Supplement of

Soil responses to manipulated precipitation changes: A synthesis of meta-analyses

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1. Categorization of meta-analyses by environmental characteristics and methodology

While it is important to understand general responses of soil properties and processes to precipitation changes, differences in site characteristics and experimental methodology cause a large amount of variability in the results of meta-analyses, and this variability is also important. By reviewing 42 soil variables studied in 16 meta-analyses, we found that environmental and methodological characteristics commonly influence effect sizes. Almost all meta-analyses, therefore, divide their dataset into smaller categories, or test the relationships between these factors and effect sizes. We identified that these factors can be categorized into six groups (Table S1): climate (temperature, precipitation and aridity), methodology (duration and intensity of treatment, measurement method, and fertilizer use), geography (latitude, longitude, and elevation), ecosystem (biome, forest type, and plant characteristics), soil (soil type, texture, depth, and carbon), and soil biota (taxonomic group, size, and trophic role).

Temperature, precipitation, and latitude are the most common abiotic factors to account for differences in ecosystem characteristics. This information is usually reported in scientific articles, and thus is a convenient means by which to group studies. Similarly, many studies use biomes (or ecosystem types) for grouping. Alternatively, aridity index is suitable for precipitation manipulation experiments as dry regions could be more sensitive to IP than wet regions, and wet regions more sensitive to DP than dry regions (Ren et al., 2018). The aridity index can be calculated with mean annual temperature (MAT) and precipitation (MAP) (Liu et al., 2016), or with MAP and potential evapotranspiration (Yuan et al., 2017; Zhou et al., 2016).

Methodological differences are also critical to take into consideration. Duration and intensity of manipulative treatments, especially, have a significant impact on soil responses (Smith et al., 2009). For R_s, R_a, R_h, and MB, measurement methods could be a significant factor; Liu et al. (2016) show that the effect size of R_s did not differ among R_s measurement methods (dynamic chamber with IRGA or other instruments, static chamber with GC, and static chamber with alkali absorption), but R_a/R_h partitioning methods (trenching, clipping, root extraction) had a significant influence on R_a and R_h effect sizes.

Moreover, synthetic fertilizer application could alter responses of nitrogen and phosphorus cycles (Xiao et al., 2018; Yue et al., 2018).

Finally, it is a common practice among meta-analyses of microbial communities to consider soil characteristics (Canarini et al., 2017; Ren et al., 2017; Zhou et al., 2018). Soil type, texture, SOC, and soil C are commonly considered in studies. Because of the association between phosphorus and soil parent materials, it is also common for studies focused on this element to consider soil characteristics such as soil type and soil depth (Yuan et al., 2017; Yue et al., 2018). We recommend that future meta-analyses categorize their dataset based on ecosystem characteristics, methodology, and other groupings that are relevant to the target soil variables.

Table S1. List of environmental and methodological factors affecting effect sizes, and count of meta-analyses taking each factor into account.

Climate	Count	**Methodology**	Count
Mean annual temperature	10	Duration of treatment	11
Mean annual precipitation	12	Intensity of treatment	9
Mean GS temperature	1	GS only or whole year	1
Mean GS precipitation	1	Rs measurement method	1
GS potential evapotranspiration	1	Ra/Rh partitioning method	1
GS soil moisture deficit	1	MB extraction method	1
Aridity	5	Fertilizer use	2

Geography	Count	**Ecosystem**	Count
Latitude	7	Biome	10
Longitude	4	Forest type (natural or plantation)	1
Elevation	2	Plant functional type	2

Soil	Count	**Soil biota**	Count
Soil type	2	Taxon	1
Texture	2	Body width class	1
Soil carbon	1	Trophic group	1
Soil organic carbon	2		
Soil depth	1		

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