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Relative contributions of vegetation change and climate variability in large watersheds vary along climatic zones in China

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Vegetation change and climate variability are often two main drivers for streamflow variation in large watersheds. The relative contributions of vegetation change and climate variability can imply their impact strength, and are highly variable among watersheds, which are often associated with vegetation type, climate condition, topography and soil pattern. However, how these factors affect hydrological processes is still a great challenge in hydrology researches. In this study, we selected 14 large watersheds vary along different climate zones in China as examples, to quantify the effects of climate variability, vegetation change and other factors (e.g., road construction, agriculture, dams, mining, urbanization) on seasonal and annual flows; to identify relative contributions of climate variability and vegetation change across climate gradients; and to investigate the relationships between climate, vegetation, topography, soil and relative contributions. We used an improved single watershed approach based on modified double mass curve (MDMC) and multivariate autoregressive integrated moving average (ARIMAX) model to calculate relative contributions. Then, regression analysis was used to identify possible relationships between climate, vegetation, topographic and soil indicators and relative contributions. Finally, we deployed partial correlation analysis to detect statistical significance of related indicators impacts. Key results are: 1) vegetation change can significantly affect hydrological processes in selected watersheds; 2) the relative contribution of climate variability plays a more significant role in most watersheds, while vegetation change contributed a lot in natural forest dominated watersheds; 3) the relative contribution of vegetation change had strong connections with dryness index, forest coverage, topsoil bulk density and soil type on annual scale, whilst no significant partial correlation was detected in relative contribution of climate variability on seasonal or annual scale. Our findings highlight hydrological processes in large watersheds are complicated and also associated with topography, soil condition and landscape pattern. This requires for effective managements to alleviate negative effects on water resource caused by vegetation change and climate variability.