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Simultaneous quantification of soil phosphorus labile pool and desorption kinetics using DGTs and 3D-DIFS

Daniel Menezes-Blackburn (1), Jiahui Sun (1), Niklas Lehto (2), Hao Zhang (1), Marc Stutter (3), Courtney D Giles (3), Tegan Darch (4), Timothy S George (3), Charles Shand (3), David Lumsdon (3), Martin Blackwell (4), Catherine Wearing (1), Patricia Cooper (3), Renate Wendler (3), Lawrie Brown (3), and Philip M Haygarth (1)

(1) Lancaster University: Lancaster Environment Centre, Lancaster, UK, (2) Lincoln University, Christchurch, New Zealand, (3) James Hutton Institute: The James Hutton Institute, Aberdeen and Dundee, Scotland, UK, (4) Rothamsted Research: North Wyke, Okehampton, Devon, UK

The phosphorus (P) labile pool and desorption kinetics were simultaneously evaluated in ten representative UK soils using the technique of Diffusive gradients in thin films (DGT). The DGT-induced fluxes in soil and sediments model (DIFS) was fitted to the time series of DGT deployment (1h to 240h). The desorbable P concentration (labile P) was obtained by multiplying the fitted Kd by the soil solution P concentration obtained using Diffusive Equilibration in Thin Films (DET) devices. The labile P was then compared to several soil P extracts including Olsen P, Resin P, FeO-P and water extractable P, in order to assess if these analytical procedures can be used to represent the labile P across different soils. The Olsen P, commonly used as a representation of the soil labile P pool, overestimated the desorbable P concentration by a seven fold factor. The use of this approach for the quantification of soil P desorption kinetics parameters was somewhat unprecise, showing a wide range of equally valid solutions for the response of the system P equilibration time (Tc). Additionally, the performance of different DIFS model versions (1D, 2D and 3D) was compared. Although these models had a good fit to experimental DGT time series data, the fitted parameters showed a poor agreement between different model versions. The limitations of the DIFS model family are associated with the assumptions taken in the modelling approach and the 3D version is here considered to be the most precise among them.