

**Reviewer comments, author responses and modifications for BGD-10-12919-2013, Caldwell et al., Simulated impacts of mountain pine beetle and wildfire disturbances.**

**Reviewer 1 comment 1:** *This is a well-written and well-organized paper. The issue of time until recovery of lodgepole pine forests in the Rocky Mountains, heavily affected by both wildfires and mountain pine beetle (MBP) outbreaks, is timely and highly relevant. The literature review is well done for the most part. The FVS parameterizations are well justified with relevant ancillary information from the MTBS and FIA programs.*

**Author response:** Thanks for taking the time to review the paper and for these positive comments.

**Reviewer 1 comment 2:** *Regeneration seems to be one of the largest sources of uncertainty in these simulations, if not the largest. I would think that this uncertainty increases over time, with time since disturbance. Because the plots were established following a random stratified design, it seems safe to assume the full range of conditions that would affect regeneration are represented, in as unbiased a manner as is possible with this many field plots. It is helpful to see a statement to this effect in the Discussion (top of P12944), but the authors might remind the readers of the sampling design.*

**Author response:** We agree that readers would benefit from a statement about our sampling design and how it resulted in a robust data set used to parameterize the REPUTE module in FVS. We have added such a statement in the discussion.

Page 12944, line 16+: “Moreover, because our field data used to parameterize REPUTE were drawn from locations selected using a randomly stratified sampling design, we are confident the full range of variability of conditions affecting forest regeneration after an MPB outbreak were included.”

**Reviewer 1 comment 3:** *The blow down events referred to at the top of P12946 could be cited, and have occurred within this study area. See Buma and Rumbaitis del-Rio pubs.*

**Author response:** We appreciate the reviewer’s suggestion to include additional references about disturbances caused by wind, and have added one of the suggested references (Buma and Wessman, 2012); see the new sentence below. While we agree that the paper by Rumbaitis del-Rio is an interesting study conducted within the same study region as the current study, their work focused on the responses among forb, graminoid, and shrub cover and was therefore omitted to maintain our more narrow focus on the response of tree species.

Page 12946, line 4+: “Potential interactions between past and future disturbances (Sibold et al., 2007), can impact conifer recruitment in a species-specific manner (Buma and Wessman, 2012), and may be required before a shift in species composition occurs (Amman, 1977).”

**Additional reference:** Buma, B., Wessman, C.A. Differential species responses to compounded perturbations and implications for landscape heterogeneity and resilience, *Forest Ecology and Management* 266, 25-33, 2012.

**Reviewer 1 comment 4:** *The authors conclude by mentioning all the factors that were not considered in these simulations. Yet the biggest one of all, climate change, is not even mentioned. This is the biggest shortcoming of the paper. Did the authors consider projecting these disturbance scenarios under anticipated climate change scenarios, using Climate-FVS? Why did they not use it? I'm not saying that they need to explicitly consider climate change, or use Climate-FVS, but it certainly deserves mention. See the recent Crookston et al. pub in Forest Ecology and Management.*

**Author response:** Good point. When initially planning this study, we did consider incorporating climate-change effects into the simulations, but ultimately decided it added too much complexity for this manuscript, given the comparison of numerous variable across 3 simulations over 200 yrs. We agree that climate change could play a critical role in future dynamics in our study area, and that Climate-FVS is a valuable tool now available for analyses such as ours. We added text to mention why Climate-FVS wasn't used in this study in section 4.3 (Uncertainties and limitations), citing the Crookston et al. 2010 FEM paper.

We changed the paragraph starting at page 12943, line 19 to read: "Although regeneration models have been developed within FVS for some regions of the US, this has not been done for the Central Rockies Variant, presenting a significant limitation to users who are interested in long-term projections of vegetation change in this area. Users have 3 options: determining and scheduling the appropriate number of seedlings to add to simulations at the appropriate time steps themselves; using Climate-FVS (Crookston et al. 2010); or using the REPUTE post-processor in FVS to impute future regeneration from their own data or additional sources of data (Vandendriesche, 2010a). Scheduling seedling establishment requires making assumptions about the species and density of seedlings likely to establish at given times in the future. Climate-FVS introduces functions to initiate forest regeneration based on stand conditions and climate predictors, but implies that users understand probable climate-related vegetation dynamics in their study system and are explicitly incorporating climate-change scenarios into their analyses. For the third option, REPUTE imputes future seedling and sapling counts based on forest type and stand structure categories. It requires field data to parameterize, which can sometimes be acquired from the nearest regional FIA dataset if the user's own data are not sufficient. However, regardless of the data source, use of REPUTE assumes that the forest structure conditions under which future seedlings will establish are represented in the input data set. If users wish to model significant future changes to forest conditions, this assumption may not be valid."

We also added text in the summary, section 4.4, pointing out that climate change may also play an important role in species composition changes, not just disturbance frequencies.

We changed the sentence starting at page 12946, line 7 to read "Improvements to our modeling methodology could include assessment of below-ground carbon pools, carbon fluxes, a more dynamic (and, ideally, field validated) approach to modeling regeneration and tree fall rates, and a focus on the potential effects of additional future disturbances over time. Using models like Climate-FVS (Crookston et al., 2010), the effects of potential climate change on species regeneration, growth rates, and mortality could be incorporated, in addition to climate-driven changes in disturbance frequency. These

improvements were beyond the scope of this analysis, but could be incorporated into future analyses and studies.”

**Additional reference:** Crookston, N.L., Rehfeldt, G.E., Dixon, G.E., and Weiskittel, A.R.: Addressing climate change in the forest vegetation simulator to assess impacts on landscape forest dynamics, *Forest Ecology and Management*, 260, 1198-1211, 2010.