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Connectivity: What is it good for?

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In extensive areas of the Panama Canal watershed, large and frequent tropical storms hit clay-rich soils that feature a low saturated hydraulic conductivity at shallow depth. As a consequence, surface runoff occurs frequently, and extremely flashy catchment responses are common. Previous studies showed that in undisturbed forests of this region, overland flow tends to concentrate in flowlines which extend the channel network and therefore provide hydrological connectivity between hillslopes and streams. In this contribution we present our latest research which aims at explaining the development and dynamics of overland-flow connectivity and its impact on catchment runoff and suspended-sediment export. In an undisturbed headwater catchment we monitored on an event basis overland-flow occurrence in all flowlines and measured discharge and suspended-sediment concentration in several flowlines and at the catchment outlet. Under certain meteorological conditions all flowlines are connected to the channel network throughout their entire lengths. Because some flowlines originate near the catchment divide, extensive parts of the catchment are then hydrologically connected. It was for these high-connectivity situations that we measured the largest storm flows and sediment yields at the catchment outlet. Yet, both runoff volume and sediment yield varied up to an order of magnitude during the high-connectivity stage. This is because our connectivity data comprise just one feature of connectivity; that is, whether flow is connected or not. Hydrologic connectivity (at the soil surface), however, also entails other critical aspects such as the duration of a particular connectivity stage. Although promising, the effort required to monitor these aspects of connectivity is substantial. Moreover, it is not clear how such specific information can be transferred to other catchments. Therefore, besides more detailed investigations we advocate applying the established link between overland flow in flowlines and catchment response as a rapid assessment tool for catchment classification in forests of the Panama Canal watershed and in similar regions elsewhere. More precisely, we propose to use flowline density, and hence the surficial expression of connectivity, to identify ‘flashy’ catchments that potentially export large amounts of sediment. We argue that the practical applicability of the connectivity concept should receive the same attention as its theoretical foundation.