TECHNISCHE UNIVERSITÄT DRESDEN

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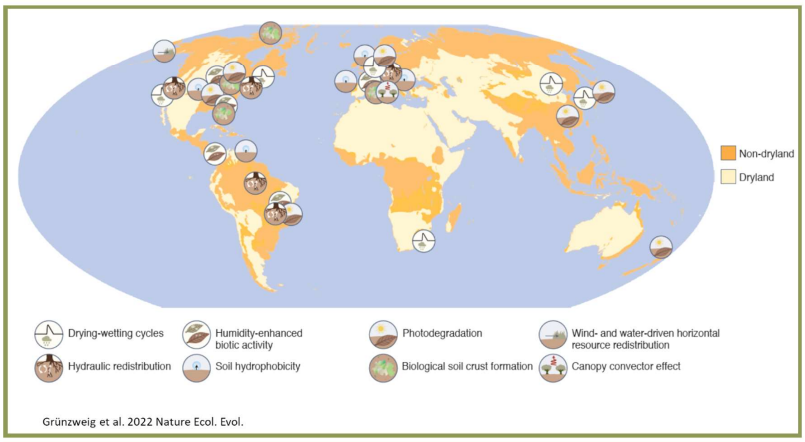
European ecosystems may function more like deserts in a changing climate – principles and implications

A warmer and drier climate, exacerbated by extreme weather events, alters the rates of numerous processes driving land biogeochemical cycles. However, beyond altering the operation of known processes, climate change can also lead to more fundamental transitions in the mechanisms governing ecosystem functioning. Climate change can force surface moisture and temperature across thresholds, beyond which mechanisms currently prevalent in dry regions start operating in historically moist biomes. Such 'dryland mechanisms' affect multiple processes of ecosystem functioning, including vegetation formation, water flow, energy budget, thus ultimately affecting carbon and nutrient cycling.

The emergence of dryland mechanisms in mesic, humid and cold ecosystems of Europe can either buffer or amplify climate change effects on biogeochemical cycles. For example, pulses of trace gases are emitted from the soil through repeated drying-wetting cycles, thus modifying the dynamics and budgets of carbon and nitrogen trace gases. Mechanisms of organic matter decay, such as photochemical, thermal and humidity-enhanced microbial degradation operate at intense solar radiation, heat and low soil moisture. Thus, decomposition continues even under conditions at which traditional rain-driven microbial degradation is minimal. Hydraulic redistribution transfers water from deep to shallow soil layers through the root system, thus enabling the survival and growth of roots. These mechanisms buffer some of the negative impacts of climate change on biogeochemical cycling. In contrast, soil hydrophobicity induced by warming and drying further enhances soil dryness, thus generating a positive feedback to climate change.

Fundamental knowledge gaps exist regarding microclimatic thresholds beyond which regime shifts occur and dryland mechanisms operate also in historically moist biomes. Traditional models based on continuous responses to climate variables would miss potential regime shifts and alternative eczosystem states, unless dryland mechanisms are incorporated.

With current and projected trends towards a warmer and drier climate and more extreme weather events, mechanisms previously restricted to drylands will increasingly control terrestrial biogeochemical cycling in many European biomes.



Wednesday 01.02.2023 | at 16:45 - 18:00

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