Dear Editor, dear Reviewers,

Thank you for the positive feedback, and the opportunity to resubmit a revised version of the manuscript. We revised the manuscript to address all comments and responded to all comments point by point.

Our replies to the comments and corresponding changes in the manuscript (manuscript with track change) are highlighted in bold.

We look forward to your decision.

Best Regards,
Dushyant Kumar and Co-authors.

Comments by referee #2:

"Thanks for the opportunity for reviewing the manuscript "Climate change and elevated CO_2 favor forest over savanna under different future scenarios in South Asia" by Kumar et al. This study uses aDGVM2 to simulate vegetation dynamics in South Asia under RCP4.5 and RCP8.5 projected by GFDL-ESM2M climate data for the period 1950 to 2099. This is entirely a modeling study, but the method description was detailed and the limitation of relying on modeling was well recognized.

Reply: Thank you for your time in reviewing our manuscript.
The writing was clear overall with sporadic grammar issues. I have the following major concerns.
1) Similar types of study have been done many times in the literature to examine climate and CO_2 effects on vegetation, through well-known mechanisms of drought and CO_2 fertilization. It would be useful for the authors to think about and explicitly describe what is novel for this particular study.

Reply: **Thank you for pointing this out. Indeed there are many studies available for the region, however, most of those studies are either global scale and have represented the region with few vegetation types with fixed trait variability or focused mainly on forest neglecting the savanna biomes. The novelty of our study is that this is the first study where we have used a fully trait based vegetation model i.e., aDGVM2, which is capable of considering trait variability and how plants adapt to changing environmental conditions. We also considered the long neglected and misrepresented savanna biomes. We also conducted simulation with/without CO_2 to investigate the role of CO2 fertilization, however the impact of climate change and rising CO_2 effects are uncertain.**

We have highlighted these explanation in the revised manuscript in bold in line 70-78.

2) Authors used MODIS ET product to validate model predictions. MODIS is per unit ground area based, while the authors converted model predictions into per biomass based. It seems to me

these two have different meanings and should not be compared directly. Further, MODIS ET also provides temporal sequence, but the authors seemed to have only validated the spatial pattern of model predicted ET. What about temporal dynamics?

Reply: **For model-data comparison (Fig. 1 and S3) , we used a 10 year average of MODIS ET and compared it to a 10 year average of model simulated ET (2000-2009). The modelled ET used for data-model comparison has also same unit as MODIS ET i.e., mm/m^2/year. For performing comparative analysis of biome level ET under different scenarios for different periods (Table 3), we estimated the ET per unit biomass for respective biome i.e., mm/kg/year. We normalized ET to biome-level leaf biomass to eliminate effects caused by change in biome area and leaf biomass per biome and make it more comparable and independent of biome attributes such as area covered by a respective biome and biome-level biomass.**

For clarification, we have highlighted the units used for data-model comparison of ET in line 240-242 and biome level ET in line 282 in bold.

In our study we did not focus on the temporal dynamics of the ET and only used the decadal average for comparison. However, we agree that it would be very interesting to look at temporal dynamics to assess the performance of aDGVM2 in capturing the seasonality of ET in the ecosystem.

3) It seems aDGVM2 predicts biome changes based on biomass and phenology, how is phenology dynamically predicted by the model?

Reply: Yes, aDGM2 predict change in phenology. In Scheiter et al., (2020) we did a detailed analysis of phenology changes from deciduous to evergreen types that can be explained by increasing precipitation and reduced transpirational demand in C_3 plants.

Here is brief summary of phenological model implemented in aDGVM2:

The aDGVM2 simulates four different phenological strategies: light-triggered evergreen, rain-triggered evergreen, light-triggered deciduous, and rain-triggered deciduous (Langan et al. 2017). Woody plants can adopt all four types whereas we assume that grasses are evergreen. Whether a plant is deciduous or evergreen and whether it is light- or water-triggered are two dynamic traits that are constant during the lifespan of a plant, but that can change between generations due to trait inheritance and community assembly processes in aDGVM2. Deciduous vegetation switches between a dormant and a metabolically active state once moving averages of soil matric potential (water-triggered) or solar radiation (light-triggered) exceed or fall below threshold values. Evergreen woody plants remain metabolically active during their entire life time. However, leaf flushing of evergreen plants is stimulated by water and light triggers, i.e., leaf flushing occurs once moving averages of soil matric potential (water-triggered) or solar radiation (light-triggered) exceed threshold values. The threshold values are plant-specific dynamic traits. They are constant during the lifespan of a plant but they can change between generations due to trait inheritance and the community assembly processes in aDGVM2. While our

approach does not allow plants to switch between phenological strategies during their lifetime, growing season length can adjust to inter-annual variation of the climate, because the thresholds used to trigger phenology can be crossed earlier or later in the year.

In asGVM2, simulated phenology is considered in the classification scheme and biome changes related to phenology are caused by changes in the abundance/biomass/cover of these different phenological strategies.

4) Biodiversity and conservation were mentioned throughout the manuscript. But these are implications, not directly addressed in this current work. I would suggest authors to focus on SPECIFIC contributions of the current work and avoid making overstatements.

Reply: The findings of our current study have specific implication for ecosystem management. For example, woody encroachment predicted in the open savanna biomes implies change in the current biome state that would threatens the biodiversity of the system and affect the wildlife. Another example is that woody encroachment in arid regions would affect water resources in the semi-arid.

We have highlighted these major implication of our current find in bold in line 497-500 and 504-506.