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Management of groundwater quantities based on numerical flow models

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Well-known fact is, that Slovenia is rich with fresh water, of which groundwater is the main source of drinking water. About 97% of drinking water comes from the aquifers; the rest comes from the surface waters and a negligible proportion from rainwater. Most of the drinking water is supplied to the inhabitants from the public water systems (85%), the rest are private wells and rainwater reservoirs. In the year 2016, 3,700 million cubic meters of available groundwater correspond to 1,800 cubic meters of available groundwater per capita of Slovenia and represents about 5% of abstracted groundwater. In general, 47% of the total drinking water supply is used for households, industrial use represents 39%, agriculture 8%, tourism 5% and other applications 1%. Despite the water abundance, locally, the availability of groundwater varies widely. Groundwater abstraction is highest in shallow alluvial aquifers (porous aquifers represents about half of groundwater resources in Slovenia, other half are karstic and fissured aquifers), where urban areas co-exists with agricultural areas and natural areas. Here, the groundwater abstraction for public water supply is accompanied with other water uses, mainly with industrial use and irrigation. Recently, available climate change analysis for Slovenia suggests caution when issuing water permits for groundwater. Sustainable groundwater management is therefore crucial and means co-ordination of interests and rights of those that already abstract groundwater and those who would like to abstract groundwater in the future. The granting of water rights through water permits and concessions is the responsibility of the Ministry of the Environment and Spatial Planning and Slovenian Water Agency. To help those decision makers in groundwater rights licensing, a complex decision support system, based on numerical groundwater modeling, has been set up.
Numerical groundwater flow modeling has long tradition in Slovenia, which began in the seventies of the last century. First, the numerical groundwater modeling supported “stand-alone” studies to simulate and predict aquifer conditions. In last decade groundwater management become crucial therefore a complex decision support system (DSS) was set up with linking the results of numerical groundwater flow models with the water permits and concessions databases in order to help groundwater managers in the decision process of water rights licensing. The DSS is operational for six shallow alluvial aquifers with significant abstraction pressures. Groundwater models have the main role in the system, since they define groundwater reserves for a given aquifer and quantity of groundwater for water rights licensing. The system enables that the water quantity data from water permits and concessions in conjunction with the results of numerical groundwater modelling are used in the managing process of granting water rights to users in terms of their long-term access to groundwater (sufficient quantity of groundwater) and in relation to the water rights of other users (co-impact of groundwater pumping). In addition, groundwater abstraction must be managed in such a way that it does not cause unacceptable local impacts (pumping must not lower the water level for more than 2/3 of water body in the medium-low hydrological conditions).