Geophysical Research Abstracts
Vol. 18, EGU2016-4226-2, 2016
EGU General Assembly 2016


# Classification as a generic tool for characterising status and changes of regional scale groundwater systems

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Regional hydrogeology is becoming increasingly important, but at the same time, scientifically sound, universal solutions for typical groundwater problems encountered on the regional scale are hard to find. While managers, decision-makers and state agencies operating on regional and national levels have always shown a strong interest in regional scale hydrogeology, researchers from academia tend to avoid the subject, focusing instead on local scales. Additionally, hydrogeology has always had a tendency to regard every problem as unique to its own site- and problem-specific context. Regional scale hydrogeology is therefore pragmatic rather than aiming at developing generic methodology (Barthel, 2014; Barthel and Banzhaf, 2016).

One of the main challenges encountered on the regional scale in hydrogeology is the extreme heterogeneity that generally increases with the size of the studied area - paired with relative data scarcity. Even in well-monitored regions of the world, groundwater observations are usually clustered, leaving large areas without any direct data. However, there are many good reasons for assessing the status and predicting the behavior of groundwater systems under conditions of global change even for those areas and aquifers without observations. This is typically done by using rather coarsely discretized and / or poorly parameterized numerical models, or by using very simplistic conceptual hydrological models that do not take into account the complex three-dimensional geological setup. Numerical models heavily rely on local data and are resource-demanding. Conceptual hydrological models only deliver reliable information on groundwater if the geology is extremely simple.

In this contribution, we present an approach to derive statistically relevant information for un-monitored areas, making use of existing information from similar localities that are or have been monitored. The approach combines site-specific knowledge with conceptual assumptions on the behavior of groundwater systems. It is based on the hypothesis that similar groundwater systems respond similarly to similar impacts. At its core is the classification of (i) static hydrogeological characteristics (such as aquifer geometry and hydraulic properties), (ii) dynamic changes of the boundary conditions (such as recharge, water levels in surface waters), and (iii) dynamic groundwater system responses (groundwater head and chemical parameters). The dependencies of system responses on explanatory variables are used to map knowledge from observed locations to areas without measurements. Classification of static and dynamic system features combined with information about known system properties and their dependencies provide insight into system behavior that cannot be directly derived through the analysis of raw data. Classification and dependency analysis could finally lead to a new framework for groundwater system assessment on the regional scale as a replacement or supplement to numerical groundwater models and catchment scale hydrological models. This contribution focusses on the main hydrogeological concepts underlying the approach while another EGU contribution (Haaf and Barthel, 2016) explains the methodologies used to classify groundwater systems.

References:
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