Reconciling drainage basin and landscape approaches to improve water quality

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Abstract

Investigating the effect of land use on water quality at the catchment scale goes back decades. Recent land cover and land use changes with increasing anthropogenic pressure on water resources have occurred at a planetary scale, leading to water quality degradation. The drainage basin appears as an appropriate landscape unit for modelling water and nutrient fluxes, according to well-defined boundaries, catchment physical characteristics (topography, pedology, geology, etc.) and measurable output. However, for drainage basins that are larger than few km2, spatially-explicit or mechanistic modelling of interactions between land use, catchment characteristics and water quality requires some degree of spatial lumping, hampering prediction and quantification of the effects of subtle spatial land use or land cover change on water quality. From a landscape perspective, riparian zones have long been considered buffer zones between the larger landscape and the stream corridor, acting as biogeochemical hot spots of nitrogen removal. However, riparian corridors are also zones of incredible spatiotemporal variability, which has been a major obstacle to scaling measured processes beyond the reach level. There is a pressing need to translate small-scale process understanding to larger-scale landscape units, particularly for inter-catchments comparison, but this requires quantifying the effects of different spatial configurations and physical characteristics on catchment water quality. In this context, we develop a conceptual framework that combines landscape-level topographic analysis, process based field investigations using biogeochemical proxies, and water retention time distributions to characterise landscape nitrogen removal capacity.

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