Factors controlling organic carbon stocks and their decline following clearing over eastern Australia

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Understanding the potential of soil to store organic carbon is important for potential climate change mitigation strategies and also for assessing soil health issues. We examined the factors controlling soil organic carbon (SOC) stocks and their decline following vegetation clearing in eastern Australia. Models were developed using a range of covariates to represent key soil forming factors together with multiple linear regression and Cubist piecewise decision tree models. Independent validation demonstrated concordance correlation coefficients up to 0.68 for SOC density in the upper intervals but progressively decreasing with depth.

The results demonstrate the necessity of considering a combination of factors, particularly climate, parent material/soil type and land use/groundcover, when deriving meaningful estimates of potential SOC stocks and their loss following clearing. Stocks in the 0-30 cm depth interval were shown to systematically vary over 45 environmental regimes from 16.3 t/ha in dry, highly siliceous parent material environments with low groundcover, up to 145.0 t/ha in moist, mafic parent material environments with high groundcover. The proportion of SOC stock in the 30-100 cm interval as a proportion of the top 100 cm was shown to vary from a low of 41% in wet climates up to a high of 59% in dry climates. Climate appears to be the dominant controller of subsoil SOC storage proportion, with parent material/soil type and vegetation cover also having partial influence.

A total loss of approximately 0.53 Gt SOC was calculated following vegetation clearing since European arrival over New South Wales. The greatest losses in both absolute and relative terms are demonstrated in moist climates with mafic parent materials (44.3 t/ha or 50.0%), with only relatively minor losses associated with dry climates with siliceous parent materials (less than 1 t/ha or 4%).