

Interactive comment on “Groundwater contribution to river flows – using hydrograph separation, hydrological and hydrogeological models in a southern Quebec aquifer” by M. Larocque et al.

A. Guadagnini (Editor)

alberto.guadagnini@polimi.it

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I would like to start my assessment by stating that I apologize with the authors for the time it took to make this assessment. I am currently on a sabbatical from my University and needed some time to get settled.

The reviews reveal some very critical points and very constructive comments have been made. These are mainly related to the hydraulic parameters' calibration proce-

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dure adopted and its ability to identify properly the system states. I do agree that an extensive set of revisions needs to be performed. This is mainly related to the fact that the authors need to convincingly prove their arguments upon properly taking into account variability and uncertainty associated with recharge (including calibration of leakage parameters, as mentioned by one of the reviewers). I am not sure that a simple procedure based on the minimization of an objective function associated with a mean-square difference between measured and modeled state variables can be enough (are there local measurements of hydraulic parameters, which can be used, for instance as a regularization term in the objective function?). I would strongly suggest to explore a Maximum Likelihood - based inverse approach, which provides more information and is compatible with model selection criteria. The adoption of the latter might be beneficial, especially with the aim of exploring the influence of uncertain recharge. The reviewers suggest using, e.g., PEST-based procedures. This is not completely necessary, as the authors could employ, e.g., adjoint state based methods. However, I do recognize that using an automated optimization software such as PEST can be appropriate. I would leave the choice of this to the authors. In any case, the calibration should be performed within a framework which allows assessing uncertainty associated with estimated parameters. The point which includes an assessment of uncertain recharge as well as leakage coefficients governing exchanges between surface water and the groundwater should be taken into account properly, together with an appropriate assessment of steady-state versus transient calibration strategies. In summary, I do believe the work to be potentially interesting, but associated with significant shortcomings which obscure the impact results. I think that performing the requested revisions might result in a paper which is significantly different from the current submission. I would advise withdrawing the current manuscript and prepare a revised work taking into account all the points mentioned by the reviewers. This will be treated as a new submission. I do understand this will come as a disappointment to the authors and the reason why I had hesitated to express my opinion in the first place was to provide them with an opportunity to prepare a revised version under the same submission round. I see that

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the authors recognize that implementing the changes suggested by the reviewers will require a significant amount of work, which is in line with my assessment.

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