

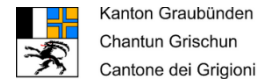


KARSYS / Visual KARSYS

Modelling karst aquifers in 3D

Workshop VS | January 30th, 2020

Malard A., Luetscher M.



A new approach in understanding karst aquifers !

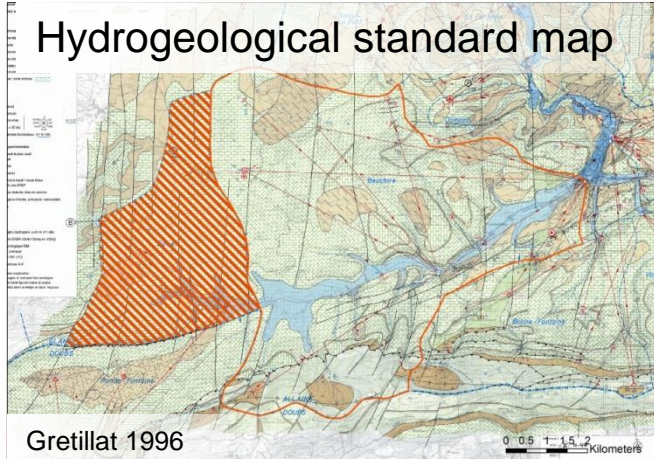
KARSYS

Visual KARSYS

Perspectives

Conclusion

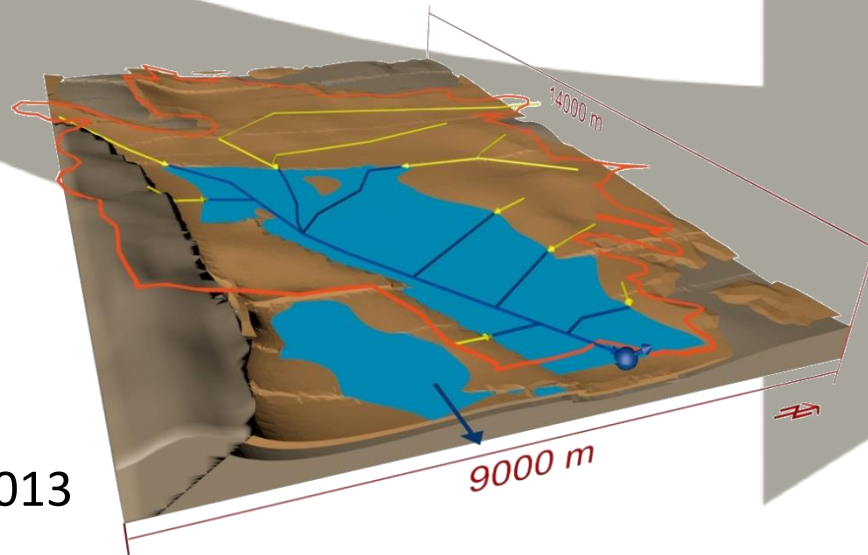
Hydrogeological standard map



Gretillat 1996

Explicit 3D
conceptual model
= KARSYS

Same data,
new approach



Applications

Jeannin et al. 2013

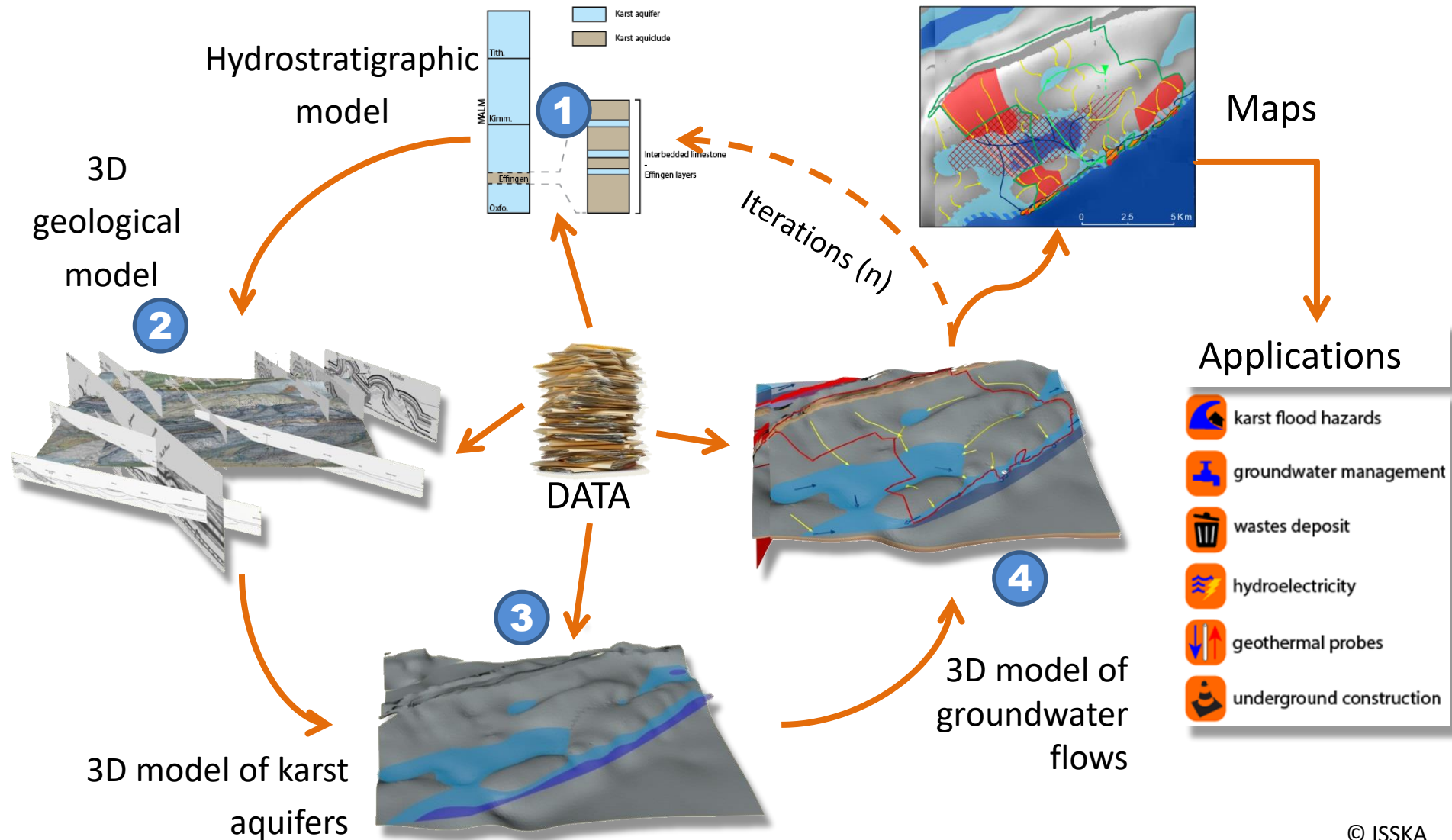
KARSYS workflow – 4 basic models

KARSYS

Visual KARSYS

Perspectives

Conclusion



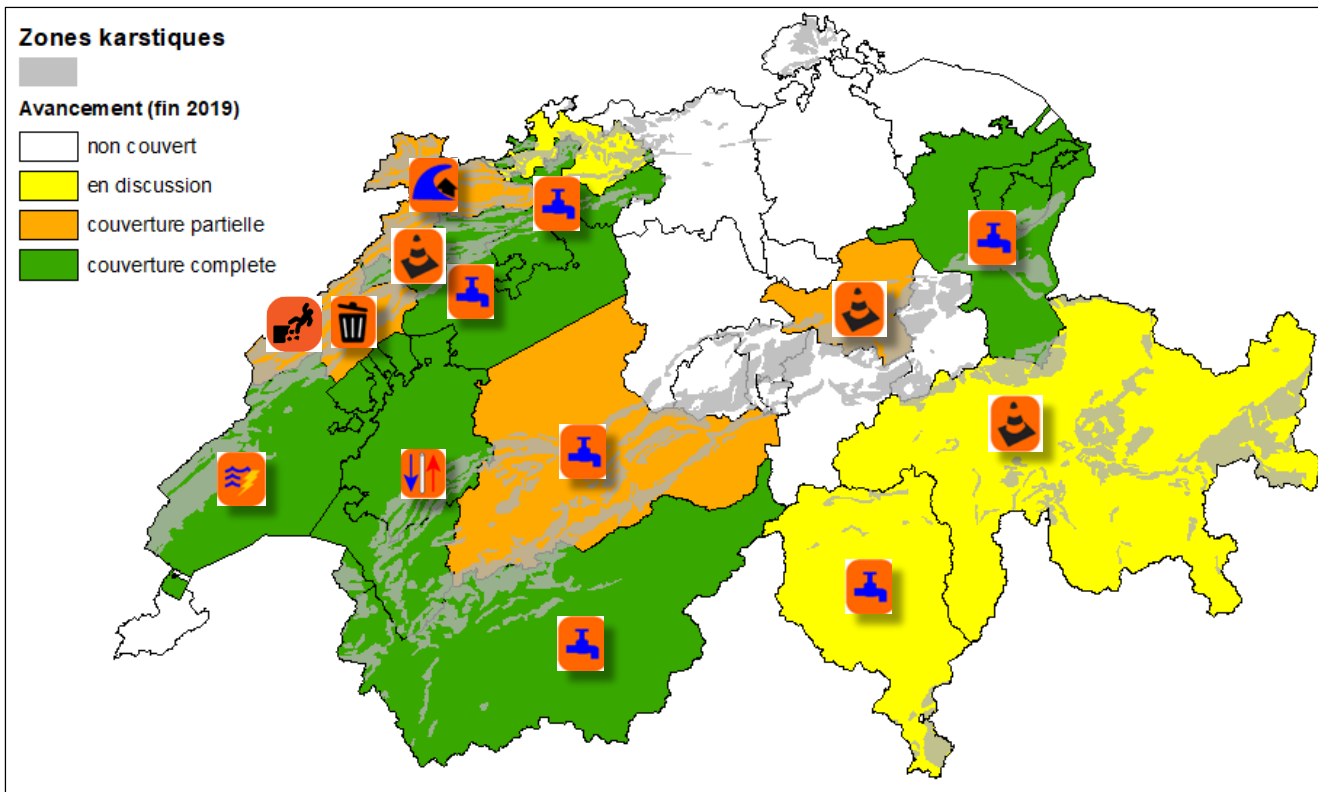
Applications – examples in CH

KARSYS

Visual KARSYS

Perspectives

Conclusion



SO / VS

Assessment of karst groundwater resources



FR

Admissibility for geothermal probes in karst



NE

Assessment of ground collapse hazards



BE

Karst hazards in underground constructions

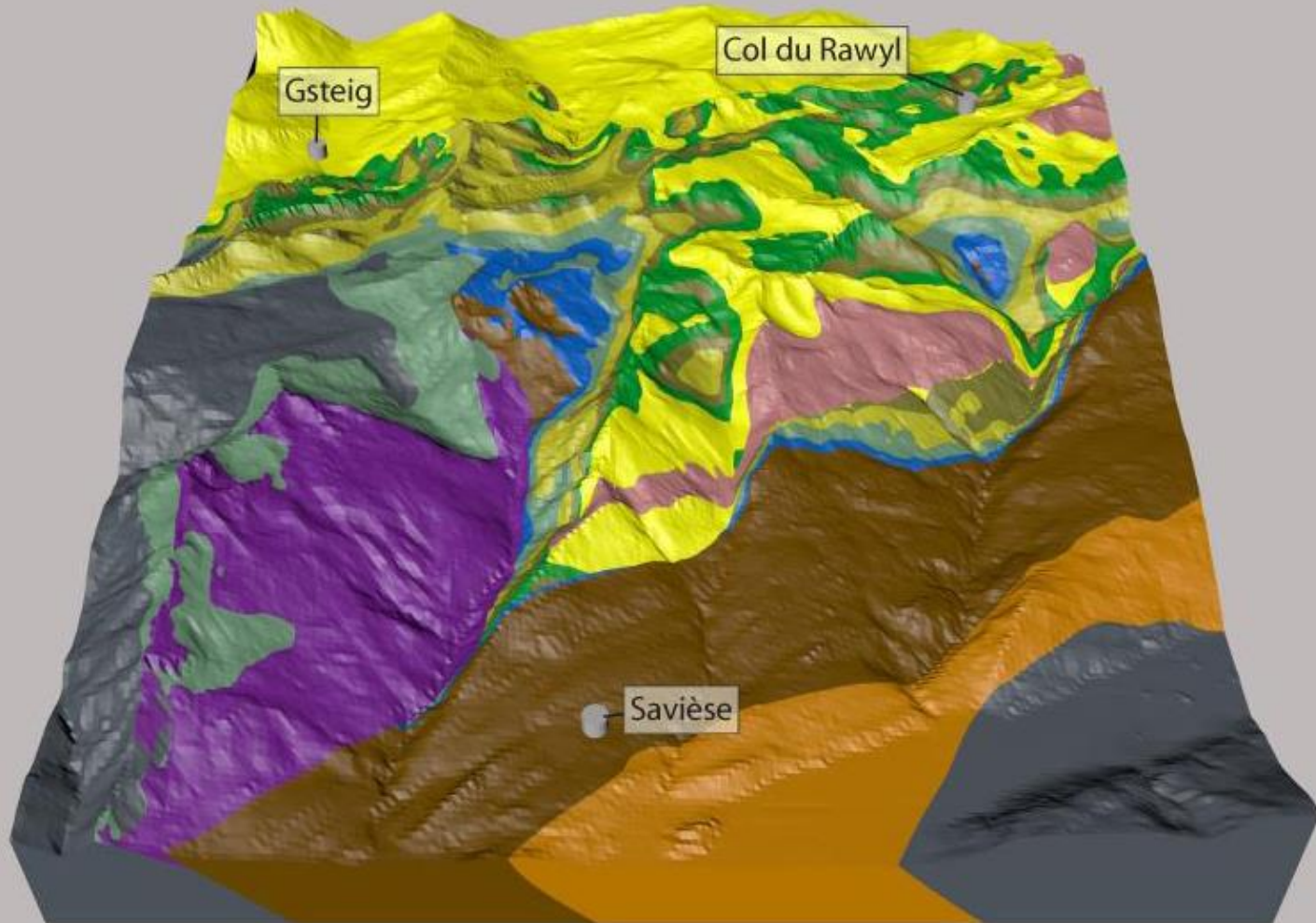
VS – assessment of GW resources

KARSYS

Visual KARSYS

Perspectives

Conclusion



VS – assessment of GW resources

KARSYS

Visual KARSYS

Perspectives

Conclusion

Carte de surface : 211266VS0002 - Loquesse

Auteur : E. Weber / M. Luetscher

Date : 29.10.2019

Echelle : 1:55 000



Légende

Interaction Ponctuelle

○ <all other values>

Source pérennes captées

● Capté, Pérenne, Indéterminé

● Capté, Pérenne, 1-10 L/s

● Capté, Pérenne, 10-100 L/s

● Capté, Pérenne, 100-1000 L/s

● Capté, Pérenne, 100-1000 L/s

● Capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 1-10 L/s

● Non-capté, Pérenne, 10-100 L/s

● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

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● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

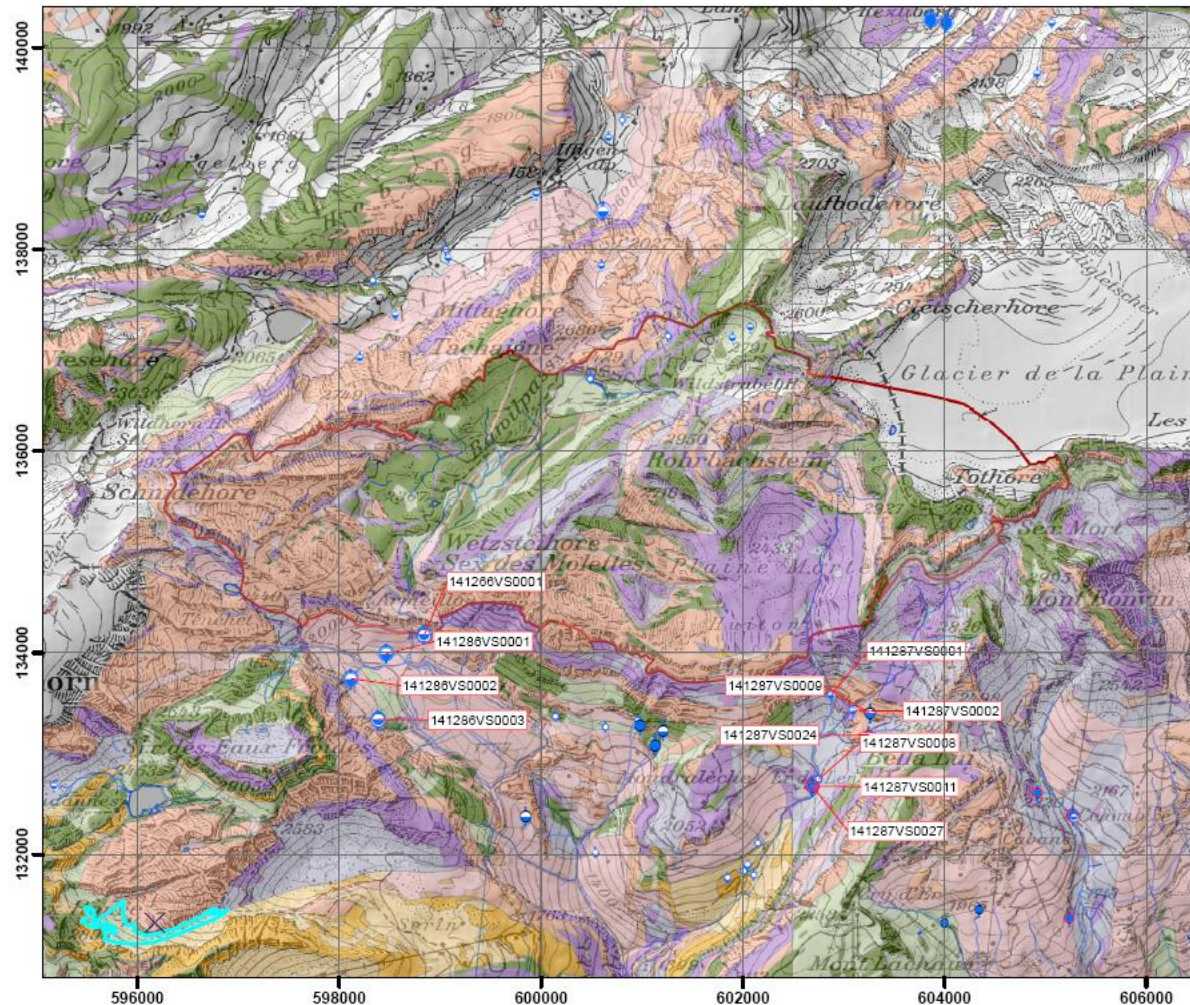
● Non-capté, Pérenne, 100-1000 L/s

● Non-capté, Pérenne, 100-1000 L/s

Propriétés de surface et sous couverture
Karstique
Semi-karstique
Karst évaporitique
Non-karstique
Karst sous couverture
Karst évaporitique sous couverture
Non karstique sous couverture
Semi karstique sous couverture
Quaternaire
Réseau hydrographique



ISSKA - Siska
Institut Suisse de Spéléologie et de Karstologie
Case postale 918
CH-2301 La Chaux-de-Fonds
www.isska.ch
t. +41 (0)31 431 15 11
f. +41 (0)32 913 35 53
e. info@isska.ch



VS – assessment of GW resources

KARSYS

Visual KARSYS

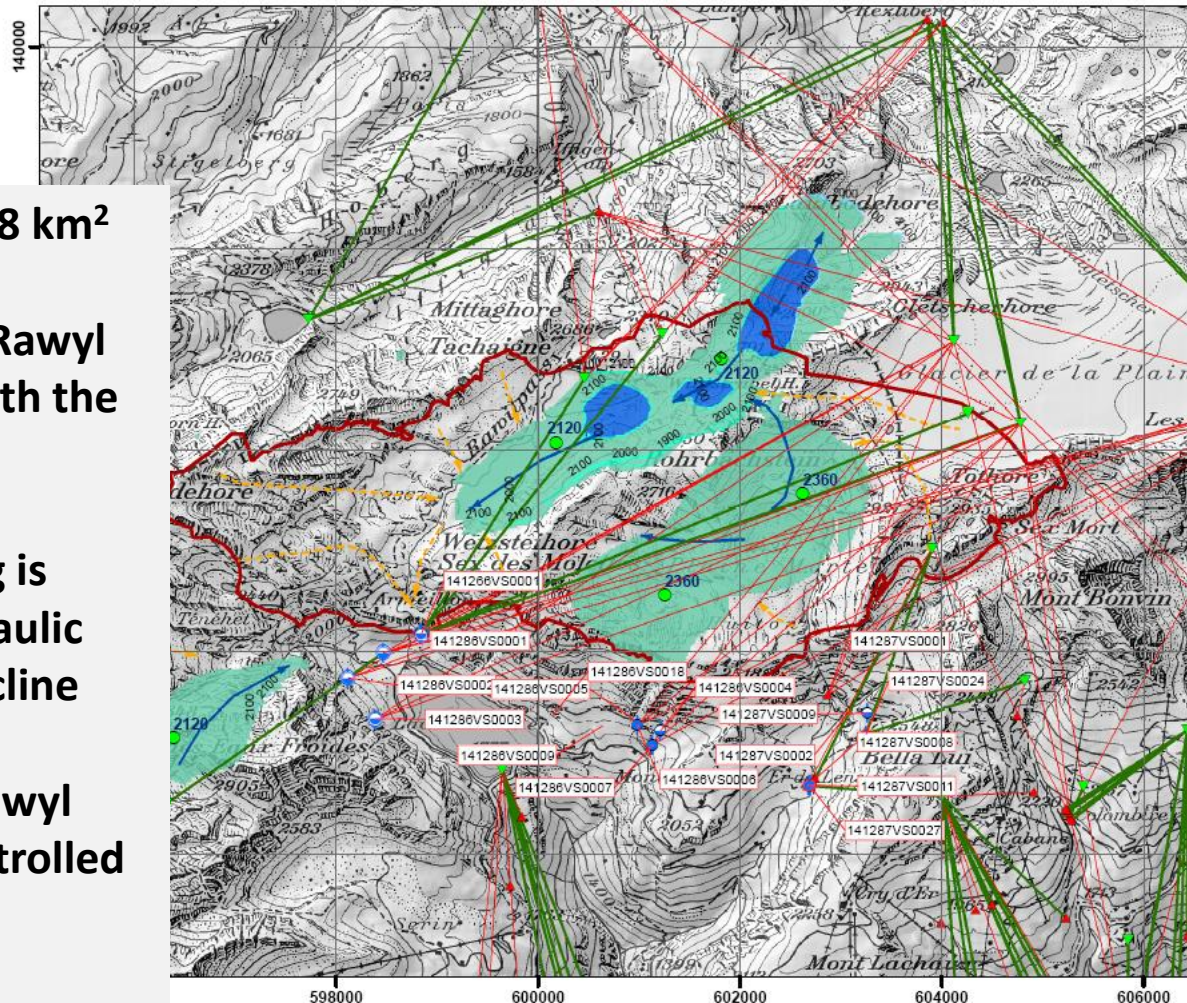
Perspectives

Conclusion

Carte des eaux souterraines : 211266VS0002 - Loquesse

Auteur : E. Weber / M. Luetscher
Date : 27.09.2019
Echelle : 1:55 000
0 0.5 1 2 Km

- 1) Catchment area of c. 18 km²
- 2) Saturated zone in the Rawyl syncline and underneath the Plaine Morte
- 3) Discharge at the spring is controlled by the hydraulic head in the Rawyl syncline
- 4) Recharge of the the Rawyl syncline is (partly) controlled by the drainage at the Weissshorlücke



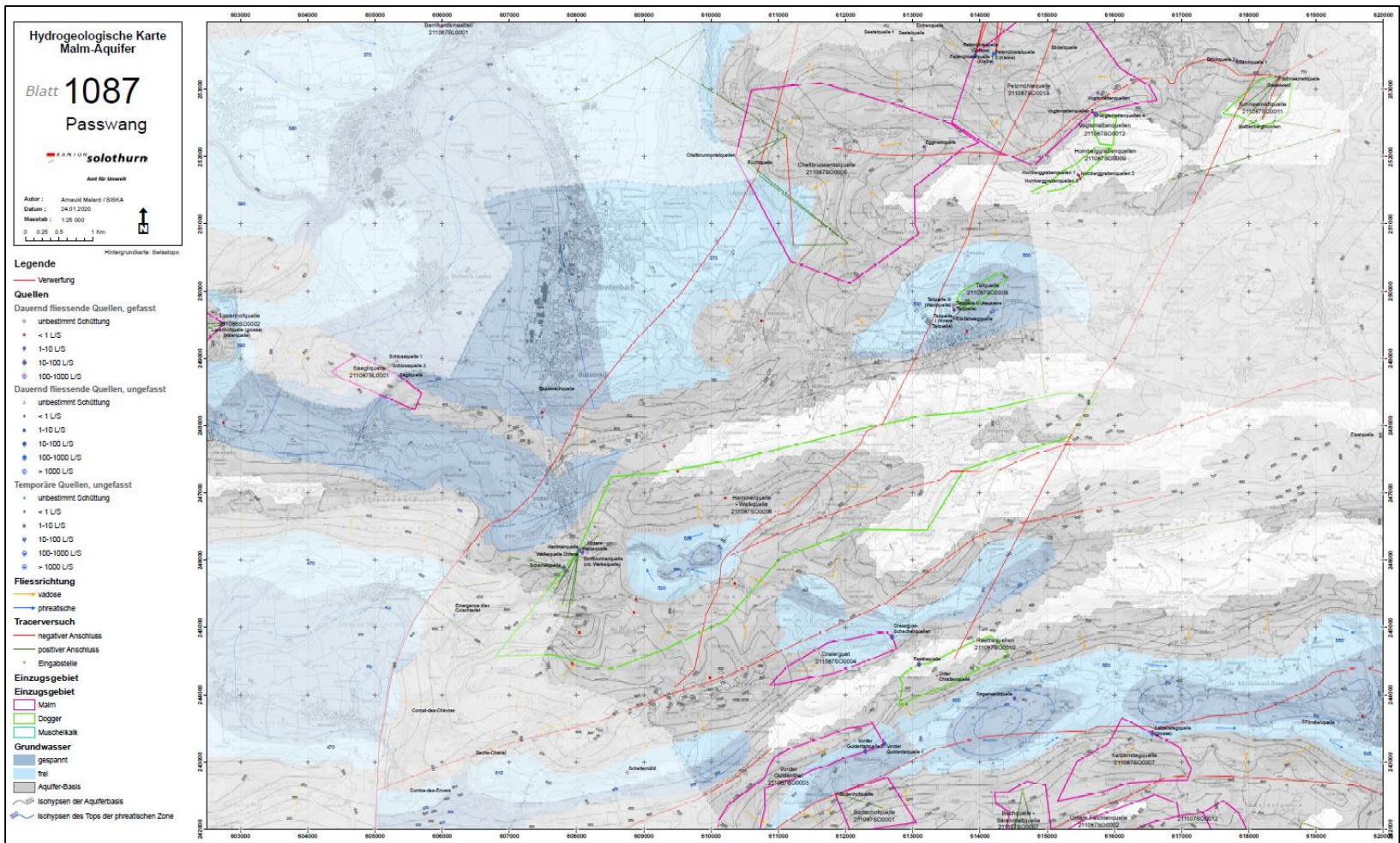
SO / VS – assessment of GW resources

KARSYS

Visual KARSYS

Perspectives

Conclusion



Karst hydrogeological map – 1/25'000

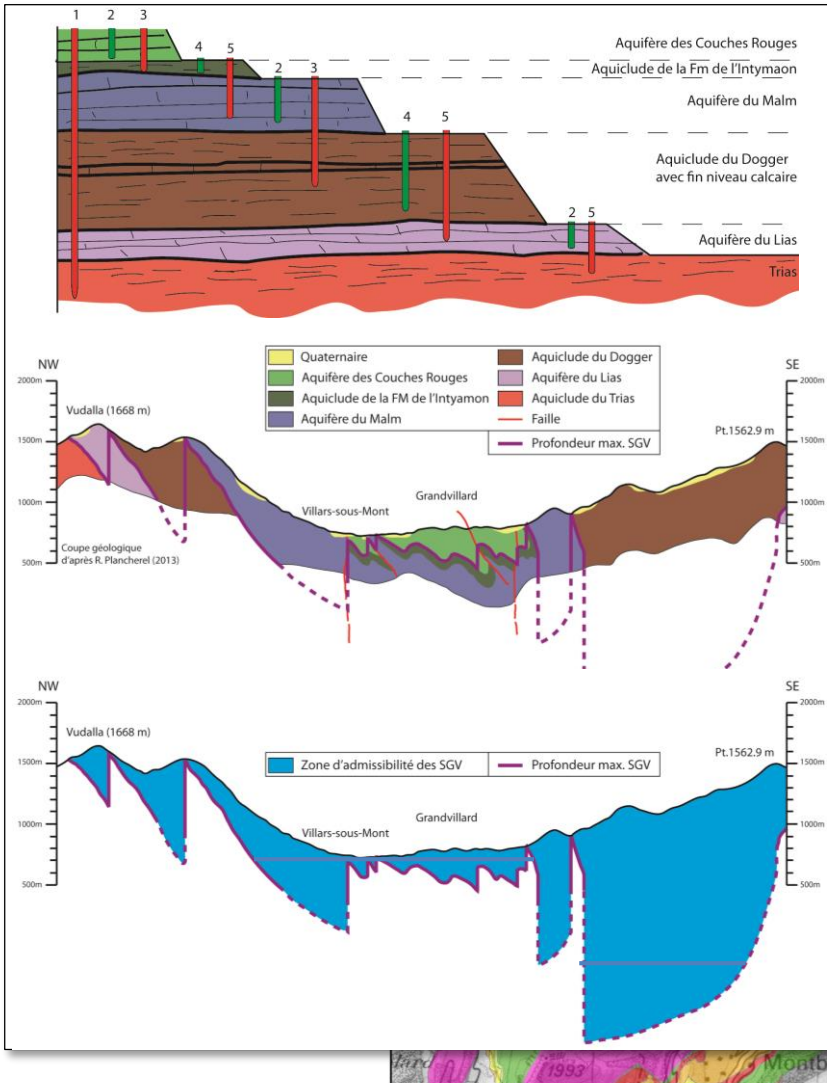
FR – admissibility for SVGs in karst

KARSYS

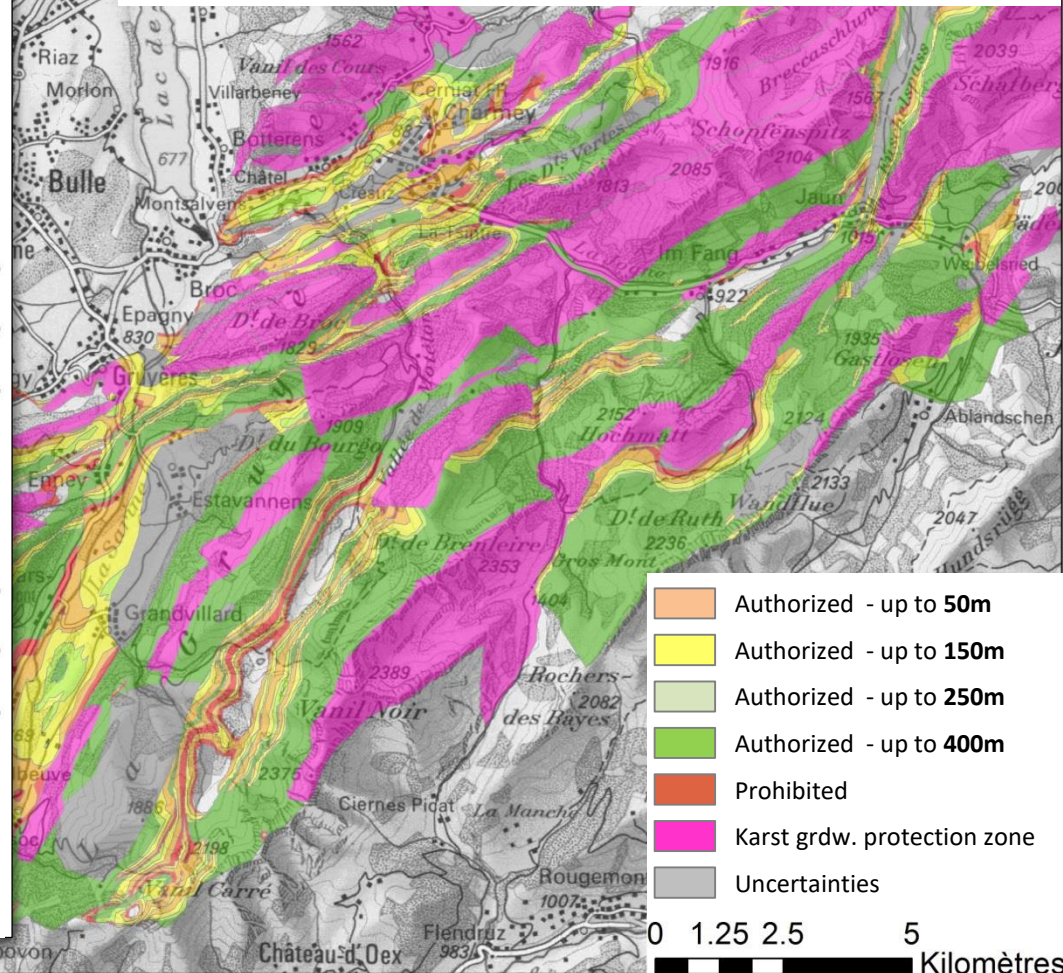
Visual KARSYS

Perspectives

Conclusion



Vertical heat pumps - admissibility karst map



NE – ground collapses hazard

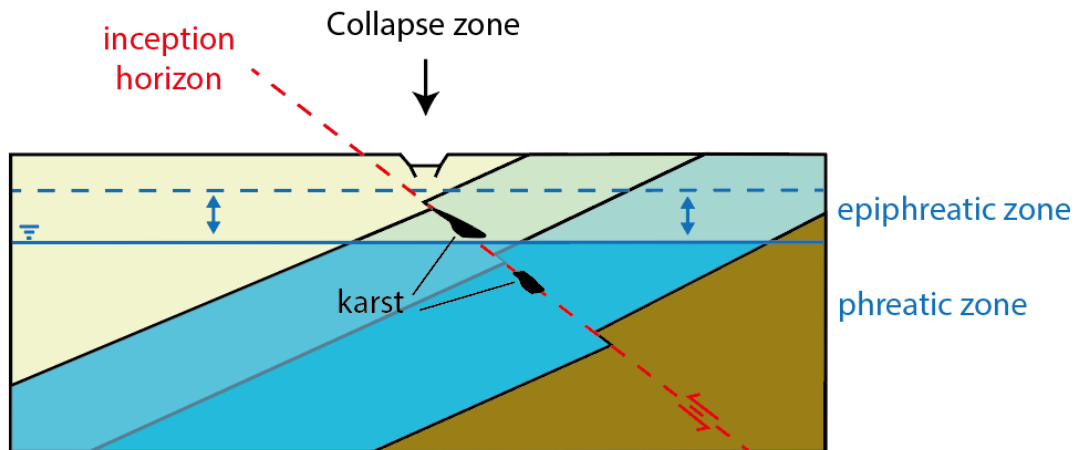
KARSYS

Visual KARSYS

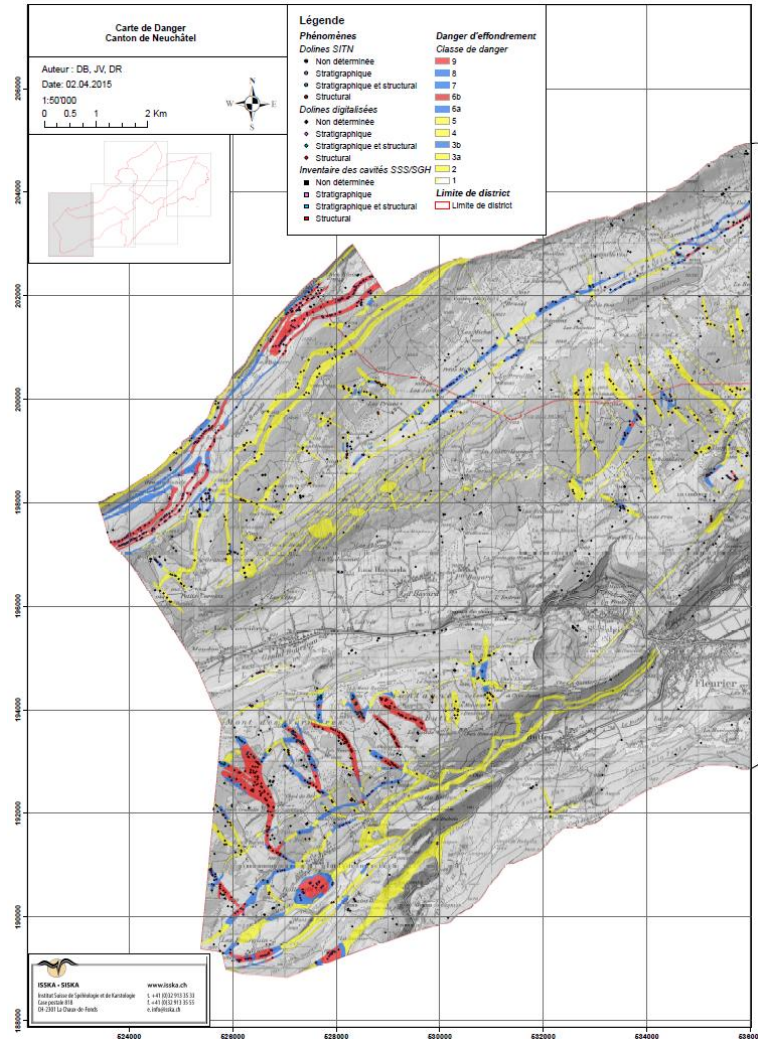
Perspectives

Conclusion

Principles:



Large scale application



Collapses hazard map

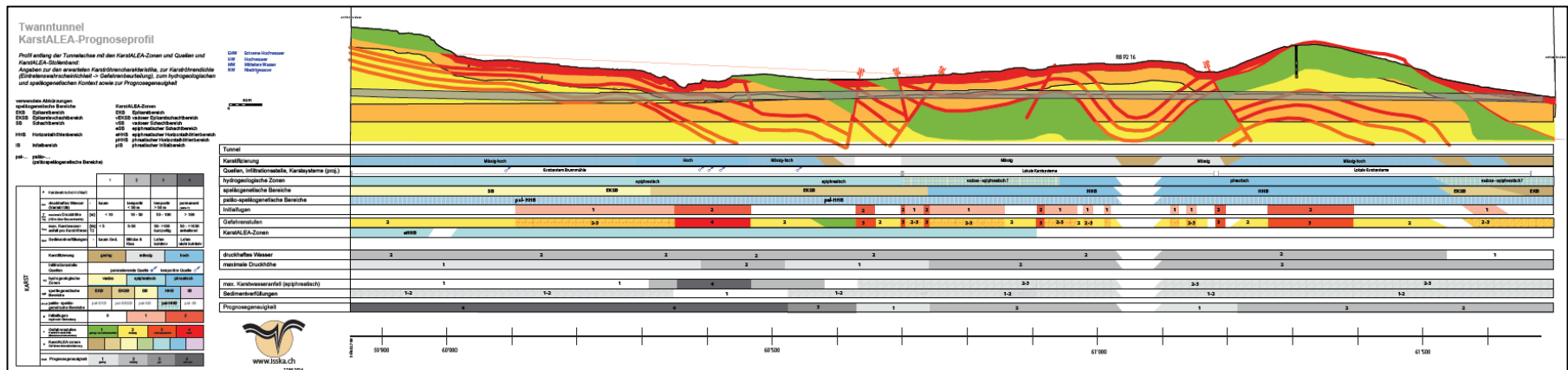
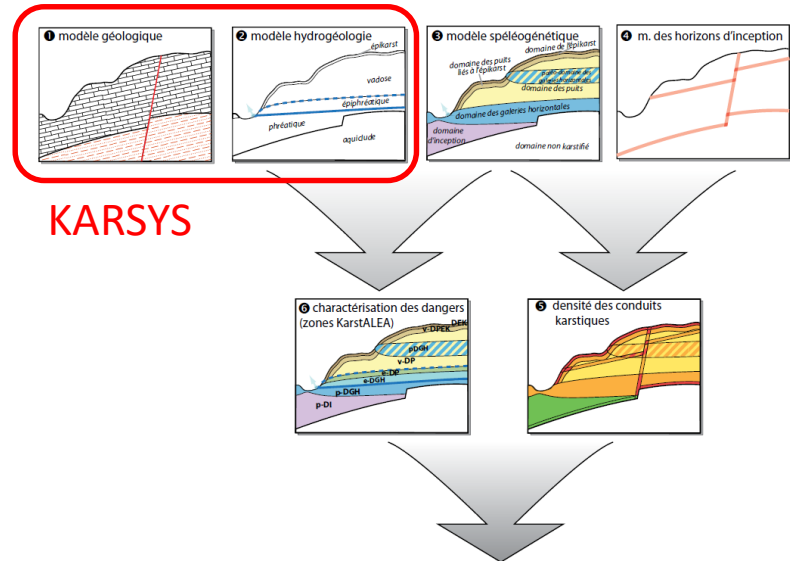
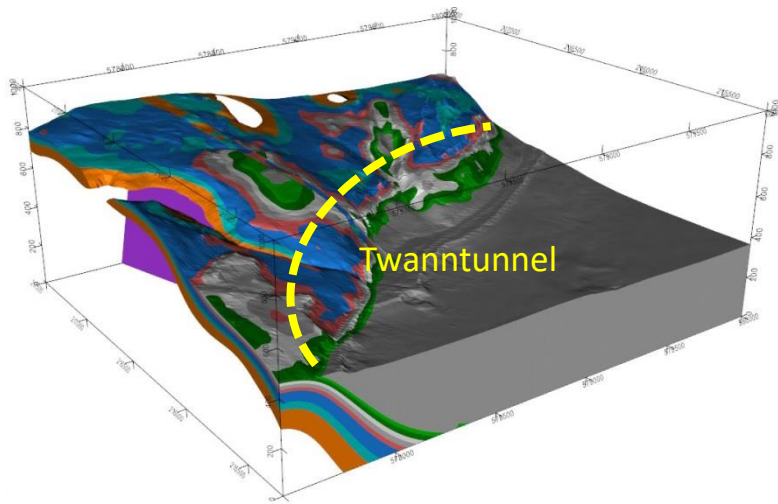
BE Karst hazards in undergr. constructions

KARSYS

Visual KARSYS

Perspectives

Conclusion



Profile of anticipated hazards due to the occurrence of karst

KARSYS – increase the dissemination

KARSYS

Visual KARSYS

Perspectives post 2019

Conclusion

A powerful approach!

- Various possible extensions
- Increasing demands in CH (KARSYS = recommended at national level)
- Increasing demands from abroad (Spain, Ireland, France, China, etc.) for applications & training

But limitations...

- Transfer of results and model updates = difficult
- Know-how only at SISKa (a few individuals)
- Training takes a long time
- CH costs to apply KARSYS abroad are dissuasive

Solution!

visual
KARSYS

Exploring karst aquifers
Managing groundwater resources

Try Visual KARSYS



Main principle of Visual KARSYS

KARSYS

Visual KARSYS

Perspectives

Conclusion



Development
& support



Modelers

- Geologists / hydrogeologists
- Private companies (civil engineering, power companies, industrial)
- Research & academics



End-users

- Administrations (federal offices, cantons, communities)
- Public water company
- NGOs, Apex org.

Extensions post 2019

Create a new project

KARSYS

Visual KARSYS

Perspectives

Conclusion



Visual KARSYS / Community-Portal

Community-Portal

MY LAST PROJECTS

Project Name	Visibility	Location
GaHOR Projet galerie Reunion Last modified: Jun 3, 2019	Private	
Brgm_test test project Last modified: May 9, 2019	Private	
test_srtm No Description Last modified: May 2, 2019	Private	
Aubonne_demo demo VK Last modified: Mar 14, 2019	Private	
Aub_zoom detail Aub-Tol-Mal Last modified: Mar 9, 2019	Private	

THE 5 LAST RELEASED PROJECTS

Project Name	Visibility	Location
GaHOR Projet galerie Reunion Last Modified: Jun 3, 2019	Private	
Brgm_test test project Last Modified: May 9, 2019	Private	
test_srtm No Description Last Modified: May 2, 2019	Private	

Create a new project

Name* TEST

Description TEST

Project Visibility

☒ Public
Everyone can see this project.

☐ Private
Only you and users with explicit permissions can see this project.

Create Cancel

Search projects

Map showing project locations across various countries including Brazil, India, and South Africa.

Shared map of projects

Setup

KARSYS

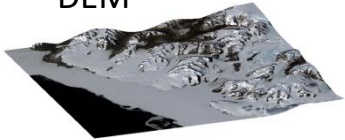
Visual KARSYS

Perspectives

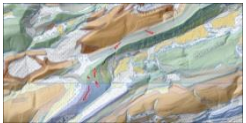
Conclusion



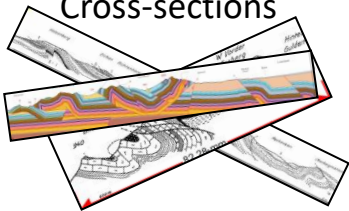
DEM



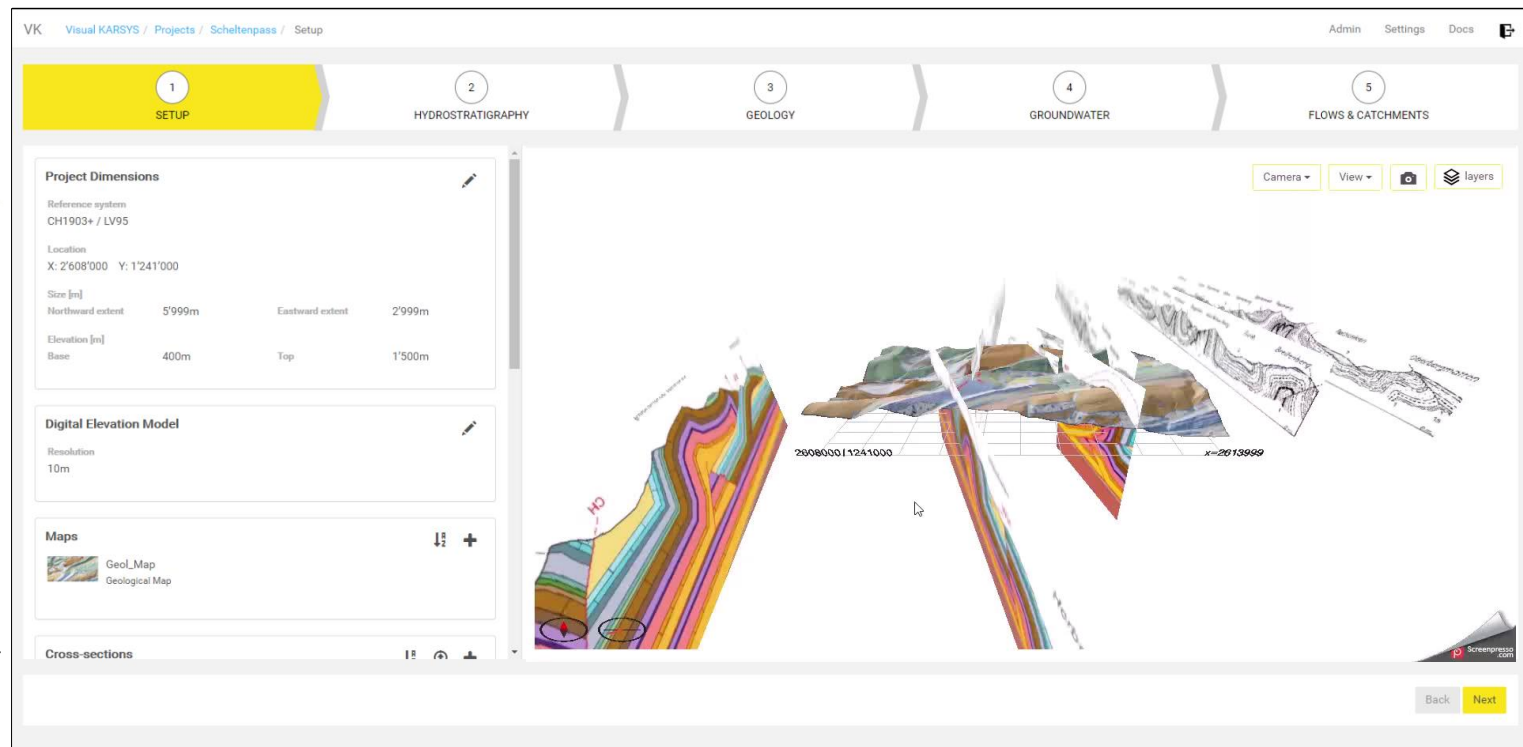
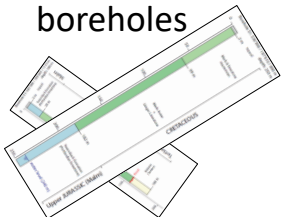
map



Cross-sections



boreholes



Project setup + data in 3D

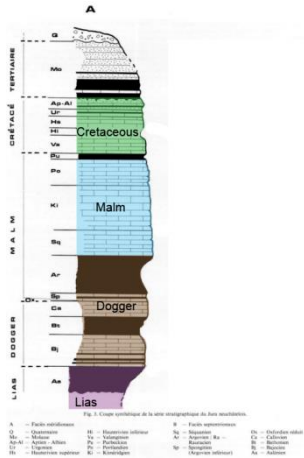
Hydrostratigraphy

KARSYS

Visual KARSYS

Perspectives

Conclusion



VK Visual KARSYS / Projects / Scheltenpass / Hydrostratigraphy

Admin Settings Docs

1 SETUP 2 HYDROSTRATIGRAPHY 3 GEOLOGY 4 GROUNDWATER 5 FLOWS & CATCHMENTS

Edit Unit Malm

Name*
Malm

Permeability*
karstified

Porosity [0% - 100%]*
1

Comments
Comments

Save

Move To:
Chose new Parent

Series	[onlap]
Molasse	non-karstified
Malm	karstified
Effingen	non-karstified
Hauptrogenstein	karstified
Unterer_Dogger	non-karstified
Lias	non-karstified
Trias	karstified

Back Next

Create and manage hydrostrat. units

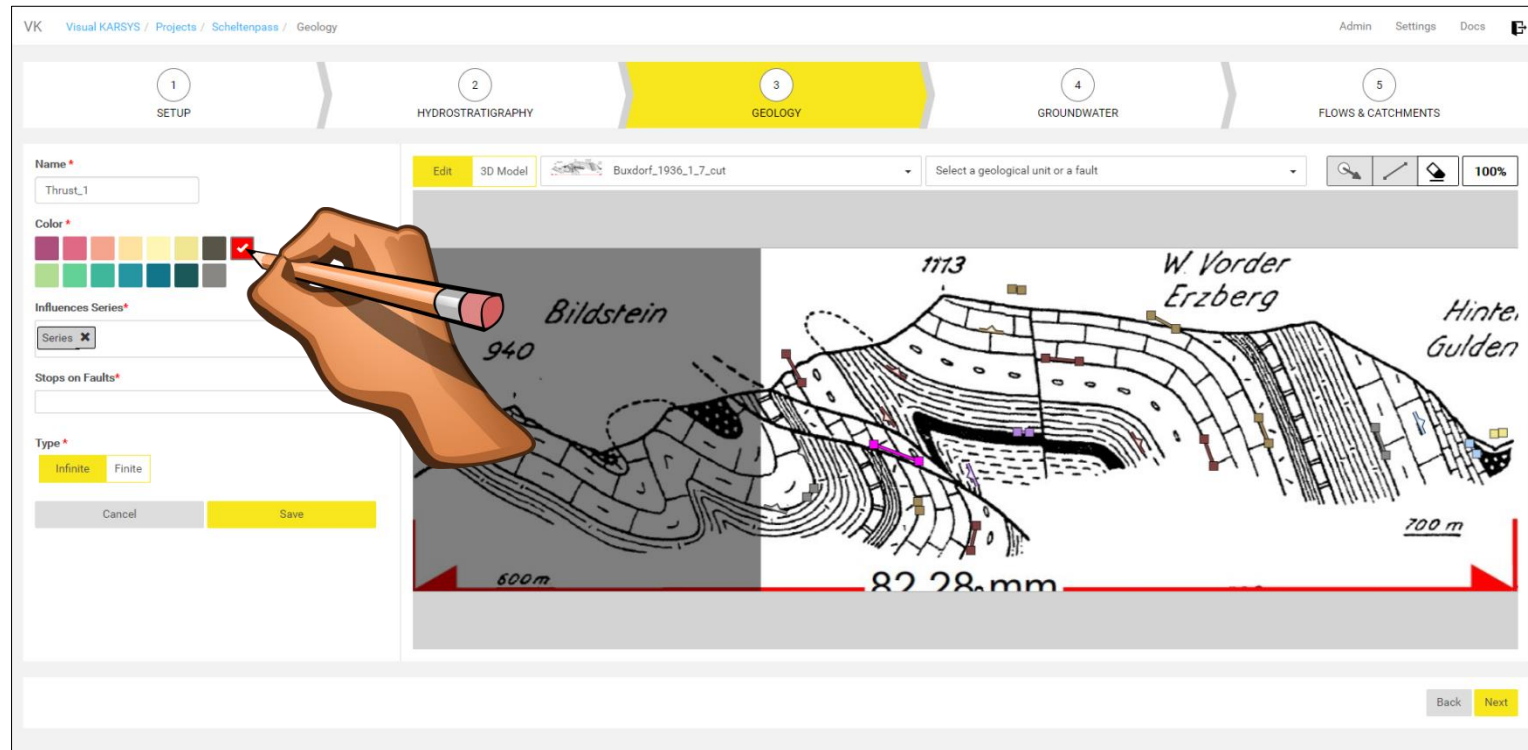
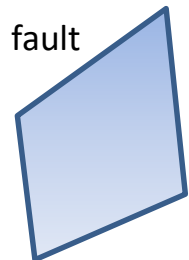
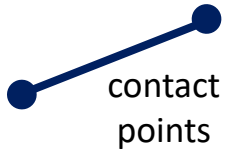
Geology

KARSYS

Visual KARSYS

Perspectives

Conclusion



Build the 3D geological model (GmLIB, col. Brgm)

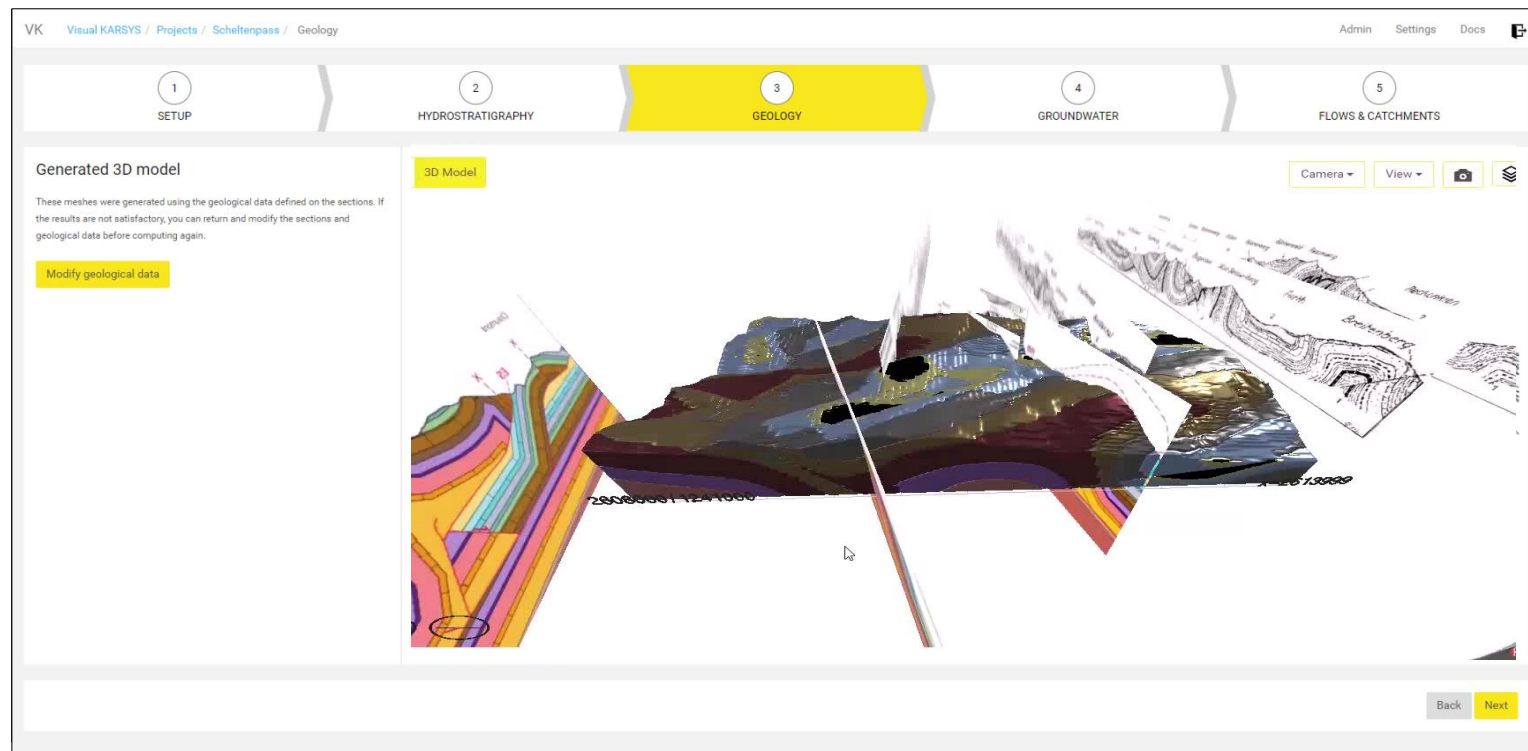
Geology

KARSYS

Visual KARSYS

Perspectives

Conclusion



Compute 3D meshes

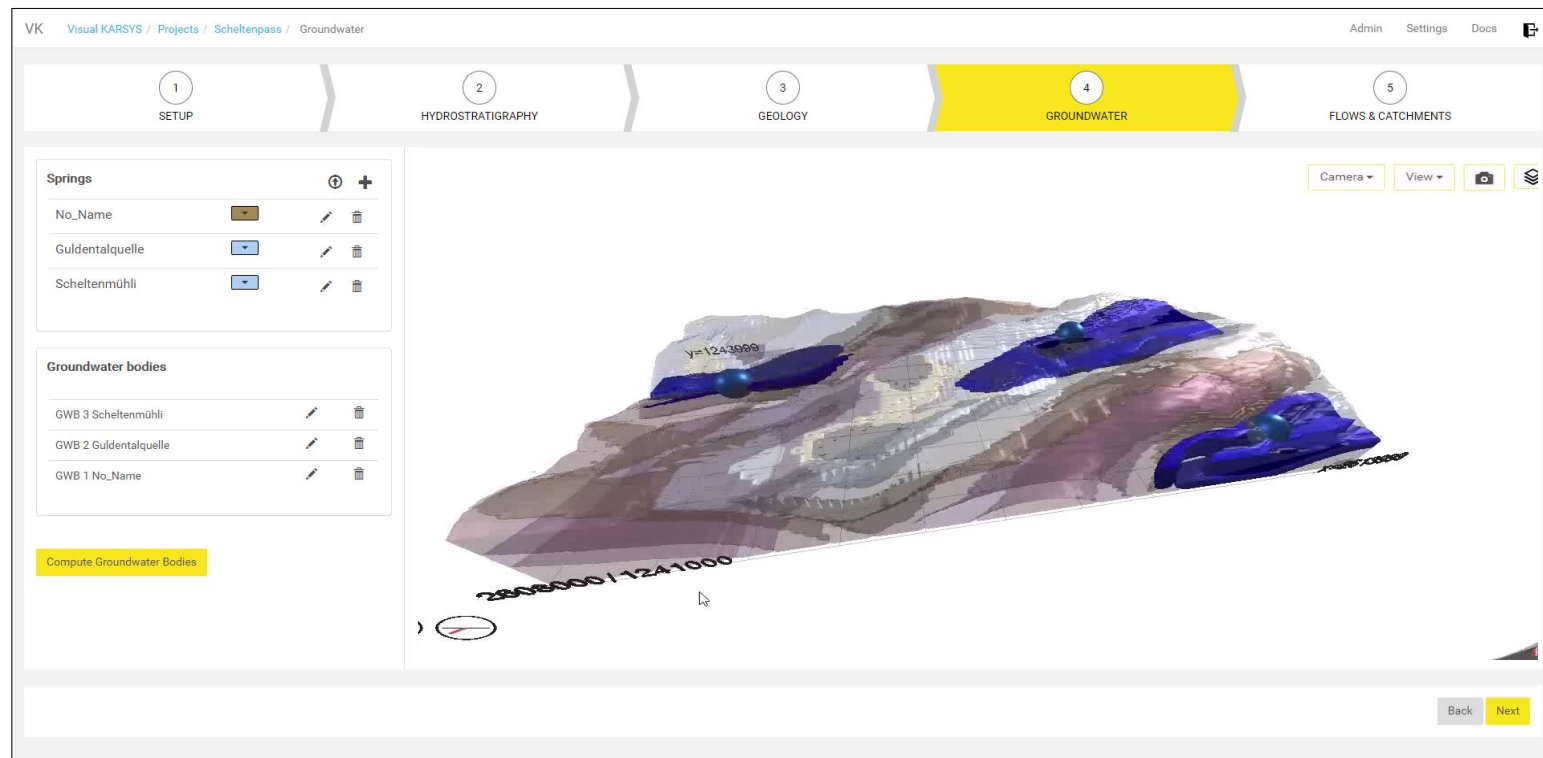
Groundwater

KARSYS

Visual KARSYS

Perspectives

Conclusion



Compute GW bodies (phreatic zones) in 3D

Flows & Catchments

KARSYS

Visual KARSYS

Perspectives

Conclusion



GW flow lines + catchments

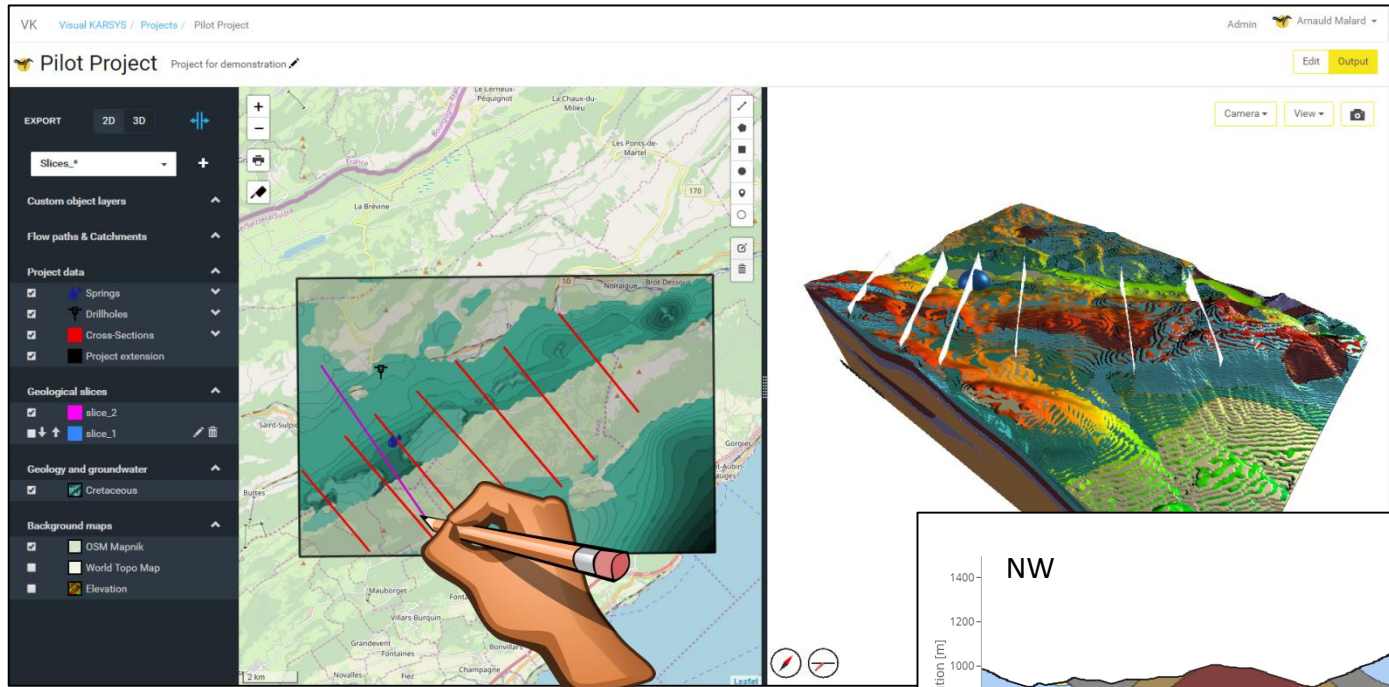
Output page – display and organize

KARSYS

Visual KARSYS

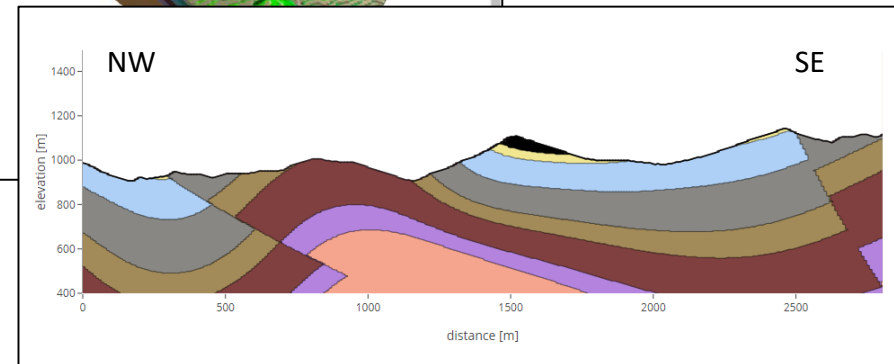
Perspectives

Conclusion



Deliver results to your customers

- Retrieve all informations in 2D / 3D
- Create cross sections
- Display geological layers
- Create groundwater layers



Output page - exports

KARSYS

Visual KARSYS

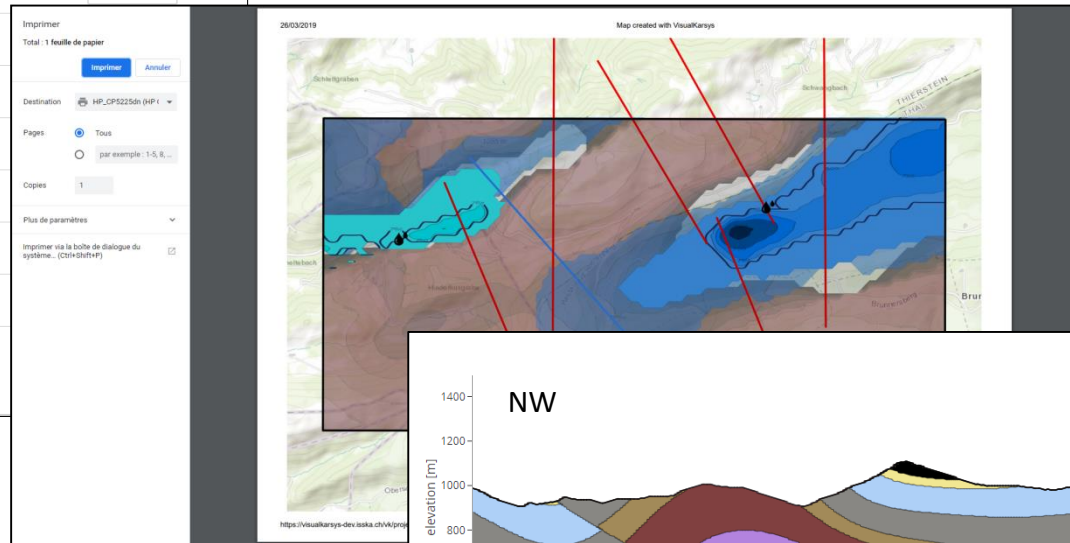
Perspectives

Conclusion

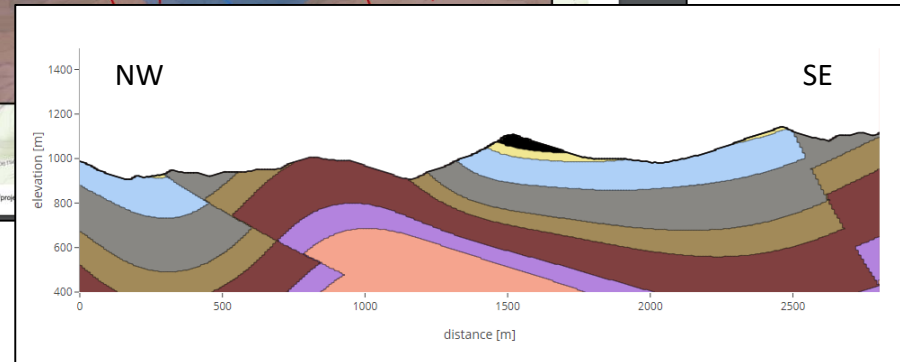


DATA MANAGER			
Cross Sections ▾	Export as ▾		
Springs			
Drillholes			
Cross Sections	Base elevation	Top elevation	Image
Maps	0	1500	Download
Geological Meshes	0	1500	Download
Groundwater Body Meshes			
Buxdorf_1936_3_cut	0	1500	
Buxdorf_1936_1_7_cut	600	1225	
Buxdorf_1936_1_5_cut	600	1225	
Buxdorf_1936_5_cut	-1000	1500	
Balsthal_5_cut	-1000	1500	
Balsthal_3_cut	-1000	1500	
Buxdorf_1936_4_cut	0	1500	

Export data
(xls, shp, pdf)



Print maps



Print cross-sections

Permissions

KARSYS

Visual KARSYS

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Conclusion

The screenshot displays the Visual KARSYS software interface. At the top, a navigation bar includes 'VK', 'Visual KARSYS / Projects / Scheltenpass', and user options 'Admin', 'Settings', and 'Docs'. The main header shows the project name 'Scheltenpass' and location 'Solothurn'. A 'Modeler' user, represented by a circular avatar of a man in an orange shirt, is shown on the left. A 'Permissions' dialog box is open in the center, showing 'Public' permissions selected. The dialog text indicates that 'Everyone can see this project' and lists two contributors: 'PYJeannin' and 'philipp.ha...', both with 'Contributor' roles. A note '(even for non-karst areas)' is overlaid on the dialog. On the right, an 'End-user' is shown with a circular avatar of a man in a blue shirt. The background shows a map view with various layers like 'DEM', 'Map', and 'Geol_Map'.

Share your project with authorized users

DEMO

www.visualkarsys.com

Why using Visual KARSY? → Concrete outcomes

KARSYS

Visual KARSYS

Perspectives

Conclusion

- To organize / archive your data in 3D
- To understand complex flows in karst aquifer
(flow divergences, transfers between aquifer compartments,...)
- To delineate protection zones in a reproducible approach
- To maximize the use of 3D geol. Model and identify spatial inconsistencies (even in non-karst areas)
- To disseminate your work (collaborators, customers)
- To provide continuously updated information
- End-users can benefit and organize results / infos as they want

⇒ **Hydrogeological studies**

⇒ **Support for decision makers**

⇒ **Communication tool for stakeholders**

Ongoing improvements 2020

KARSYS

Visual KARSYS

Perspectives

Conclusion

- Increase the resolution of 3D meshes
- Assign geological data to drillholes
- Assign hydrological data to drillholes (hydr. Heads, variations, etc.)
- Enable versioning
- Make possible to build complex GWB
- Add custom objects in 3D scene for geological vizualisation (tunnels, underground works, dams, etc.)

Perspectives for extensions

KARSYS

Visual KARSYS

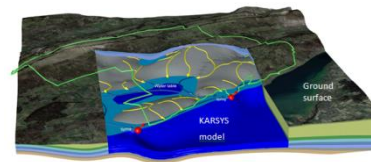
Perspectives

Conclusion

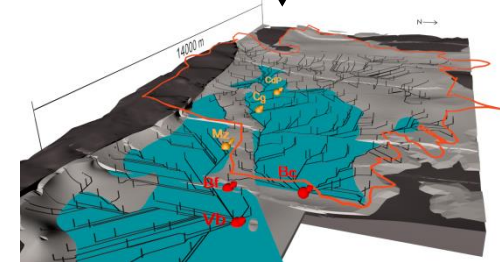
Karst extensions

- Conduits generating
- Flow simulation
- Decision-support tools
 - KarstALEA (assessment for underground works)
 - Hazards assessment (floods, collapses)
 - Land planning tools (infiltration, etc.)
 - Vulnerability (EPIK), S zones, etc.

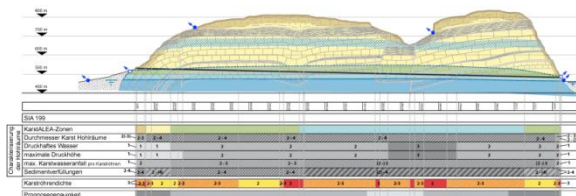
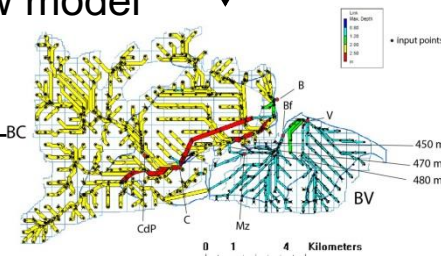
KARSYS model



Conduits
generating



Hydraulic Flow model



Decision-support tools

Perspectives for extensions

KARSYS

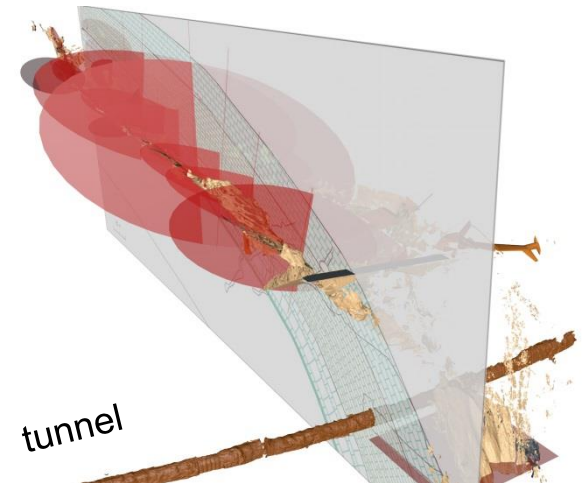
Visual KARSYS

Perspectives

Conclusion

Extensions for other environments / applications

- Volcanic, glaciers hydrology, highly fractured media, porous, etc.
- Tunneling, dams, underground works (BIM), etc.
- Geothermal energy
- Geological data acquisition, models versioning, uncertainties assessment, etc.



Interested? → We are looking for technical and funding partners!



Thank you for your attention

[www. visualkarsys.com](http://www.visualkarsys.com)



Sign in!