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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Quantification of anthropogenic impact on groundwater dependent terrestrial ecosystem using geochemical and isotope tools combined with 3-D flow and transport modeling" *by* A. J. Zurek et al.

Anonymous Referee #1

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GENERAL COMMENTS The presented study was aimed at comprehensive investigation of groundwater dependence of a terrestrial ecosystem (GDTE) consisting of valuable forest and associated wetland; the central hypothesis of the presented work was that the studied GDTE relies also to a significant extent on groundwater originating from deeper aquifer layers. One of the main goal of the paper is also to evaluate the impacts against the GDTE due to possible overdrafting of the confined aquifer. Basically the paper is the description of a case study; so the novelty and the general usefulness for the international scientific community could be poor. By the way, due to the ever

increasing importance of GDE in addressing correct management of groundwater resources and also for an interesting demonstration of multiple tools of investigation, I think the paper deserves publication in an international journal but with the following revisions (the first one to be considered a major one): 1) 3D Flow and Transport Modelling: this is the main drawback of your paper. The use of a 3D flow model is important because the paper must provide some quantitative evaluation of the long term impact to GDE (the forest and the fen) due to pumping. The only way to provide this is by a flow and transport model but: - You must dedicate more text to describe how you have implemented and calibrated the model - You must show the results of the possible impact not only showing, in a purely qualitative way, the comparison between two contour maps but estimating the expected shortage of groundwater fluxes to the fen or the expected lowering of the water table. - Your on site investigation, through direct push drillings and sampling and by the geochemical approach, has provided you the needed data to calibrate and properly design the model but you have to use the model in a quantitative way answering the following questions: - - how much is the shortage of groundwater seepage to the fen and to the river, depending of different scenarios of expected pumping rate? - How much is the lowering of water table and the effects against the forest, depending of different scenarios of expected pumping rate? In the chapter dedicated to the model you simply talk about a generic time of piezometric delay but it is a purely qualitative chapter. But you must be quantitative in forecasting scenarios; applied hydrogeology must provide quantitative estimates. You write in the conclusions "strongly suggest that prolonged groundwater abstraction through the newly-established cluster of water-supply wells at maximum permitted capacity (ca. 10 000m3 d−1) represents significant risk to the studied GDTE. It may lead to reorganization of groundwater flow field in the study area and significant drop of water table" and in the abstract "may trigger drastic changes in the ecosystem functioning, eventually leading to its degradation" but: how much is the risk? How much is the water table drop? How intense are these changes? 2) In the conceptual model of the site you can rely on direct drillings and geological logs or on geophysics. You begin the de-

scription of your geologic conceptual model with geophysics. It's an error: geophysics is an indirect investigation tool and can accomplish and integrate the geological direct investigations but not be the starting point. So improve the description of your conceptual model starting from geological logs and drillings. You performed direct push at shallow depth. You should have direct geological information. 3) The text is well written and clear and does not need correction for english. By the way, particularly in the introduction, the text is too much long and boring in some parts, it seems more the introduction of a master thesis. Some parts could be integrated in material and methods, some parts could be strongly reduced, some parts should be skipped (the less useful for the investigation; see the specific notes) 4) About vertical fluxes between the confined aquifer and the fen, have you head profile data showing how hydraulic head changes along the vertical in order to demonstrate upward seepage of groundwater from Bogucice Sands aquifer toward Wielkie Bloto?. Was you able to measure head? Comment upon that 5) A Piper diagram should be useful to map the hydrochemical facies in a more quantitative way.

SPECIFIC COMMENTS

THE STUDY AREA Comment upon the fact that the runoff value is higher than the difference between total precipitation and actual evapotranspiration. Express the data in a more precise way. Is evapotranspiration actual, I presume? The range 8-28% of coefficient of infiltration is related to outcropping lithology? Comment upon it Comment and describe the degree of consolidation or looseness of sands (any cementation? Grain-size?), parameters important from hydrogeologic standpoint. You talk of sands but also of sandstones. Clarify better. They are sands or sandstones? What do you mean as "disposable resources" in hydrogeological terms? A safe yield? A maximum sustainable pumping rate? A recharge rate? Explain better and also make reference to the references and the evaluation method Is there a relationship between the vegetative assemblage and the depth to water table? Where depth to water table is higher than 2 m the typology of the forest is different from areas with shallower water table? If yes

describe shortly in which sense.

MATERIAL AND METHODS Change the order of description, starting with the field tools, the sampling tools and finally the analytical methods, in a logical order The description of the modelling is too much detailed for a chapter dedicated to material and methods and too much simplicistic and low understandable for a chapter dedicated to the model description. If the modelling is important for your research dedicate a chapter to it, otherwise skip it. In the material and method it is enough to describe the code. Moreover the description is confusing, mixing together flow, transport, calibration, in a messy way

RESULTS AND DISCUSSION Skip completely the paragraph of introduction. It's redundant. You can integrate the informations about the goal of the various investigations in the material and method section. Delineation of Quaternary cover It's strange to begin with indirect surveys (geophysics) that can accomplish and integrated direct data but cannot be the foundation of the conceptual model. Shallow geoelectrics has a high degree of inaccuracy in represent the structure and stratigraphy of subsoil and this is more true in your case for the very low expected thickness of clay layer and the noise that different sources (water content, grain size, organic content, air content) can provide to determination of resistivity. It's very strange to begin the conceptual model with geophysics and not with direct data. What about the importance of GPR? Simply to define the position of the bottom of moorsh? How this is important for your study? The delineation of Quaternary cover should be completely rewritten,. Begin it starting from direct data (boreholes) and then, eventually, integrate it with geophysics. You cannot base your conceptual model simply upon geophysics Geochemical evolution A Piper diagram should be useful to map the hydrochemical facies in a more quantitative way. Water balance of the Dluga Wouda catchment Explain why the MTT of 3.2 months is not affected by the contribution of 30% of slow recharge water (presumably with a different input signal of delta 18O; see sentence at the end of 9688), whereas you see this contribution in the tritium Clarify how the flow rate measurement were taken in rela-

tionship to rainfall. Independently or not during rainfall event? Explain better, in a short statement, how Wundt (a very old method!) determines the base flow. The term “low flow” sounds not good, also because in some months it is not so low. If the “low flow” is, as I presume, the base flow component of total runoff (coming from the discharge of the aquifer), I think, independently of Wundt, that base flow is a better term. MMBF, at the end, will be the mean monthly base flow. It’s more correct from a hydrogeologic standpoint.

TABLES AND FIGURES Table 1: badly sealed well (not “liquidated”) Table 4: put the meaning of n.m. in the legend Fig.1: indicate the time of reference or date for the head measures Fig.2: some of the terms in the legend are poorly understandable for not very specialistic experts (gyttia, moorsh) define it in more hydrogeologically meaningful terms and more widely known for wetland experts: poorly decayed peat, acrotelm, catotelm, for example, or other terms The position of 11 VES soundings should be better rendered in the legend; if one dot is a VES, in the legend you have to maintain only one dot. Fig.4: the resistivity numbers in the upper panel are too much little. In the legend the second point is b and not c. Fig.8: on the x axis (time) put in evidence the months of the year to better appreciate the seasonality. Explain in the legend the meaning of the small graph inside the lower diagram, there is non explanation of that (characters perhaps are too much little) Fig.11: I guess that the symbol to the right top is ground surface. Put in evidence this attribution

TECHNICAL CORRECTIONS r.8: 9674 provided better than supplemented r.11: 9674 to be assessed better than quantified r.14: 9674 Bogucice sand aquifer should be introduced before at r.28 of page 9673 r.4: 9675 Badenian: which period? Miocene? specify r.17-19: 9675 I suggest to skip these unuseful oxides and traces elements if they do not affect meaningfully the discussion and conclusion of the paper r.25: 9675 aquitard is better than semi-permeable r.27: 9675 hydraulic head or piezometric surface (not water table). r.27: 9675 go to a new row after seepage. r.11: 9676 do not use the term “diffuse”, related to agricultural and not industrial sources. r.11: 9677 which

kind of land improvement?. r.21: 9677 not water table, the wells pump put groundwater from deep aquifer r.1: 9678 upward leakage (or flow) is a better term (respect to diffusion) r.3: 9678 integrated better than supplemented r.6: 9678 which code was used? MATERIALS AND METHODS r.7: 9679 PVC. Describe the depth and filter position and also diameter of the tubes; open stand-pipes is a better term than tubes r.22: 9679 badly liquidated? What does it mean? Use a better term, more clear. It’s not clear if the spring is natural or not. Perhaps it’s not a spring but it is a flowing not properly sealed artesian well. r.9: 9680 Phreatimeter r.18: 9680 You talk about rectangular cell but they are square in plain section r.20: 9681 Any measuring unit? r.1-5: 9683 skip these unuseful information r.20: 9683 in the study area r.26: 9683 “and shows values around 64 pMC” (comment upon this value, what does it imply?) r.22: 9684 comment upon the value and the significance of these value of partial pressures of carbon dioxide r.6: 9687 which kind of difficulties? Describe better and in which sense they could bias the results r.26: 9687 Maloszewski et al. is missing in the references r.9: 9688 specify “relatively to the river section used for sampling water” r.23: 9688 explain a bit the insert graph in fig.8b and the meaning of parameters r.7: 9691 a K of 1E-5 m/s seems to me very low for an important sandy aquifer like yours. Are you sure about this value? Comment upon it

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