A Systematic Review of Large-Scale Controls of the Partitioning of Precipitation

Padrón, Ryan S., Department of Environmental Systems Science, Swiss Federal Institute of Technology in Zurich (ETHZ), Universitätstrasse 16, 8092 Zürich, +41 44 632-9153; ryan.padron@env.ethz.ch

Gudmundsson, Lukas, Swiss Federal Institute of Technology in Zurich (ETHZ)
Greve, Peter, International Institute for Applied Systems Analysis (IIASA), Vienna, Austria
Seneviratne, Sonia I., Swiss Federal Institute of Technology in Zurich (ETHZ)

Long-term mean Precipitation (P) over land is partitioned into runoff (R) and evapotranspiration (ET), which is commonly characterized as the ratio ET/P. The ratio between potential evapotranspiration and P is explicitly considered as a control of this partitioning within Budyko's framework, whereas all other controls are often integrated into one single parameter. Although the joint effect of these additional controls of ET/P can be significant or even dominant, a detailed understanding of them is yet to be achieved.

Here we address this issue based on a new observational global dataset for the long-term mean partitioning of P into ET and R in 1604 catchments, which is obtained from a systematic examination of peer-reviewed studies. The new dataset is complemented with information from 22 indices of possible controls of ET/P that have been previously proposed in the literature. Through a correlation analysis we test the significance of the proposed indices and assess their relative contribution for explaining long-term ET/P.

Results reveal that (i) climate type is a significant control of ET/P, and additional controls vary with climatic region; (ii) the ratio of potential ET and P explains approximately half of the ET/P variance in most of the world, while is only about 10% in Arid regions; (iii) climate characteristics and catchment slope dominate over other catchment controls; (iii) despite the high attention that vegetation-related indices receive as controls of ET/P, they are found to be less important and not always significant; and (iv) the fraction of frozen precipitation is, together with PET/P, the most important control in regions with snow climate.

Overall, this study provides process-related insights about the partitioning of P with potential use for model development, watershed management, and projections of water availability around the globe. In future work we will combine lysimeter and flux data to study the partitioning of P with high (sub-daily) temporal resolution.