Carbon saturation deficit of soils in relation to the C loading: influence of soil Order

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Although many soils have the capacity to store large amounts of carbon (C), it is generally assumed that their capacity to store and stabilise C is finite. The difference between the C concentration of the fine fraction (<50 µm) and the C concentration at saturation can be termed the C saturation deficit (mg C g-1 soil).

Despite NZ soils typically containing high C concentrations, recent studies have indicated that many have C saturation deficits greater than zero. We used an independent dataset (n=149 soils) to test and improve a previously published quantile regression model which estimated 90th and 50th percentiles to determine the C saturation deficit. Thus, the C saturation deficit of long term pasture and cropping sites was estimated across a range of New Zealand Soil Orders (Allophanic, Brown, Gley, Pallic and Recent).

Specific surface area and pyrophosphate extractable aluminium were the key variables used in a new regression model. Over 90% of non-allophanic soils had a C saturation deficit, but the percentage was only 50% for the allophanic soils.

The C saturation deficit was also calculated as a difference between the 90th percentile and the actual measured C concentration. On this basis, the cropping soils generally had greater deficits than the pasture soils, especially for the allophanic soils.

There was also evidence that the C loading (mg C m-2 surface area) needed to achieve a C saturation deficit of zero was considerably higher for non-allophanic soils than for allophanic soils. We conclude that C loading may be a useful indicator of a soil's C saturation deficit.