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Quantification of floodplain sediment storage for an upland river catchment in the Lake Tana Basin, Ethiopia

Girma Worku Awoke (1,2), Jef Brees (1), Pascal Boeckx (3), Karen Vancampenhout (1,4), Enyew Adgo (5), Jan Nyssen (6), Mengiste Abate (2), Alemayehu Wassie (5), Amaury Frankl (6), and Gert Verstraeten (1)

(1) KU LEUVEN, GEO-Instuut, Department of Earth and Environmental Sciences, Leuven-Heverlee, Belgium (graceworku@gmail.com), (2) Department of Hydraulic and Water Resources Engineering and Blue Nile Water Institute, Bahir Dar University, Ethiopia, (3) Department of Applied Analytical and Physical chemistry and Isotope Bioscience Laboratory-ISOFYS, Ghent University, Belgium, (4) Bioengineering Technology TC, Kleinhoefstraat 4, 2440 Geel, Belgium, (5) Department of Natural Resource Management , Bahir Dar University, Ethiopia, (6) Department of Geography, Ghent University, Belgium

Floodplains act as a buffer in the fluvial system regulating the amount of eroded soil that is transported out of the catchment. Whilst numerous data on floodplain sediment storage have recently become available for Europe and N-America, often for lowland river systems, much less is known about floodplain sediment storage in mountainous river basins and for African river catchments in general. Here, we present the first quantification of floodplain sediment storage for the Gumara River, one of the main tributaries draining to Lake Tana, NW Ethiopia. The Gumura catchment is characterized by relatively gently sloping to flat lowlands near the lake (1788 masl) and steeper river reaches in the uplands towards Mount Guna (4120 masl). Floodplain sediment storage was estimated by combining information on floodplain spatial extent obtained through field-based and remote sensing based approaches, with information on sediment thickness obtained through sediment coring and the analysis of cut-banks. Floodplain sediment storage was first estimated per homogenous floodplain zones and grouped for floodplain classes following the classification scheme of Nanson and Croke (1992). Average floodplain sediment storage per unit river length varies between different floodplain types which can be used to extrapolate our findings to similar river catchments draining to Lake Tana. In the uplands, the river is incised into the bedrock and the steep gradients limit the storage potential. Also, lateral reworking in these confined channels is high compared to total storage. Sediment storage greatly increases when the gradient decreases and an alluvial floodplain up to several hundred meters wide are established. First results show that 13.39 Mt of sediment is deposited in the headwaters of the Gumara river (1027.85 km^2; 176 km river length). Comparing this with floodplain sediment storage in similar-sized European catchments that are characterized by long-term human impact (Hoffmann et al. 2013) shows that floodplain sediment storage in the Gumara catchment is up to 10 times lower. The topography and climatic difference between the two regions could be the potential factors for such floodplain sediment storage variations. These data will complement existing information on suspended sediment flux into Lake Tana and data on the intensity of soil erosion in the Ethiopian highlands as well, in order to develop a complete sediment budget for the Lake Tana basin.

References:

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