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Aridity threshold in controlling ecosystem nitrogen cycling in arid and semi-arid grasslands

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Higher aridity and more extreme rainfall events in drylands are predicted due to climate change. Yet, it is unclear how changing precipitation regimes may affect nitrogen (N) cycling, especially in areas with extremely high aridity. Here we investigate soil N isotopic values ($\delta^{15}\text{N}$) along a 3,200 km aridity gradient and reveal a hump-shaped relationship between soil $\delta^{15}\text{N}$ and aridity index (AI) with a threshold at $\text{AI}=0.32$. Variations of foliar $\delta^{15}\text{N}$, the abundance of nitrification and denitrification genes, and metabolic quotient along the gradient provide further evidence for the existence of this threshold. Data support the hypothesis that the increase of gaseous N loss is higher than the increase of net plant N accumulation with increasing AI below $\text{AI}=0.32$, while the opposite is favoured above this threshold. Our results highlight the importance of N-cycling microbes in extremely dry areas and suggest different controlling factors of N-cycling on either side of the threshold.

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