EGU21-15912
https://doi.org/10.5194/egusphere-egu21-15912
EGU General Assembly 2021
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Understanding the feedback of landuse practices and vegetation change in a Namibian savannah - a model assessment

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Changing climatic conditions and unsustainable management strategies associated with biodiversity loss are perceived as major threats to Namibian savannahs. In the past, land-use in Namibia is dominated by livestock-farming as one of the major economic products. However, high grazing pressure led to degrading pastures in many regions in the country. In response, more farmers have recently shifted their land-use strategy from livestock to wildlife-based management, with so far unclear consequences for ecosystem dynamics.
In this study, the ecohydrological, spatially explicit savanna model EcoHyD (Tietjen et al. 2009, 2010; Lohmann et al. 2012, Guo et al. 2016) was used to assess the impact of different land-use strategies on plant composition and ecosystem properties. The aim was to systematically evaluate the impact of different land-use strategies in terms of animal types and densities on the diversity of major plant groups (shrubs, perennial and annual grasses) and on several ecosystem processes. The results allow for identifying sustainable landuse strategies that avoid degradation and that lead to long-term provision of ecosystem services and economic income.
We identified typical different functional plant types (PFTs) of the study region and parameterized the model to reflect the local environmental dynamics of the private game reserve Etosha Heights in Namibia. Afterwards, we run the model and assessed the composition and cover of our simulated PFTs, as well as water availability dependent on the land-use scenario. The results are in line with our expectations: they show that total plant cover increases with decreasing stocking rate and that cover and biodiversity are generally higher in browsing scenarios. In addition, we could explore, which PFTs of a given plant group are best adapted to grazing or browsing animals in a certain density. We could also show that perennial grasses benefitted more than shrubs from lower stocking rates. This benefit led to an improved soil water availability to plants, since less water was lost by overland flow, implying also a lower erosion risk. As the model has been applied to a variety of environmental settings regarding climatic conditions but also soil properties, we are confident that this study can serve as blueprint to assess shifts in land-use also in other savannah systems.