Reply to Referee #1

We appreciate the constructive comments and suggestions from Referee #1. We have addressed the comments in our revised manuscript as described in the following.

Comments from Referee #1:

1) The authors describe a dual system of porosity when most researchers in karst describe a triple porosity system (matrix, fractures, conduits). This difference needs to be addressed.

Response: In the literature, both dual and triple porosity concepts of karst systems exist. We have addressed this case in the revised manuscript as follows:

'Groundwater flow in karst aquifers can be conceptualized by a dual flow system: water flows in pipe-like conduits and open cave stream channels (conduit flow system) as well as flow through fractures and pores (diffuse flow system). This dual flow concept is described in the literature and widely used in karst studies (e.g., Shuster and White, 1971; Atkinson, 1977; White, 1988; Kiraly, 1998; Ford and Williams, 2007). Other researchers use a triple porosity concept for the description of karst aquifers, where groundwater flow is attributed to conduits, pores of the rock matrix and an intermediate flow system representing fissures and joints (e.g., Worthington et al., 2000; Baedke and Krothe, 2001). In the conceptual model of the present study, the simpler dual porosity concept is used, which is well suited to describe the nitrate characteristics of the observed karst springs.'

The new passage has replaced the sentence 'Karst groundwater systems are characterised by a duality of flow: slow flow along with large storage occurs in the rock matrix (diffuse flow system), while fast flow along with low storage occurs in fractures (fracture flow system) and solutionally enlarged conduits (conduit flow system) (Atkinson, 1977; Bakalowicz, 2005).'.

References used:

Atkinson, T.: Diffuse flow and conduit flow in limestone terrain in the Mendip Hills, Somerset (Great Britain), J. Hydrol., 35, 93-110, 1977.

Baedke, S., and Krothe, N.: Derivation of effective hydraulic parameters of a karst aquifer from discharge hydrograph analysis, Water Resour. Res., 37, 13-19, 2001.

Ford, D. C., and Williams, P. W.: Karst hydrogeology and geomorphology, John Wiley & Sons, 2007.

Kiraly, L.: Modelling karst aquifers by the combined discrete channel and continuum approach, Bulletin d'Hydrogéologie, 16, 77-98, 1998.

Shuster, E. T., and White, W. B.: Seasonal fluctuations in the chemistry of lime-stone springs: A possible means for characterizing carbonate aquifers, J. Hydrol., 14, 93-128, http://dx.doi.org/10.1016/0022-1694(71)90001-1, 1971.

White, W. B.: Geomorphology and hydrology of karst terrains, Oxford university press New York, 1988.

Worthington, S. R., Ford, D. C., and Beddows, P. A.: Porosity and permeability enhancement in unconfined carbonate aquifers as a result of dissolution, Speleogenesis Evolution of Karst Aquifers: Huntsville, Alabama, National Speleological Society, Inc, 463-472, 2000.

2) Dye tracing is mentioned on page 4137, line 25, but no information about how it was done and no results are presented. Either explain the methods and results or delete.

Response: In the revised manuscript, we omitted the section on dye tracing as suggested by the reviewer. On the one hand, this was justified as it does not change the main conclusions of the paper and, on the other hand, revisions based on the comments of Referee #2 resulted in additional sections and therefore required some reductions to keep the manuscript concise.