

Anonymous Referee # 1, 29 Mar 2023

- The authors would like to thank Referee #1 for their time and feedback. Their suggestions will greatly improve the reasoning and clarity of this manuscript.
- Author note: Referee comments are reproduced in Times New Roman font. Author responses to referee comments will be included as bulleted, Arial-font text beneath the relevant comments.

Thank you for the opportunity to review this paper, it was an engaging exercise. Overall this paper presents an interesting and technically sound approach to develop, calculate, and predict seasonal flow metrics using available hydro-climatic data to facilitate adaptive water management for an upcoming spring and summer season. The results suggest this could be a very useful approach for local water managers and stakeholders in the study watershed. A few major issues to be addressed:

I am not sure that this study really took a functional flows approach as the authors suggested. In the conclusions these hydrologic metrics are framed as decision-support metrics, which seems a more appropriate couching for what has been done. It is reasonable to state that the metrics are linked with ecological functions, but that is not the same as applying a functional flows approach or the functional flow metrics developed for CA. Next, this study focused on a single watershed, but I would encourage the authors to try to broaden the paper discussion and limitations sections to how this can or can't be applied in other settings. For instance, the analysis relied on long climate records and a detailed hydrologic model. Are these data always needed for such an analysis? Are the findings transferable to other systems? Additionally, there are a lot of great ideas that are raised in passing that could use additional thoughtful discussion and citations to really bring to light. My remaining concern is the quality of writing in the manuscript, including terminology, grammar, sentence and paragraph structure issues. I must note that the repeated references to other chapters of your dissertation feels unprofessional. As a reviewer I would like to know that you have put in your best effort to make this a clean, standalone manuscript and not simply submitted your dissertation chapter to a journal directly. I look forward to reviewing a revised version with these changes addressed so the reader can really focus on the interesting research and implications.

- We identify 3 main critiques in the general comments provided by Referee # 1.
- Regarding the framing as a functional flows exercise: the manuscript introduction and discussion has been revised to clarify that this study does not apply a typical functional flows approach; rather it uses the existing functional flows framework to provide context for a proposed new approach to developing a decision-support tool that would be specific to a target watershed.
- Regarding the recommendation to broaden the discussion for applying to other settings: additional text has been added to the discussion to outline how this approach could be applied to other watersheds (with abundant hydroclimate data). But we also point out that the assessment of the feasibility of this generalization would be beyond the scope of the subject study and should be explored in a future investigation.

- The proposed edits will improve the writing quality and readability of the manuscript. References to dissertation chapters has been removed and other structural changes have been made (i.e., moving the model diagnostics figures to an Appendix) to produce a standalone manuscript.

Specific comments:

1. Abstract: In general, I would suggest to provide more general, compelling information and not include variables, multiple units, HUC#, etc in an abstract. See additional in-line comments.

- We have revised the abstract as follows:
- Abstract. In undammed watersheds in Mediterranean climates, the timing and abruptness of the transition from the dry season to the wet season have major implications for aquatic ecosystems. Of particular concern for resource managers in many coastal areas is whether this transition can provide sufficient flows at the right time to allow passage for spawning anadromous fish, which is determined by dry season baseflow rates and the timing of the onset of the rainy season. In (semi-) ephemeral watershed systems, these functional flows the dry season baseflow and rainy season onset timing also dictate the timing of full reconnection of the stream system. In this study, we propose methods to predict, approximately five months in advance, two key hydrometeorologic metrics in the undammed rural Scott River watershed (HUC8-18010208) in northern California. ~~Both~~ The two metrics are intended to quantify the relative transition timing from the dry to the wet season, and to characterize the severity of a dry year. The ability to predict these metrics in advance could ~~and~~ support seasonal adaptive management. The first metric is the minimum 30-day dry season baseflow volume, Vmin, 30 days, which occurs at the end of the dry season (September-October) ~~in this Mediterranean climate~~. The second metric is the cumulative precipitation, starting Sept. 1st, necessary to bring the watershed to a “full” or “spilling” condition (i.e. initiate the onset of wet season storm- or baseflows) after the end of the dry season, ~~referred to here as Pspill~~. As potential predictors of these two values metrics, we assess maximum snowpack, cumulative precipitation, the timing of the snowpack and precipitation, spring groundwater levels, spring river flows, reference ET, and a subset of these metrics from the previous water year. ~~We find that, t~~ hough many of these predictors are correlated with the two metrics of interest, ~~of the predictors considered here, we find that~~ the best prediction for both metrics is a linear combination of the maximum snowpack water content and total October-April precipitation. These two linear models could reproduce historic values metrics of Vmin, 30 days and Pspill with an average model error (RMSE) of 1.4 Mm³ / 30 days (19.4 cfs) and 25.4 mm (1 inch), corresponding to 49% and 37% of mean observed values, respectively. Although these predictive indices could be used by governance entities to support local water management, careful consideration of baseline conditions used as a basis for prediction is necessary.

2. 1-2 sentences should not be standalone paragraphs, as is currently done several times (L51, L72, L124, L369, etc). Please revise your paragraph and section structures accordingly.

Please use “functional flows” throughout to be consistent with the published literature

- The paragraphs on L51, L72, L75, L124, and L369 have been edited or combined with other text as suggested.
- Terminology has been standardized to use “functional flows” throughout as suggested.

3. Tense issues throughout manuscript, particularly in the Results - past, present, and "have been...". Choose one (I suggest past tense to be consistent with most journal articles) and use consistently throughout.

- The tense of the Results section has been revised to be consistently past-tense.

4. Some steps in the methods remain unclear. For instance, 2.3.1. is the first mention of a "model" and there is no indication of what type of model you are trying to develop or why (e.g. linear regression modeling to predict X as a function of Y...).

- The sentence "In this study we used linear regression modeling to predict watershed behavior at the end of the dry season (the response) using data available the previous spring (the predictors)" has been added to the beginning of the Methods section for clarification.

5. There are some grammatical and spelling issues to be addressed (see inline comments) Some terms could be more clearly defined or concepts more clearly described (e.g. echo effect, partial one-year holdover, GSP).

- These grammatical and spelling issues have been revised as described in responses to inline comments below.

6. Please provide a more clear explanation for the selection of the Q spill threshold. Looking at Panel A in Figure 4, since individual hydrographs cannot be clearly distinguished I find myself struggling to fully understand how you visually determined this threshold.

- We have conducted a more detailed analysis, based on rainfall-runoff responses in dry and wet seasons, to support the selection of the Q spill threshold. This has been concisely described in the Results section and included in more detail in an Appendix.

7. Figure 8 and other map figures – add scale bar, north arrow, and in Fig 8 additional points of reference in the Scott watershed (e.g. gage locations, etc). Also, there are a lot of figures. Could any be combined or moved to SI to simplify the message?

See other inline edits in PDF.

- A scale and a north arrow have been added to Figures 3 and 8.
- Figure 8 (wells) and Figures 9-14 (model evaluation figures) have been moved to an Appendix.

In-line edits:

Page 1:

If you are talking about natural/unimpaired flow patterns, then I don't think concern is the right word for trying to understand the natural processes that will vary from year to year

- The phrase “for resource managers” has been added to clarify the concerned party (see revised abstract in response to Specific Comment 1).

which? FFs have not been defined yet

- The two key flows have been identified by name rather than being grouped under the term “these functional flows” (see revised abstract in response to Specific Comment 1).

flow metrics?

- Text has been clarified to say “hydrometeorologic metrics” rather than “hydrologic metrics”, to reflect the distinction that only one of the two metrics is directly related to flow; the other concerns cumulative rainfall. (see revised abstract in response to Specific Comment 1).

Remove text “(HUC8 18010208)”

- The suggested text has been removed (see revised abstract in response to Specific Comment 1).

Remove text “in this Mediterranean climate”

- The suggested text has been removed (see revised abstract in response to Specific Comment 1).

Page 2:

Suggest replacing “ones” with “those”

- The text has been revised as suggested.

To...

- The text “by water agencies to inform adaptive management decisions” has been added to clarify the sentence.

Suggest replacing “functional ecosystem flows are a” with “the functional flows approach is a...”

- The text has been revised as suggested.

Remove text “(see Chapter 1 of this dissertation)”

- The text has been removed as suggested and replaced with the text “(Moyle 2002)”.

Replace “modern” with “current” or “ambient”

- The text has been revised as suggested.

Replace “baseline” with “unimpaired” or “natural”

- The text has been revised as suggested.

Remove text “HUC8”

- The text has been revised as suggested.

What type of decisions?

- The text “such as agricultural cropping choices or regulatory water use restrictions” has been added for clarification.

Replace text “For example,” with “Specifically”

- The text has been revised as suggested.

Do you have a citation for this strong statement? Is that analysis done in the CDFW 2015 study, or is that citation in reference to the second noted linkage, to spawning habitat?

- The linkage to spawning habitat and the citation has been clarified.

Page 3:

Suggest inserting text “runoff”

- The text has been revised as suggested.

Page 4:

Replace “functional flow types” with “functional flows” or “functional flow components”

- The text has been revised as suggested.

Add “r” to correct typo

- The text has been revised as suggested.

Which concept? FFs? threshold-based runoff response? Be specific

- The text “basin-scale, threshold runoff storm response concept from the temporal scale of a season” has been added for clarification.

This paragraph needs citation

- Two citations and additional clarifying text have been added per suggestion.

Page 6:

Suggest changing word choice of “hydraulic response”

- The phrase “hydraulic response” has been replaced with “flow surge”.

Standardize “functional ecosystem flow” as “functional flow(s)” throughout

- The text has been revised as suggested. In this specific instance the word “ecosystem” has been removed.

Citations needed to support paragraph including manuscript line 130

- Citations have been added as suggested.

That is the fall pulse as we defined it... or I'm not clear what you are describing and how it is different than the fall pulse. There is also a start of wet season metric and a wet season baseflow metric. Could you clarify how your additional proposed metric differs from what already exists?

- Specification of a slow increase in flow, rather than an abrupt “pulse”, has been added to the text for clarification.

Tense: replace “can use” with “used”

- The text has been revised as suggested.

Page 7:

Tense: make “test” past tense

- The text has been revised as suggested.

Consider alternate word choice for “durable”

- The phrase containing the word “durable” has been removed from this paragraph.

Page 8:

Remove text “and Chapter 1 of this dissertation”

- The text has been revised as suggested.

Replace text “uncertain” with “unpredictable”

- The text has been revised as suggested.

Insert text “station records”

- The text has been revised as suggested.

This appears to be the first mention of a "model", at least in the last few pages as far as I am seeing. The type of modeling being done needs to be clearly stated upfront.

- The sentence “In this study we used linear regression modeling to predict watershed behavior at the end of the dry season (the response) using data available the previous spring (the predictors)” has been added to the beginning of the Methods section for clarification.

Page 10:

Figure 3 should have a scale bar and north arrow

- The figure has been revised as suggested.

Page 11:

has this (“partial one-year holdover term”) been defined already? Otherwise a definition would be helpful

- The term has been replaced by a short definition.

Change “indicate” to “indicates”

- The text has been revised as suggested.

This (determination of the QSpill threshold) is a critical part of your methods and could benefit from more detail on how this was determined.

- A more detailed analysis, based on rainfall-runoff responses in dry and wet seasons, has been conducted to support the selection of the Q spill threshold. This is concisely described in the Results section and is included in more detail in an Appendix.

Page 12:

Figure 4 Panel A has a key but the line is not visible.

- This oversight has been corrected – the line has been added to Panel A.

Page 13:

Tense issues throughout results - past, present, and "have ...". Choose one (I suggest past tense to be consistent with most journal articles) and use consistently throughout

- The tense of the Results section has been revised to be consistently past tense.

Well identifiers: use a shorter identifier or move to SI if critical information.

- The well identifiers are not critical and have been removed.

Page 17:

“Conversely” not an appropriate first word in paragraph

- The text has been revised.

“cumulative ET0 Oct-Apr”: confusing order, be consistent

- The text has been revised for consistency.

Is this something you are certain of, or your interpretation? Either way, why is this?

- The text has been revised for clarity.

“echo” effect: I am not familiar with this term. If you use this because you have seen it in other papers, cite it, and it should not be in quotes. Otherwise do not come up with new terms and just describe clearly what is happening

- The text has been revised as suggested.

very long sentence, consider splitting into 2

- The sentence has been shortened.

Replace “worse” with “larger”

- The text has been revised as suggested.

Page 22:

It would be more clear to label panels with letters for consistency - for this and following multi-panel figures.

- All multi-part figures in the main text have been labeled with panel letters.
Figures 9-13 have been moved to an Appendix.

Page 23:

Replace “upward” with “increasing”

- The text has been revised as suggested.

Page 26:

Remove text “state of being”

- The text has been revised as suggested.

Page 28:

Figure 15: Is the third panel necessary?

- The third panel is necessary to illustrate that a long-term trend is not as visible in the DWR water year type schematic than in the quantitative indices P spill and V min.

Page 29:

Remove text “(see water budget information in Chapter 2 of this dissertation)”

- The text has been removed and replaced by the citation “(DWR 2004)”.

Page 30:

Could this not be done already with existing data?

- Existing data on human land and water use has been incorporated into the Scott Valley Integrated Hydrologic Model, and in the authors’ judgement, remains too coarse to confidently parse the year to year influence of human actions on summer surface flow, relative to climate inputs.

Remove text “referred to as Vmin, 30 days”

- The text has been revised as suggested.

In the introduction these are framed as functional flow metrics. These are very different concepts that should be reconciled

- The manuscript introduction and discussion have been revised to clarify that this study does not apply a typical functional flows approach; rather it uses the existing functional flows framework to provide context for a proposed new decision-support tool in a specific watershed.