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Evaluating uncertainty in ^{7}Be-based soil erosion estimates: an experimental plot approach

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Soil erosion remains a major concern for the international community and there is a growing need to improve the sustainability of agriculture to support future food security. High resolution soil erosion data are a fundamental requirement for underpinning soil conservation and management strategies but representative data on soil erosion rates are difficult to achieve by conventional means without interfering with farming practice and hence compromising the representativeness of results. Fallout radionuclide (FRN) tracer technology offers a solution since FRN tracers are delivered to the soil surface by natural processes and, where irreversible binding can be demonstrated, redistributed in association with soil particles. While much work has demonstrated the potential of short-lived ^{7}Be (half-life 53 days), particularly in quantification of short-term inter-rill erosion, less attention has focussed on sources of uncertainty in derived erosion measurements and sampling strategies to minimise these. This poster outlines and discusses potential sources of uncertainty in ^{7}Be-based soil erosion estimates and the experimental design considerations taken to quantify these in the context of a plot-scale validation experiment. Traditionally, gamma counting statistics have been the main element of uncertainty propagated and reported but recent work has shown that other factors may be more important such as: (i) spatial variability in the relaxation mass depth that describes the shape of the ^{7}Be depth distribution for an uneroded point; (ii) spatial variability in fallout (linked to rainfall patterns and shadowing) over both reference site and plot; (iii) particle size sorting effects; (iv) preferential mobility of fallout over active runoff contributing areas. To explore these aspects in more detail, a plot of 4 x 35 m was ploughed and tilled to create a bare, sloped soil surface at the beginning of winter 2013/2014 in southwest UK. The lower edge of the plot was bounded by a perforated pipe which fed into a collection bin for overland flow and associated sediment capture. At the same time, a flat area at the top of the slope was ploughed and tilled to create a reference site with same inventory baseline as the slope. Rain gauges were set up at the reference and slope site. The tilled surface had a low bulk density and high permeability at the start of the experiment ($k_{sat} > 100$ mm hr^{-1}). Hence, despite high rainfall in December 2013 (200 mm), notable runoff was observed only after intense rain storms during late 2013 and early January 2014 when the soil profile was saturated. Captured eroded sediment was analysed for ^{7}Be and particle size. Subsequently, the plot soil surface was intensively sampled to quantify ^{7}Be inventory patterns and develop a tracer budget. Preliminary results are discussed in the context of the above potential sources of uncertainty.