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Evaluation of the compound-specific stable isotope (CSSI) technique in an agricultural watershed in Manitoba, Canada

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Tracing the movement of sediment within a watershed allows for the determination of sediment sources and sinks. By tracing and apportioning sources contributing to a sink, environmental concerns such as erosion and the transport of sediment-bound pollutants may be addressed. Common tools used in tracing have included the use of soil geochemistry, fallout radionuclides (FRNs), color and magnetism. Recently, the use of compound-specific stable isotopes (CSSIs) has been investigated as a potential tracing tool. The application, reliability and analytical procedures for CSSIs in soil and sediment tracing are still undergoing evaluation in order to determine the robustness, cost and reliability of the method.

The CSSI technique adds to the current toolbox of methods by providing a land use-specific tracer i.e. organic compounds (fatty acids, FAs) that are of plant origin. The FAs are analyzed for the 13C:12C ratios (the stable isotopes of carbon) for each specific type of FA uniquely of plant origin. An investigation of FA biomarkers and their applicability to tracing using the CSSI technique was undertaken in the South Tobacco Creek Watershed (STCW, 75 km2), Manitoba, Canada, over a two year period (2012-2013) throughout the growing season. Transects and sampling points were determined so as to capture temporal and spatial variability within the watershed. The vegetation i.e. crops were planted so as to be separated topographically, thereby isolating field hydrology and mixing of crop FA signals, with inter-annual crop rotation. The data are to be analyzed to determine the spatial and temporal influences of the CSSI signal and the potential for recognizing a representative field sample. Points further downstream of the cropped fields were also sampled to determine the ability to apportion sediments and detect influences on the CSSI signal after transport. Results of the sampling, in both the near and far field, will allow the evaluation of this technique as a robust and reliable tracer within a mixed crop basin.