EGU22-5665
https://doi.org/10.5194/egusphere-egu22-5665
EGU General Assembly 2022

Sediment source and pathway identification using Sentinel-2 imagery and (kayak-based) lagrangian river profiles on the Vjosa river

Jessica Droujko[1], Srividya Hariharan Sudha[1], Gabriel Singer[2], and Peter Molnar[1]
[1]Chair of Hydrology and Water Resources Management, ETH Zurich, Zurich, Switzerland (droujko@ifu.baug.ethz.ch)
[2]Department of Ecology, University of Innsbruck, Innsbruck, Austria

Estimates of suspended sediment concentration (SSC) at high spatial resolution can be used to identify sediment sources, track the natural erosion gradients over entire mountain ranges, and quantify anthropogenic effects on catchment-scale sediment production, e.g. by dam construction or erosion control. Measurements of SSC at a basin outlet yields a basin-integrated picture of possible hydroclimatically-driven sources of sediment. However, a statistical analysis of one-dimensional input-output relations does not give us a full spatial perspective on sediment pathways of production and, potentially transient, storage within the catchment. These sediment pathways within catchments are difficult to identify and quantify due to the lack of affordable monitoring options that can create both spatially and temporally highly resolved datasets. Here, we propose a methodology to quantify these pathways using Sentinel-2 Level-1C imagery and in-situ measurements from a small network of sensors. The study is carried out on the Vjosa river, which represents one of the last intact large river systems in Europe. Geological diversity in the catchment and its widely unobstructed fluvial morphology over the entire river length makes it extremely interesting to monitor natural sediment dynamics. The remote sensing signal from the river's water column, extracted from satellite imagery, contains an optical measure of turbidity. Furthermore, in-situ turbidity measurements between May 2019 and July 2020 from seven turbidity sensors located across the Vjosa provide ground-truthing. A significant multiple linear regression model between turbidity and reflectance was fitted to these data. The regression model has a low adjusted R^2 value of 0.30 but a highly significant p-value (< 2.2e-16). The satellite data together with the regression model were used to generate longitudinal profiles of predicted turbidity over the catchment from August 2020 to August 2021. Validation of these predictions for two different Sentinel-2 acquisition dates was done with in-situ turbidity measurements taken from a kayak during descents of the entire river. This validation showed accurate prediction of trends on a catchment scale but poor accuracy in the prediction of pointwise turbidity quantification. The model also showed accurate estimation of trends during different climatic seasons, suggesting that our approach captures the temporal variability in suspended sediment concentrations driven by long-term hydrological processes. Gridded rainfall from E-OBS was used to identify short-term hydrological forcing such as storm-driven activation of sediment sources. In order to monitor the many physical connections between hydrology, river processes, and

sediment fluxes, future work will include extension of the in-situ turbidity sensor network with new sensors developed by our group. We plan to place these low-cost sensors at the outlet of every major tributary, on the main stem both above and below a confluence with a tributary, and within morphodynamically unique reaches.