MODELLING GROUNDWATER FLOW IN CARBONATE RIDGES: THE CASE OF M. PAGANUCCIO AND CESANE (ITALY)

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In carbonate aquifers, the complex geological structures is reflected in the heterogeneous nature of groundwater fluxes, which is mainly driven by the fractures and conduits orientation and aperture. Here, the elevated cost of drilling wells in mountain areas suggests that geological and geomechanical surveys are cost effective tools to qualitatively solve groundwater directions in upland catchments. In addition, numerical modelling can help to quantitatively constrain the hydrogeological conceptual models of these aquifers. The aim of the study is to propose an integrated approach that combines the classical hydrogeological characterization by means of recharge estimates, spring and streams base flow discharge, hydraulic conductivity estimates from geomechanical surveys in well defined hydrogeological basins, with a three dimensional steady state flow model using MODFLOW-2005 in a MODEL MUSE environment (Winton 2009). This methodology aims to highlight the limitations of various modelling approaches, like the vertical/horizontal anisotropy in an equivalent porous medium or the conduit flow process (Hill et al. 2010) in fractured aquifers characterized by groundwater data paucity. The M. Paganuccio and Cesane (IT) carbonate ridges were selected as representative case studies due to their well-bounded hydrogeological basins. The results show that the application of the proposed approach to the study areas was able to highlight the weaknesses of each numerical approach. At the same time, this study shows that the comparison between different modelling approaches can provide constraints to the uncertainties related to highly sensitive parameters like hydraulic conductivity and recharge rate. This was established by comparing the long-term hydrogeological budget of each basin with the model output using the Zone Budget package and stream discharge measurement along the model domain.

References

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Winston RB (2009) ModelMuse: a graphical user interface for MODFLOW-2005 and PHAST. US Geological Survey Techniques and Methods 6-A29, 52 pp.