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Improving catchment scale water quality modelling with continuous high resolution monitoring of metals in runoff

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High metal concentrations in natural waters is one of the key environmental and health problems globally. Continuous in-situ analysis of metals from runoff water is technically challenging but essential for the better understanding of processes which lead to pollutant transport. Currently, typical analytical methods for monitoring elements in liquids are off-line laboratory methods such as ICP-OES (Inductively Coupled Plasma Optical Emission Spectroscopy) and ICP-MS (ICP combined with a mass spectrometer). Disadvantage of the both techniques is time consuming sample collection, preparation, and off-line analysis at laboratory conditions. Thus use of these techniques lack possibility for real-time monitoring of element transport.
We combined a novel high resolution on-line metal concentration monitoring with catchment scale physical hydrological modelling in Mustijoki river in Southern Finland in order to study dynamics of processes and form a predictive warning system for leaching of metals. A novel on-line measurement technique based on micro plasma emission spectroscopy (MPES) is tested for on-line detection of selected elements (e.g. Na, Mg, Al, K, Ca, Fe, Ni, Cu, Cd and Pb) in runoff waters. The preliminary results indicate that MPES can sufficiently detect and monitor metal concentrations from river water. Water and Soil Assessment Tool (SWAT) catchment scale model was further calibrated with high resolution metal concentration data. We show that by combining high resolution monitoring and catchment scale physical based modelling, further process studies and creation of early warning systems, for example to optimization of drinking water uptake from rivers, can be achieved.