Geophysical Research Abstracts
Vol. 19, EGU2017-15724, 2017
EGU General Assembly 2017

Assessing catchment connectivity using hysteretic loops

Jason Davis (1), Rens Masselink (1), Mikel Goni (2), Rafael Gimenez (2), Javier Casali (2), Manuel Seeger (3), and Saskia Keesstra (1)

(1) Wageningen University, Soil Physics and Land Management, Wageningen, Netherlands (saskia.keesstra@wur.nl), (2) Department of Physical Geography, Public University of Navarra, Spain, (3) Department of Physical Geography, University of Trier, Germany

Storm events mobilize large proportions of sediments in catchment systems. Therefore understanding catchment sediment dynamics throughout the continuity of storms and how initial catchment states act as controls on the transport of sediment to catchment outlets is important for effective catchment management. Sediment connectivity is a concept which can explain the origin, pathways and sinks of sediments within catchments (Baartman et al., 2013; Parsons et al., 2015; Masselink et al., 2016a,b; Mekonnen et al., 2016). However, sediment connectivity alone does not provide a practicable mechanism by which the catchment's initial state – and thus the location of entrained sediment in the sediment transport cascade – can be characterized. Studying the dynamic relationship between water discharge (Q) and suspended sediment (SS) at the catchment outlet can provide a valuable research tool to infer the likely source areas and flow pathways contributing to sediment transport because the relationship can be characterized by predictable hysteresis patterns. Hysteresis is observed when the sediment concentration associated with a certain flow rate is different depending on the direction in which the analysis is performed – towards the increase or towards the diminution of the flow. However, the complexity of the phenomena and factors which determine the hysteresis make its interpretation ambiguous. Previous work has described various types of hysteretic loops as well as the cause for the shape of the loop, mainly pointing to the origin of the sediments.
The data set for this study comes from four experimental watersheds in Navarre (Spain), owned and maintained by the Government of Navarre. These experimental watersheds have been monitored and studied since 1996 (La Tejería and Latxaga) and 2001 (Oskotz principal and Oskotz woodland). La Tejería and Latxaga watersheds are similar to each other regarding size (approximately 200 ha), geology (marls and sandstones), soils (fine texture topsoil), climate (humid sub Mediterranean) and land use (80-90% cultivated with winter grain crops). Ozkotz principal (ca.1,700 ha) is covered with forest and pasture (cattle-breeding); while Oskotz woodland (ca. 500 ha), a sub-watershed of the Oskotz principal, is almost completely covered with forest. The predominant climate in the Oskotz catchments sub-Atlantic. Furthermore, antecedent conditions and event characteristics were analysed. The loops were compared quantitatively and qualitatively between catchments for similar events and within the catchments for events with different characteristics.
In this study, several measures to objectively classify hysteresis loops in an automated way were developed. These were consecutively used to classify several hundreds of loops from several agricultural catchments in Northern Spain. These loop characteristics were compared to event specific characteristics such as antecedent precipitation, time of year, and precipitation intensity, duration and total. The combination of hysteresis loops and variables influencing connectivity can then tell something about the sources of sediments for different events and catchments.

References

Baartman, J.E.M., Masselink, R.H., Keesstra, S.D., Temme, A.J.A.M., 2013. Linking landscape morphological complexity and sediment connectivity. Earth Surface Processes and Landforms 38: 1457-1471.
Masselink RJH, Heckmann T, Temme AJAM, Anders NS, Gooren HPA, Keesstra SD. 2016. A network theory approach for a better understanding of overland flow connectivity. Hydrological Processes. DOI: 10.1002/hyp.10993
Masselink, R.J.H., Keesstra, S.D., Temme, A.J.A.M., Seeger, M., Giménez, R., Casalí, J., 2016. Modelling Discharge and Sediment Yield at Catchment Scale Using Connectivity Components. Land Degradation and Development 27: 933–945, DOI: 10.1002/ldr.2512
Mekonnen, M., Keesstra, S.D., Baartman, J.E.M., Stroosnijder, L., Maroulis, J., Reducing sediment connectivity through man-made and natural sediment sinks in the Minizr catchment, north-west Ethiopia. Accepted to Land Degradation and Development.

Parsons A.J., Bracken L., Peoppl , R., Wainwright J., Keesstra, S.D., 2015. Editorial: Introduction to special issue on connectivity in water and sediment dynamics. In press in Earth Surface Processes and Landforms. DOI: 10.1002/esp.3714