Simulated tree-grass competition in drylands is modulated by CO$_2$ fertilization

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Interannual variability in climatic drivers can have a strong impact on dryland ecosystem functioning globally. While interannual variations in dryland ecosystem processes are mainly driven by rainfall, other global change drivers such as CO$_2$ fertilization and rising temperatures can play an increasingly important role for these ecosystems. Yet, the high complexity of dryland ecosystems makes it difficult to unravel the individual and compound impacts of these different drivers. In this work we study the impacts of interannual climatic variability on the dryland ecosystems of the Sudano-Sahel region for the period 1981–2019. By using a dynamic vegetation model (LPJ-GUESS v4.0), we show that the year-to-year variability in dryland ecosystems that originates from interannual variability in rainfall is modulated by effects of CO$_2$ fertilization, which can strongly impact woody encroachment and resource competition between vegetation types. We also show that this response varies with aridity subtype, depending on the amount and type of woody cover. By untangling the impacts of climatic drivers on dryland vegetation, this study helps us to understand the different sensitivities of dryland ecosystems to climatic variability.