

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

**P. Fox et al.**

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We appreciate the reviewers second set of comments. Each comment made by the reviewer has been numbered by the manuscript authors and responses are shown just below each.

Comment 1. On reading the author response I figured out what is bothering me: The authors are comparing observed current flows to modeled "natural flows". [1] Natural flows are a counter factual scenario created by modelling the recent rainfall record but using historical land use scenarios. At present, as I see it, the model is an unvalidated one. I had assumed somewhere that if the same ET modelling approach were applied to current land uses it would reproduce current flows within reasonable bounds - hence

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my questions about urban return flows and groundwater depletion. Now I realize this wasn't actually done. But without this step, the model remains unvalidated.

Response: The paper does not compare observed current flows with modeled natural flows. The metric of interest, Delta outflow, is reported at the mouth of a tidally influenced estuary where direct measurement of flows is not feasible. Measured Delta outflow data for the period 1922 to 2009 do not exist, although Delta inflows are measured and tidally-averaged Delta outflows, referred to as the Net Delta Outflow Index or NDOI, have been computed by others using a similar mass balance approach. See: <http://www.water.ca.gov/dayflow/>. We are comparing two sets of hypothetical flows to determine the impact on Delta outflow of changes in land use. Both sets assume a fixed land use over an 88-year period, and a repeat of the historical climate (i.e., precipitation and temperature). The first set of flows uses the 'existing' (2011) land use, the second set of flows uses pre-development land use.

Comment 2. I think the authors should do this given the controversial claims of the paper. This should be possible to do this with the data available. Simply put - use the exact same approach to current land uses, show that it replicates current flows and then compare ET today to ET in the natural scenario. [2]

Response: While we understand the sentiment of wanting to validate a model, we are not "modeling" either natural flows or current flows as they existed at any point in time. Rather, we are comparing two sets of hypothetical flows under varying land use conditions with constant climate to evaluate the impact of land use changes on Delta outflow. Others have used a similar mass balance approach to estimate actual Delta outflows, referred to as the NDOI. We agree that it would be useful to compare current ET with pre-development ET and will add a bar chart to the final manuscript, based on the Net Delta Outflow Index, that makes this comparison.

Comment 3. Because the numbers are not communicated clearly, it is difficult to track the pieces. E.g. the paper states that of the 52 billion m<sup>3</sup>/year of water available

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(including  $\sim 2$  billion  $\text{m}^3/\text{year}$  of inter-basin imports and GW depletion) about 32 billion  $\text{m}^3/\text{year}$  is used by humans and 20 billion  $\text{m}^3/\text{year}$  is outflow to the delta. What I don't understand is how come ET from natural landscapes is currently zero? Does the 32 billion  $\text{m}^3/\text{year}$  include native vegetation or is that truly negligible? Is the amount of water consumed for "irrigation, municipal, industrial, and other uses" 32 billion  $\text{m}^3/\text{year}$  (Line 14) or 26 billion  $\text{m}^3/\text{year}$  (Line 26) on Page 3865? Or is the difference between the two ET from current natural vegetation?

Response: The 26.0 billion  $\text{m}^3/\text{year}$  cited in this comment is a typographical error, also noted by Referee #3, Comment 9. The amount of water consumed by irrigation, municipal, industrial, and other uses is the same in both cases or 31.9 billion  $\text{m}^3/\text{year}$ . This typographical error will be corrected, i.e., 26.0 billion  $\text{m}^3/\text{yr}$  will be changed to 31.9 billion  $\text{m}^3/\text{yr}$ . We will also add a figure to the final manuscript that compares current land use with natural land use to clarify the fact that development has resulted in removing nearly all of the natural vegetation.

Comment 4. Clear visualization of the break-up of water balance in the three scenarios (current, unimpaired and natural) is critical to making the case to the scientific community and ultimately policy makers. E.g. Pie charts of the 2011 water balance or stacked bar charts over time comparing the water balance components under current, unimpaired and natural scenarios would be helpful.

Response: "Unimpaired" is not a land-use based scenario. It is derived from an incorrect assumption by others that depletion of water on the Valley Floor is approximately balanced by precipitation on the Valley Floor. We will add a figure to the revised manuscript consisting of 3 adjacent pie charts that compare key components of the natural, current, and unimpaired water balances.

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

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