H43O-08: Changes in precipitation-streamflow transformation around the world: interdecadal variability and trends.

Thursday, 14 December 2017
15:25 - 15:40
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Accurate prediction of hydrologic response to potentially changing climatic forcing is a key current challenge in hydrology. Recent studies exploring decadal to multidecadal climate drying in the African Sahel and south-eastern and south-western Australia demonstrated that long dry periods also had an indirect cumulative impact on streamflow via altered catchment biophysical properties. As a result, hydrologic response to persisting change in climatic conditions, i.e. precipitation, cannot be confidently inferred from the hydrologic response to short-term interannual climate fluctuations of similar magnitude.

This study aims to characterise interdecadal changes in precipitation-runoff conversion processes globally. The analysis is based on long continuous records from near-natural baseline catchments in North America, Europe, and Australia. We used several complimentary metrics characterising precipitation-runoff relationship to assess how partitioning changed over recent decades.

First, we explore the hypothesis that during particularly dry or wet decades the precipitation elasticity of streamflow increases over what can be expected from inter-annual variability. We found this hypothesis holds for both wet and dry periods in some regions, but not everywhere. Interestingly, trend-like behaviour in the precipitation-runoff partitioning, unrelated to precipitation changes, offset the impact of persisting precipitation change in some regions. Therefore, in the second part of this study we explored longer-term trends in precipitation-runoff partitioning, and related them to climate and streamflow changes. We found significant changes in precipitation-runoff relationship around the world, which implies that runoff response to a given precipitation can vary over decades even in near-natural catchments. When significant changes occur, typically less runoff is generated for a given precipitation over time - even when precipitation is increasing.

We discuss the consistency of the results and how the likely drivers differ between regions, and between water-limited and energy limited environments. We argue that when considering the impact of climatic change on hydrological systems we need to consider potential cumulative impacts of climatic shifts.

Plain Language Summary

Authors

Margarita Saft *
University of Melbourne

Murray Cameron Peel
University of Melbourne

Vazken Andreassian
IRSTEA

Juraj Parajka
Vienna University of Technology

Gemma Coxon
University of Bristol

Jim E Freer
University of Bristol

Ross A Woods
University of Bristol

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