Geophysical Research Abstracts
Vol. 19, EGU2017-7141, 2017
EGU General Assembly 2017

Impact of Land Use Changes on Long-term and Extreme Runoff over a Period of Three Centuries: a Case Study from Myjava River Basin, Slovakia

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The way land is used has a significant impact on many hydrological processes that determine the water availability, development of soil erosion or the generation of flood runoff. Advancements in remote sensing, which took place in the second half of the 20th century led to the rise of a new research area focused on analyses of land use changes and their impact on hydrological processes. This, together with the historical information about the land utilization enables to quantify the impact of past and present land use changes on hydrological processes and water fluxes in a catchment. This study deals with an analysis of the changes in land use over a period of almost three centuries in the Myjava River basin, which has been significantly influenced by intensive anthropogenic processes. In order to obtain information about the way the land was used in the past, three historical mappings, representing various periods, were used: 1st military mapping (1764-1787), 2nd military mapping (1807-1869) and a military topographic mapping (1953-1957). The historical evolution of land use was compared with a concurrent land use mapping which was undertaken in 2010 that exploited remote sensing techniques. The study also quantifies the impact of these changes on the long-term catchment runoff as well as their impact on flows induced by extreme precipitation events. This analysis was performed using the WetSpa distributed hydrological model in a daily time step. The analysis showed that the selected catchment has undergone significant changes in land use, mainly characterized by massive deforestation at the end of the 18th century and by land consolidation in the middle of the 20th century induced by communist collectivisation. The hydrological simulations demonstrated that the highest and lowest mean annual runoffs were simulated under the conditions of the first (1st military mapping) and the last (concurrent land use monitoring) scenarios respectively with the smallest and largest percentages of forested areas. The study also discusses the uncertainties linked with the use of hydrological models in the land use change impact studies.