Global relevance of selected results from soil research in Hawaii

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Hawaii is a model system for understanding soil development during weathering of mafic rocks, but it also has allowed us to understand soil processes globally. Results generated along well-constrained sampling gradients in Hawaii have generated hypotheses that can be tested using global databases. There is significant danger in using global databases to test soil processes because the soil sampling criteria for those databases may vary greatly from those imposed within a model system. Thus database analysis is ulimately a statistical game that may lose the power of understanding of the underlying processes that emerge from the model system analysis. With that as backdrop concern, I highlight several examples where Hawaii results led to successful global hypothesis testing.

The threshold in soil pH at about 0 water balance (MAP-PET) that is strongly evident in Hawaii is also evident in a global database of >20,000 soil pedons. Eric Slessarev has shown that variance from the expected patterns are explicable in the context of soil age and paleoclimate. An early result from Hawaii by Margaret Torn showed the importance of poorly crystalline metal – organic complexes in sorbing carbon and slowing turnover of soil organic matter. A globally representative set of samples measured by Marc Kramer shows a similar pattern to be true and importantly that the prevalence of those mineral – organic complexes increases rapidly on the positive side of the water balance line. If you were going to try to intervene in the carbon storage processes in soil you would want to do it on soils that are in the slightly positive water balance climate regime. The importance of oxygen supply in humid upland forest soils in Maui was initially pointed out Ted Schuur and later has been greatly amplified by Marco Keiluweit and Scott Fendorf. With increasing rainfall although the mineral – organic complexes of poorly crystallized minerals still sorb a large fraction of carbon in the soil, the lack of oxygen supply to support microbial turnover of carbon becomes more and more important.