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Preliminary use of compound-specific stable isotope (CSSI) technique to identify and apportion sediment origin in a small Austrian catchment

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The overall impacts of climate change on agriculture are expected to be negative, threatening global food security. In the agricultural areas of the European Union, water erosion risk is expected to increase by about 80% by the year 2050. Reducing soil erosion and sedimentation-related environmental problems represent a key requirement for mitigating the impact of climate change.

A new forensic stable isotope technique, using the compound specific stable isotope (CSSI) signatures of inherent soil organic biomarkers, can discriminate and apportion the source soil contribution from different land uses. Plant communities label the soil where they grow by exuding organic biomarkers. Although all plants produce the same biomarkers, the stable isotopic signature of those biomarkers is different for each plant species.

For agri-environmental investigation, the CSSI technique is based on the measurement of carbon-13 (13-C) natural abundance signatures of specific organic compounds such as natural fatty acids (FAs) in the soil. By linking fingerprints of land use to the sediment in deposition zones, this approach has been shown to be a useful technique for determining the source of eroded soil and thereby identifying areas prone to soil degradation.
The authors have tested this innovative stable isotopic approach in a small Austrian agricultural catchment located 60 km north of Vienna. A previous fallout radionuclide (i.e. 137-Cs) based investigation established a sedimentation rate of 4 mm/yr in the lowest part of the study site.

To gain knowledge about the origin of these sediments, the CSSI technique was then tested using representative samples from the different land-uses of the catchment as source material.
Values of 13-C signatures of specific FAs (i.e. C22:0 = Behenic Acid ; C24:0 = Lignoceric Acid) and the bulk 13-C of the sediment mixture and potential landscape sources were analyzed with the mixing models IsoSource and CSSIAR v1.00. Using both mixing models, preliminary results highlighted that about 50-55% of the sediment located in the deposition area originated from the main grassed waterway of the catchment.