Geophysical Research Abstracts
Vol. 20, EGU2018-12474, 2018
EGU General Assembly 2018

Sources and proportions of modern versus aged organic carbon eroded from soils under different land-use within a Nepalese catchment – Insights from bulk and compound-specific ^{13}C & ^{14}C analysis in combination with novel isotope mixing models

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There is currently a lack of necessary measurements and data to fully capture the high degree of heterogeneity in organic carbon (OC) exported from eroding landscapes. The respective fluxes of modern (biospheric) and aged OC are poorly constrained, and mechanisms controlling OC export have remained elusive. Recently, the age of riverine OC was found to increase with the proportion of human-dominated landscapes within a catchment, potentially due to aged soil OC that is mobilized by human disturbance and reintroduced into the modern C cycle (Butman et al., 2015). Furthermore, most previous studies have focused on catchment outlets, whereas a greater within-catchment focus will undoubtedly provide further direction to pinpoint locations of aged OC export to the river, and to better constrain its impact on the C cycle and aquatic biogeochemistry.

This study aims (1) to quantify the sources and proportions of modern versus aged OC exported from soils into river systems within a catchment and (2) to investigate if theses sources and proportions of OC are dependent on the different types of land-use within a catchment. Therefore, bulk ^{14}C and compound-specific ^{14}C analyses of vegetation markers (long-chain fatty acids, FAs) in soils under different land-use and suspended river sediments will be performed and the proportions of modern versus aged OC determined by application of isotope mixing models.

The study site is located in the mid-hill region of Nepal within a catchment that exhibits different land-uses including various types of forest and agricultural land-use. Soils were sampled before and sediments during monsoon seasons. A broad data basis is already available for the content and stable C isotopes ($\delta^{13}C$) of bulk OC and FAs. Fatty acids will be collected in sufficient amounts by preparative gas chromatography and will be analyzed for ^{14}C using accelerator mass spectrometry. Isotope mixing models that use bulk and compound-specific ^{13}C and ^{14}C data will be applied to estimate the relative contributions of modern versus aged OC.

The study will generate an extensive ^{14}C dataset of bulk OC and specific vegetation markers in soils under different land-use and suspended river sediments to provide a within-catchment focus on the mechanisms controlling OC export from terrestrial and aquatic ecosystems. Combination with the available complementary datasets for ^{13}C of bulk OC and specific vegetation markers will reveal the sources and proportions of modern versus aged OC within the catchment. This information is needed to develop accurate constraints on fluvial transfer of modern OC, which is of importance to predict OC fluxes quantitatively as a result of anthropogenic change. The study furthermore aims to test whether soils under different land-use export different proportions of modern versus aged OC into river systems and thus determines the responds to human disturbance such as changes in soil management. In summary, our study will contribute to a comprehensive understanding of the factors that control the sources, transport pathways and turnover times of terrestrial OC within river systems.

Butman et al., 2015. Increased mobilization of aged carbon to rivers by human disturbance. Nature Geoscience 8, 112-116.