Assessing the Impacts of Climate Changes on the Regional Hydroclimatic Conditions of U.S River Basin over the 21st Century

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Abstract. Changes in hydroclimatic conditions may have substantial impacts on freshwater availability and basin characteristics. Assessment of long-term shifts in hydroclimatic conditions in advance can help to mitigate potential consequences on agriculture, environment, economy, society and ecosystem. This study assesses hydroclimatic changes of U.S river basins over the 21st Century induced by shifts in the Budyko space. The hydrologic responses of three climate change emission scenarios ranging from the driest to wettest conditions are projected using the Variable Infiltration Capacity (VIC) model with climate forcing from Multivariate Adaptive Constructed Analogs (MACA) dataset. Then, shifts in hydroclimatic characteristics of U.S river basins are evaluated by magnitude and direction of changes in the Budyko space. The results indicate hydroclimatic responses vary from a river basin to another because of differences in geographical characteristics, regional climate and physical processes. However, HUC08 river basins in the same neighborhood follow a systematic movement in the Budyko space indicating that there should be a common water and energy balance adaptation to regional climate changes. Systematic hydroclimatic shifts can be a sign for initiation of prolonged drought and land-use changes. Under all climate projections, the majority of river basins in the south of the U.S are likely to experience warmer and drier conditions. Under the driest scenario, most river basins in the southeast of the U.S are changing from Temperate to Continental climate zone. Additionally, aridity increases in the middle of the U.S, leading to expansion of Arid climate zones. This study can help decision-makers to assess and improve the ability of various water supply systems to mitigate or adapt to the impacts of regional climate changes.