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Radionuclide determination techniques and spectroradiometry as tools to determine soil erosion

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Natural ($^{210}Pb_{unsupported}$, ^{226}Ra, ^{210}Po and ^{7}Be) and artificial ($^{239,240}Pu$, ^{137}Cs) radionuclides are largely used as tools for studying and quantifying soil erosion. The global fallout of artificial radionuclides derived from weapons testing that took place during 1945's and 1960's was rapidly and firmly fixed in the soil surface, allowing to calculate further soil erosion by comparing inventories at individual sampling points with a reference inventory representing the local fallout input. This procedure is complemented with the $210Pb_{uns}$ inventory calculation as indicator of the local average radionuclides deposition. Mathematical models, combining radionuclides inventories and soil properties, are lately applied to estimate the erosion rates.

Spectroradiometry, is a further technique to determine soil erosion processes, by characterising soil surface reflectance values and relating these with soil properties such as structure, texture, mineral composition and organic matter content obtained from the laboratory analyses. The effect of erosion on these soils implies the presence of contrasting soil horizons emerging at the surface. In this case, surface reflectance measurements of soil samples are determined and associated to data obtained from the laboratory analyses. This technique uses spectral characteristics that can be extrapolated from the field scale to satellite coverage of an entire area.

The aim of this work is to use both radionuclides determination and laboratory spectroradiometry techniques to evaluate soil erosion processes in well-developed soils (Alfisols) and its spatial distribution in an agricultural area near to Camarena within the Province of Toledo (Central Spain).

The methodology includes the test of the sampling devices during the sampling campaign, the radionuclides analysis at different soil depths and the determination of their activity concentration levels by means of gamma spectrometry, complementing with alpha spectrometry to improve the measurement uncertainties. Furthermore, spectroradiometry is implemented to associate soil surface reflectance measurements to soil properties related to soil erosion processes. A further step in the methodology is the identification of spectral characteristics which could then be used for the spatial analyses of soil erosion applying remotely sensed data obtained either as airborne or satellite-borne images. As a result, a spectral library could be compiled with spectra and soil analyses to obtain reference spectra of characteristic surface conditions associated to soil erosion, but more researches are needed.

Preliminary results, in a duplicate soil core from Camarena, ^{137}Cs and $^{210}Pb_{uns}$ show inventories of 576±77 (^{137}Cs Bq·m^{-2} ±1s), 677±88 (^{137}Cs Bq·m^{-2} ±1s) , 7561± 1439 ($^{210}Pb_{uns}$ Bq·m^{-2} ±1s) and 11292± 2598 Bq·m^{-2} ($^{210}Pb_{uns}$ Bq·m^{-2} ±1s), respectively, and are similar to those obtained in nearby areas with the same climatology. This shows that erosion processes are taking place in these soils, however, ongoing work on the soil analyses of the samples has to be completed before a complete interpretation can be carried out.