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Activity report on postprocessing and evaluation of data model in pilot area Kraków

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Content

1. Executive summary in English language

Please insert here half up to one page of summary of this report

This report provides an overview of the post processing steps of the geological and numerical models in the pilot area Krakow. We created our models with professional software systems, Schlumberger Petrel software for geological modelling and ModFLOW for numerical modelling. Furthermore, we used more commonly applied software systems such as e.g. ArcGIS for postprocessing. Postprocessing of exported data from the models was necessary to derive secondary maps, such as resource maps, in the harmonized GeoPLASMA-CE standard for uploading to the GeoPLASMA-CE webportal. This mainly involved adapting and changing the file structure and coordinates system modification

We were able to finalize all post processing steps for both models according to project's needs. As of now, there are no activities planned for the geological model outside of GeoPLASMA-CE.

Detailed information about all postprocessing steps, model uncertainties and error estimations are included in D.T3.3.1 – Activity report on 3D modelling – Part 1 and Part 2.

2. Streszczenie

Please translate this header and translate English version of summary into your national language.

Niniejszy raport opisuje kroki podejmowane w ramach postprocessingu – obróbki danych i map po ich wyeksportowaniu z dostępnych modeli. Opisujemy modele, które wykonaliśmy z pomocą profesjonalnego oprogramowania – Schlumberger Petrel do modelowania geologicznego i ModFLOW do modelowania hydrogeologicznego. Ponadto, wykorzystaliśmy bardziej powszechne oprogramowanie takie jak ArcGIS w celu wykonania koniecznych operacji na mapach. Obróbka wyeksportowanych danych była konieczna w celu dostarczenia ich w formatach i układach odniesienia wymaganych w projekcie GeoPLASMA-CE ze względu na ich załadowanie do portalu mapowego GeoPLASMA-CE. Wiązało się to głównie z modyfikacją tabel atrybutów, struktur plików i zmian układów odniesienia map.

Byliśmy w stanie wykonać wszystkie konieczne kroki zarów3.no dla modeli jak i map, jakie były wymagane w projekcie.

Szczegółowe informacje o poszczególnych krokach obróbki danych, niepewnościach i szacowanych błędach modelu zostały włączone w dokumencie D.T3.3.1 – Activity report on 3D modeling – Part 1 and Part 2.

3. Introduction

3.1. Aim and scope of this report

This report describes post processing steps performed on the model of the pilot area Krakow, which have been created within the frame of Activity A.T3.3. These reports summarize activities on post processing and evaluation of 3D model of the pilot areas. It identify strong and problematic points of preparation of the model.

This report describes the following post processing steps:

General post processing steps

- Harmonization of attributes
- Transformation of the reference system and parameter units to GeoPLASMA-CE standards

Geological 3D modelling

- Change the model representation (e.g. 3D/2D, unit tops)
- Change data structure (e.g. grids, triangulated surface)
- Quality control, validation and error estimation
- Visualisation of modelling results and derivation of secondary maps

Numerical modelling

- Quality control, Validation and error estimation
- Changes of the file structure (e.g. ESRI database, shapefile)
- Visualisation of modelling results and derivation of secondary maps (e.g. calculation of resource maps for open loop systems)

4. General postprocessing steps

4.1. Harmonisation of attributes linked to modelling

Please list the parameters of the joint output dataset list, which refer to modelling (geological or process modelling), did you apply any joint data standards defined in GeoPLASMA-CE referring to the output parameters

We applied all joint data standards defined in GeoPLASMA-CE to the output parameters. The common reference system chosen is ETRS-UTM34N for the pilot area Krakow. The harmonized standards for all output parameters can be found in the annexes of D.T2.3.1 – Set-up of harmonized data management infrastructure (for GeoPLASMA-CE).

See Table 1 for all output parameters related to modelling in the pilot area Krakow. 3D Geological modelling was used to derive the tops of geological units, bulk thermal conductivity and subsurface temperature maps.

Table 1. Output parameters related to modelling in the pilot area Krakow.

Output-ID	Parameter	Relation to modelling
ID09-PP09-PA09-OP01-(01-15)	Top of geological unit	Derived directly from 3D geological model
ID09-PP09-PA09-OP02-(01-04)	Average thermal conductivity maps	Calculated based on 3D geological model
ID09-PP09-PA09-OP06-(01-04)	Subsurface temperature maps	Calculated based on 3D geological model

4.2. Transformation of the reference system and parameter units to GeoPLASMA-CE standards

Please specify local coordinate systems and parameter units, which were used for modelling and needed to be transferred to joint coordinate systems or physical units;

We used local coordinate system (EPSG: 2180) during geological and process modelling in the pilot area Krakow. All results were adapted following the GeoPLASMA-CE standards for the coordinate system UTM belt 34 and the physical units after the modelling.

5. Numerical modelling

5.1. Overview of applied products

Please list the software products you have used;

Table 2 lists the software products, which we applied for geological 3D modelling.

Table 2. Applied software products for geological 3D modelling.

Version	Software	Activities related to numerical model
18	Petrel	3D geological modelling
10.6.1	ArcGIS	Geodata preparation and georeferencing

5.2. Changes of the model representation

Please any transformation of the geological model, which needed to be applied regarding the dimension (3D to 2D) and geological references);

Beside exporting TIN model, no transformations were carried out regarding the 3D geological model prior to the implementation into the GeoPLASMA-CE portal. At the GeoPLASMA-CE webportal (https://portal.geoplasma-ce.eu/) virtual boreholes are automatically generated for location specific queries, which extract depth information for respective stratigraphic horizons

from the 3D model, and the webportal also links to the interactive 3D GST Web Viewer developed by GiGa, where the model can be explored in full detail.

5.3. Changes of the data structure

Please describe any changes in the data structure for later post processing, which includes transformation from surfaces to voxels or triangulated surfaces to regular grids;

Structural surfaces delivered from the 3D model were converted into triangulated surfaces. Resolution of triangular mesh was set equal to the resolution of 2D grids to avoid increasing the error due to surface resampling.

5.4. Quality control, validation and errror estimation

Please describe all measures executed for quality control (e.g. plausibility checks), validation and error estimation;

Geostatistical methods have not been applied for quality control of the 3D Model. However, as abundance of well data in the pilot area are usually prevalent in the shallow subsurface decreasing with depth, so is the reliability of modelled horizons decreasing with depth below surface. Furthermore, geological borehole profile descriptions proved to be highly inconsistent due to different well interpreters. Additionally, inaccurate measurements of borehole elevation, which did not match with the topographic DEM surface, hampered proper modelling. However, we performed quality checks of semantics, plausibility and data consistency checks on input data sets by visualizing the spatial relationships of all available subsurface features in a 3D environment in depth domain.

5.5. Visualisation of modelling results and derivation of secondary maps

How were the models visualized, do you use data viewers for publishing the models outside the GeoPLASMA-CE portal? Which postprocessing steps have you undertaken to create secondary maps (e.g. thickness maps or structural maps); please also indicate the services on the GeoPLASMA-CE web portal linked to your 3D model

The 3D model can be explored interactively via a Web 3D Viewer, which can be accessed on the GeoPLASMA-CE portal. The Web 3D Viewer is operated by GIGA Infosystems. Thickness maps or structural maps have been calculated based on the modelled horizons in Petrel software.

5.6. Overview of applied products

Please list the software products you have used;

Table 2 lists the software products applied for numerical modelling.

Table 2. Applied software products for numerical modelling.

Version	Software	Activities related to numerical model
11	ModFLOW	Numerical modelling
10.6.1	ArcGIS	Pre and post processing of numerical model
18	Petrel	Map algebra

5.7. Changes of the file structure

Please describe any changes of the file structures including data formats, which needed to be applied for postprocessing steps

All files required conversion of coordinate system from local EPSG 2180 into UTM belt 34. This operation was performed in ArcGIS software.

5.8. Quality control, validation and errror estimation

Please describe all measures executed for quality control (e.g. plausibility checks), validation and error estimation;

Quality control was performed by comparison of obtained results of water table level with field measurements, which were not introduced into the hydrogeological model. Error was not estimated.

5.9. Visualisation of modelling results and derivation of secondary maps

Has the numerical model been visualized? Please briefly describe any statistical analyses or other mathematical operations applied to modelled data; if applicable, please explain why the modelled data could not directly be used for creating the output parameters shown on the web services;

Maps were exported directly from Petrel software. Hydrogeological modelling data was exported from ModFLOW and imported to Petrel where all needed calculations and operations were performed. After that exported from Petrel.

6. Conclusions and outlook

Please refer to the following points regarding post processing:

- *General aspects: was the workflow efficient and are there any pitfalls which need to be avoided; what are the strengths and weaknesses of the applied workflow – what is missing or could not be realized (e.g. error estimation);*
- *Are there any specific aspects you would like to mention, which refer to individual output parameters (e.g. unification of legends not possible for some parameters across the different pilot areas);*
- *Are there any activities concerning postprocessing of data planned after the end of GeoPLASMA-CE (e.g. additional focus on error estimation and validation)*

The work model performed in GeoPLASMA-CE modelling process was efficient and it may be successfully applied in any other area. Of course, some details would need to be discussed on-the-fly during modelling, as it happened in case of Krakow pilot area.

Right now no additional activities are planned, yet in the future the model may be improved by new drilling and geophysical data. Validation and error assessment may be simultaneously performed if any new data is provided.