

***Interactive comment on “Groundwater  
ecohydrology: GIScience tools to forecast change  
and sustainability of global ecosystems, studies  
in Africa, Europe and North America” by  
D. R. Steward et al.***

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Received and published: 22 July 2009

Reviewer #2 put forth the following comments:

Comment #1: The paper presents a GIS framework for organizing data of different type, source and use, related to groundwater ecohydrology. It then shows three case studies in which numerical models are applied to such organized data, and it provides some insights about the results obtained. The paper lies within the context of 'Geographic

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Information Science', which develops computing tools for organizing and interpreting geophysical data. Since a systematic data-banking improves data availability and interoperability, these tools are useful in particular for interdisciplinary research fields such as ecohydrology. I appreciate the paper's goal about efficient data-banking and bridging different approaches to groundwater science; however, I question the ultimate objective of 'developing a comprehensive, systematic understanding of continental water dynamics' (lines 3-4).

Comment #2: Collecting and organizing data does not mean to 'develop new understanding to address scientific challenges' (lines 123-124), which is a grand challenge and a much more difficult goal. The claim that an efficient data-banking can improve the knowledge and understanding of natural processes is questionable, if not unreasonable.

Comment #3: The paper does not have fair and realistic objectives and it does not place them in the wide and diverse context of Ecohydrology. No general model is proposed for an improved understanding of ecohydrological processes, but only a framework for data organization, yet useful, efficient and science-based. Case studies are presented to show some applications of the framework and the corresponding 'conceptual models', while numerical results are provided by softwares taken from the literature. Some confusion may thus arise about the 'conceptual models': these are, in fact, data structures built according to the knowledge of each specific case study. 'Conceptual models' are thus not tools for general quantitative descriptions of processes, but collections of data which are depicted in Figures 4-6-8.

Comment #4: In conclusion, the paper does not state the real (more limited) advances proposed. Data have been collected from available sources (lines 196-203), the theory describing soil water balance and groundwater flow (lines 146-167) is well known, numerical codes used for processing data (lines 196-203) are found in literature: : . In my opinion, there is little novelty and a wealth of details and comments about the case studies.

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Comment #5: If the paper is going to be accepted, -the real advance (data organization) needs to be stated clearly from the beginning, -misleading sentences about the paper ultimate objective should be avoided, -the title could be rephrased in order to better address the topic, -and the whole work should be much shorter and use less citations (to be reduced to the essentials).

These comments have been addressed as follows:

Comment #1: The paper presents a GIS framework for organizing data of different type, source and use, related to groundwater ecohydrology. It then shows three case studies in which numerical models are applied to such organized data, and it provides some insights about the results obtained. The paper lies within the context of 'Geographic Information Science', which develops computing tools for organizing and interpreting geophysical data. Since a systematic data-banking improves data availability and interoperability, these tools are useful in particular for interdisciplinary research fields such as ecohydrology. I appreciate the paper's goal about efficient data-banking and bridging different approaches to groundwater science; however, I question the ultimate objective of 'developing a comprehensive, systematic understanding of continental water dynamics' (lines 3-4).

Response #1: We agree that the first sentence of the abstract needs to be focused.

Change to manuscript #1: This sentence has been modified through aid of language from reviewer #1 about the major contributions of this manuscript, and the sentence now reads:

This study examines the interface between groundwater hydrology and ecology, and addresses the problem of how to incorporate ecohydrological information into hydrological models.

Comment #2: Collecting and organizing data does not mean to 'develop new understanding to address scientific challenges' (lines 123-124), which is a grand challenge

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and a much more difficult goal. The claim that an efficient data-banking can improve the knowledge and understanding of natural processes is questionable, if not unreasonable.

Response #2: We agree that this needs to be stated more clearly.

Change to manuscript #2: We removed the bulleted items from Newman et al. (2006), and replaced this sentence as follows.

In these studies, we demonstrate the capacity of the GIScience methods to handle large-scale transient models and data sets, its capacity to support the NHI (an integrated system of models for the national water management of The Netherlands), and its capacity to address problems broad in area with relatively sparse data.

Comment #3: The paper does not have fair and realistic objectives and it does no place them in the wide and diverse context of Ecohydrology. No general model is proposed for an improved understanding of ecohydrological processes, but only a framework for data organization, yet useful, efficient and science-based. Case studies are presented to show some applications of the framework and the corresponding 'conceptual models', while numerical results are provided by softwares taken from the literature. Some confusion may thus arise about the 'conceptual models': these are, in fact, data structures built according to the knowledge of each specific case study. 'Conceptual models' are thus not tools for general quantitative descriptions of processes, but collections of data which are depicted in Figures 4-6-8.

Response #3: We believe there is confusion about what we mean by a conceptual model; in this paper, we use the existing resources, which are documented here, as well as field visits and studies by the authors to develop our view of the important properties and processes in the case studies. We then demonstrate that the GIScience methods are capable of storing this conceptualization and supporting a variety of numerical models.

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Change to manuscript #3: This is made clearer by the changes to the first two comments, where we clarify the scope of the manuscript. Additionally, we are rewriting the second paragraph in section 3. Case studies as follows.

In the following sections, we study the groundwater ecohydrology of these regions using the GIScience methods and computational approaches previously described. First, the groundwater ecohydrologic processes and current state of knowledge are reviewed and the ecosystem forcings from human activities, changes in species, and natural processes are identified. A conceptual model is then formulated using existing resources as well as field visits and studies by the authors to develop our view of the important properties and processes in the case study. The capacity of the GIS data organization to store these conceptualizations and to support a variety of computational tools is also demonstrated. A variety of data sources are identified and documented for each case study region; for example, different sources were used to construct the pictures of soils for the three areas in Fig. 3. Numerical models are applied to implement the conceptual model and provide information to understand each ecosystem, and findings are summarized.

Comment #4: In conclusion, the paper does not state the real (more limited) advances proposed. Data have been collected from available sources (lines 196-203), the theory describing soil water balance and groundwater flow (lines 146-167) is well known, numerical codes used for processing data (lines 196-203) are found in literature: : : . In my opinion, there is little novelty and a wealth of details and comments about the case studies.

Response #4: The manuscript has been modified, as requested, to clarify contributions and the real advances in the manuscript. As discussed by reviewer #1, this manuscript, "provides an innovative and systematic framework technique" implemented in "Three extensively investigated and well documented case studies" and is "well written and clearly describes and makes plausible how the proposed methodology can lead to the prediction of the influence of groundwater management measures on ecosystems."

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Change to manuscript #4: This has been addressed by clarifying contributions as discussed above.

Comment #5: If the paper is going to be accepted, -the real advance (data organization) needs to be stated clearly from the beginning, -misleading sentences about the paper ultimate objective should be avoided, -the title could be rephrased in order to better address the topic, -and the whole work should be much shorter and use less citations (to be reduced to the essentials).

Response #5: We have modified the manuscript as requested.

Change to manuscript #5: Please see above changes to the manuscript.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 2795, 2009.

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