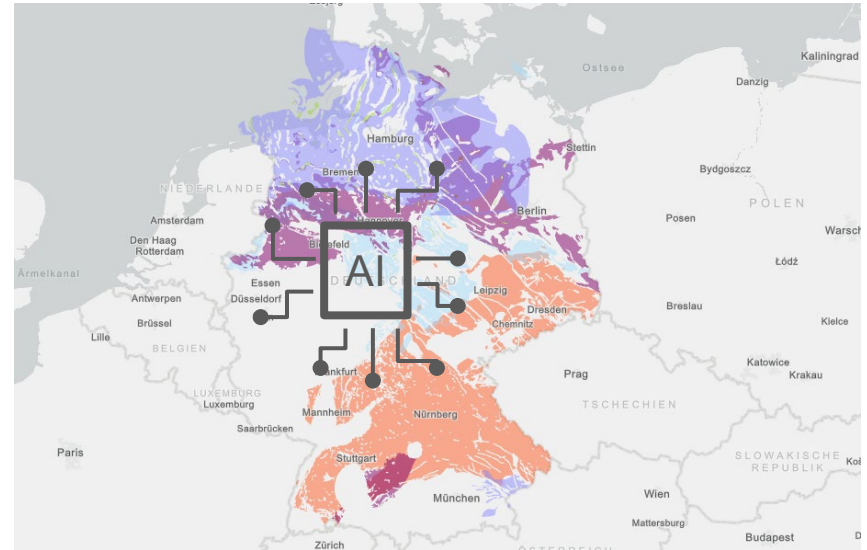


Potentials and challenges of applying Artificial Intelligence (AI) in geosciences for the search of a repository for high-level waste in Germany

Krob, F.C., Krohn, J., Ustohalova, V., Wittek, S., Bratzel, D.



Research Project on behalf of the BASE

The use of artificial intelligence (AI) in the German site selection process (GSSP) for a deep geological repository for high-level waste

Öko-Institut: Krohn, J., Ustohalova, V., Krob, F., Chaudry, S.
TU Clausthal: Rausch, A., Wittek, S., Bratzel, D.



Federal Office
for the Safety of
Nuclear Waste Management



Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology



TU Clausthal

Anwendung der künstlichen Intelligenz (KI) für die Standortauswahl von tiefen geologischen Endlagern (AKI)

Vorhaben mit FKZ 4721E03210 für das Bundesamt für die Sicherheit der nuklearen Entsorgung (BASE).

Die Anwendung von KI-basierten Methoden bietet Chancen, um bei der Auswertung der großen Datensätze und Modellberechnungen komplexer langfristiger und gekoppelter, geologischer Prozesse die Bewertung und somit das StandAV effizienter und sicherer zu gestalten. Die Forschung zur Anwendung von KI hat entsprechend auch in den Geowissenschaften im Laufe der letzten Jahre deutlich zugenommen.

Diese Studie identifiziert auf Basis einer umfassenden internationalen Literaturrecherche Einsatzbereiche künstlicher Intelligenz (KI) in den Geowissenschaften allgemein und bewertet diese im Hinblick auf den Einsatz für die geowissenschaftlichen Fragestellungen im StandAV. Zudem werden Grenzen und notwendige Voraussetzungen, die sich aufgrund der Risiken des Einsatzes von KI ergeben, im Hinblick auf die Schlüsselaktivitäten im StandAV formuliert.

Autoren: » [Krohn, J.](#) | » [Ustohalova, V.](#) | » [Krob, F.](#) | Chaudry, S. | Rausch, A. | Wittek, S. | Bratzel, D.
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Research Project on behalf of the BASE

Development an interdisciplinary assessment tool to evaluate the applicability of AI methods

- evaluation of quality, qualification, traceability, relevance
- both in geosciences generally
- and regarding geological key activities within the GSSP

Based on an international literature study

Today: focus on potentials, challenges and limitations that may arise from the use of AI during the GSSP

GSSP: Goals and Challenges

Search for the site with the best possible safety for a deep geological repository for high-level waste

- for a period of one million years
- science-based, iterative, participative site selection process

Investigation and evaluation of the geological subsurface of the German federal territory

- large variability in geological rock formations
- very long verification period to ensure best possible long-term safety
- enormous amount of heterogenous geodata

State-of-the-art in Geosciences

Application of AI in geosciences

- recognition, segmentation, generation and processing of data in digital images (computer vision)
- predictions, forecasts, surrogate models
- anomaly detection

Geological key activities

- sampling, field work, laboratory methods
- processing and evaluation of large heterogenous data sets
- calculation and modelling of complex and coupled processes

Results & Conclusions I

Potentials of the use of AI within the GSSP

- data management
- handling high dimensional data sources
- geostatistical analysis
- modelling of multiscale spaces and time intervals
- cost- and time consuming calculation and modelling of complex and coupled processes
- control instance, detection of errors and anomalies

- **support** decisions
- **complete** processing data
- **supervise**



Results & Conclusions II

Challenges of the use of AI methods within the GSSP

- risks of obscured uncertainties, generation of error chains
- risks of data and developer BIAS
- inter- and extrapolations over large geological spaces of any scale
- caution with generation of data
- validation, applicability and transferability of a method to the needs and requirements of the GSSP is not always provided
- dealing with general suspicion and scepticism in the public reception

- **transparency** and **traceability**

- **combined** AI methods

- bear **risks** of jeopardizing the **trust** of the population



Outlook

Use and application of AI will most likely be inevitable and necessary during the GSSP

Adaptions, conditions and limitations

- AI methods must be subject-specific and methodologically appropriate
- a high-quality database is a basic requirement
- high demands on the traceability and transparency
- always evaluate and validate iteratively all AI methods
- provide results to the public



**AI should only be used in a supportive way
and must not have any decision-making power when used in the GSSP**

Thank you for your attention!

Do you have any questions?



Contact

Dr. Florian Krob

Researcher

Nuclear Engineering Facility Safety

Office Darmstadt

Phone: + 49 6151 8191-142

Email: f.krob@oeko.de

<https://www.oeko.de/en/the-institute/staff/team-detail/florian-krob>

<https://www.linkedin.com/in/dr-florian-krob-3bbba5199>

<https://www.researchgate.net/profile/Florian-Krob>

For more information:

