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Hydrology and Earth System Sciences Discussions

Interactive comment on "Complexity versus simplicity: an example of groundwater model ranking with the Akaike Information Criterion" *by* I. Engelhardt et al.

Anonymous Referee #2

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Review of 'Complexity versus simplicity: an example of groundwater model ranking with the Akaike Information Criterion'. Summary

The paper describes the application of the AIC criterion to 7 selected model parameterisations, to determine the optimal model parameterisation. The case study model application is a groundwater model used in the management of groundwater abstractions, and in particular the management of a number of water supply abstractions. This paper is a case study. There is no new methodological development presented. The paper is well written, with the case study thoroughly presented, and the application of

the AIC criterion is well discussed. However the paper would benefit from an English language edit, see a few selected examples below.

The use of the AIC criterion and model residuals to determine an optimal model parameterisation provides only a very basic analysis of relative model likelihood. The AIC criterion is an empirical tool used to assess the relative likelihood of the model representation of the real world, in terms of more and less complex models in terms of (i) the fit to observed data (residuals), (ii) the number of observations, and (iii) the number of parameters employed. It assumes normally distributed residuals.

The paper would be strengthened by comparison with the use of other criterion used to weigh up relative model worth, e.g. the similarly constructed BIC, KIC, AICc. Similarly, methods which explore the mathematical limits of parameterisation parsimony could be used to provide a contrast in the analysis, e.g. using methods such as singular value decomposition of the model normal matrix, or as encapsulated in the predictive uncertainty analysis predunc/predvar methods outlined in Doherty (2012). Alternatively, Bayesian model averaging would provide a comparison.

Finally, there was a brief note of the presence of bias for the very simple sedimentological estimate of parameters, but no exploration of the model bias was provided in the paper. An exploration of the relationship between bias and degrees of parsimony would be an interesting way to strengthen the paper (e.g. using methods discussed in Doherty and Christensen 2012).

Specific comments Page 9691, line 19. What is Mio? Page 9699, line 24, '..calibration errors' change to 'residuals' for consistency in terminology.

Some selected Language examples... Page 9689, line 15, 'In addition, AIC allows to rank the models. . ..' Change to 'In addition, AIC allows the ranking of models . . .; Page 9691, line 18. '...was rebuild' replace with ' change to '...was rebuilt'. Page 9696, line 11, '. . .the less plausible it is to be the best one.' Change to '. . .the less likely it is to be the best one.' Page 9700, line 23, 'Computing the AIC allowed to evaluate the benefit of

adjusting high numbers of model parameters.' change to 'Computing the AIC allowed the evaluation of ..'

References: Doherty (2012). Addendum to the PEST Manual; www.pesthomepage.org/getfiles.php?file=addendum.pdf Doherty and Christensen (2011). Use of paired simple and complex models to reduce predictive bias and quantify uncertainty. WATER RESOURCES RESEARCH, VOL. 47, W12534, 21 PP., 2011, doi:10.1029/2011WR010763

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 9687, 2012.