Geoscientific

Model Development

Discussions

**[GMDD]**

**Interactive**

**comment**

# *Interactive comment on* "A tuning-free method for the linear inverse problem and its application to source term determination" *by* O. Tichý et al.

**Anonymous Referee #2**

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General comments

In the paper the authors propose to apply the Variational Bayesian methodology to estimate the tuning parameters of the objective function given in Eckhardt et al. (2008). The authors describe the method and the algorithm to compute such tuning parameters. Then they show the performance of the proposed algorithm using a synthetic dataset, and the ETEX dataset. Its performance in the ETEX dataset is compared with the performance of other state-of-the art algorithms.

Individual questions / issues

- page 3, line 20: For clarity, the optimization problem can be written including the non-negative constrain for x

x = argmin_x (J1 + J2 + J3) s.t. x >= 0

- page 4, line 16: The Gaussian assumption is a good choice if, in fact, the errors in the model are Gaussian. Otherwise, this can cause deviations in the estimation. The authors should justify why the Gaussian assumption is a reasonable one in this case. Also, this particular regularization enforces smoothness in the solution. It should be mentioned that it is not suitable for releases generated, for example, during explosions.

- page 5, line 1: gamma(x) should be defined more precisely.

- page 5, line 10: define approximate inference. The authors also should explain how they concluded that this method does not yield acceptable results.

- page 5, line 16: why do the authors assume that the variance for all the measurements is the same? Is it not more reasonable to define w as a vector instead of a scalar?

- page 5, line 20: the authors should explain why the gamma distribution is chosen to model w.

- page 5, line 25: explain in more detail why this particular relaxation has been chosen.

- page 6, line 16: The authors should explain why they conclude that a wider range for that parameter l_j is not recommended. What are the effects if the range is wider?

- page 6, line 23: does conditional independence make sense here? The authors should explain why they are making that assumption.

- page 7, line 11: the derivation of the parameters is not in the Appendix B. Only the definition of the parameters is given. An explanation on how the authors arrive there is recommended.

- page 8, line 1: since local minima exist, good initial points should be taken, or several initial points may be considered.

- page 8, line 8: The authors should also comment on the convergence guarantees of

the algorithm.

- algorithm 2: Step 2 is not clear. Is $\langle x \rangle^{(i)}$ equal to $\langle x \rangle$? What is exactly the analytic expression for $\langle x \rangle^{(i)}$?

- page 8 , line 12: The authors should provide the condition number of the matrix M.

- Figure 2: x-axis labels are missing

- page 8, line 14. It is not clear if the three 'sets' refer to three different synthetic experiments, or not.

- page 8 : in the experiments with the synthetic dataset, it would be interesting to compare the estimated parameters w.r.t their truth value, i.e. as in the case for the source term, a red line representing the ground truth could be added in the other plots. It will give a more precise idea of the quality of the estimate of the parameters.

- Matlab code: the Matlab code provided reproduces the results given by the LS APC algorithm. To facilitate the reproducibility of all the results in the paper, the authors should include the code used to generate the results given by the other algorithms as well.

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