A first attempt to derive soil erosion rates from 137Cs airborne gamma measurements in two Alpine valleys

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The application of fallout radionuclides (FRNs) as soil tracers is currently one of the most promising and effective approach for evaluating soil erosion magnitudes in mountainous grasslands. Conventional assessment or measurement methods are laborious and constrained by the topographic and climatic conditions of the Alps. The 137Cs (half-life = 30.2 years) is the most frequently used FRN to study soil redistribution. However the application of 137Cs in alpine grasslands is compromised by the high heterogeneity of the fallout due to the origin of 137Cs fallout in the Alps, which is linked to single rain events occurring just after the Chernobyl accident when most of the Alpine soils were still covered by snow.

The aim of this study was to improve our understanding of the 137Cs distribution in two study areas in the Central Swiss Alps: the Ursern valley (Canton Uri), and the Piora valley (Canton Ticino). In June 2015, a helicopter equipped with a NaI gamma detector flew over the two study sites and screened the 137Cs activity of the top soil. The use of airborne gamma measurements is particularly efficient in case of higher 137Cs concentration in the soil. Due to their high altitude and high precipitation rates, the Swiss Alps are expected to be more contaminated by 137Cs fallout than other parts of Switzerland. The airborne gamma measurements have been related to several key parameters which characterize the areas, such as soil properties, slopes, expositions and land uses.

The ground truthing of the airborne measurements (i.e. the 137Cs laboratory measurements of the soil samples collected at the same points) returned a good fit. The obtained results offer an overview of the 137Cs concentration in the study areas, which allowed us to identify suitable reference sites, and to analyse the relationship between the 137Cs distribution and the above cited parameters. The authors also derived a preliminary qualitative and a quantitative assessment of soil redistribution rates for the two study areas.

Future works will focus on (i) the comparison to other soil erosion studies conducted in the same areas and (ii) the comparison of present results with the airborne measurements performed over the same areas in 1986 just after the Chernobyl power plant accident.