Reduction of scenario uncertainties through climate models (REDUKLIM)

Implementation methods

Marc Johnen, Judith Flügge, Jens Wolf

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1. URS Workshop – Day 2

Hannover

BGE BUNDESGESELLSCHAFT FÜR ENDLAGERUNG

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Structure

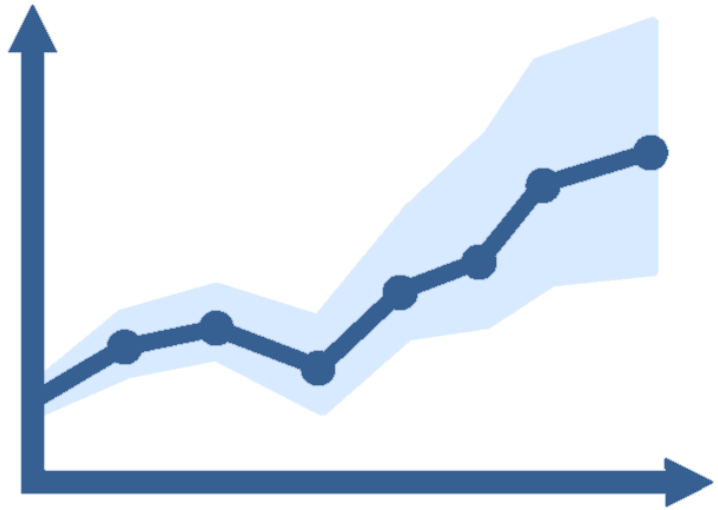
1. Project aims
2. d^3f++ GW-flow and transport code
3. Sensitivity analysis
4. Summary

Project aims

Repetition from yesterday

How can **future climate developments** be taken into account in the context of **long-term safety** and which **uncertainties** do these developments have?

- Assessment period of one million years (EndSiAnfV § 3)
- ➢ Consideration of the geological and climatic situation
  - Developing a better understanding of potential future climate developments
  - Linking of climate modelling and groundwater processes for the safety assessment
- Consideration of uncertainties in the context of the site selection

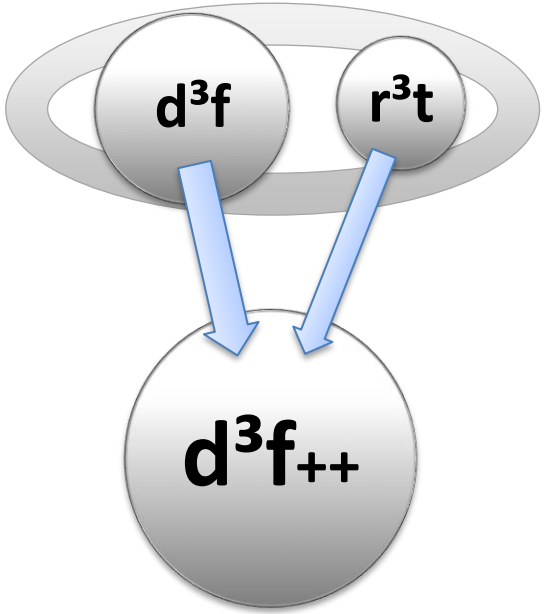


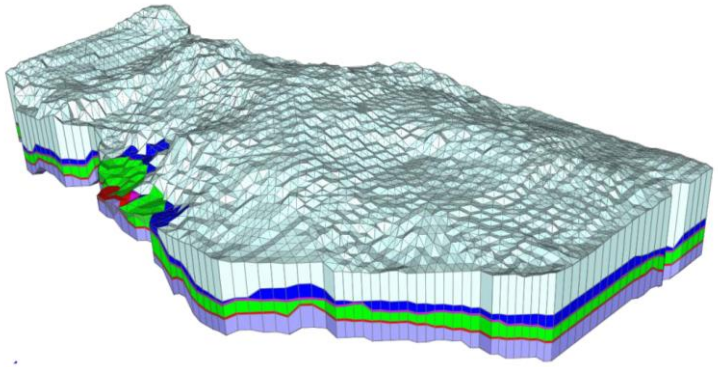
➢ Create additional confidence in the site selection

Implementation

Which tools or methods will be used in REDUKLIM to assess uncertainties in future climate scenarios?

- Building models with d³f++
  - Groundwater flow and transport code for three-dimensional, complex models
    - Developed since 1990's and steadily evolving
    - **d³f** → **d**istributed **d**ensity-**d**riven **f**low
    - **r³t** → **r**adionuclide, **r**eaction, **r**etardation, and **t**ransport
  - Merge of the two modules to **d³f++**





Schneider et al. 2020 (GRS-566)

d³f++ profile - flow

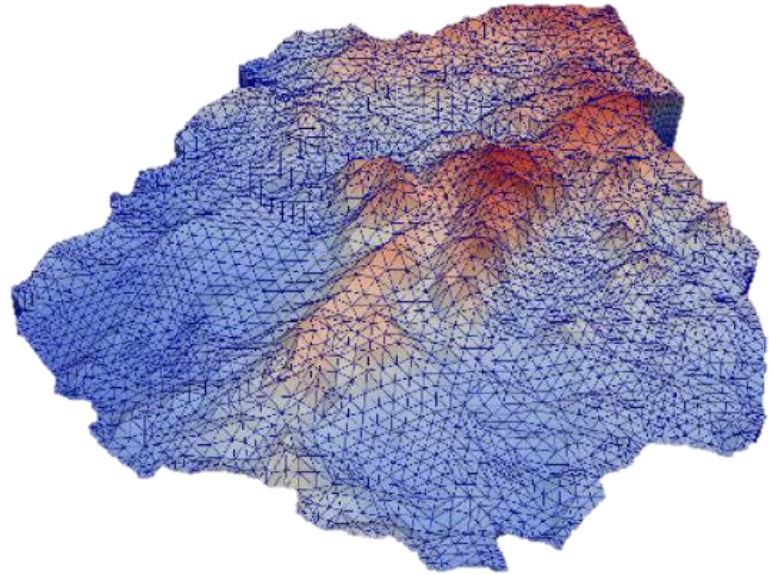
- Flow and salt transport equations
- Finite Volume Discretisation
- Fully parallelized
- Structured and unstructured grids
- Advection, dispersion, diffusion
- Porous medium and fractures
- Sources and sinks
- Free groundwater surface
- Heat transport
- Permafrost conditions (icing and melting)
- Dirichlet, Neumann and Cauchy boundary conditions
- Fluid density and viscosity in depending on salt concentration and temperature

d³f++ profile - transport

- Transport equations
- Advection, dispersion, diffusion
- Element dependent porosity
- Dirichlet, Neumann and In/Out boundary conditions
- Sources and sinks
- Radioactive decay
- Sorption
- Precipitation / Solution

Implementation

- Derivation of possible climate developments in stylised states
- Variation of boundary conditions and parameters
- Representation of different climate scenarios e.g.
  - Glaciation
  - Permafrost
  - Sea level changes



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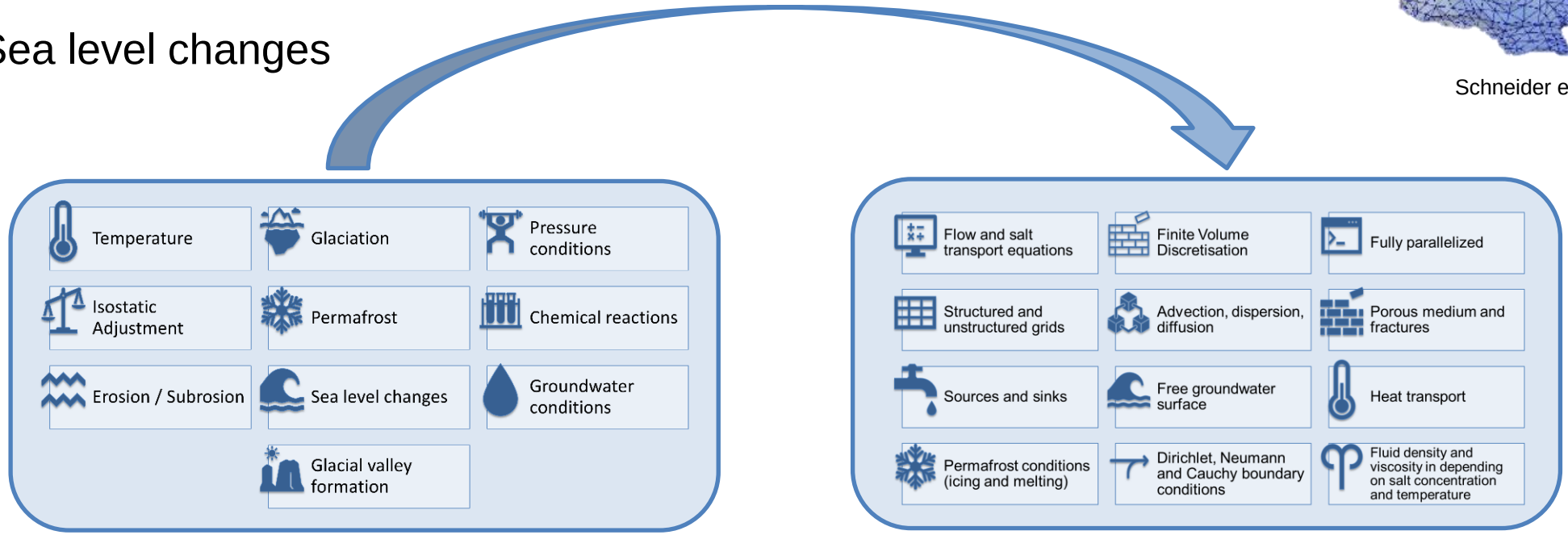
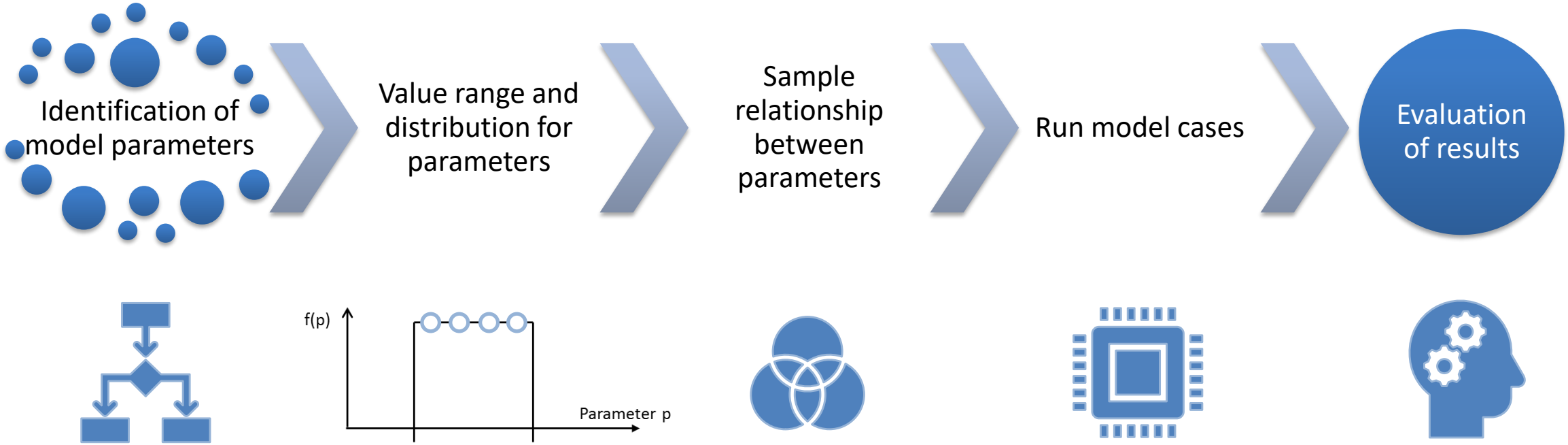


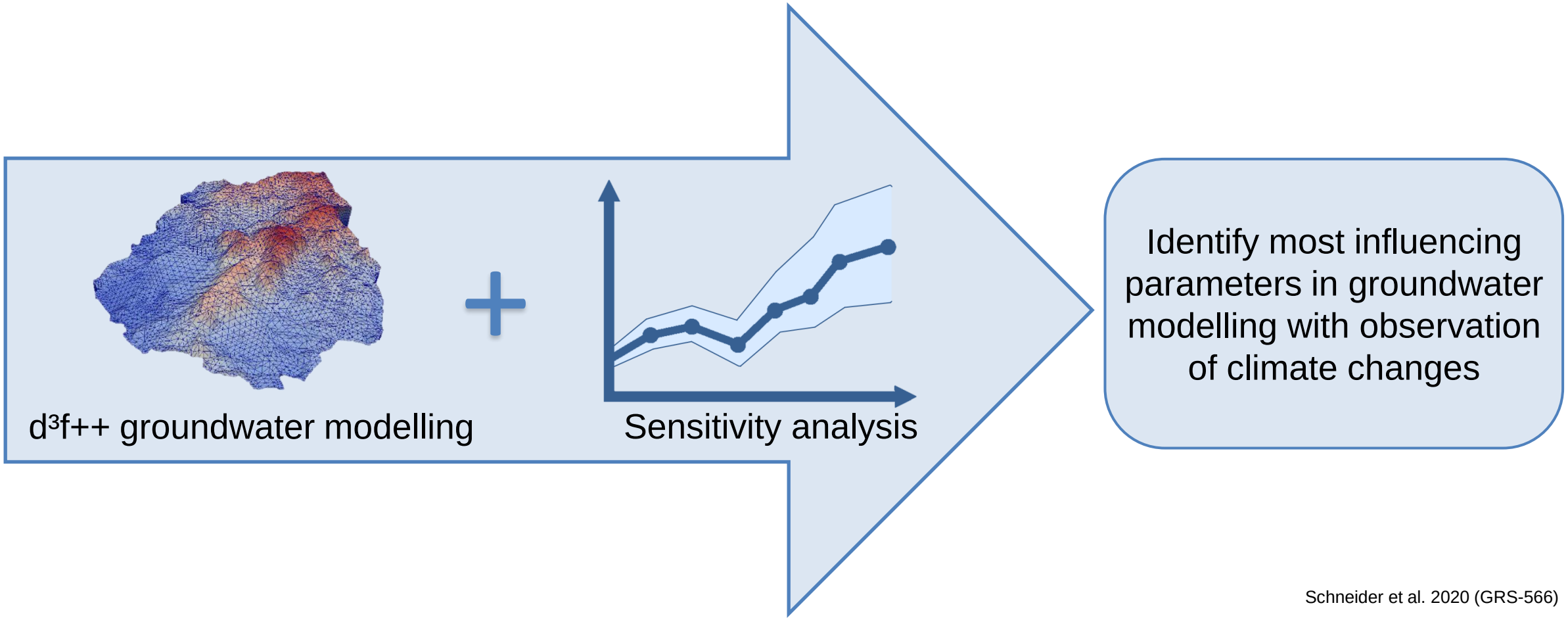
Sensitivity analysis

- Sensitivity analysis to quantify uncertainties
  - Run many model cases to obtain a statistical significance



Summary

Which tools or methods will be used in REDUKLIM to assess uncertainties in future climate scenarios?



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Thank you for your attention!

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Contact: marc.johnen@grs.de