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Modeling the influence of long term human-induced land use conversion on sediment fluxes and carbon dynamics at the catchment scale

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Over the past 20 years, there has been increasing evidence of the strong impact of human activities on the landscape, specifically on soil erosion due to the removal of natural vegetation cover for agricultural and urban purposes. The results question the widespread hypothesis of a steady state landscape since it appears that the balance between soil production and erosion may be broken altering the interactions between chemical, physical and biological processes in both soil and landscape system. Yet, the relationship between this accelerated erosion and the carbon dynamics at the landscape scale remains an important area of investigation.

Recent attempts to combine geomorphic models, soil redistribution and carbon dynamic has proved themselves valuable in term of supporting the importance of lateral fluxes as a crucial control of carbon dynamic at the landscape scale.

We use the SPEROS LT model, a modified version of SPEROS-C which includes dynamic land use and soil physical properties, to assess the impact of historical land use conversion on sediment and carbon fluxes in the Dijle catchment. This particular location has experienced a significant human impact since the Roman period, undergoing heavy deforestation and expansion of agricultural lands followed by a period of abandonment. The last 400 to 500 years saw a dramatic increase in the intensity of land use conversion associated to population growth leading to forest cleaning and urbanization. Our main objective is to validate the combined geomorphic and soil carbon turnover process descriptions of the model.

Historical land use proportions are based on existing literature estimations and spatial assignation of the land conversion relies on simple allocation rules based on criteria such as slope or soil texture. Land use scenarios are constructed for the last 2000 years. We confront the model results with observations and perform a sensitivity analysis. The results indicate that the general trends in sediment production and deposition, as well as soil carbon storage are well predicted by the model. We discuss the key-parameters of the model and the implications of past erosion-deposition for the future C budget of the Dijle catchment.