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Dynamic modelling of post-fire transient hydrological behavior of the permafrost basin

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Wilfire have profound effect on landscape properties and consequently on hydrological processes. In permafrost zone fire affects vegetation structure, soil moisture and ground thermal regime, active layer depth dynamics, talik formation and snow accumulation that drive flow generation mechanisms.
The goal of the study was to develop a modelling approach that is able to explicitly account for rapid environmental changes after fire event to describe and potentially forecast the hydrological response to fire disturbance. The process-based Hydrograph model is the core of the developed dynamic modelling approach. The Hydrograph model uses observable landscape properties as the parameters. This ability is of high importance in presented study because it allows direct linking of flow formation conditions and mechanisms.
The case study is the Vitimkan River basin, Eastern Siberia. It has an area of 969 km2. The basin is located in high-elevated permafrost zone and is covered by mountainous tundra and larch forest. In May-June 2003 78 % of the watershed was burned according to the MODIS Burned area date product. The pair-watershed approach was employed for preliminary investigation of fire impact on hydrological regime. For deeper insight into the processes the Hydrograph model was applied with conventional static parameters. The results of both pair-watershed and model detection methods suggest profound effect of the fire on the Vitimkan River runoff in 2003 and 2004. Post-fire soil and vegetation properties of the watershed were estimated in dynamic mode in each hydrological response unit according to remote sensing data and literature review and used as the model parameters for disturbed period. The ability of the dynamic modelling approach to present hydrological response in non-stationary post-fire conditions will be discussed.