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SWISSKARST Project - how to document the karst aquifers in Switzerland using the KARSYS approach.

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Swiss karst aquifers are poorly documented although they represent a resource estimated to around 120 km3 of fresh water - which is comparable to the water volume of all Swiss lakes. Within the framework of the Swiss National Research Program 61 an opportunity was given to develop a systematic way to characterize karst aquifers and to describe their hydrological behaviour. The project aims at providing methodologies or guidelines to approach karst systems and to improve their management. This covers a large range of fields such as water supply, civil engineering, renewable energies, natural hazards, etc. In this context SISKA developed a dedicated approach named KARSYS for KARst SYStems characterization. It is based on iterations of 3D geological models combined with some basic hydraulic principles taking place in karst media. The main principles are: (i) The 3D geometry of the aquifer set the framework in which flow processes take place (ii) Aquifers are flooded below the level of the main perennial springs (iii) The expansion of the water table upstream of the main springs is lower than 1% (low water stage). High water gradients are simulated according to the elevation of temporary springs or observations in existing boreholes or caves. The approach explicitly shows through 3D visual that some groundwater bodies may be separated at low water stage and connected at high water. Such 3D views bring often explanations to the interpretation of “strange” or “not repeatable” dye tracer’s results. A major input of KARSYS approach is to provide a systematic construction of a conceptual model for all hydrological karst systems. It also considers interactions between adjacent systems, providing new concepts on the delineation of karst systems. KARSYS approach can be applied in a quick and approximate way and improved along in order to reach a precision according to the question to be addressed.
Results of KARSYS applications are: (i) The delineation of catchment areas of the considered karst system including sub-area units, which are diffluent or not (ii) the delineation of the extension of the karst water bodies inside carbonate formations including their confined or unconfined parts and (iii) a sketch of the main groundwater flowpaths including an indication of their vadose or phreatic properties, (iv) An assessment of the volume of the groundwater resources according to the local porosity value. A new concept of hydrogeological karst map has been then developed in order to depict characteristics derived from the KARSYS approach.
It is expected to cover all major karst systems in Switzerland (∼200 systems) until 2015. Results are progressively available on www.swisskarst.ch. Several projects are already derived from these results in various domains such as the evaluation of karst hydropower potential or the prediction of natural hazards (flooding) by karst inundations.
The KARSYS approach is really effective for the sustainable management of karst waters, and is a very useful base for any further hydrogeological study in a karst region such as flow modelling, impact assessment of global change on resources or the delineation of groundwater protection areas.