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Climate and anthropogenic effects on the coevolution of soils and vegetation: A case-study in the Pacific island of Santa Cruz (Galapagos, Ecuador)

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Understanding the complex interactions between climate, vegetation and soils is important for the sustainable management of soil ecosystems in the context of climate and land use change. Few benchmark data exist on soil-landscape and vegetation interactions, as most soil ecosystems have a legacy of past land use and management.

By working in the Galapagos Islands, a UNESCO World Heritage Site, we have the opportunity to better constrain the coevolution of soils and vegetation over millennial timescales for pristine soil ecosystems. Five monitoring sites are located on the Pacific Island of Santa Cruz, and they cover a ~10 km long NW-SE stretch. Along this gradient with a 10-fold increase in mean annual precipitation, the climate effects on the coevolution of soils and vegetation were quantified. Soil weathering extent was assessed through geochemical proxies, and these data were then related to time-series of precipitation, air and soil temperature, and humidity to explore the relationships between soil and vegetation development, and climate. Then, by contrasting the data from five pristine soil ecosystems with data from agricultural soils, new information was obtained on the anthropogenic effects on soil ecosystems.

Soil weathering indices and elemental mass balances were used as a measure of soil development and were derived from the soil's physical and chemical properties measured at soil profiles. For the pristine sites, there is a nonlinear relationship between the degree of soil and vegetation development and (hydro)climatic data. Forest conversion into agricultural land leads to measurable effects on soil ecosystem services and functions.