Topical Session 3: Digital transformation (HERMES & DITOCO)

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AGENDA

Digital transformation

Introduction – DITOCO , HERMES (Réka Szőke, Sergey Churakov)

DITOCO

Green Paper – Arto Laikari

White Paper – Pablo Cayon

HERMES

HERMES-Model/Data-HUB development – Olaf Kolditz

Application of AI in reactive transport modelling – Nikolaos Prasianakis

Macroscopic and pore-scale modelling of gas transport – Magdalena Dymitrowska

Q & A

DITOCO

Large experience!

Industrial innovation
Design, Construction, Operation, Maintenance

D15.1 Current practices of digital twins

Green paper

D15.2 Gap analysis report

One common merged Green paper (due M13) D15.5

Outlines the landscape

Presents gaps

White paper

Nuclear Waste Challenges
DGR design, WMO expectations

End User Involvement!

12. 09: Annual meeting
29.09: Stakeholder reach out

NAGRA'S INTEGRATED DIGITAL ENVIRONMENT

Dynamic Repository Modelling (DRM)

Design → Construction → Optimization

Integrated Geo-Model (IGM)

Common Project Environment (CPE)

Building Information Modelling (BIM)

Information & Data Centre (IDC)

Digital Twin

feeds into

Digital Safety Case

HERMES - MODELHUB

WebLayer

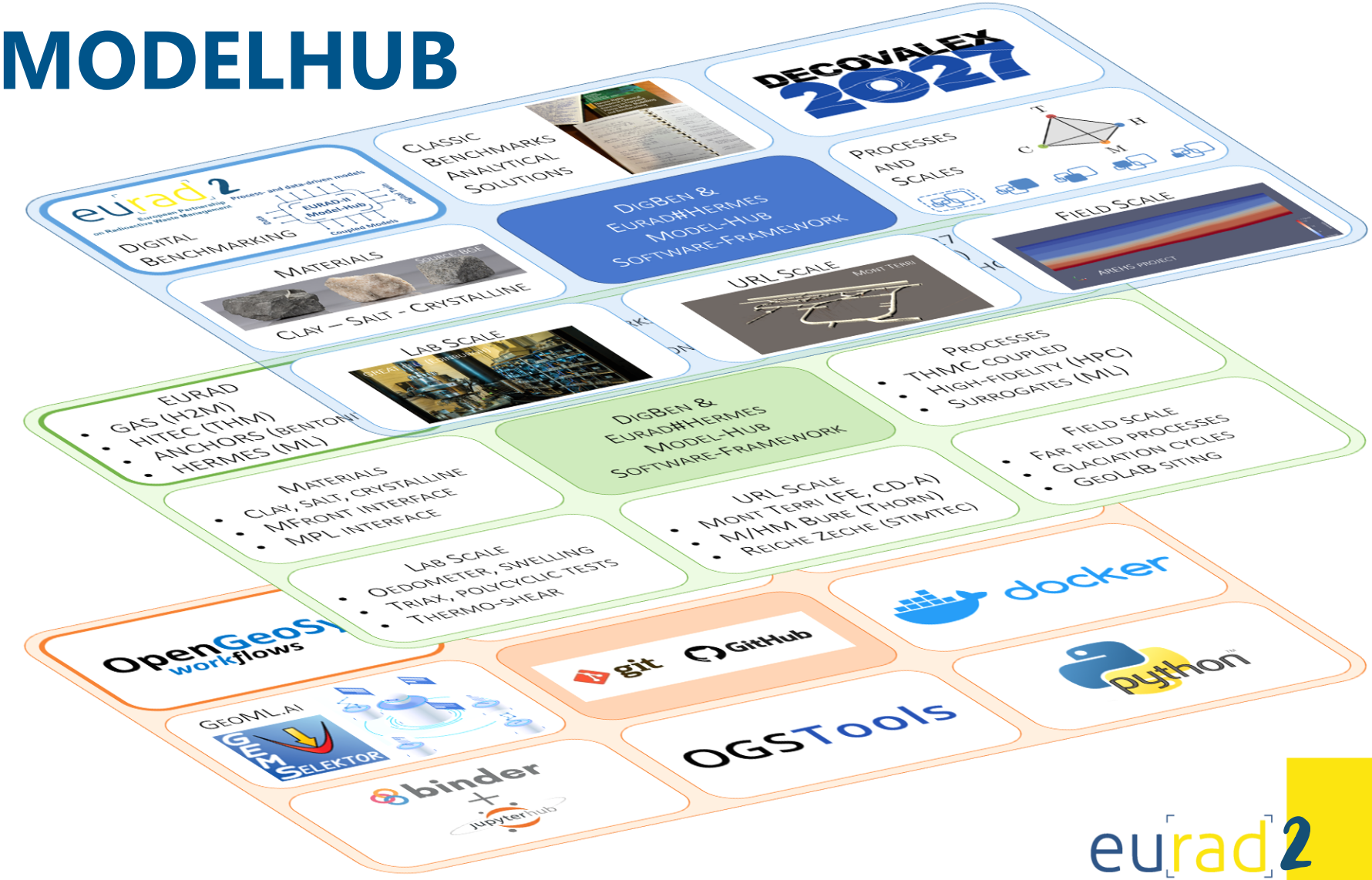
structured user-web-interface organized by thematic areas: materials, processes, scales > projects

InfoLayer

specific information about thematic areas including literature links > list of current benchmarks and examples (extending)

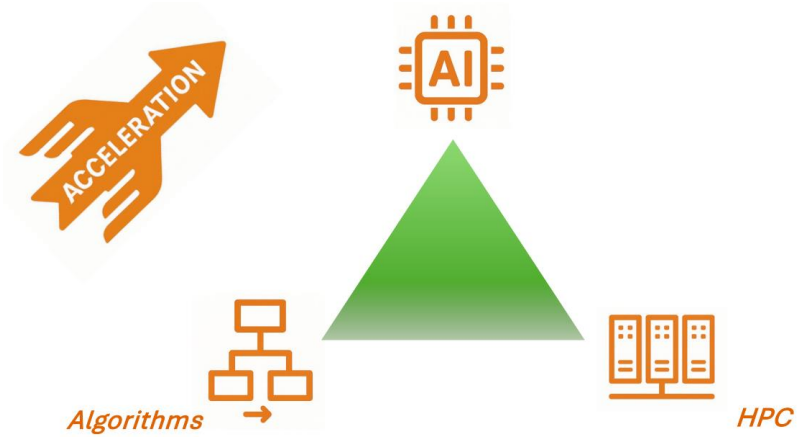
JupyterLab

interactive Jupyter Notebooks of benchmarks and examples < coding area for interactive work



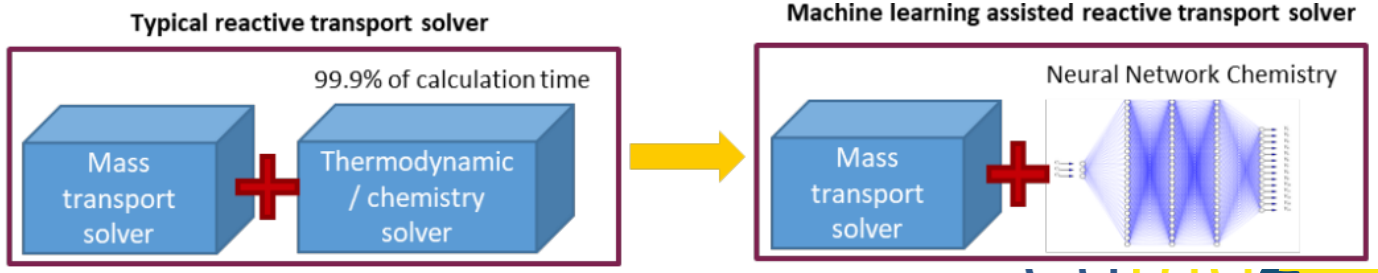
HERMES – USE OF AI/ML IN REACTIVE TRANSPORT

- Using AI in the computation system that greatly increase the speed of the simulations.



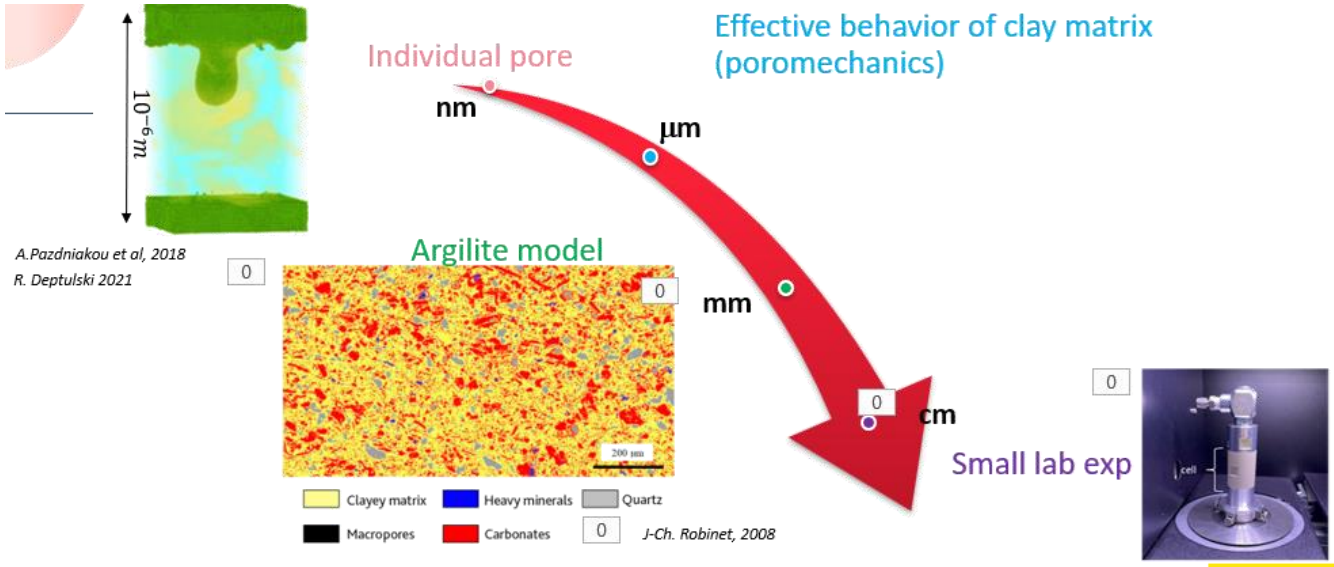
- In addition to increasing the speed of simulations, the accuracy of the physical model behind the calculations cannot be compromised.

- Surrogate models are simplified models that approximate complex, high-fidelity systems or simulations
- By learning the input-output behavior from a limited set of data, surrogate models provide faster, less costly results
- Surrogate models provide a significant acceleration to the THMC simulation codes



ML TECHNIQUES IN GAS TRANSPORT

- Example of the application of ML techniques in a gas transport calculation problem: changing the scale of the simulation between pore-scale and reservoir-scale simulations to laboratory scale
- The use of physics-based neural networks (PINNs) is planned in the calculation of scale-up routes.
- These are physics-based machine learning methods that seamlessly integrate physical knowledge with data.



TAKE-AWAY MESSAGES

- A lot of experience is gathered in the field of Digital Twins in the industry
- To have an effective co-operation an effective dialog with the End-Users is important
- Dynamic Repository Modelling: approach to follow the lifecycle of a DGR
- AI / ML are the important and effective tools
- It is important to focus on the accuracy of the physical models as well as the improvement of the speed of the simulations