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FIRE-CAUSED NONSTATIONARITY OF HYDROLOGICAL SYSTEMS IN COLD ENVIRONMENTS: THE EXAMPLES FROM OBSERVATIONS AND MODELLING ACROSS RUSSIAN SIBERIA AND FAR EAST

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Wildfires lead to rapid short and long-term environmental transformation that include changes of vegetation cover, soil properties, heat and water fluxes between atmosphere and soil, hydrological regime, erosion and mass movement. Fires affect significant territories of Russia each year and serve as important factor of natural forest dynamics.

The goal of the study was to identify wildfire effects on hydrological regime of watersheds in scarcely-gauged Russian Siberia and Far East in recent years using available hydrometeorological data and hydrological modelling.

We used monthly gridded 500 m MODIS Burned Area Product (MCD45) available for the period 2000-2013 to select the basins with fire-affected area rate from 20 to 86 %. About 40 river basins in Siberia and Far East with area range from 12 to 16 000 km^2 were chosen for analysis. Daily river discharges, meteorological data, available data on soil variable states, basic topography, geology and landscape information were collected for each basin. Pair-watershed approach and analysis of hydrometeorological time series data were used to identify possible impact of fire-induced landscape change on river hydrology in selected basins.

The process-based distributed hydrological model Hydrograph was applied to burned basins to assess the fire influence on hydrological regime and internal flow formation processes. The advantages of the Hydrograph model for application to non-stationary systems are observable model parameters that do not require calibration on observed data but rather adequate process conceptualization. The Hydrograph model includes all hydrological processes in the river basin: interception of liquid precipitation, snow accumulation and melting, evapotranspiration from various surfaces (snow, soil, vegetation cover), surface runoff and percolation, soil water dynamics and ground flow formation, heat dynamics and phase change in soil strata, slope and channel flow transformation.

Preliminary results of hydrological and meteorological data analysis suggested that the small basins with high burned area have quick and profound hydrological response to wildfire expressed in increased peak flow. Larger basins with lower burned rates show no significant changes of runoff after the fire.

Specific hydrological response to fire in different landscape, climate and topographical conditions across Russian Siberia and Far East will be presented. The results of the Hydrograph model applications to the basins with pronounced fire impact in stationary and dynamic mode will be shown.