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# Global distribution of earthworm diversity

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Soil harbours high biodiversity, which is responsible for a large number of ecosystem services and functions. Despite its importance, across large scales little is known about the distribution, diversity and threats facing the organisms that live there. Environmental drivers will shape belowground communities across large scales, but they may not be the same as those shaping aboveground communities. This may have implications if aboveground diversity or environmental drivers are used as proxies for belowground diversity in conservation strategies. Here, we use a specifically compiled dataset on sampled earthworm diversity from across the globe (over 7000 sites in 55 countries) to predict earthworm diversity and identify which environmental drivers shape their diversity patterns across the globe.

Earthworms are a key group of soil macrofauna which provide a number of ecosystem functions, and are easy to identify to species level, thus relatively large amounts of data is available across multiple scales. We created models using three measures of diversity; species richness, community abundance, and community biomass. Diversity predictors were based on environmental drivers in five categories; soil, habitat cover, precipitation, temperature, and water-retention properties of soil. We used mixed effects models, containing variables from the five categories of environmental drivers, to predict earthworm diversity across the globe.

We show that local species richness and community abundance of earthworms typically did not peak in the tropics, but rather towards the poles, such as the southern tip of South America. Community biomass often peaked in the tropics, but other regions of the globe were also predicted to have just as high biomass, such as North America and the southern part of Russia. In all the models, climate variables were often the most important, with soil variables usually being of lower importance, which contradicts findings of previous small-scale studies that highlighted the significance of soil variables. Notably, as climatic variables are often used by aboveground modellers, this work suggests that methods can easily be transferred belowground. In contrast, as the patterns in earthworm diversity do not match patterns seen in other aboveground taxa (e.g., high diversity in the tropics), we cannot rely on conservation strategies based on aboveground diversity for soil macrofauna. And it's important that we understand diversity patterns of soil macrofauna, such as earthworms, due to their impact on many ecosystem functions. This work is the first step towards knowing how future changes in diversity drivers, such as earthworms, might affect earthworm diversity and what that means for the ecosystem functions upon which we depend.