Iceland Liechtenstein Norway grants

Norway grants

Optimal management of low-temperature geothermal reservoirs - Polish-Icelandic cooperation on reservoir modelling

project GeoModel

Maciej Miecznik
MEERI PAS

GeoModel conference, Kraków, September 5, 2023

What is GeoModel all about?

- **The aim of the GeoModel** project is to improve the management of low-temperature geothermal resources by facilitating access to appropriate reservoir modelling tools and promoting the benefits of regular and thorough resource monitoring.
- We believe that reducing barriers (learning curve / cost) related to access to tools for modelling geothermal reservoirs should partially contribute to this.
- These tools need high-quality records of historical measurements - especially pressure and flow rate to calibrate the model.

Expected project outcomes

- A set of tools to optimise the geothermal resources exploitation and management, including placement of new wells within a geothermal field under exploitation.
- Geothermal field operators will gain information on the forecasted reservoir pressure and temperature – a key issue for sustainability of geothermal projects and for avoiding reservoir overexploitation (unsustainable production)
- Tools that are more user-friendly than previous versions while, at the same time, providing more information and opportunities.

What is going to be done?

- The project will develop tools that will support the calibration of numerical models build to simulate heat transport and fluid flow in highly saline reservoirs (such as in the Polish Lowland).
- Tools will be helpful in calculating parameters at wellheads, as well as support the decision-making process regarding the optimal location of future drillings.
- The tools developed in the project will be tested on real data from the monitoring of selected geothermal systems in Poland and Iceland. These data will be used to check whether the tools developed under the GeoModel project allow for the creation of reliable exploitation forecasts for various types of reservoirs.

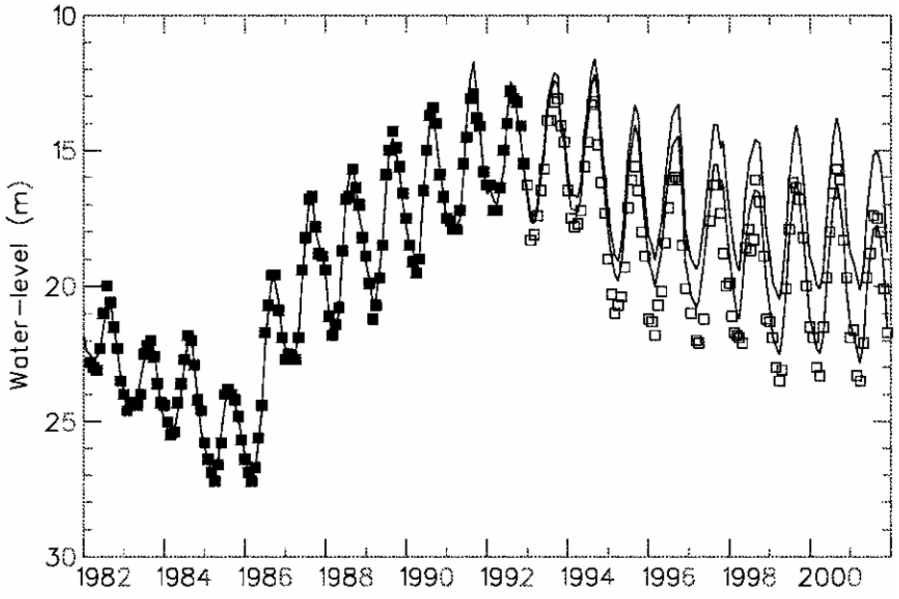
What is going to be done?

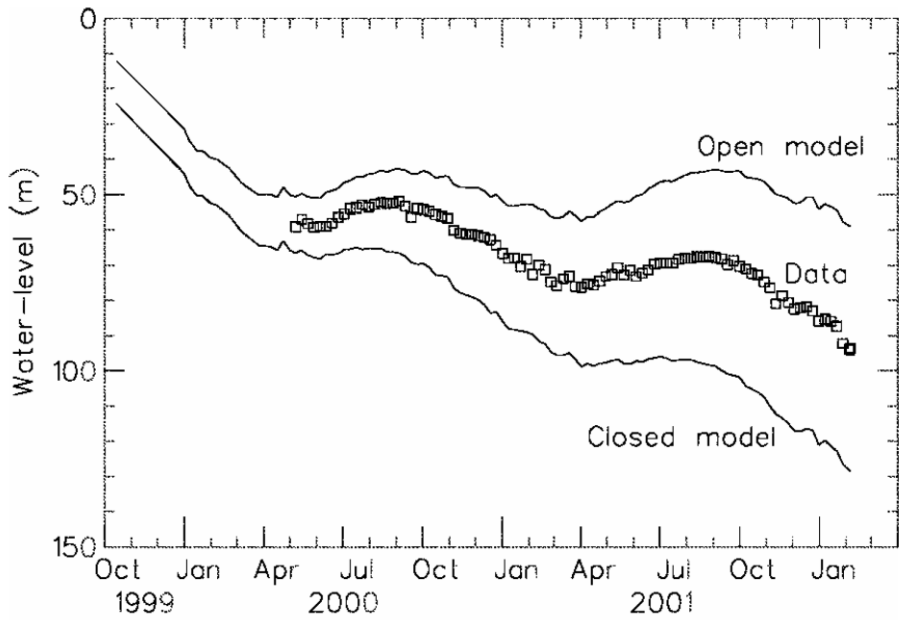
The goal of the project will be achieved in two ways:

Lumpfit: this program, by solving the inverse problem (matching the geothermal system model to the observation data), allows the model to be calibrated, and then to make forecasts for further operation (changes in pressure or water table as a function of flow rate and time). Lumpfit is a lumped parameter model code. The new version of the code will allow for individual representation of each well in the geothermal system, thanks to which it will be possible to calibrate the geothermal reservoir model even more precisely and create even more reliable forecasts for further exploitation.

Lumped models

- Simple models requiring minimal setup time
- Have proven track record of reliably predicting pressure/waterlevel responses to production



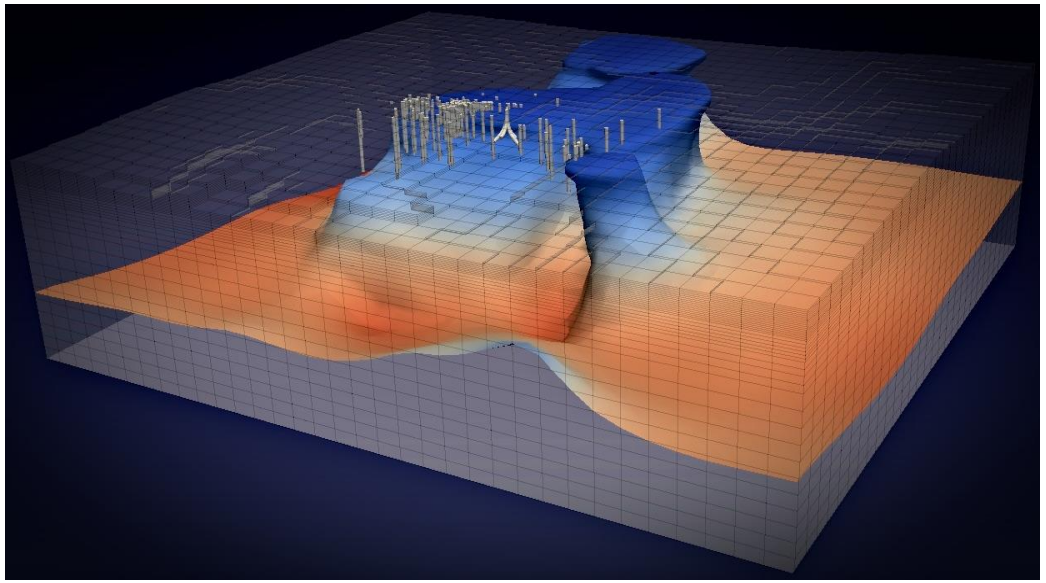


Left: Model fitted to data (filled boxes) from Hamar geothermal system in Iceland along with model (solid line). The open boxes are data that were not included in the fitting of the model and serves as a comparison to the model prediction.

Right: Comparison of measured data from Hofstadir geothermal system (Is) to a model prediction for an open and closed model. The open system is connected to a infinite reservoir. Often the open and closed models represent two extremes in predicted pressure/waterlevel.

What is going to be done?

Waiwera (https://waiwera.github.io/): this is an open-source code developed at the University of Auckland, New Zealand, to create 3D models for comprehensive geothermal system imaging and simulation of reservoir response during exploitation. As it is a program designed for creating complex 3D models, a spatial distribution of reservoir parameters and monitoring data of the analyzed system are required in order to calibrate it. As a part of the GeoModel project, we plan to extend the possibilities of Waiwera software by creating either integral or independent components:

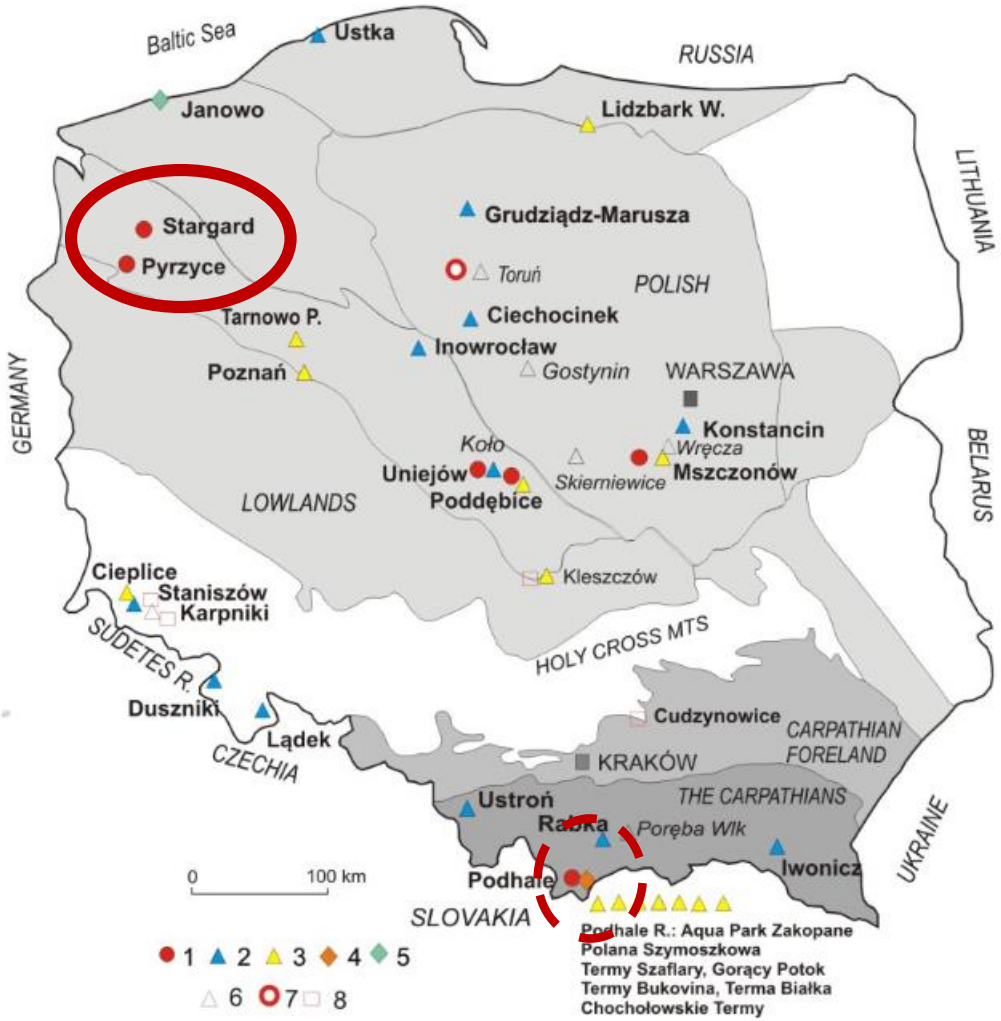


Retrieved from https://waiwera.github.io

- development of a new equation of state for highly mineralized waters to be used with Waiwera;
- development of a script to eliminate the thermal lift effect from wellhead data;
- development of a script for determining the physical parameters of the fluid during wellbore exploitation (wellbore simulator);
- development of an algorithm that will optimize location of new geothermal wells.

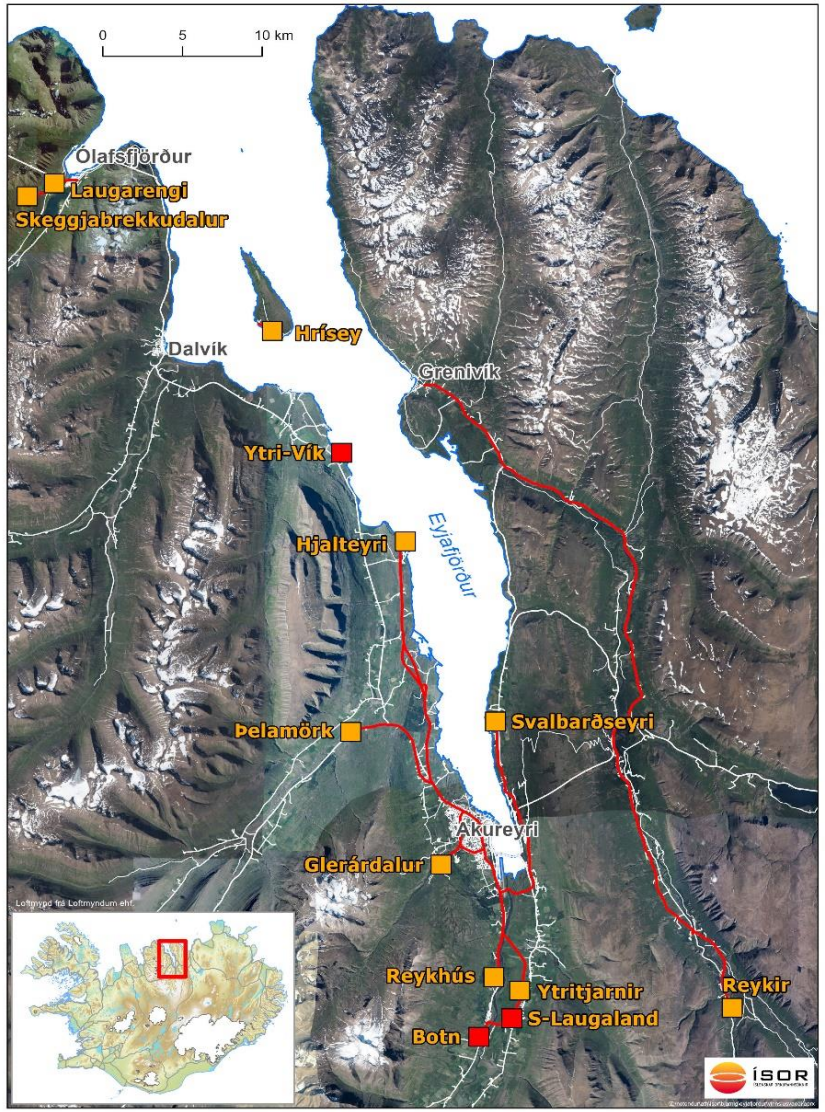
Proposed test-reservoirs in Poland

Name of the geothermal field	Pyrzyce	Stargard
Reservoir temperature [°C]	65	87
Reservoir salinity [g/dm^3]	121	> 140
No. of production wells	1	1+2 new
No. of injection wells	4	2+2 new
Start of operation	1997	2005
Operator	Geotermia Pyrzyce Ltd.	G-Term Energy Ltd.



Proposed test-reservoirs in Iceland

Geothermal field	Botn	Ytri-Vik	S-Laugaland
Reservoir T [°C]	91 / 78	84	93-95
No. of production wells	2	1	3
No. of injection wells	0	0	1
Start of operation	1981	1997	1976
Operator	Norðurorka	Norðurorka	Norðurorka



Target groups

- Operators of geothermal systems, reservoir engineers
- Scientific community,
- students

Project info:

- **Project Parties:**
  - Mineral and Energy Economy Research Institute, Polish Academy of Sciences (MEERI PAS) – project leader
  - Iceland GeoSurvey (ISOR) – project partner

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

ÍSOR

- **Programme Operator:**

Ministry of Climate and Environment, Poland
https://www.gov.pl/web/climate

Ministerstwo Klimatu i Środowiska

- **Type of the project:** predefined, bilateral
- **Programme:** Environment, Energy and Climate Change

Project budget and dates:

- **Total value of the project:** 1 654 012.69 PLN = 362 229.58 EUR
- **Grant awarded**: 1 654 012.69 PLN = 362 229.58 EUR (100,00%)
- **Funding:**
  - EEA Financial Mechanism: 812 947.24 PLN = 178 035.84 EUR (49.15% of the total funding)
  - Norwegian Financial Mechanism: 841 065.45 PLN = 184 193.74 EUR (50.15%)
- **Project duration:** 1 October 2022 – 28 February 2025
- **Actual start of the project:** January 2023

Project website: www.geomodel.pl

Iceland Liechtenstein Norway grants
Norway grants

Project | Knowledge | Press | Download | Contact | PL

- Geothermal systems
- Lumped parameters models
- Distributed parameters models (3D models)
- Flow in geothermal well
- Fresh water vs brine

GeoModel

Optimal management of low-temperature geothermal reservoirs – Polish-Icelandic cooperation in the field of reservoir modelling (GeoModel)

About project →

The aim of the GeoModel project is to improve the management of low-temperature* geothermal resources by facilitating access to appropriate reservoir modelling tools and promoting the benefits of regular and thorough resource monitoring. We believe that reducing barriers related to access to tools for modelling geothermal reservoirs should contribute to this. These tools need high-quality records of historical measurements – especially pressure and flow – to calibrate the model.

↓ Read more

* Low-temperature geothermal, according to several commonly used classifications, is considered to be resources with a temperature not exceeding 150 °C. In this project, low-temperature geothermal reservoirs are those in which the formation fluid is liquid water or brine, so the flow is single-phase.