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On the watershed response to land use/cover change and climate variability in the Prairies

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Land use change for agriculture purposes or due to urbanization may change the movement patterns and also sources of water within a watershed boundary. It is of key interest to know how the integrated impact of these disturbances, along with a regime change due to natural climate variability or human induced climate change, affects runoff response behavior of a watershed. This study investigates changes in runoff production behavior of over 50 small to very large watersheds with drainage areas ranging from 35 to 160000 km2 in the North American Prairies. These depression-dominated watersheds which are characterized with strong memory properties have been subjected to diverse human disturbances. Our statistical analysis shows that there has been a range of diverse change in seasonal regimes of runoff as well as changes in snowfall versus rainfall patterns over the study area. This study shows that in watersheds with recorded history of disturbances the impact of human interference, along with modifications to climate inputs, on runoff response behavior is nonlinear, complex, and diverse. The results of this study suggest that different disturbances (i.e. removal of vegetation, changes in texture and structure of the soil through tilling or grading, ditching, construction of dams, etc.) may have varying or even opposite impacts on the residence time of water on the ground and in bodies of surface water such as streams or wetlands within the watershed boundaries. It seems that a change in watershed response behavior is a function of interaction among these diverse land use/cover changes as well as modifications to climate inputs. This complex response results in varying nonstationarity behaviors depending on the extent of each modification and also spatial scale of the watershed under study.