

## ***Interactive comment on “Climate change and climate-driven disturbances in the San Juan River sub-basin of the Colorado River” by Katrina E. Bennett et al.***

### **Anonymous Referee #1**

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“Climate change and climate-driven disturbances in the San Juan River sub-basin of the Colorado River” submitted by Bennet et al. addresses the timely and important question of the interrelated influences of vegetation and climate change on a Colorado River headwater’s system. I found the title to be appropriate and the abstract to represent the discussion presented in the manuscript. While I generally agree that vegetation dynamic may present an important complication to modeling future climate states, I feel the authors did not clearly explain the mechanisms driving the modeled change or thoroughly fit their work into a greater body of growing literature as summarized in my general comments below.

C1

1. The vegetation properties and dynamics are not clear, particularly for a reader that is not familiar with the dynamic vegetation processes in Earth Systems Models (ESMs). The authors should provide additional details on how vegetation dynamics are modeled in the ESMs used here, as well as in the VIC simulations of vegetation change. This description should include the range of relevant vegetation parameters for each scenario/land cover classification (LAI, coverage, etc.) Ultimately, this discussion should also support a better description of the mechanisms behind the modeled hydrologic change. For example, the authors state that LAI values are similar between shrubs and forests (pg 10 Ln 16), and that the changes in water and energy balances are therefore related to changes in snow processes. LAI is known to have a strong control on snow processes, so in the absence of LAI differences, the authors should explain what physical vegetation characteristics are driving these changes.

2. The authors failed to cite a substantial number of recent references on vegetation and climate change in the Rocky Mountains, often relying on references from other regions such as Canada and Alaska. The differences in aridity and evaporative demand suggest regional references are more appropriate. (For example see Pribulek et al 2016 and Carroll et al. 2017 for additional modeling studies on vegetation and climate change effects on hydrology using more integrated modeling approaches, Penn et al 2016 for a modeling study of the effect of vegetation change across scales, Livneh et al. 2015 for another bark beetle modeling study that shows muted streamflow effects with regrowth, and Bearup et al. 2016 for a paper on vegetation effects on changes in streamflow partitioning). These references may also help to support a discussion on the importance of groundwater and evapotranspiration in this system and across scales.

Technical Corrections: Pg 4 Ln 16-18: Check section numbers Pg 7 Ln 10-13: At what timescales are the model results and observations compared for calculation of NSE? Hourly? Figure 3: It is not clear what the light gray shading is or why there is a gap in the dark grey shading near peak streamflow (i.e. late April). Figure 3 Caption: Clarify

C2

if historical period is from model runs or observations (throughout). Figure 4: It would be interesting to see how rain and snow is partitioned differently due to temperature change in these scenarios, either here or in another figure. Also, the axes units are not provided.

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