**Toward a new modelling paradigm: from turnover-defined to physically-defined soil organic matter pools.**

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Globally soils contain three times the amount of carbon (C) stored in the atmosphere, and 68% of this is stored in soil below 30cm. Changes to the size of the soil C stocks could significantly impact the net terrestrial-atmosphere $CO_2$ exchange and thus either mitigate or increase atmospheric concentrations of $CO_2$. Yet we are currently unable to conduct reliable predictions of the direction and magnitude of soil C stock changes, since current soil C models fail to accurately capture the current understanding of how soil organic matter (SOM) forms and persists, and the vertical movement and deep soil processing of SOM. I will discuss how emerging and consolidated views of SOM dynamics can be incorporated into soil C modelling, by shifting from a turnover-oriented approach to a more functional-oriented approach. New generation soil C models should use measurable SOM pools with specific function in soils, with respect to their physical structure (soluble *versus* particulate), microbial accessibility (free *versus* mineral or aggregate protection) and ability to transfer along the soil profile (through water flow or by mass transport). I will present experimental evidence from a number of studies conducted in the past few years using stable isotope tracing in support of incorporating a dissolved organic matter (DOM)-microbial path and a physical transfer of particulate organic matter path in soil C models, and our progress incorporating this understanding in a new soil C model.