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Open areas in patchy ecosystems: key spaces for vegetation survival.

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Drylands are one of the largest biomes over the Earth, covering around 40% of land surface. These are water limited ecosystems where vegetation occupies the most favourable positions over the landscape. Less favourable areas are frequently covered by other biotic and abiotic components such as biological soil crusts, bare soil, or stones. During most rainfall events, runoff is generated in open areas (runoff sources) and redistributed through vegetation patches (runoff sinks), therefore increasing water and nutrient availability for plants. Water redistribution feedbacks determine vegetation coverage and productivity, modulate changes in its spatial distribution, and could ameliorate the predicted negative effects of climate change over these ecosystems.

The principal aim of this study was to quantify the impact of water redistribution processes on vegetation performance, and to evaluate how this effect varies in response to aridity. To achieve it, we analysed the relationships between runoff redistribution from open areas and vegetation productivity, by combining satellite information on vegetation state and topography. More precisely, we calculated Normalized Difference Vegetation Index (NDVI) dynamics during three hydrological years in 17 study sites along an aridity gradient in the SE of the Iberian Peninsula using SENTINEL 2 images. Then we used a DEM and a high spatial resolution vegetation map to derive a water redistribution index that simulate source-sinks interactions between vegetation and open areas. Finally, we analyse the relationship between, potential water redistribution and vegetation dynamics and how it varies along the aridity gradient.

We found a non-linear relationship between potential water redistribution and vegetation productivity. Overall, vegetation NDVI increases as potential water redistribution did, which demonstrated the importance of water redistribution processes on drylands vegetation performance. However, vegetation capacity to retain runoff water is limited and there is a clear threshold above which increased potential water redistribution does not promote vegetation productivity. Thresholds are caused by the limit capacity of vegetation to infiltrate run off when preferential flows are forming, increasing ecosystem connectivity, and involving local water losses for vegetation. Therefore, an increase in open areas between vegetation patches could have a positive effect over vegetation through hydrological connectivity but until to a certain point in which global connectivity supposed water losses for plants. This process could have important effects under climate change, by controlling the resistance and resilience of vegetation in drylands

ecosystems.

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