Hydrol. Earth Syst. Sci. Discuss., 12, C1970–C1974, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C1970/2015/
© Author(s) 2015. This work is distributed under
the Creative Commons Attribute 3.0 License.

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Reconstructing the natural hydrology of the San Francisco Bay-Delta watershed" *by* P. Fox et al.

P. Fox et al.

djhowes@calpoly.edu

Received and published: 5 June 2015

We appreciate the reviewers insightful comments. Responses are shown below the original comments listed below.

Comment 1. There is vagueness in the context about to what degree this underestimation of the natural vegetation uses can impact the calculation of the "natural" Delta outflow. In Sect. 3, there are some explanation about the data sources that may underestimated some vegetation types. The "CSU Chico" study is the key about the fundamental information of the natural vegetation configuration. An original figure of vegetation covers from this study and comparing it with Fig. 4 can be helpful. And also, because that the CSU Chico study might be a main source of the underestimation of

some types of vegetation covers, I think it is important to know is there any information in those sources and maps that can help to ensure the errors to be indifferent. It is noticed that in page 3866, the last paragraph of Sect. 4, the authors briefly discussed about the assumptions. I believe this part can be improved if the authors can give a more detailed analysis.

Response: See our response to Referee #2's Comment 4. The CSU Chico map was only the starting point for our work. We used numerous other sources to confirm and modify the Chico map. Our analyses are documented in Fox and Sears 2014. Comparisons of our natural vegetation land area estimates with those made by others indicate that our estimates result in evapotranspiration on the lower end of the range. When faced with a choice, we intentionally made land use assumptions that underestimate evapotranspiration in an effort to assure that natural Delta outflows were not underestimated in our base case (Case I). We then varied our vegetation land use assumptions in sensitivity Cases II – VIII to explore the effect of land use assumptions on natural Delta outflow. The revised manuscript will be modified to summarize the comparison of our base case vegetation land areas with those made by others and explain their impact on our resulting estimates of Delta outflow.

Comment 2. Abstract – p.3849 Line 7: Confused statement. This paper is arguing that the annual average Delta outflow is not decreasing due to development. Thus the reduction in annual average Delta outflow does not exist and should be excluded from the causes of the ecosystem declines, according to this study.

Response: The sentence will be rephrased as follows: "Thus it is unlikely that observed declines in native freshwater aquatic species is a result of annual average Delta outflow reductions."

Comment 3. Sect. 3.2 – p. 3854 Line 23-27: Dubious. Is that true that the long-term groundwater storage did not changed significantly? The massive replacement of natural vegetation cover by artificial landscapes usually changed the surface infiltration

and thus may resulted in declining groundwater level. This simplification may lead to ignorance of the most important factors that may contribute to the reduction of the Delta outflow. Please give some measures or data about the historical groundwater table variation to clarify that this point.

Response: We agree with the reviewer that replacement of natural vegetation with artificial landscape has changed surface infiltration and other factors that have impacted groundwater levels. Certainly groundwater levels are lower under current conditions relative to natural conditions. However, the statement on p. 3854 relates only to the steady state assumption associated with Equation 1 under natural conditions. We agree that modification of the landscape changed surface infiltration and other factors that have affected the groundwater table under current conditions. Our analysis assumes that, under natural conditions, groundwater conditions are at dynamic steady state, i.e. no long-term gains or losses in groundwater storage are experienced over the 88-year period of record. No changes to the text are proposed.

Comment 4. Sect. 3.4.3 – p.3862 Line 12: Why case 4 is necessary? Why there isn't a case that it is rainfed grassland in Sacramento and Delta Basins and mix of perennial grassland and vernal pools in San Joaquin Basin?

Response: The annual water budgets produced by our analysis suggested that water supply in the San Joaquin Basin may have been insufficient to support Case III vegetation. As a remedy, the landscape assumption was modified in Case IV. We will add additional text to justify the need for Case IV.

Comment 5. Sect. 3.4.3 – p. 3863 Line 15-24: Is the grasslands in Case 7 and 8 are constant or variable? Are they used to compare with Case 1 and 4? This should be clearly stated and may be important. If this is it, why not add more cases to compare with case 5 and 6 to explore impact of the foothill hardwoods and wetland at individual years level? Aren't the case 5 and 6 are more closely represent the natural conditions?

Response: As the reviewer correctly points out, we believe Cases V and VI most

closely represent the natural landscape. And as the reviewer suggests, many sensitivity scenarios could be explored and reported. We believe that the eight scenarios that we show are all reasonable scenarios, and while providing additional scenarios would be interesting, the presentation and discussion of additional scenarios would become unwieldy. Regarding Cases VII and VIII, (1) the grassland assumptions are identical to Case I, i.e. they are constant and (2) the purpose of these cases was to explore sensitivity of the Case I hardwood assumption. No change to the text is proposed.

Comment 6. Sect. 3.4.3 – p. 3864 Line 1-4: Same question as 3. Why specifically wetlands in San Joaquin Basin are assumed as rainfed grasslands as case 8. Why no case 9 that Sacramento and Delta basins with rainfed grasslands? I am not very familiar with the study areas, what's the difference between these two regions that makes the authors focused just on changing settings in San Joaquin Basin?

Response: As the reviewer points out, this comment is similar to that raised regarding Case IV. The motivation for considering both scenarios is similar – the San Joaquin Basin has a smaller water supply available to it relative to the Sacramento Basin and the Delta. We agree with the reviewer that clarifying text will be helpful to justify the special attention provided to the San Joaquin Basin. Such clarifying text will be provided.

Comment 7. Sect. 4 – p. 3864 Line 23: I did not find the numbers of 29.6 and 30.8 in Tab. 5. It seems according to Tab. 5, the total water use are respectively 30.4 and 29.7 billion m3yr-1 for case 5 and 6. And excluded the aquatic surface, the natural water use in this two cases should be 30.1 and 29.4 billion m3yr-1. It this a mistake? BTW, I notice that the sum of water use by grassland-vernal pool and wetlands is 74%(40%+34%) of the supply, that these natural vegetation types are classified as independent types in Tab. 3. I wonder why it is larger than the total water use, which is 60% of the supply.

Response: The total water use numbers will be changed to 30.4 and 29.9 billion m3yr-1 for Cases V and VI as correctly identified by the reviewer. Also, the percentages

reported in the text and noted by the reviewer are misleading. The intent of the text was to provide an approximate breakdown of the water use, i.e. about 74% of the water use is associated with grasslands-vernal pools and wetlands. So this use would be 44% of the supply (0.74 x 0.60). The text will be revised to be more clear and precise.

Comment 8. Sect. 6 – p. 3869 Line 13-14: Same as 1. If the annual average freshwater outflow reduced, it still may be cause of the ecosystem declines.

Response: The sentence will be rephrased as follows: “Thus it is unlikely that observed declines in native freshwater aquatic species is a result of annual average Delta outflow reductions.”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 3847, 2015.