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Biogeosciences Discussions

Interactive comment on "Inverse method for estimating respiration rates from decay time series" *by* D. C. Forney and D. H. Rothman

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Dear Referee 1,

Thank you for the kind words and thoughtful comments regarding this manuscript. Below are our responses to your comments. A short overview of your comments are given first in *italics*:

1. *Comment on other inversion/regularizations approaches, which may allow for more roughness in the solution*. Other regularization approaches, such as those mentioned in the paper or Provencher (1982), still require choosing a regularization operator. No matter what form the regularization operator takes (derivative, entropy, etc), its effect is to smooth the solutions. In this manner it reduces the ill-conditioning of the problem.

This however is not necessarily a confounding artifact as it is not clear that the true solution should be a discrete number of decay pools. The regularization method can identify smooth multi-modal solutions. However, for litter decay, the solutions are typically unimodal. An inversion method which does not utilize regularization is the phase function method (also mentioned in the paper). It handles discontinuities in solutions slightly better than regularization, but still yields smooth solutions.

2. P 3802 *discuss the benefits or drawbacks of the discretization method you choose.* We found that an acceptable choice for discretizing the k axis is to use uniform logarithmically-spaced nodes. This discretization provides appropriate resolutions over the decay time scales associated with the datasets. Inversions using this discretization were not computationally intensive, although more efficient discretizations likely exist. We also considered Gaussian quadrature and uniform linear discretization. Gaussian quadrature (see references in the text) provides an optimal spacing of nodes along positive real axis, $0 < k < \infty$. However the nodes suggested from quadrature are often located at irrelevant rates, and a large portion of the discretized $\rho(\ln k)$ is zero. Increasing resolution results in a large number of nodes, inefficient for numerical inversion. Obtaining appropriate resolution with a linear discretization also requires a large number of nodes as decay rates often vary many orders in magnitude. Numerical inversion from a linear discretization would be computationally intensive.

3. *Remaining comments.* Thank you very much for the remainder of your suggestions. We will implement all of these changes for the next submission.

Bibliography

Provencher SW. CONTIN: A general purpose constrained regularization program for inverting noisy linear algebraic and integral equations. Computer Physics Communications. 1982 Sep;27(3):229-242. Available from: http://dx.doi.org/10.1016/0010-4655(82)90174-6.)

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