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Thomas Hoffmann

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# **Sediment residence time and connectivity in non-equilibrium and transient geomorphic systems**

**Thomas Hoffmann<sup>1,2</sup>**

**<sup>1</sup>Federal Institute of Hydrology, BfG, Koblenz, Germany (Thomas-Hoffmann@bafg.de)**

**<sup>2</sup>Department of Geography, University of Bonn, Germany**

## **Abstract**

Growing empirical evidence shows that many geomorphic systems are in transient state or out of equilibrium with respect to the external driving forces. The transient state is often related to the (dis)connectivity of the many constituent parts of geomorphic systems as a result of sediment storage along the sediment flow path from its source to the final sink. The response time of geomorphic systems to external changes is thus depended on the residence time of sediment in various storage compartments. Here, I present a mathematical concept based on reservoir theory to model residence time of sediment using millennial scale sediment budgets. The framework sheds light on the limitation of the sediment delivery ratio, which is often used as a measure of sediment connectivity in geomorphic systems, and provides analytical information on process type, pace of sediment flux and connectivity of storage compartments along the sediment cascade. The application of the reservoir theory to geomorphic systems under agricultural land use show that sediment delivery ratios are linked to the virtual velocity of the eroded sediment, the time since the onset of agricultural land use and the size of the studied basins. With respect to the temporal evolution of sediment storages that temporarily remove sediment from the conveyor belt, the framework aims to estimate the sediment residence time in storages, which is linked to the

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