Geophysical Research Abstracts
Vol. 20, EGU2018-3835, 2018
EGU General Assembly 2018

Connecting seasonal streamflow patterns and hydrological statistics to climate forcing on a global scale

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Hydrology has a clear need for a catchment classification system that can be applied globally and shows where hydrologically similar locations might be found. Such a system would use knowledge about climatic forcing and catchment structure to group catchments with similar hydrological responses. This study presents a continuous hydrologic climate classification scheme, which we use to connect climatic forcing to seasonal streamflow patterns and hydrological statistics. We find that a catchment's "hydro-climate" can be adequately expressed with three simple indices, and that these indices are strong global predictors of the seasonal flow regime. These findings can contribute to creating a global catchment classification system.

From gridded precipitation, temperature and potential evapotranspiration data we calculate three climatic indices: an aridity index, an aridity seasonality index and a precipitation-as-snow index. We investigate how the typical flow regime of 1100 catchments around the globe relates to the climate in each catchment, expressed in the three indices. Catchments with similar climates show similar streamflow response, regardless of geographical proximity. Climatic conditions change more gradually in space than catchment attributes (such as soil type and topography), which can explain streamflow differences between catchments with similar climates. However, changes in streamflow regimes coincide with changes in climate. Therefore, we advocate that the climate attributes of catchments are compared on a continuous hydro-climatic spectrum, as given by the three climatic indices.