Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-352-RC2, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Rapid surface water volume estimations in beaver ponds" *by* Daniel J. Karran et al.

Anonymous Referee #2

Received and published: 21 November 2016

Recommendation: Major Revisions

General Comments:

This study explores the capabilities of different geometric methods to estimate surface water storage in beaver ponds; to do so, the authors use topographic datasets from multiple beaver ponds that range in hydrogeologic setting. The paper is generally well written (but see technical corrections) and presents results in informative, polished figures. The paper's main contribution is its quantitative comparison of different methods, which require different input datasets (from simply dam length to coupled measures of water depth and inundated area), to predict beaver surface water storage (see Section 4.4). Considering the number of beaver ponds and their contribution to watershed storage and release, such assessed tools are useful for watershed assessments, plan-

ning, and modeling over large spatial scales. However, I find the paper too long and with unnecessary text for a focused evaluation of methodologies for storage volume estimation. With that said, there are also opportunities (often alluded to in the text) to expand the work, where the focus is broader: beaver pond morphologies, their drivers, and their implications. As such, I see two options to reframe the paper that should be considered:

1) Technical Note: Streamline the paper's text and focus to compare methods for predicting volumes. This will also require clarifying some of the methods and their linkages (see specific comments below). Text to consider removing/shortening includes:

Page 1, Line 25 through Page 2, Line 23. Rather, the introduction could succinctly state: beaver ponds are ubiquitous and important to watershed water storage, highlighting the need for methods to quickly estimate storage use; methods have been developed for other wetland features, and here we apply these for beaver ponds.

Section 2.5. No need to describe the sites in detail (e.g., vegetation); instead, simply present needed information (hydrogeologic setting, DEM datasets) in the table.

Text distributed throughout results (e.g., Page 8, Lines 26-31) that describes the variation in beaver pond morphology. This text should be retained for Option 2 (below), but removed for a technical note solely focusing on a methodology.

Similarly, Sections 4.2 and 4.3 could be removed for a technical note; instead, the discussion should simply revisit the methods to discuss tradeoffs between accuracy and data needs among the methods evaluated (i.e., section 4.4).

2) Research Article: For this option, the manuscript could be expanded, where it focuses on the variation, drivers, and implications of a suite of morphological metrics (in addition to storage volume) for beaver ponds. At times, the manuscript points to some of these topics (e.g., the importance of SI for groundwater exchange, beaver ponds store less water than potholes b/c of ontogeny of ponds, time variation of pond mor-

phometry, etc), but these points seem somewhat tangential for the current manuscript focus. However, the paper could make a meaningful comparison across ponds and regions by deemphasizing the volume storage methodology and including: 1) a full comparison of the different metrics (SI, storage, dam lengths, maximum depth, etc) across systems, 2) analyses of their drivers (e.g., predictive relationships with stream order, watershed slope, etc), and 3) focused intro and discussion text regarding implications (cumulative storage, perimeter to area ratios for water exchange and habitat, sediment storage, etc). Again, there is some mention of such topics (e.g., Section 4.5), but a quantitative evaluation of the drivers and importance of beaver morphology means a full treatise on this subject, where the volume storage estimation is one method applied. For this option, authors could consider either just including the 40 ponds used here (in which case, the actual bathymetric curves could be used), or they could use the 40 ponds to verify the Simple V-A-h method, and then use a larger set of ponds with available required datasets to derive volume, SI, and other metrics.

In short, I contend that the manuscript is lacking clear and organized scope. The two options suggested above will help frame the work in a clear way, be it as a technical note or an evaluation of beaver pond morphologies; I believe either option will provide a valuable contribution. Given this suggested shift in scope, specific comments depend on option chosen. As such, I have limited the number of comments below, and include only those that should be addressed regardless of option, or that I point to an Option-specific revision.

Specific Comments:

Page 1, Line 14: Be specific when discussing surface water storage as a function of stage vs. storage capacity.

Page 2, Line 6: Why are beaver populations expected to increase with climate change?

Page 2, Lines 12 – 23: Too much focus here on restoration, even for Option 2, and especially for a technical note. Instead, informing restoration is just one importance of

good volume estimation.

Page 2, Line 31: Define basin morphometry.

Page 3, Line 2: Qualify “with little additional effort”.

Methods: For option 1, a conceptual 2-panel figure (cross section and plan view) would really help to define terms used in the equations.

The methods are hard to follow; some reorganization and explicit text to link methods would help; how this is done will depend on the manuscript’s new scope. For Option 1, this would mean revising Section 2.2 to explicitly distinguish the variables that were used for simple predictions of volume (dam length, SI) versus the relationships that were used to evaluate model predictions (i.e., Dact). It could also be clearer what Dact and Dest refer to; the “actual V-h relationship or point on the bathymetric curve” makes that confusing without more clarification. It might help to switch 2.2 and 2.3. For Option 2, methods would reflect the various different metrics used to describe pond bathymetry and how these were compared across sites.

Page 5, Eqns 8 and 9: Where is the exponent in Eqn 8 that then appears as p/2?

Section 2.4: Again this information could be streamlined and probably just included in a table.

Section 4.3: Points raised here are not addressed by the results. For Option 1, remove text altogether, other than just pointing to the importance of a simple method to estimate storage considering this time variability. For Option 2, consider retaining text, but only if some results can point to this time variability.

Page 12, Lines 29-31: Good point and method application.

Section 4.5. Example of inferences that could be expanded in Option 2 but minimized in Option 1.

Technical Corrections:

Page 1 Line 27: Complete sentences should be follow semicolons. This needs to be addressed throughout in a number of places (e.g., Page 2, Line 27)

Page 2, Line 8: “by virtue of the fact that it..” Awkward.

Page 2, Line 32: . . .basin morphometry are not considered.

Page 9, Line 4: Need a comma after Aerr.

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