Understanding social-ecological (dis)similarity across the world’s tropical dry forests and savannas

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Abstract

Conservation of socially and ecologically valuable ecoregions like tropical dry forests and savannas is increasingly becoming more complex. Conservationists rely on a legacy of tools and institutions that are not suited anymore to the wicked nature of today’s socialecological systems. Land system science is making progress in providing solutions to that problem through the establishment of tools that structure the complexity of land systems and identify structures of cases, where conservation procedures can be studied and compared. One strategy that aims at reducing the multidimensionality of socialecological systems for a better transferability of interventions are geographic similarity analyses. With this study, I introduced an exploratory approach that elucidates the concept of similarity from different perspectives. I used an unsupervised machine learning clustering algorithm and internal evaluation metrics to discover spatial patterns in a selection of ecological, social, and social-ecological variables in tropical dry forests and savannas. In the next step, I examined the patterns of occurrence of deforestation frontier archetypes in ecologically, socially, and social-ecologically similar ecoregions. The clustering analysis revealed that similarities of all three domains are distributed globally and are not dependent on geographic proximity. The ecological clustering produced a valid spatial similarity classification. Social and social-ecological clustering mainly revealed patterns of population distribution and activeness yet were limited to data availability. The examination of frontier archetypes in similar regions returned a more uniform archetype composition inside of biogeographic realms than inside areas of ecological, social, or social-ecological similarity. The consideration of only six clusters may however hamper this analysis, since detail gets lost when the spatially diverse distribution of archetypes is intersected with large, clustered areas. The identification of ecologically, socially, or social-ecologically similar areas can help to estimate the conservation value of a region and to anticipate land use changes based on a similar agricultural production potential. However, to better capture the diversity of land use actors and practices, other approaches like regionalization and archetype analyses can be integrated, to effectively structure the complexity surrounding land use dynamics.

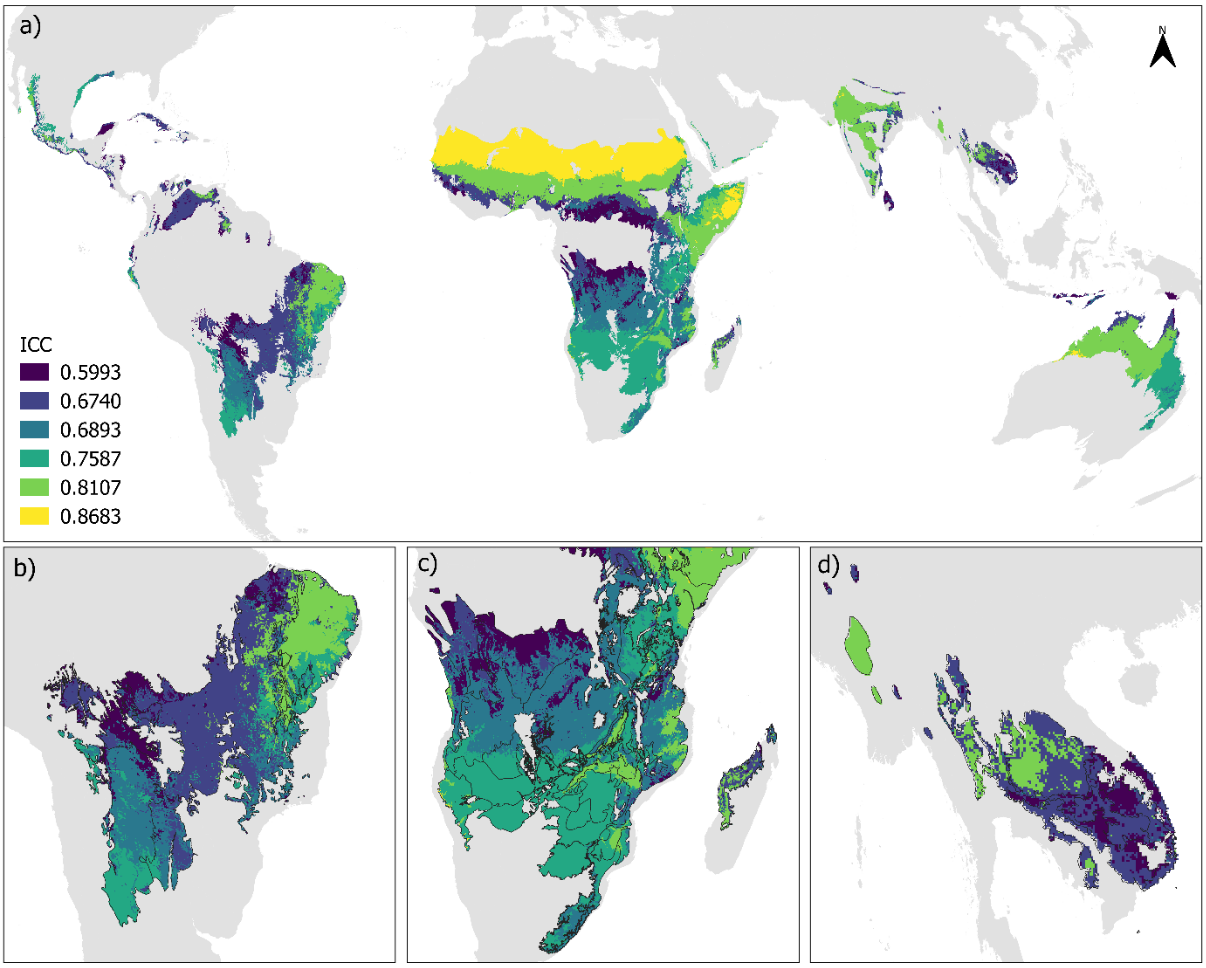

Figure 1: Spatial clusters of ecological variables. The color gradient visualizes the six calculated clustered areas as resulted from the K-Means analysis. The values correspond to associated intracluster-correlation coefficients and indicate different levels of homogeneity and separation of the data inside a cluster. The map therefore jointly depicts interregional and internal similarity.

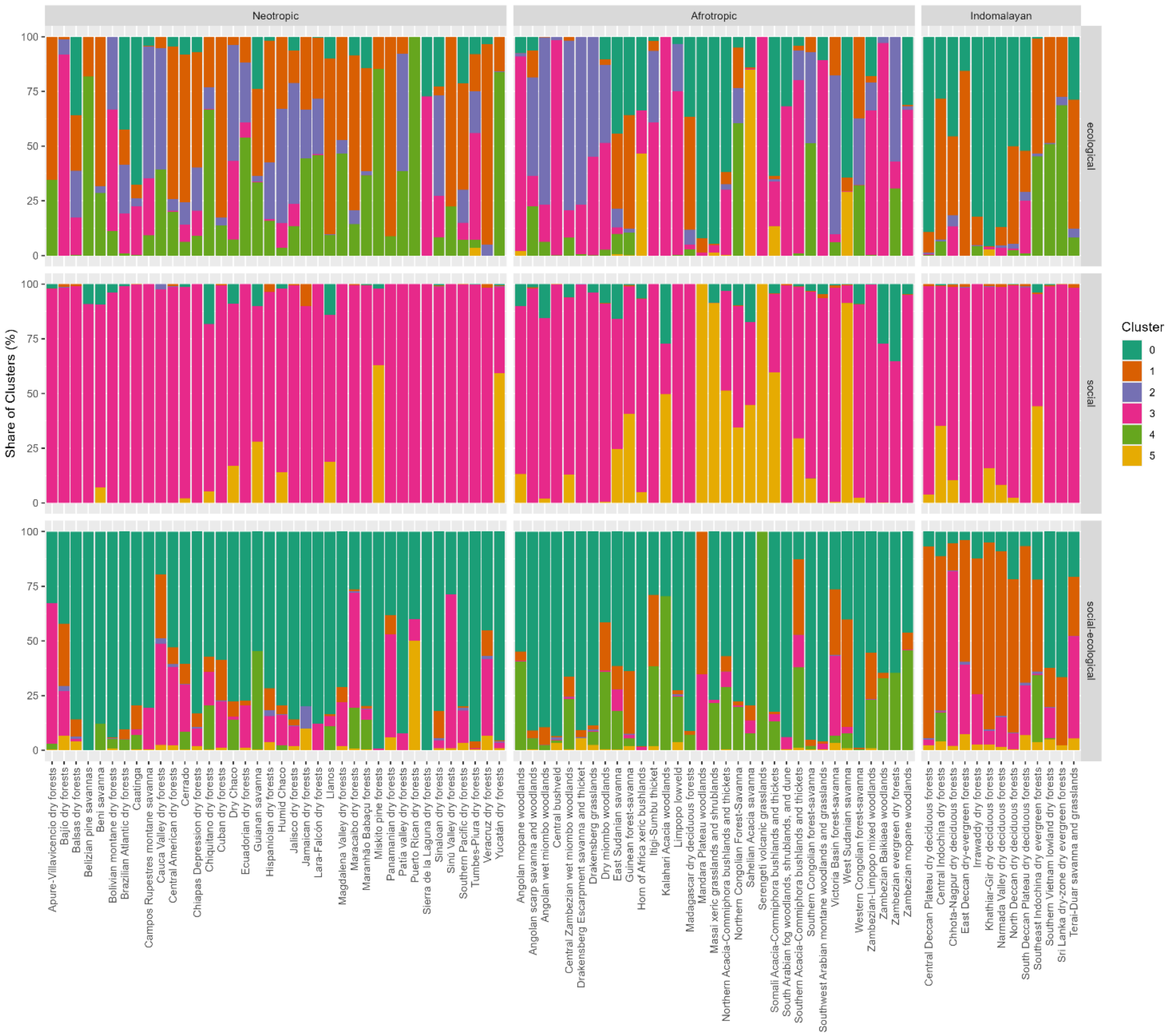

Figure 2: Shares of clusters inside TDF ecoregions. The stacked bars indicate how many clusters a TDF comprises, as well as their percentage share in the total TDF area, grouped by domain and biogeographic realm. This depiction represents a way to visualize intraregional similarity.

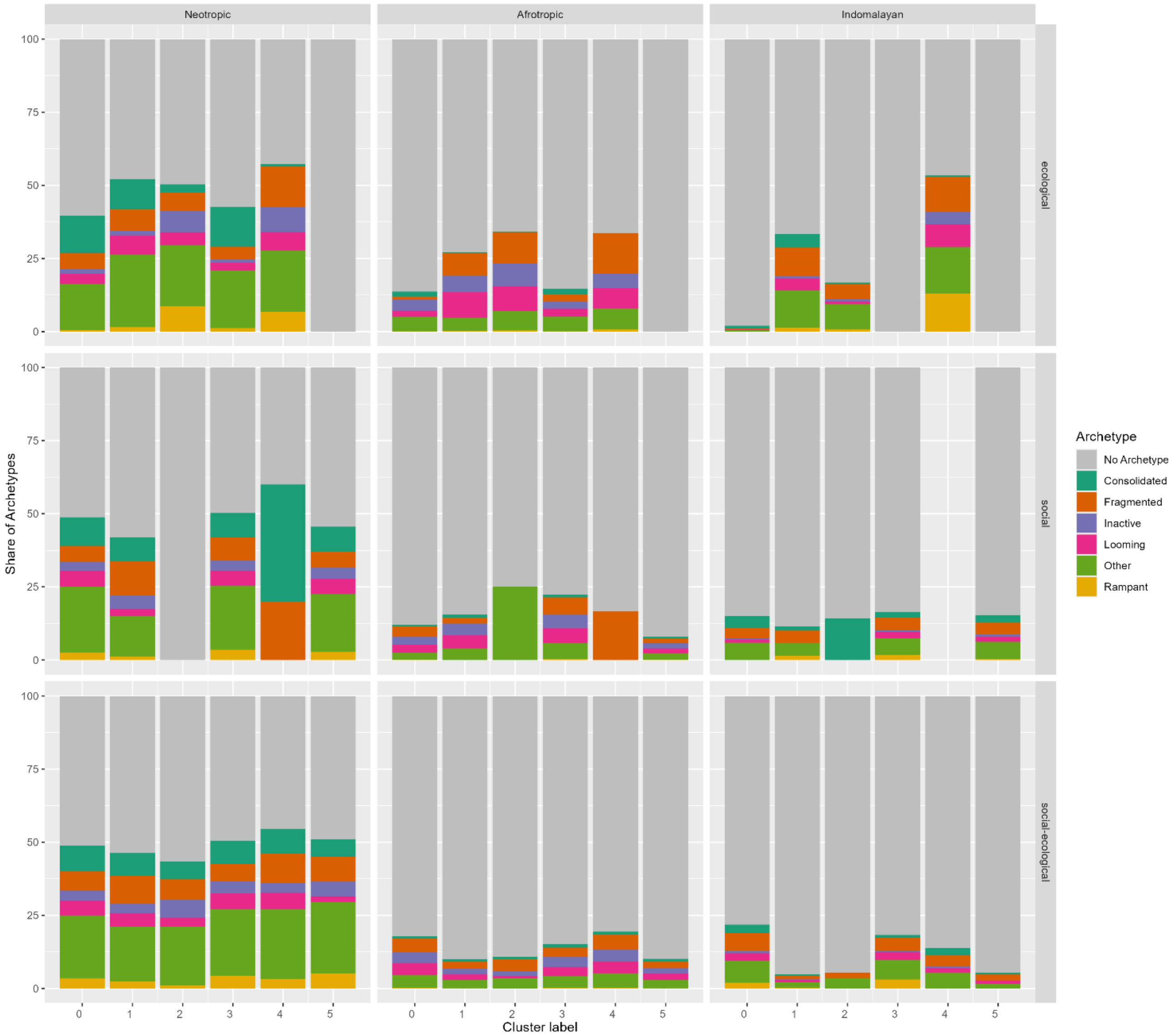

Figure 3: Archetype composition in clustered areas. The stacked bars indicate which deforestation frontier archetypes overlap with the clustered areas, as well as their percentage share in the total clustered area, grouped by domain and biogeographic realm.