Reviewer Report

Manuscript title:
Dispersal dynamics along river corridors modulate impact of climate change on treeline shift in Hengduan Mountain

This manuscript extends the spatially explicit individual-based model LAVESI to four major river corridors in the Hengduan Mountains and examines historical and future treeline dynamics using field observations, tree-ring records, multispecies parameterization, and replicate simulations. The distinction between along-corridor displacement and elevational change is potentially useful, and the study represents a substantial modelling and data-collection effort. However, the current design does not yet clearly separate the effects of river-corridor characteristics from those of initialization, model calibration, domain geometry, and climate forcing. Several central interpretations, particularly the claim that river corridors modulate treeline migration and the proposed explanation for the stronger response under SSP2-4.5, therefore require additional support or more cautious framing.

1. The four transects have very different spin-up lengths, whereas seedintro_maxy is fixed at 5000 m in all simulations. Direct seed introduction therefore covers the entire Dadu spin-up zone but only approximately 1.7–2.5% of the other three zones. The long spin-up period and permanent background seed rain may reduce this discrepancy, but the manuscript does not clarify whether the permanent seed input is also restricted by seedintro_maxy, nor does it demonstrate that all four transects had reached comparable equilibrium states by 1940. A simple pre-1940 stability diagnostic is needed; otherwise, the comparison between Dadu and the other rivers should be interpreted more cautiously.

2. The authors initially compare simulations with plots 401–472, but the final elevation offset of 900 m is selected using the single best-performing reference plot, plot 404, and then applied to all four river systems. Because this parameter compensates for differences between coarse-resolution climate forcing and local mountain climate, its transferability across climatically and topographically distinct river corridors requires validation. The manuscript should report model performance across the full plot dataset and demonstrate that the main inter-river patterns are not highly sensitive to the chosen offset.

3. The finding that SSP2-4.5 often produces greater cumulative advance than SSP5-8.5 is potentially important. The discussion already offers plausible explanations involving local environmental constraints, species-specific climatic suitability, and nonlinear responses to warming. However, these explanations remain inferential. Because LAVESI explicitly represents growth, establishment, competition, and mortality, a limited process-level analysis should be used to determine whether the weaker response under SSP5-8.5 is actually associated with reduced growth or establishment, increased drought stress, or greater mortality. Otherwise, these explanations should be presented explicitly

as hypotheses.

4. The current experimental design does not isolate a river-corridor effect. All simulations are conducted within narrow domains extending only 30 m on either side of the river centreline, and seeds leaving one lateral boundary are reintroduced from the opposite side. This geometry constrains long-distance movement primarily along the transect. In addition, there is no non-river control, such as a ridge or non-valley slope, and hydrological dispersal, flooding, and riparian disturbance are not explicitly represented. River-specific topography, climate, wind forcing, simulation length, and spin-up length also vary simultaneously. The results therefore demonstrate heterogeneous dynamics among four river-aligned transects, but do not by themselves show that river corridors enhance or modulate treeline migration relative to non-river landscapes. The causal language in the title, abstract, and conclusions should either be supported by an appropriate control or moderated accordingly.

5. Future temperature and precipitation are taken from a single climate model, MPI-ESM1.2-LR. The simulations therefore represent differences among SSPs under one model realization, but do not account for structural uncertainty among climate models. This is particularly relevant because the non-monotonic ordering of SSP2-4.5 and SSP5-8.5 may depend on the regional temperature–precipitation response of the selected model. The authors should justify the choice of MPI-ESM1.2-LR and make clear that the projections are conditional on this forcing. If a multimodel sensitivity analysis is not feasible, the potential model dependence of the scenario ranking should at least be discussed.

6. Future wind fields are generated by resampling historical winds from 1940–2020. The manuscript explains that this was done to avoid the lower spatial resolution of future wind data, but the resulting stationarity assumption is not discussed. Because wind speed and direction directly determine seed dispersal, the authors should clarify whether the resampling preserves seasonality, the joint distribution of wind speed and direction, and temporal persistence. It should also be stated whether the three SSPs use identical or statistically equivalent wind forcing.

7. The supplementary material substantially improves the transparency of the multispecies parameterization by providing parameter values and tree-ring data sources. Nevertheless, several missing parameters are transferred from congeners as "educated guesses, and many demographic parameters are shared across species. The manuscript should briefly explain the most important parameter transfers and discuss whether uncertainty in dispersal, establishment, drought sensitivity, and mortality parameters could affect the relative results among rivers. A full new parameter table is not required, but the consequences of parameter sharing should be acknowledged.