

# Regional Patterns and Homogenization of Residential Yard Soil Moisture in US Cities

Wheeler, M.M.<sup>1</sup>, S.J. Hall<sup>1</sup>, J. Learned<sup>1</sup>, & H. Heavenrich<sup>1</sup>. <sup>1</sup>School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501

**How do soil moisture regimes compare among residential yards across the country? How does soil moisture in residential yards differ from soil moisture in minimally managed areas of native vegetation, and does this relationship differ regionally?**

**I predict that soil moisture will be similar among residential yards due to similar residential management practices, with residential moisture in arid regions increased relative to moisture in minimally-managed reference sites.**

## Background

Similar management practices in residential yards across the country are hypothesized to lead to homogenization of several aspects of the urban environment, including climate (Groffman et al. 2014, *Front Ecol Environ* **12**: 74). Soil moisture is a key parameter for understanding plant growth, microbial communities, and hydrology in a system. In addition to precipitation, soil characteristics, and slope, soil moisture is influenced by residential management actions, both directly through irrigation and indirectly through manipulations such as buildup of impervious surfaces and soil amendment or replacement.

## Study Sites & Methods

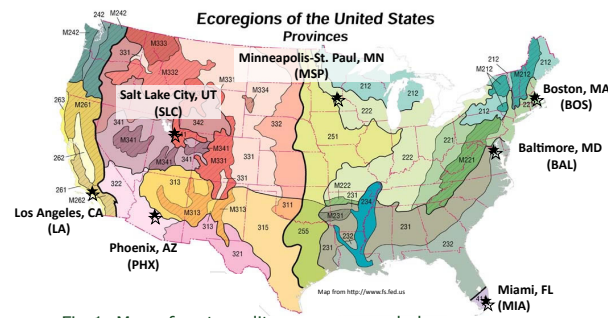


Fig 1. Map of metropolitan areas sampled.

- Sampled in six metropolitan statistical areas (MSAs) across the country
  - Sampled 11-15 residential yards per MSA
  - Also sampled 3-6 minimally managed reference areas per MSA
- Installed soil moisture probes ~10 cm under dominant vegetation (usually lawn in yards)
- Measured soil moisture (volumetric water content) every half hour to hour (depending on MSA) for up to three years



Fig 2. Soil probe installation.

## Results

- 1. Residential soil moisture seasonal patterns in different MSAs are distinctive.** The wetter MSAs (Baltimore, Boston, Miami, and Minneapolis-St. Paul) have more irregular, variable soil moisture, while Los Angeles and Phoenix are more constant with distinct rainfall events.

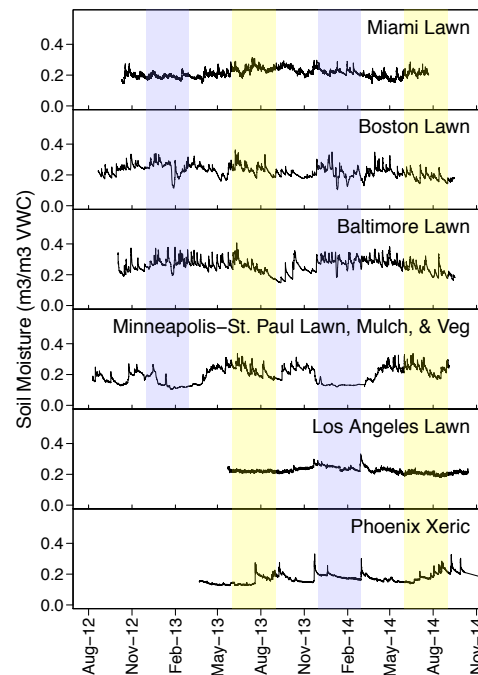


Fig 3. Soil moisture dynamics by MSA. Lines show the average of all sampled at each 1 hr time point for all time points where data exist for at least half of sites in the MSA. Summers (June 1 – September 1) are highlighted in yellow and winters (December 1 – March 1) are highlighted in blue.

- 2. Residential soil moisture differs from reference soil moisture but is relatively homogenous among MSAs.** Residential soils more frequently have higher soil moisture than reference soils in most MSAs, and residential soils have more similar moisture density distributions than do reference soils.

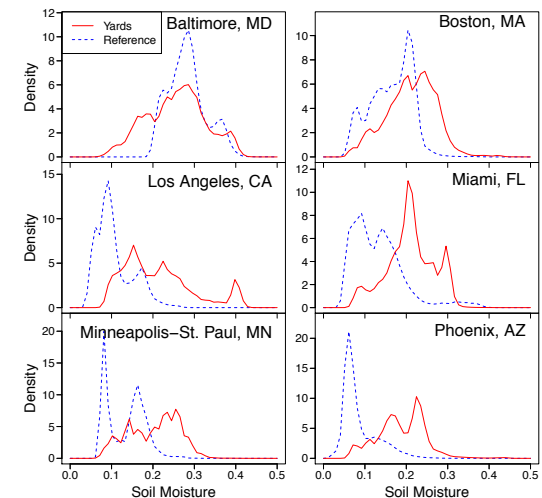


Fig 4. Kernel density plots of one year of soil moisture data in all sites in each MSA.

## Future Questions & Next Steps

**How do soil and vegetation properties affect variation in soil moisture?** Soil and vegetation data were also collected for these sites and may explain some variation within and between MSAs and between residential yards and reference sites.

**How can these data be used to inform and generalize ecohydrological models?** These extensive soil moisture measurements over broad geographic ranges could be used to extend existing models of residential soil moisture dynamics.