

Short course KARSYS: applied and innovative methods for the management of karst environment

Date / place: Sunday 22nd September, 2019 / Malaga, Spain

Instructors: Dr. Pierre-Yves Jeannin, Dr. Arnaud Malard (ISSKA, CH).

This workshop is dedicated to the learning of the KARSYS approach through an application on a pilot site by using the Visual KARSYS web-service which is under development (<https://visualkarsys.isska.ch/>). Participants will be introduced in theoretical aspects of the approach and in the practical process of its application.

KARSYS is developed for hydrogeologists working in karst regions, in order to address hydrogeological questions in a very pragmatic and concrete way. KARSYS makes it possible to build an explicit conceptual model (3D image) of the karst aquifers and of the associated flow systems. The approach is based on a 3D model of the aquifer synthesizing all standard geological and hydrological data and coupling a series of simple hydraulic principles. This provides, within a limited effort, a consistent hydrogeological conceptual model of karst flow systems within any investigation area. The course is designed for hydrogeologists with basic knowledge on karst, hydrogeology and 3D modelling. Any professional interested in groundwater management, engineering, renewable energies in karst environments will gain a good understanding of karst hydrogeology and a pragmatic way to assess karst hydrogeological systems.

The course will be extended further with an introduction to KarstALEA method, which has been developed for predicting the position and characteristics of karst occurrences within a massif. KarstALEA was initially designed for tunneling, but can be applied to any kind of underground construction in karst areas. At last, an outlook to flow simulation procedures based on KARSYS (KarstFlowSIM) will be presented.

KarstALEA and KarstFlowSIM are both extensions of KARSYS, providing *de facto* a consistent and continuous workflow in karst to address pragmatic issues.

Key-words: Karst hydrogeology, Conceptual model, 3D, Water management, KARSYS, KarstALEA, Visual KARSYS, KarstFlowSIM



Short course agenda:

09:00 – start of the course

Introduction to the KARSYS approach

10:30 – 11:00 – break

Introduction to Visual KARSYS (<https://visualkarsys.isska.ch/>):

- Presentation of the web-tool
- Creation of user's account
- Application on a pilot site
 - o Data integration
 - o 3D-geological modelling

Lunch break (12:30 – 13:30)

13:30 – return to course

Application on a pilot site (continuation)

- 3D sketch of the flow system and catchment delineation
- Overview of the output page
- Discussion of the results

15:00 – 15:30 – break

Introduction to the extensions to KARSYS (overview):

- KarstALEA: a pragmatic method for the assessment of karst-related hazards in underground construction
- KarstFlowSIM: recharge and hydraulic flow simulations in karst aquifers based on KARSYS model

17:00 – end of the course



About Instructors:

Pierre-Yves Jeannin (SISKA), Ph.D., is hydrogeologist, Director of the Swiss Institute for Speleology and Karst-Studies and Invited lecturer and researcher at Centre d'hydrogéologie (Univ. Neuchâtel). He is a researcher on karst hydrogeology since 1988 and closely supervised several PhD-theses related to the understanding and modelling of flow and mass transport in karst systems. He also took part to the development of methods for the evaluation of the vulnerability of karst groundwater (EPIK and VULK). Pierre-Yves supervised several research projects on the infiltration of water in karst regions, showing the very important role of the soils and the epikarst (weathered zone at the top of limestone) for absorption, temporary storage and the self-purification of water. In 2009, he successfully submitted the Swisskarst project to the Swiss National Science Foundation on the sustainable management of water (PNR61). The KARSYS approach developed in this project induces a high degree of interest among the water community because it provides an explicit 3D conceptual model of karst hydrogeological systems.

Arnauld Malard (SISKA), Ph.D., is scientific collaborator since 2011 and specialist for 3D modelling and flow simulation. He works as hydrogeologist for 15 years in different public offices and private companies in France and overseas department. He is member of the French geological society and responsible for several publications in karst and volcanic aquifers. Arnauld Malard was the main actor for the development of KARSYS in the frame of the Swisskarst project (2011-2013). He is now in charge of the implementation of Visual KARSYS (2016-2019) and on the development of extensions to KARSYS, mainly regarding hydrogeological mapping principles and flow-simulation modules.