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Towards reconstructing herbaceous biome dynamics and associated precipitation in Africa: insights from the classification of grass morphological traits

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Inter-tropical herbaceous ecosystems occupy a 1/5th of terrestrial surface, a half of the African continent, and are expected to extend in the next decades. Dynamic of these ecosystems is simulated with poor accuracy by Dynamic Global Vegetation Models (DGVMs). One of the bias results from the fact that the diversity of the grass layer dominating these herbaceous ecosystems is poorly taken into account. Mean annual precipitation and the length of the dry season are the main constrains of the dynamics of these ecosystems. Conversely, changes in vegetation affect the water cycle. Inaccuracy in herbaceous ecosystem simulation thus impacts simulations of the water cycle (including precipitation) and vice versa. In order to increase our knowledge of the relationships between grass morphological traits, taxonomy, biomes and climatic niches in Western and South Africa, a 3-step methodology was followed: i) values of culm height, leaf length and width of dominant grass species from Senegal were gathered from flora and clustered using the Partition Around Medoids (PAM) method; ii) trait group ability to sign climatic domains and biomes was assessed using Kruskal-Wallis tests; iii) genericity and robustness of the trait groups were evaluated through their application to Chadian and South African botanical datasets. Results show that 8 grass trait groups are present either in Senegal, Chad or South Africa. These 8 trait groups are distributed along mean annual precipitation and dry season length gradients. The combination of three of them allow to discriminate mean annual precipitation domains (<250, 250-600, 600-1000 and >1000 mm) and herbaceous biomes (steppes, savannas, South African grasslands and Nama-Karoo). With these results in hand, grass Plant Functional Types (PFTs) of the DGMV LPJ-GUESS will be re-parameterized and particular attention will be given to the herbaceous biomass assigned to each grass trait group. Simultaneously, relationships between grass trait groups and phytolith vegetation proxies will be quantified in order to reconstruct the past dynamics of herbaceous ecosystems and associated mean annual precipitation domains.