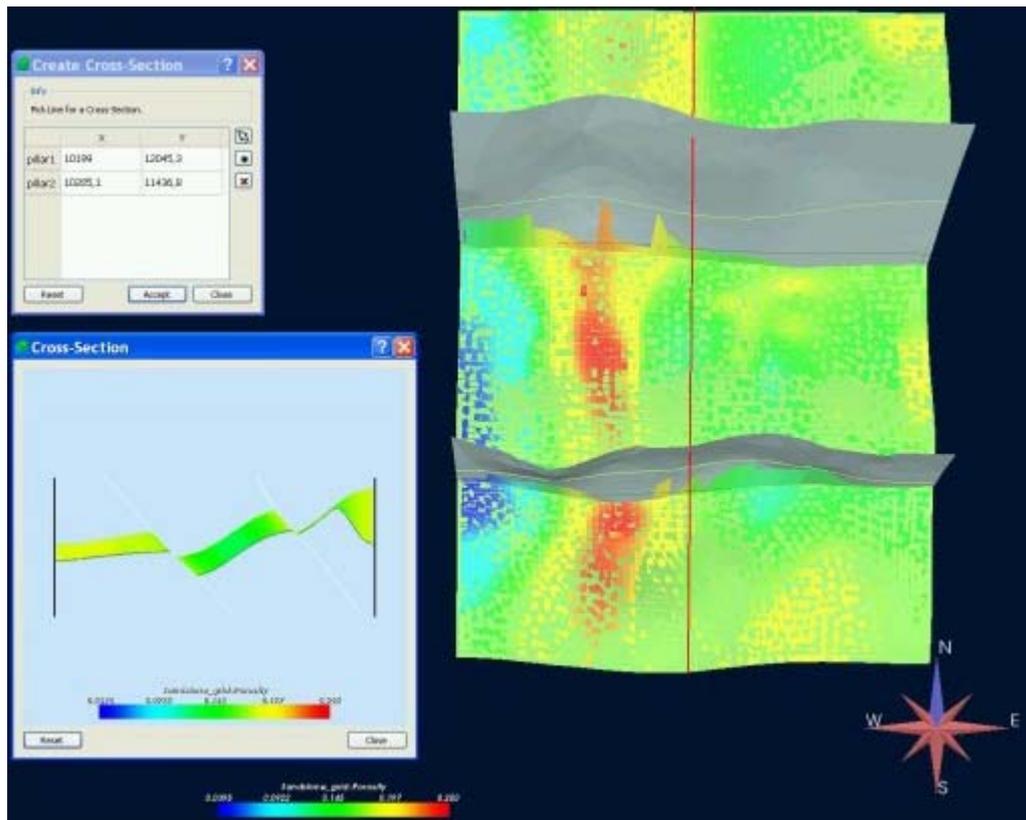


Fig1. Geocando 3D window and cross section window

It is also useful before starting any modelling, to acquire as much information as possible of the geology of the area and also to keep an open communication throughout the modelling process with the geologists when doubts arise, to make sure the model is as real as possible.

It is important to keep in mind that no model is perfect and sometimes there are limitations due to the amount and the quality of the data available. For that reason uncertainty models can also be created to show the user how the data controls the confidence of the model.

## **4. Future collaboration**

### *Continued Knowledge exchange:*

Continued discussions and knowledge exchange in the use of Gocad for 3D modelling will continue with Mike McCormac as the 3D modelling progress in GSI.

### *Engagement of wider group of COST participants:*

Other COST members could benefit from the expertise that BGS has in Gocad and contribute in the development of best practice in 3D modelling and data delivery.

## **5. Summary**

Altogether the STSM was successful, all the topics suggested were covered and the participant had the opportunity to work with her own data. It also gave the participant a general idea of how Gocad works, how to create basic 3D modelling and how to export the models to the users.

BGS with its extensive experience in the use of Gocad provides a good example to COST cities in the best practice in 3D modelling.

The 3D model of Glasgow it is also a good example of how collaborations with City Councils can help the users that do not have geological knowledge in their planning decisions.

## 6. STSM Host institution approval/sign-off

Report noted with approval,



A handwritten signature in black ink that reads "DS Campbell". The signature is written in a cursive style. Below the signature, there is a short horizontal line.

Dr. Diarmad S. Campbell, BGS.