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Modeling extreme flood characteristics at two mountainous watersheds of Russia with contrasting conditions using historical pluviograph data

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The annual damage from floods on the territory of Russia is estimated at about 570 million euro.
The reliability of extreme flow characteristics assessments is associated with non-stationary nature of the environment and significant reduction of hydrometeorological observation network when statistical approaches become irrelevant. Thus, the development of modeling methods for calculating the hydrological characteristics is an urgent task.
We have chosen two watersheds with different conditions and scale in flood-prone areas of Russia as the objects of our studies: the Kontaktovy Creek of the Kolyma Water Balance Station at North-East Russia (21.3 km2), and Tuapse river at the Black Sea coastal area (351 km2). The Kolyma Water Balance Station is located in the headwaters of the Kolyma River, in a mountainous region with the combination of extremely severe climate and continuous permafrost. The area of the Black Sea coast is characterized by disastrous local precipitations, which lead to the formation of extreme floods. Both study areas are described as poorly gauged in hydrological and meteorological sense.
Historical pluviograph data describing the duration and intensity of rain within extreme precipitation events was analyzed and used as the input data for modelling extreme flow discharges for the chosen watersheds.
The process-based hydrological Hydrograph model was used in the study (Vinogradov et al., 2011; Semenova et al., 2013) as it describes hydrological processes in different environments. In the Hydrograph model the processes have a physical basis and certain strategic conceptual simplifications. The level of model complexity is suitable for watershed with different scales and different climatic zone as it allows for a priori assessment of the model parameters. Parameterization of the Hydrograph model is carried out on the basis of an analysis of the hydrothermal regime and runoff formation processes in the typical landscapes.
In this study we aimed to assess the additional value of detailed historical precipitation data for modelling flood discharges at small watersheds in poorly gauged regions. Uneven calculation time step was used where the data of pluviograph was available as the input to hydrological model. Simulated maximum discharges were compared to the observational data. It allowed for the hydrological model parameters correction and better reproduction of maximum discharges within the periods when only standard (3-hours) data was available. Thus, additional accuracy was obtained for modeling the maximum water flow, which is important for forecasting extreme floods. The model showed an adequate response to the input information. We conclude that historical data about duration and intensity of rain is extremely helpful for the increasing model realism.