



## **Hydroclimatic Changes of Water on Land and their Drivers from Local-Regional to Global Scales**

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Past and current climate change in the atmosphere (in terms of temperature  $T$  and precipitation  $P$ ), hydroclimatic changes in the water system on land (in terms of runoff  $R$  and evapotranspiration  $ET$ ) and their links to each other and other possible environmental changes, need to be studied and understood in order to realistically assess how forthcoming changes may affect freshwater resources and to plan for relevant adaptation to these changes. Here we use openly available data for  $T$ ,  $P$  and  $R$  development from the beginning of the 20th century until present time in 1260 catchments spread over all continents. The aim is to assess hydroclimatic changes, and the links among atmospheric climate change, changes to land-use and water-use (LUWUC), and water changes on land from the first half (1901-1950) to the second half of the 20th and a bit into the 21st century (1961-2009). In particular, we evaluate changes in  $ET$  and in the short-term, intra-annual variability (in terms of the coefficients of variation) of  $P$  and  $R$  ( $CV(P)$  and  $CV(R)$ , respectively), aiming to distinguish effects on these hydroclimatic changes from atmospheric climate change and from possible LUWUC and other landscape changes that may have occurred between these time periods. By evaluating the change links across global, hemispheric, continental and local-regional catchment scales, we identify dominant influences of climate and other possible change drivers, such as LUWUC, on the observed hydroclimatic changes in the system of water on land. These influences include a) different types of partitioning of given  $P$  changes into  $ET$  and  $R$  changes in different regions of the world, b) changes to runoff variability and c) changes in hydroclimate within Budyko space, of which atmospheric climate change could not be the main driver. The results of this study point to the necessity of considering and accounting for impacts of landscape and not only atmospheric changes on previous, ongoing and future changes of water on land.