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Flow-proportional large volume composite sampling to assess substance fluxes

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Adequate monitoring solutions for substance fluxes in rivers are needed to survey catchment processes, to identify pollutant sources and to comply with ecological and legal guidelines. Being driven by rainfall, a large share of the (annual) substance flux takes place during few isolated events, when discharges and substance concentrations are high. This is especially the case for suspended sediment and subsequently for particle-bound substances such as heavy metals, phosphorous and organic pollutants. To create load estimates of rivers, continuous stream flow data is usually coupled with (e.g. monthly) concentration measurements from grab samples. This approach is biased by non-linearly related flow and concentration dynamics, which are inconstant across seasons and catchments. Continuous optical or ion- selective in-situ measurement probes can be unstable in harsh environments and are limited to certain parameters. To tackle these issues, we designed an automated sampling device called Large Volume Sampler (LVS), which creates flow-proportional composite samples of 1 m^3 within several days to weeks. The large sample volume guarantees sufficient material for a broad chemical analysis and reduces potential sampling biases. The system is connected to a flow monitoring station and takes an aliquot (i.e. 10 l) each time a pre-defined volume of water has passed the measurement station. The samplers were installed in German and Brazilian agricultural catchments with potentially high sediment fluxes. After more than one year of sampling in Germany and eight months in Brazil, monitored suspended fluxes were considerably higher than USLE-based sediment input modeling. The gap may not be fully explained by a combination of other sources of suspended sediment (sewer systems, waste water treatment plants, river bank erosion). A potential underestimation of the sediment input modeling must be considered, especially as the derived sediment rating curves show exponential increase of loads towards high-flow events. Future research will address a fingerprinting of suspended sediment sources as well as sediment input model approach adaptations.