Ecosystem warming experiments are a powerful tool for understanding how temperature increase influences soil organic matter dynamics. Although temperature is the most important variable explaining global soil carbon abundance and persistence, soil moisture is a secondary master variable. We sought to create an improved baseline for comparison across a global network of warming experiments by quantifying changes in soil moisture due to warming, as well as seasonal patterns of warming and soil moisture as a function of depth. Using a new open source database, the Soil Warming to Depth Data Integration Effort (SWEDDIE), we aggregated data from 15 experiments meeting the criteria of a measured temperature change ≥ 1 °C to a depth of ≥ 0.2 m over ≥ 3 y. The experiments span a wide range of climatic conditions (tropical to boreal), soil orders (9), and ecosystems (grassland, cropland, forest, tundra). Warming methods compared included buried resistance rods or cables, aboveground infrared heaters, snow removal, and geothermal heating. Median target temperature change across the experiments was 4 °C and median experimental duration was 10.4 y.

Across the experiments, control plot soil moisture was consistently higher than in warmed plots. Warming induced drying varied with depth, and was greatest at the soil surface (0-0.1 m) and in the deepest soil layers (0.8-1 m), possibly indicating an interaction with rooting. Sites with monsoon climates showed greater moisture differentials during the wet season, suggesting warming could depress productivity during optimal growth periods. In a subset of experiments heated seasonally, we observed persistence of the drying effect when heating was inactive, pointing to a possible legacy effect of warming on ecosystem water absorption or retention. We are currently working to quantify how soil properties, vapor pressure deficit, heating infrastructure, and rooting patterns relate to the observed depth dependence of soil moisture and warming across our sites. Incorporating the confounding effects of depth and soil moisture may help to resolve the contradictory impacts on soil C reported in previous warming experiment synthesis efforts, and ultimately will further our ability to predict soil carbon stock changes in a warming world.