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# Which sampling design to monitor saturated hydraulic conductivity?

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Soil in a changing world is subject to both anthropogenic and environmental stressors. Soil monitoring is essential to assess the magnitude of changes in soil variables and how they affect ecosystem processes and human livelihoods. But which sampling design is best for a given monitoring task?
We employed a Rotational Stratified Simple Random Sampling (rotStRS) for the estimation of temporal changes in the spatial mean of saturated hydraulic conductivity (Ks) at three sites in central Panama in 2009, 2010 and 2011. In order to assess this design's efficiency we compared the resulting estimates of the spatial mean and variance for 2009 to those gained from the Stratified Simple Random Sampling (StRS) which was effectively the data obtained on the first sampling time, and to an equivalent unexecuted Simple Random Sampling (SRS).
The poor performance of geometrical stratification and the weak predictive relationship between measurements of successive years yielded no advantage of sampling designs more complex than SRS. The failure of stratification may be attributed to the small large-scale variability of Ks. Revisiting previously sampled locations was not beneficial because of the large small-scale variability in combination with destructive sampling, resulting in poor consistency between re-visited samples.
We conclude that for our Ks monitoring scheme, repeated SRS is equally effective as rotStRS. Some problems of small-scale variability might be overcome by collecting several samples at close range to reduce the effect of fine-scale variation. Finally, we give recommendations how to consider including stratification and rotation when designing a soil monitoring scheme.