



GeoMol Switzerland – Completed!

Landesgeologie 2017 10

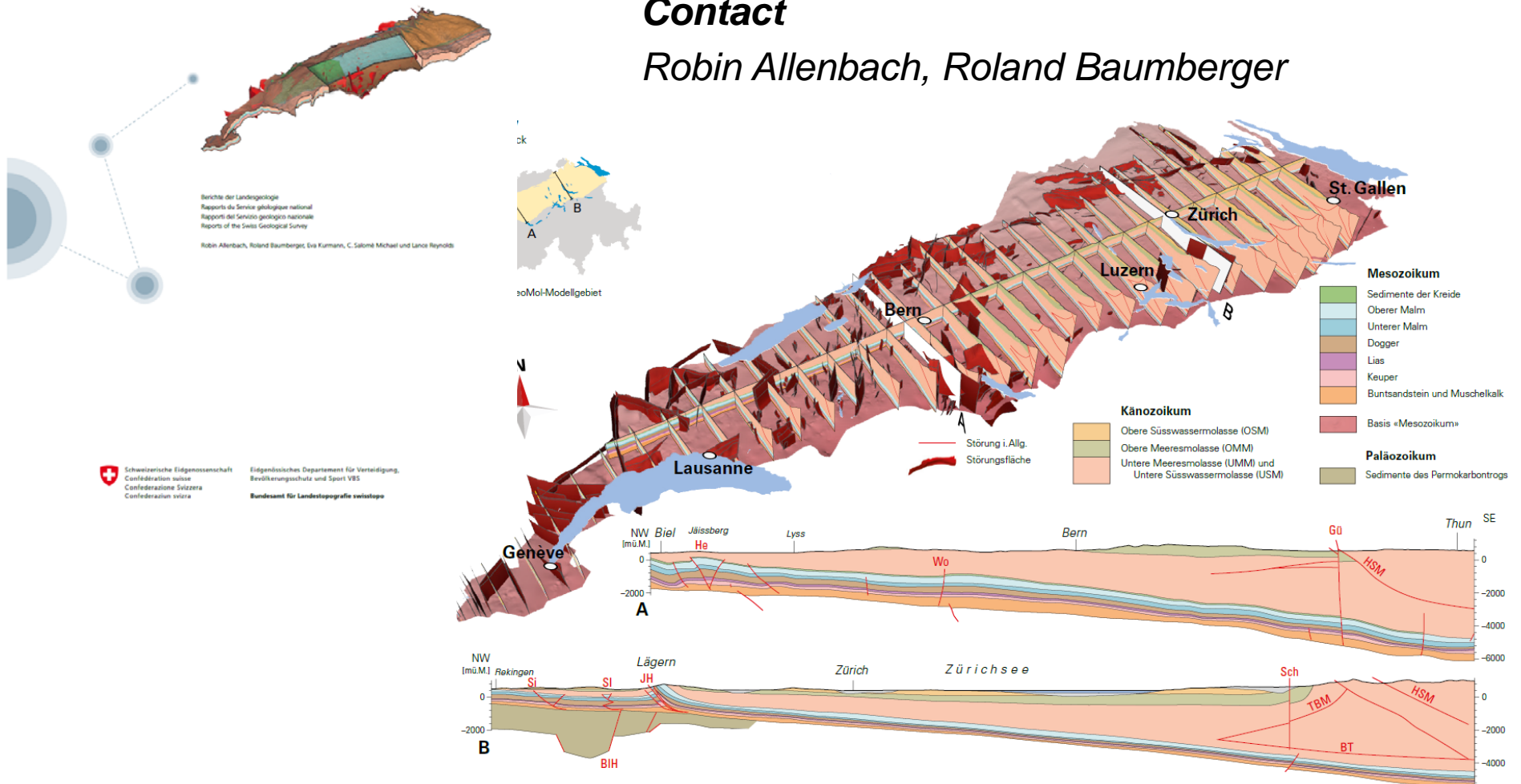
GeoMol: Geologisches 3D-Modell des Schweizer Molassebeckens – Schlussbericht

Online access

<https://viewer.geomol.ch>

Contact

Robin Allenbach, Roland Baumberger



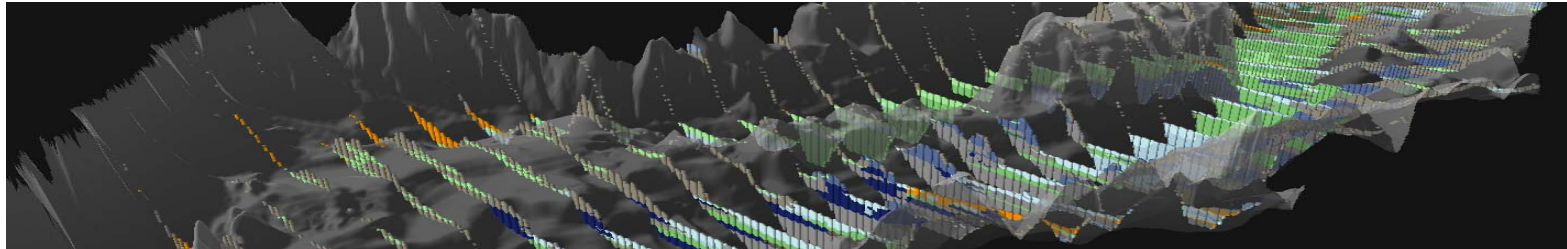
Schweizerische Eidgenossenschaft
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Eidgenössisches Departement für Verteidigung, Bevölkerungsschutz und Sport VES
Bundesamt für Landestopografie swisstopo

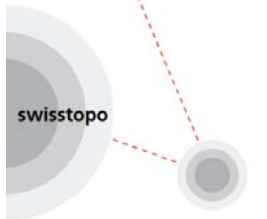
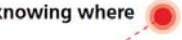


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Landesgeologie



wissen wohin
savoir où
sapere dove
knowing where



GeoQuat project: Semi-automated 3D voxel modeling of Quaternary deposits and post-products generation

Philip Wehrens

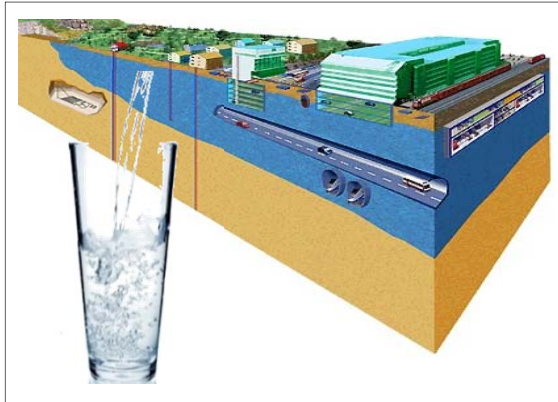
4th European Meeting on 3D Geological Modelling,
Orléans 21-23 February 2018



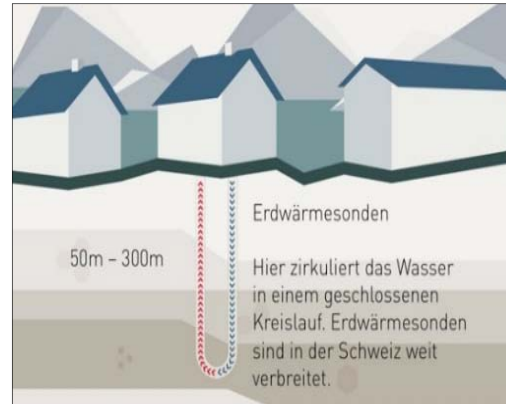
Managing the subsurface

Importance of 3D distribution of Quaternary deposits

Hydrogeology



Geothermal Energy



Geotechnics



Raw material resources



Earthquakes

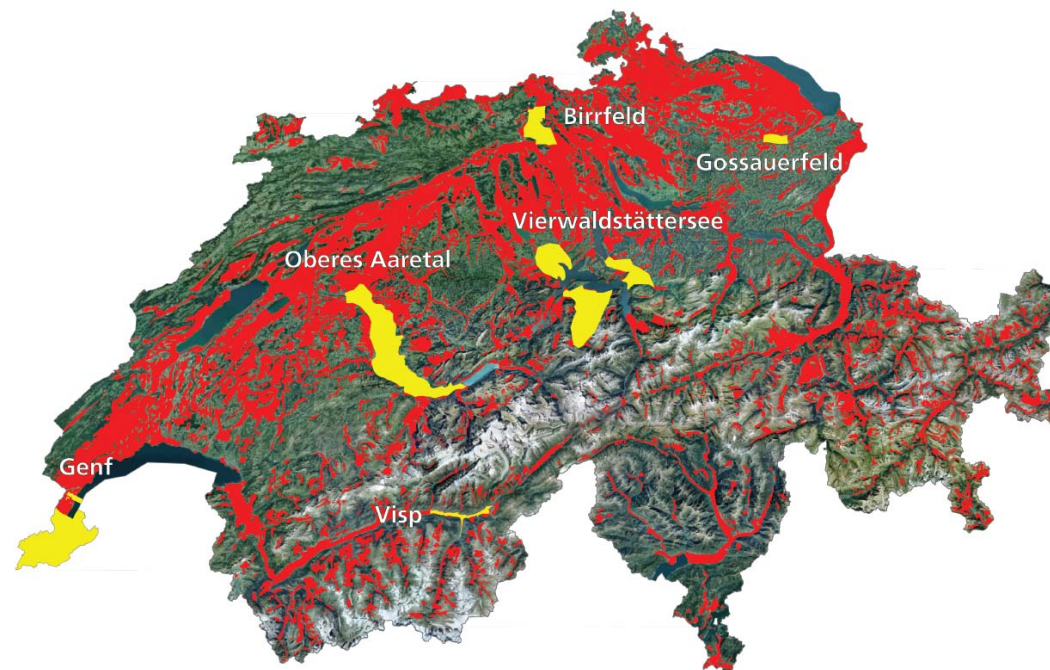




The GeoQuat project

Building a semi-automated infrastructure for Quaternary data

Standardization → Harmonization → 3D modelling → Derived products





The GeoQuat project

Building a semi-automated infrastructure for Quaternary data

Standardization → Harmonization → 3D modelling -> Derived products

Why Voxel Modelling?

Complexity

Heterogeneous structure of the Quaternary with lateral and vertical discontinuous processes and complex geometries have to be modelled

Reproducibility

Input data as well as the creation of the 3D model can be documented to allow reproduction (e.g., algorithms, anisotropies).

Update efficiency

New data has to be efficiently used to update /re-run the model (Canton Bern ca. 1000 new boreholes per year)

Volume models

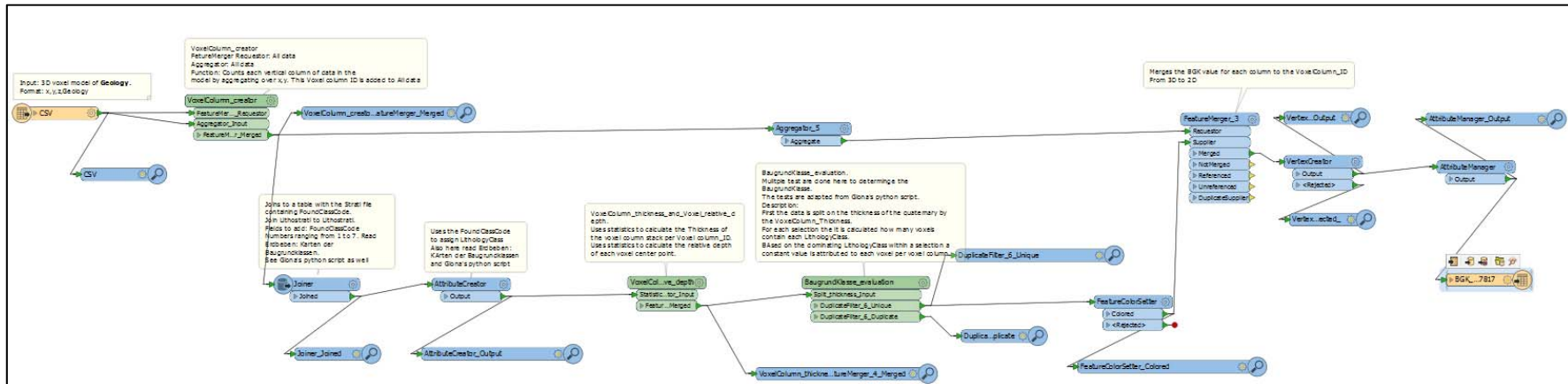
Efficient calculation / generation of derived volume based products



The GeoQuat project

*Building a semi-automated infrastructure for Quaternary data
Standardization → Harmonization → 3D modelling → Derived products*

Automation using FME (Feature Manipulation Engine by safe software)

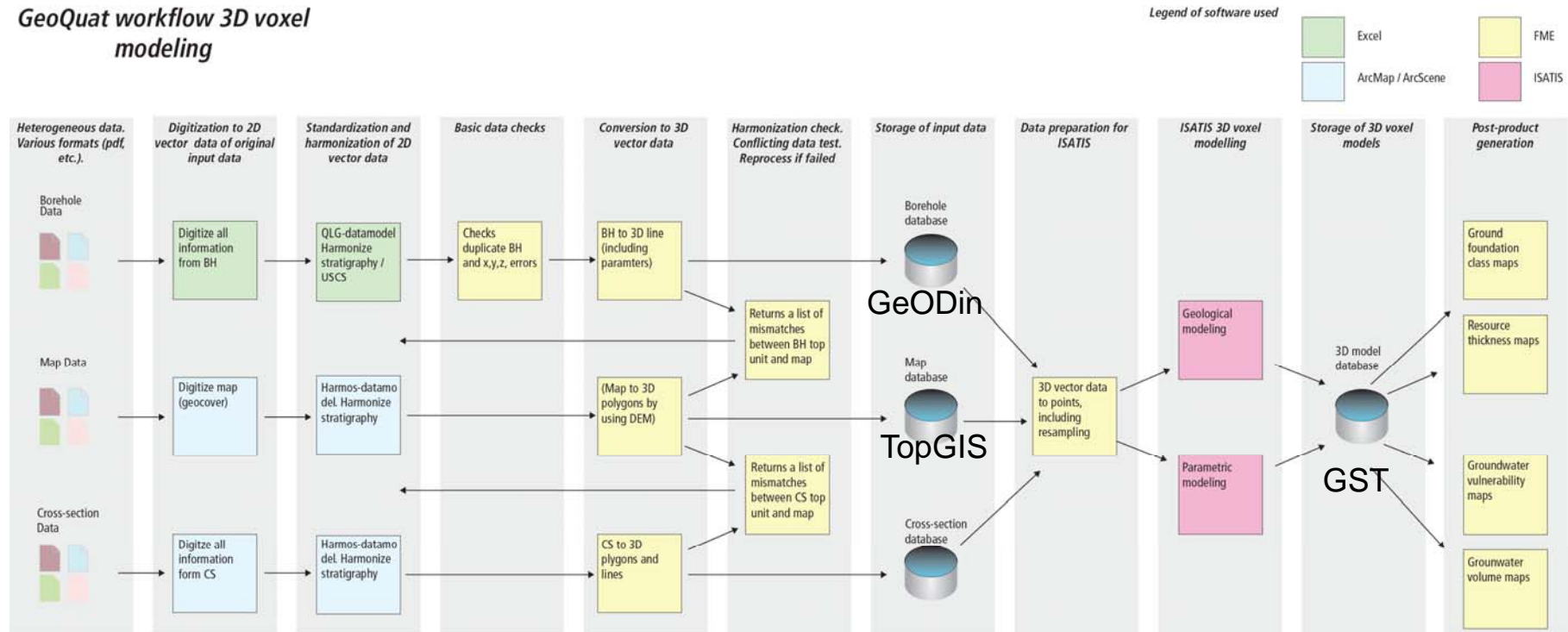


Visual display of data manipulation
Easy to document data manipulation



Workflow and automation overview

GeoQuat workflow 3D voxel modeling



Standardization and Harmonization



Data checks and 3D vectorization



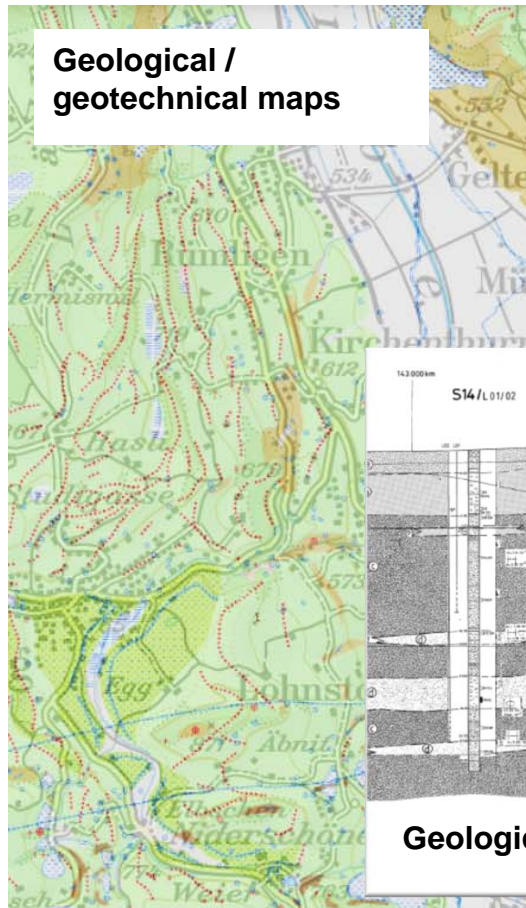
Voxel modeling



Post-product generation



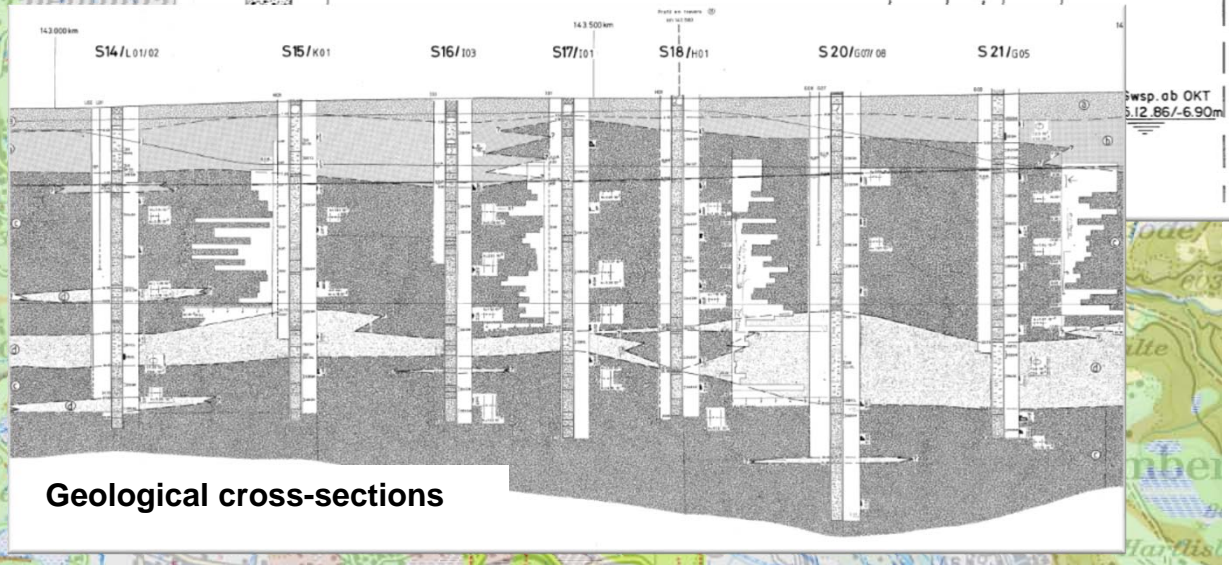
Heterogeneous input data



Geological / geotechnical maps

Borehole data

TERRAIN	NR	AUFGESCHLOSSENEN BOHRGUTES	U. S. C. S.	GEOLOGIE	SPT 40 80	HYDROGEOLOGIE
0.80		Handaushub	—	Künstliche Schüttung Alter Boden	N=51	Piezometer
1.80		Kies, siltig, schwach tonig mit reichlich-viel Feinsand, vielen Steinen und mit wenigen organischen Beimengungen, eckige Gerölle (v.a. Temerschiefer), kohäsionslos, dunkelbraun-schwarz.	GM-ML			
2.70		Sand, schwach siltig, mit viel Kies, kohäsionslos, braun-schwarz.	SM			
2.90		Sand, siltig, mit reichlich-viel Kies, mit organischen Beimengungen, eckige Gerölle (Temerschiefer), schwach bindig, braun.	SM-ML			
3.20		Sand-Feinsand mit wenig-reichlich Kies und einzelnen Steinen, im oberen Teil mit einer grauen siltigen Linse, kohäsionslos, beige.	SM			
3.60		Kies, schwach siltig, mit viel Sand-Feinsand, mit einzelnen schwach gerundeten Tonschiefern, kohäsionslos, dunkelgrau.	GM			
4.10		Sand, schwach siltig mit viel Kies, Gerölle gut gerundet, kohäsionslos, beige-braun.	GM			
4.40		Kies, schwach siltig, mit viel Sand-Feinsand, mit einzelnen schwach gerundeten Tonschiefern, kohäsionslos, dunkelgrau.	GM			
		Sand, schwach siltig mit viel Kies, Gerölle gut gerundet, kohäsionslos, beige-braun.	SM			

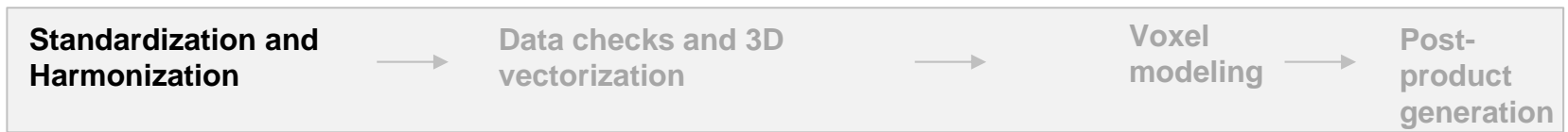
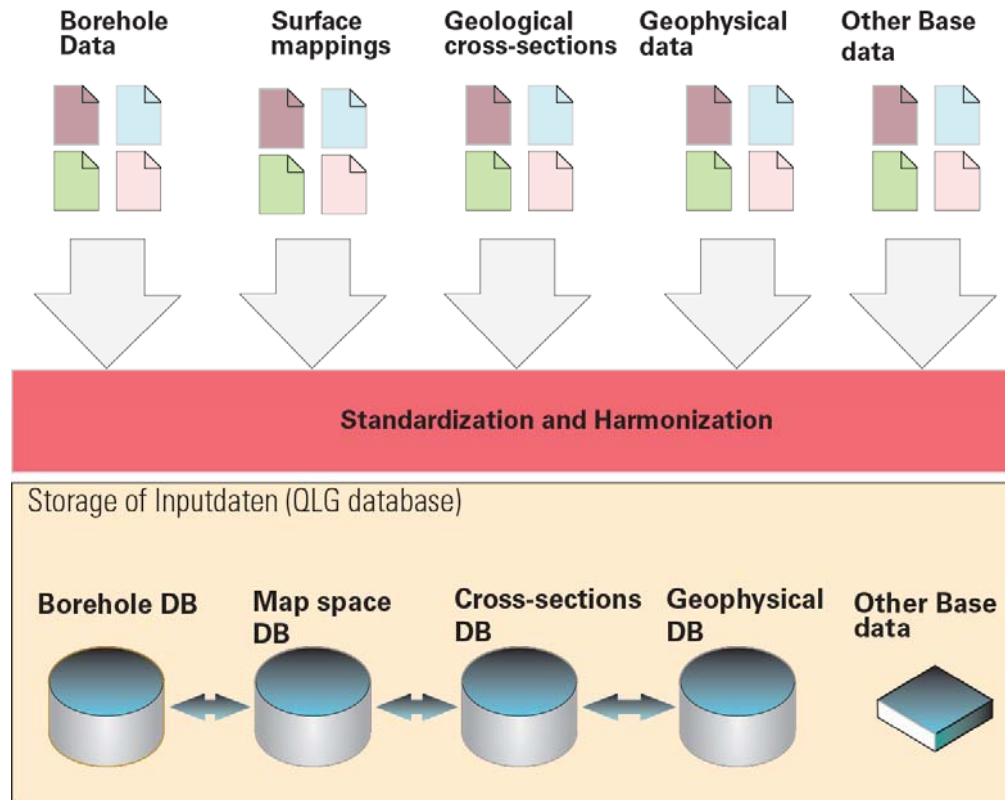


Geological cross-sections



Standardization and harmonization

- prerequisite for DB storage, automation and 3D modelling

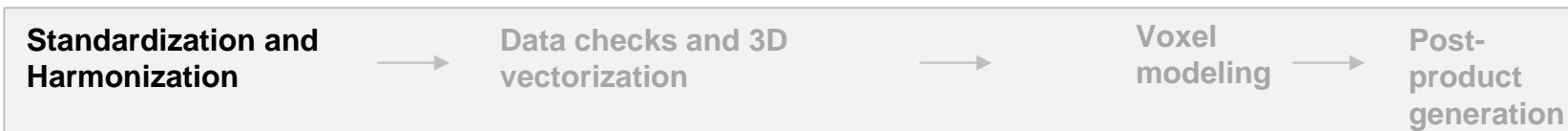
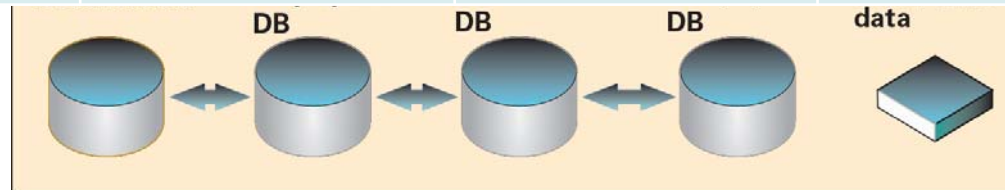




Standardization and harmonization

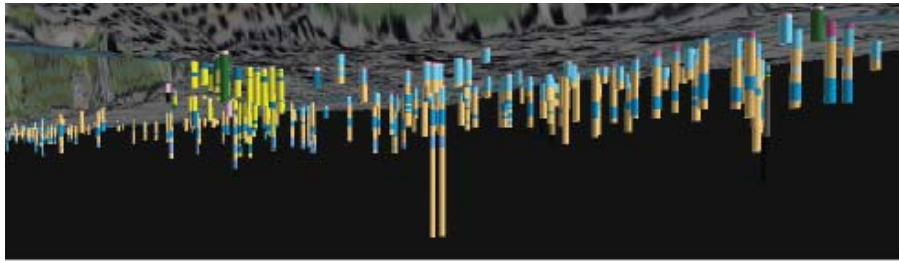
- prerequisite for DB storage, automation and 3D modelling

Pilot region	No. boreholes	Borehole length	No. layers
Birrfeld	1'577	37'230	19'830
Visp	788	17'955	11'674
Aaretal	3'280	60'215	36'275
Vierwaldstättersee	741	15'423	8'120
Genf	615	11'240	7'143
St. Gallen	686	7'300	2'170
Total	7'687	149'363	85'212

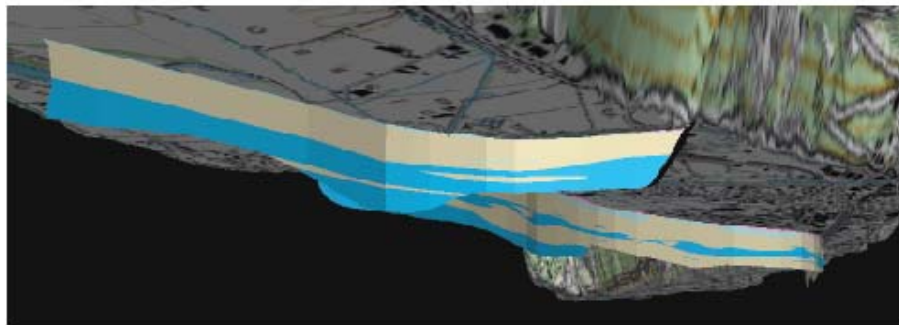




Vectorization and 3D data checks



→ Visualization in ArcScene



- Automated mismatch list between maps and cross-section and boreholes
- Visual checks in 3D



Standardization and
Harmonization



Data checks and 3D
vectorization



Voxel
modeling



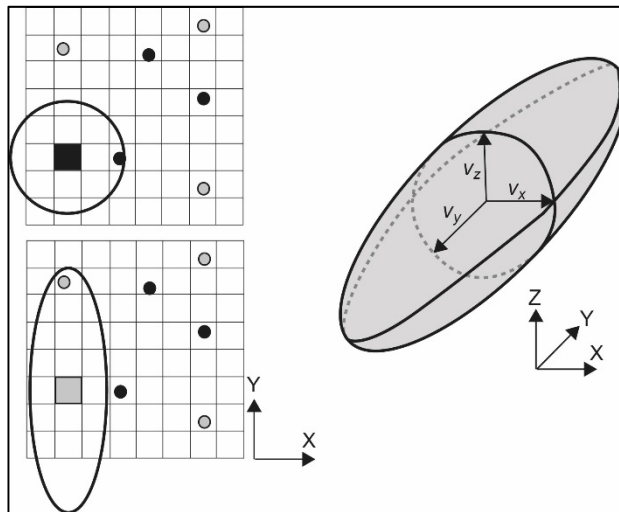
Post-
product
generation



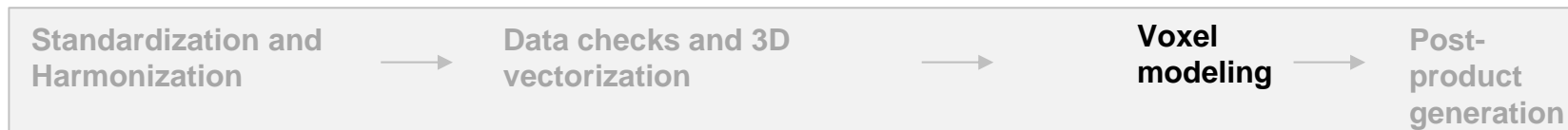
Voxel modelling in ISATIS



3D Voxel Models	Modelled Parameter	Type	Method
Geological	Lithostratigraphy	Discrete	Nearest Neighbour
<i>Geological</i>	<i>Lithostratigraphy</i>	<i>Continuous + Discrete</i>	<i>Sequential Geological Probabilistic Modelling (Indicator Kriging)</i>
Parametric	Hydraulic conductivity	Continuous	Co-Kriging



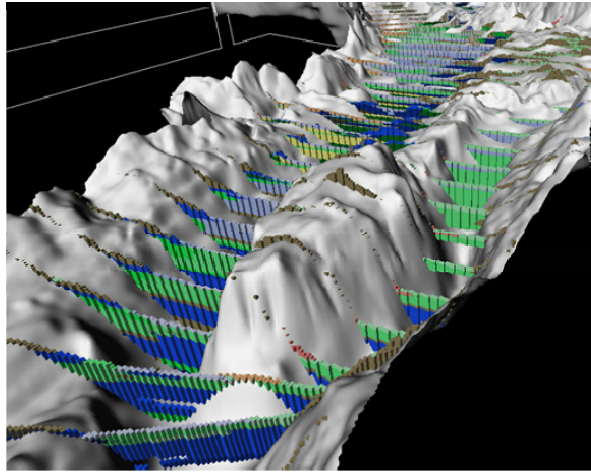
- Variogram statistics is not automated
- Definition of modelling parameters is not automated
- Modelling runs are automated



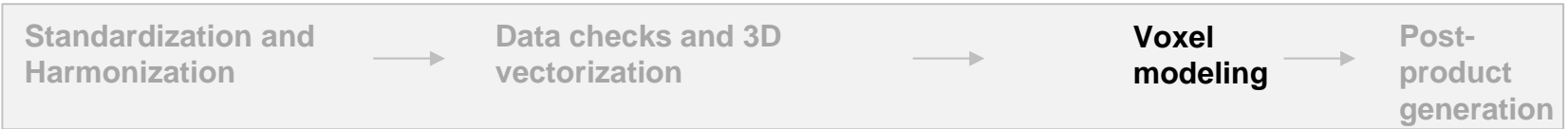
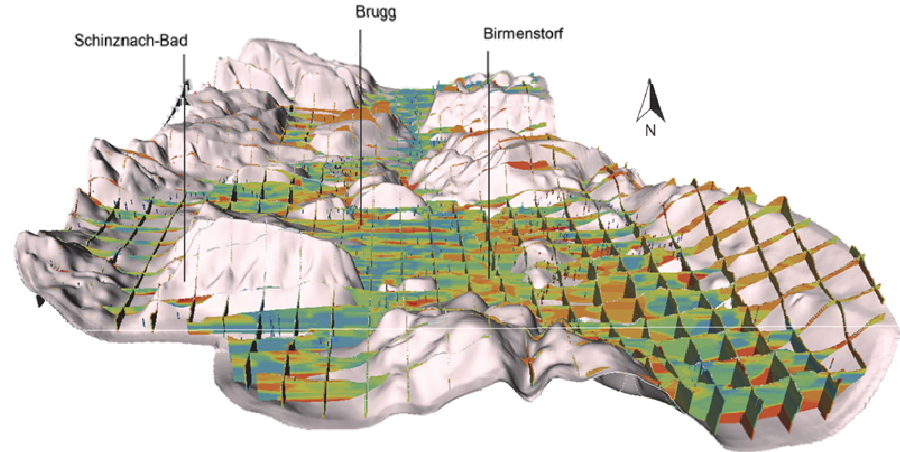
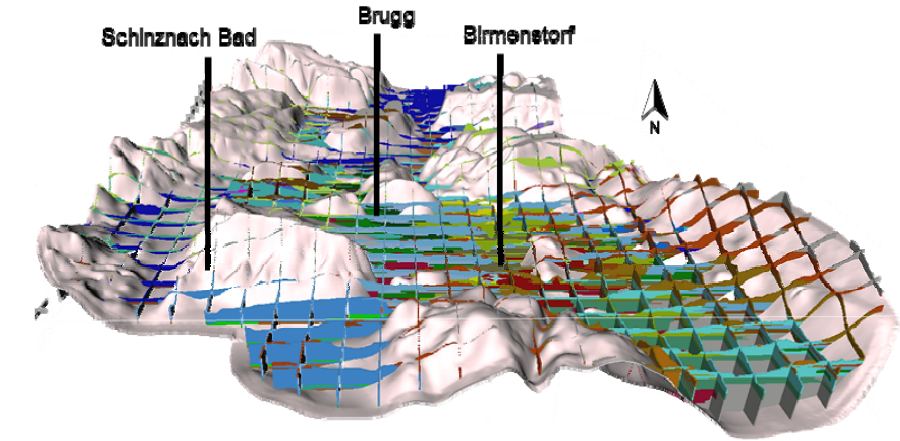
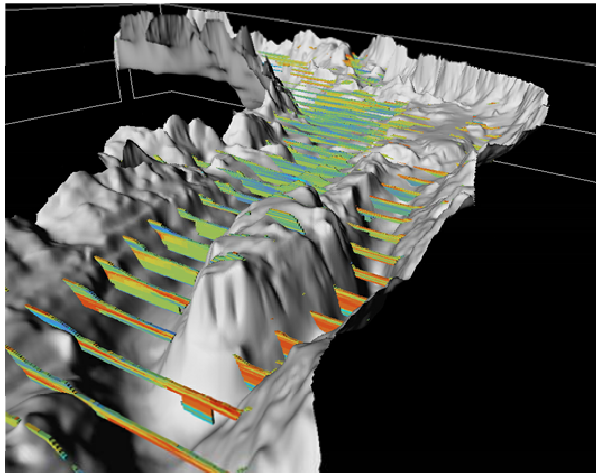


Examples of 3D models

Geological model

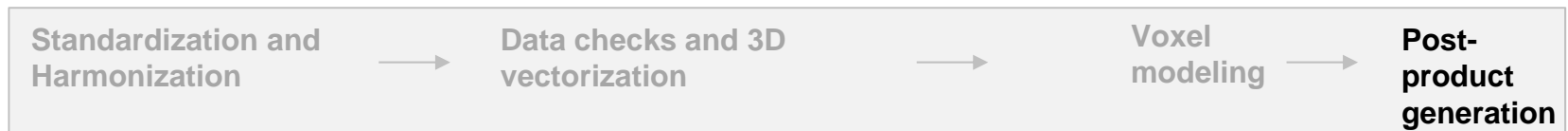
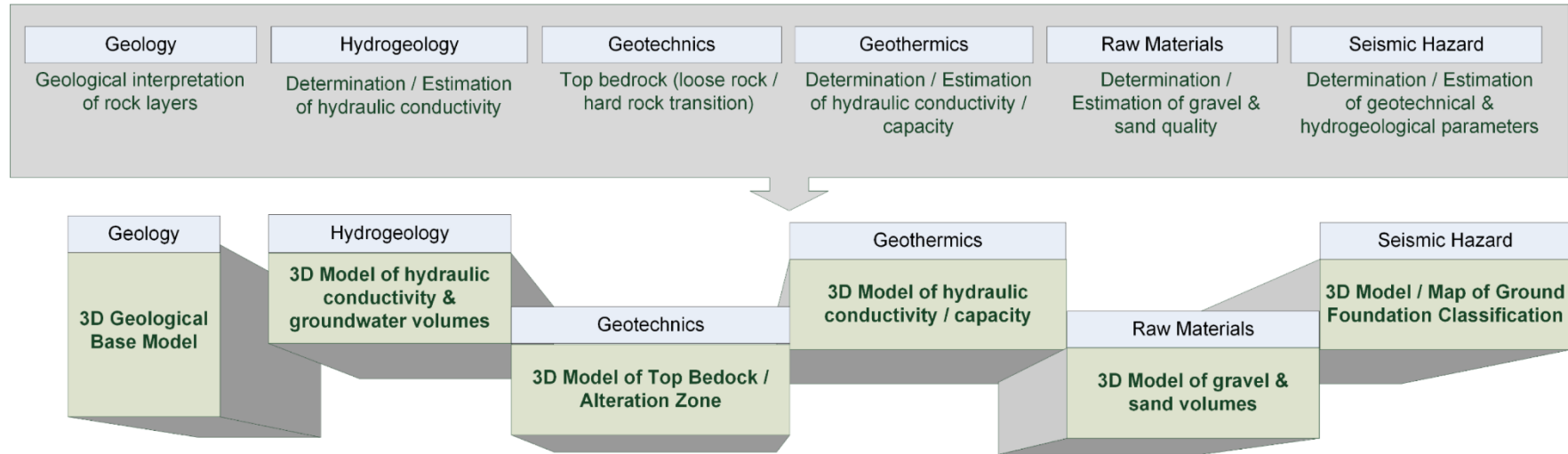


Parametric model



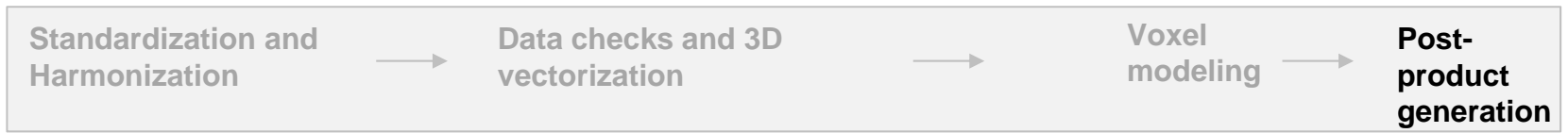
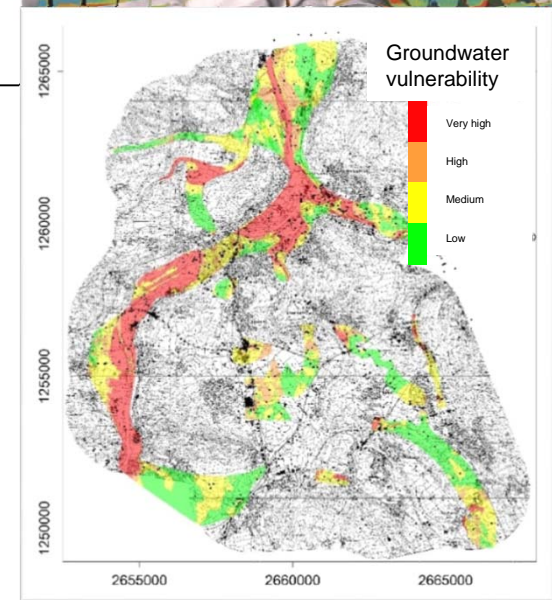
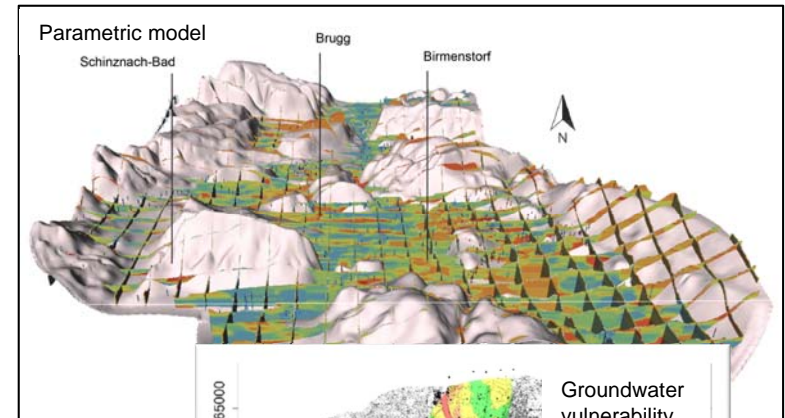
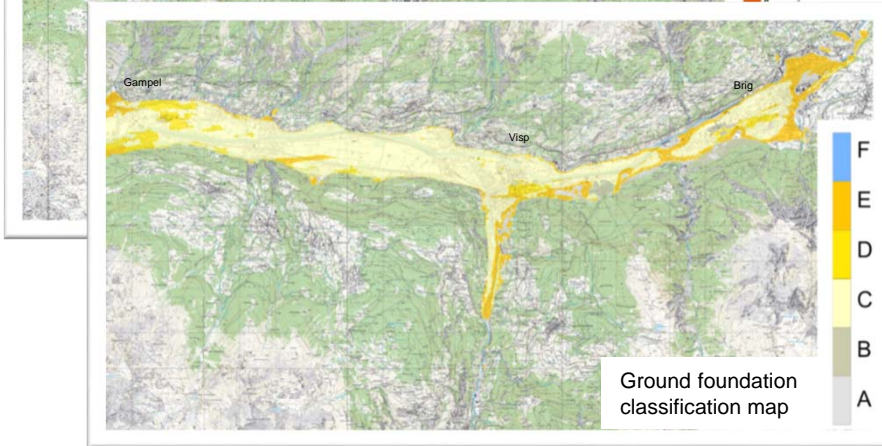
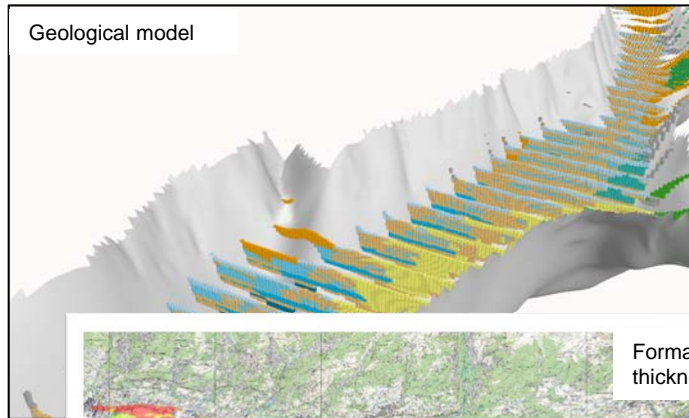


3D models and post-products



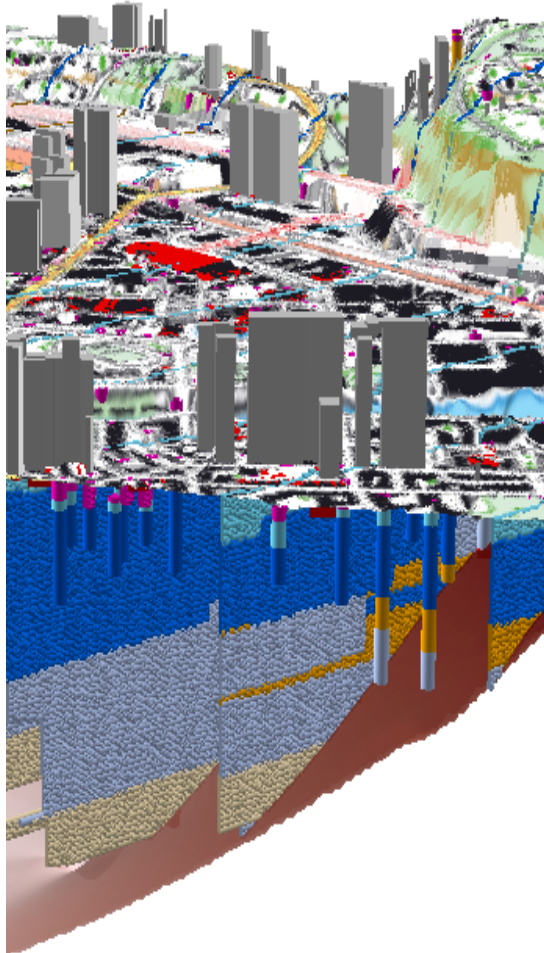


Examples of post-products





Outlook



- Testing the developed data infrastructure and workflows in in urban environment
 - pilot area Geneva
 - interaction with BIM data
- Optimizing the derived products in collaboration with the cantons and other partners
 - check different options to visualize and analyse geological 3D data
- From project to process:
Implement the developed data infrastructure and workflows in the SGS processes

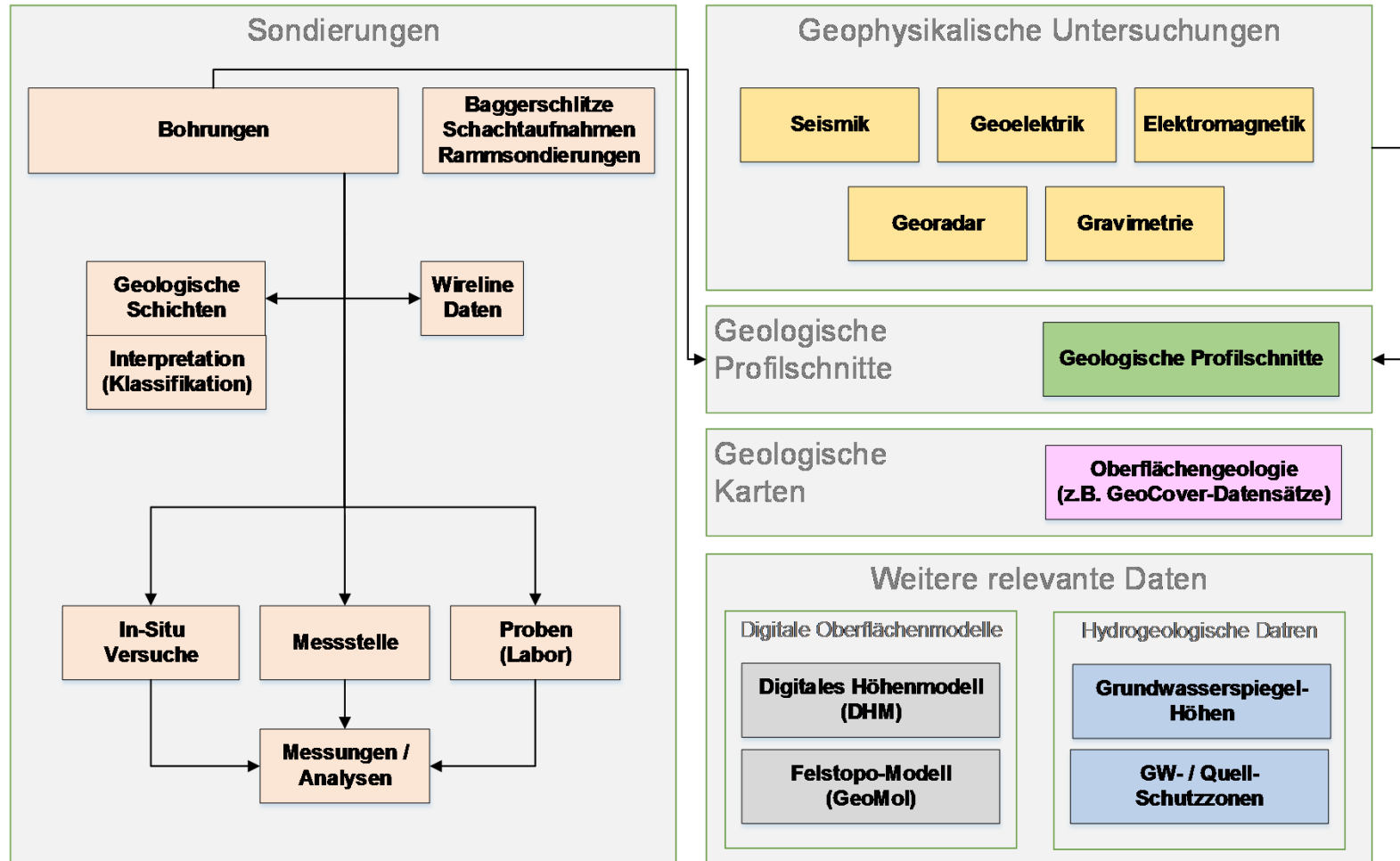


Thank you





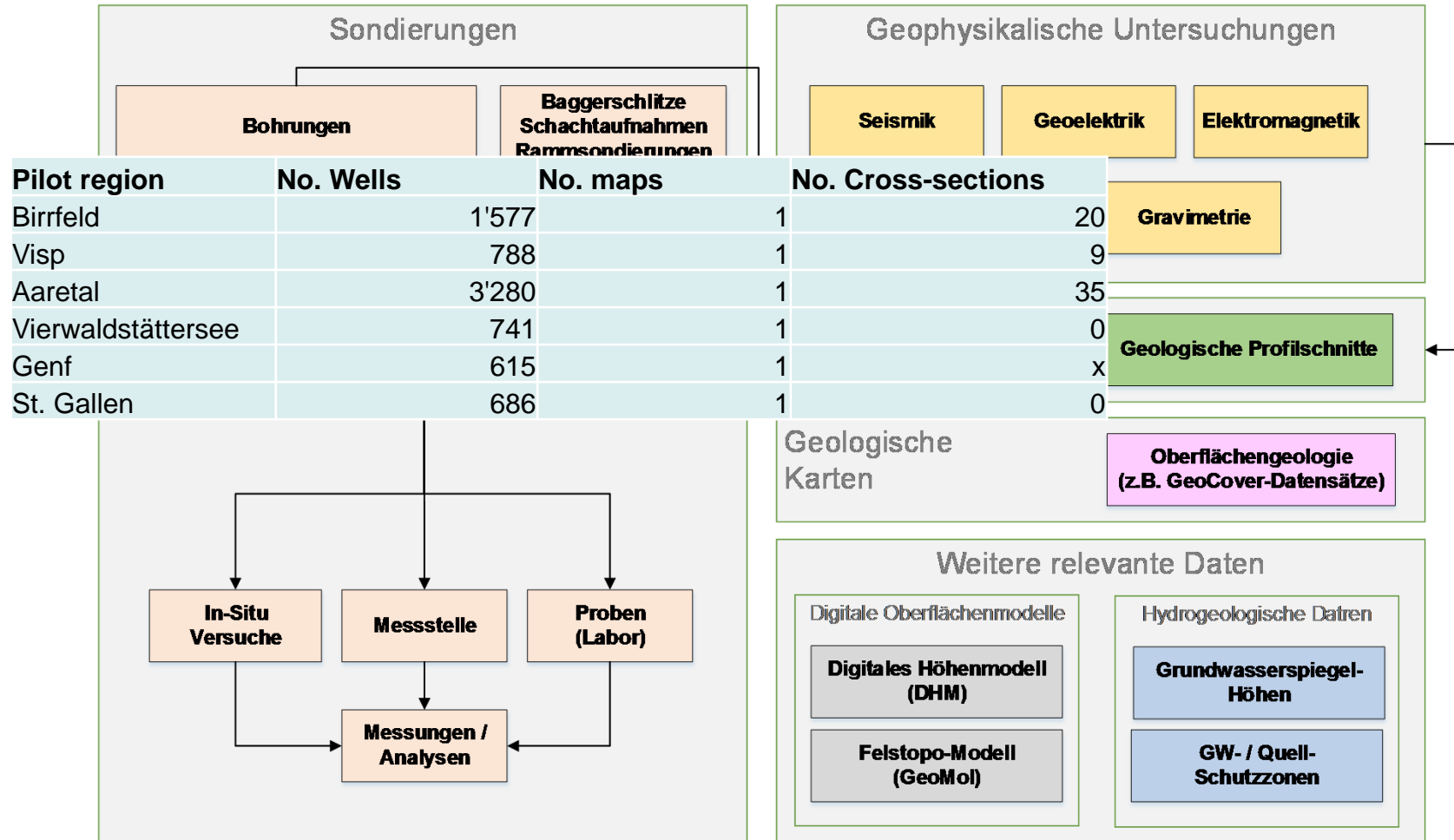
Standardization of data - prerequisite for automation





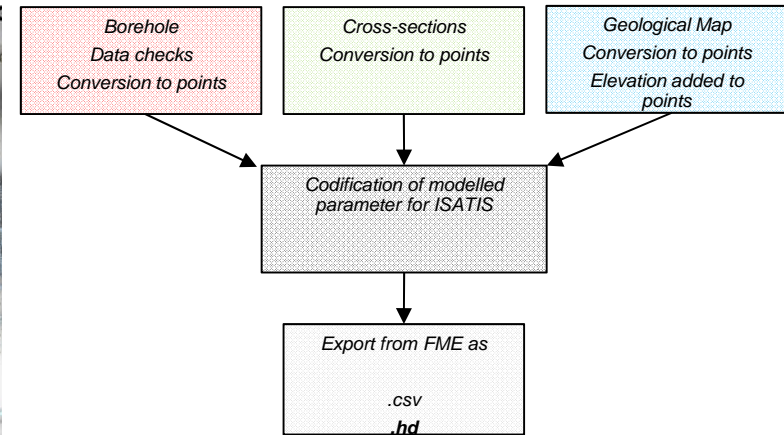
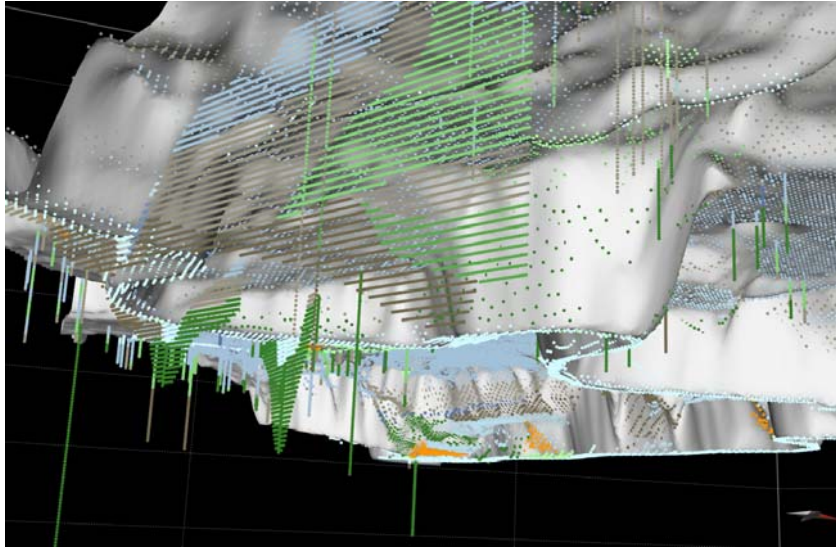
Standardization of data

- prerequisite for automation





Preparing data for modelling



→ Visualization in Move3D

- Automated conversion of all data to points and prepared for ISATIS 3D voxel modelling

Data checks and 3D
vectorization



Conversion
to points



Voxel
modeling



Post-
product
generation