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Assessing soil erosion at landscape level: A step forward in the up-scaling of ^{137}Cs measurements through the use of in-situ lanthanum bromide scintillator

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Measuring Fallout Radionuclides (FRN), in particular ^{137}Cs, is a well-established method to estimate soil erosion and deposition in agricultural landscapes. While extremely sensitive, laboratory based gamma-ray spectrometry requires careful handling and preparation of measurement samples with a lengthy measuring time ($\sim$1 day), *In-situ* gamma-ray spectrometry can give near instantaneous results, allowing prompt decisions to be made and identification of critical spots of soil erosion, while the equipment is in the field.

The aim of this investigation was to compare the precision of the *in-situ* FRN measurements, made by a cost-effective lanthanum bromide ($LaBr_3$ (Ce)) scintillation detector of ^{137}Cs against those from conventional (high-purity germanium HPGe detector) but laborious laboratory based gamma-ray spectrometry for assessing soil erosion.

As preliminary test, five cores of a gleyic Cambisol - per increments of 5 cm until 1 m depth - were collected at the experimental research station of the Austrian Agency for Health and Food Safety located in Grabenegg 130 km west of Vienna. Three soil cores were sampled at the study site and, in the vicinity of this experimental site, two additional cores were collected at two different undisturbed reference sites.

Laboratory gamma analyses were carried out during 50 000 seconds using a HPGe coaxial detector. The gamma measurements performed at the laboratory confirmed the undisturbed status of the two selected reference sites (i.e. exponential decrease with depth of the ^{137}Cs content). Using the surface area of the sampling tool, the ^{137}Cs areal activities of the cores sampled in the study site have been established at 2134$\pm$465 Bq m^{-2}, 1835$\pm$356 Bq m^{-2} and 2553$\pm$340 Bq m^{-2}, and, for the two reference sites at 3221$\pm$444 Bq m^{-2} and 3946$\pm$527 Bq m^{-2}.

At the same location and prior to collect the five soil cores, in-situ measurements using a lanthanum bromide ($LaBr_3$ (Ce)) scintillator were performed. The detector was placed at 2 cm above ground and each measurement was conducted for 900 seconds. A significant positive correlation (i.e. R^2=0.82; $p < 0.001$) has been established between the ^{137}Cs areal activities obtained with the in-situ and laboratory based measurements.

The first results relating to in-situ measurement of ^{137}Cs offer an exciting potential for the application of FRN measurements and their up-scaling in the framework of soil erosion assessments at the landscape level. This includes cost, time, and portability, the potential to work in remote areas, pre-screening to develop more effective sampling strategies and rapid repeat surveys. This work is still in its initial stage and more research is required to validate this innovative in-situ technique.