

Interactive comment on “Hydrologic and geochemical modeling of a karstic Mediterranean watershed” by N. P. Nikolaidis et al.

Anonymous Referee #2

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Nikolaidis et. al present the application of the SWAT model to describe discharge behavior and nitrate transport in a large karstic catchment in Crete, Greece. For this reason, the SWAT model is enhanced respectively coupled with a karst model. SWAT is used to determine the nitrate input and transport within the catchment as function of land use, soil etc. The study deals with an interesting and relevant problem – the use of catchment scale models like SWAT can be useful for water resources management. However, these models are not intended for the special situation of most karst aquifers and, therefore, application is coupled with assumptions and limitations. The manuscript in the current state misses some of these points. For that reason, major revisions are necessary in order to improve the contribution.

General comments: Karst aquifers can be conceptualized in a wide variety, ranging

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from diffuse flow systems without distinctive solution enlarged flow paths to matured conduit flow systems with large channels and potentially free-surface flow similar to overland flow. Several specific karst elements are important in order to describe the functioning of a karst catchment, for example the already mentioned solution enlarged conduits, the specific recharge mechanisms, the epikarst layer (subcutaneous zone), and so on. Standard karst literature give a profound overview about these topics, e.g. White 1969 (featured reprint in Ground Water 50(2), 2012), White 2003 (Conceptual models for karstic aquifers, Speleogenesis and Evolution of Karst Aquifers, 1(1), 1-6). The authors should provide more information about the investigated catchment in order to provide conceptual insights in the catchment. What are the relevant mechanisms and processes? How can these processes be considered while modeling?

You say that the model was enhanced to consider karst features. But what specific model version of SWAT was used for the study – one already adapted to consider karst features as described by Affinowicz et al. (2005) / Baffaut and Benson (2009)? How was the enhancement of SWAT done?

The possibilities and limitations of SWAT for the intended use should be critically discussed. Karst aquifers can be extremely heterogeneous with a very distinctive anisotropy due to solution enlarged features like conduits, the groundwater catchment can differ from the river catchment – is this represented by the SWAT model? Further, models like SWAT provide a list of parameters that can be used to calibrate the model. There is the potential risk of over-parameterization, i.e. to overcome a poor conceptual representation of the catchment by calibrating the many parameters. The authors should provide an insight in how many parameters are used for model calibration and what parameter ranges they used. Some parameters seem to be important for the model results like the deep karst factor but these parameters are not further explained.

Specific comments p2: Poor description of karst. Please refer to some standard literature.

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p3: The paragraph regarding modeling should be improved. Development and application of karst models is not limited to the past five years and is also not limited to Europe, North America and Asia. You mention some model approaches without giving a clear structure of the different model approaches (e.g. lumped parameter models, distributed parameter models, models that consider karst features explicitly, e.g. by the Manning equation).

p3 In 29: Visual Modflow is a graphical user interface and not a model.

p4: Use of SWAT for karst models should be clarified. Refsgaard 1997 doesn't use SWAT for karst.

p8/9: A sketch of the model functioning would be useful.

p9: How is the deep karst factor considered by the model / within the model equations?

p10 In1: Do you mean spreadsheet instead of excel (or do you mean Microsoft Excel?)

p10: Determination of the extended karst contribution by trial and error = is this calibration? Are there other ways to determine this?

p10/11: How many parameters were calibrated? What parameter range was used?

p11 In 5: For me it is not clear how the model is set up. If possible, refer to figure 1. What is the difference between "region" and Koiliaris catchment?

p12: May be providing results with a table? This is somewhat hard to read / to compare all the numbers embedded in plain text.

p14 In 14: How was the dilution factor assumed? Is there any justification? Is this the deep karst factor from p.9?

p15 In5: For what reason are flood events simulated with the SWAT model? Are there measured data for comparison? Is the SWAT model intended for event simulation?

p17 In 1: first bullet point: what is successfully?

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p17 In 11: Is the model really validated? (cf. Oreskes et al. (1994), Verification, Validation, and Confirmation of numerical models in earth sciences, Science, 263, 641-646.)

Fig1: Please revise (legend, directions, etc.)

Fig2: Please revise (clear presentation, some time axis for all plots, etc.)

Fig3: Hard to read - lines are much too fat

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