Climate Change, Ecosystems and Hydrology; How Ecosystems Adjust Their Root Zone Storage Capacity.

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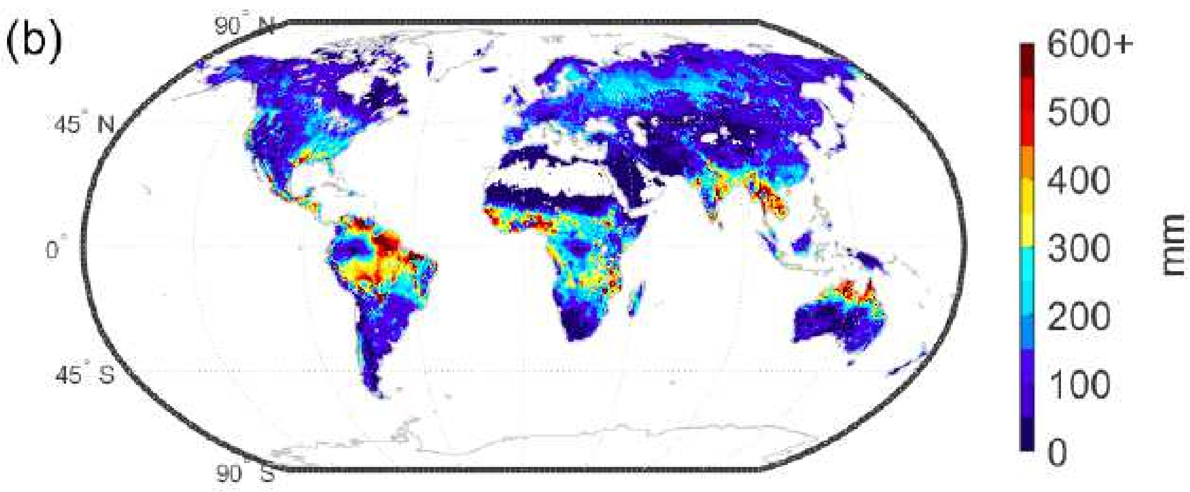
Climate, Ecosystems and Hydrology are closely connected and have co-evolved over time. Understanding the mechanisms of co-evolution is key to understanding (and prediction of) how climate, ecosystems and hydrology change over time. Ecosystems, like climate and hydrology are not in steady state. They change over time, but do so in conjunction. The fact that a certain ecosystems exists in a particular setting is prove that it survived the conditions of the past and evolved in interaction which its climatic and hydrological drivers. In turn, ecosystems influence hydrology and even climate, implying that these three system elements co-evolve over time. In the Anthropocene, societies are part of this complex system, whereby societies not only depend on climate, ecosystems and hydrology, but also influence them. This fact is the motivation for the IAHS decade on Panta-Rhei, which uses socio-hydrology as the science to enhance our understanding of this complex interaction (Sivapalan et al., 2012).

This mutual interaction is not only a complication for hydrological modelling, it is also the way to help us understand the interdependency between climate and important hydrological variables, such as the root zone storage capacity of ecosystems. Recent research has shown that it is possible to derive a key hydrological model parameter, such as the root zone storage capacity, from climate information (Gao et al., 2014). This knowledge can help us to predict how the structure of hydrological models will change over time, in response to climatic change. In this presentation, an example is given of a scale-independent hydrological model, parameterized on the basis of climatic time series, which can predict evaporation and runoff both at local and global scale (Wang et al., 2016). The Figure shows how the root zone storage capacity (mm) varies over the world. We can see that this capacity is largest in the subtropics, or in the tropics where evergreen forests have to overcome extended periods of drought. In places where rainfall occurs throughout the year, the storage capacity is smaller, even if the evaporative demand is large (e.g. on the equator). In the colder parts of the world, where the evaporative demand is low and rainfall is high, the storage capacity is small. In the (semi-)deserts the storage capacity is also small because there is no vegetation, or the vegetation that is present has other coping mechanisms to overcome a drought.



So in conclusion we can see that the root zone storage capacity is the result of coevolution between ecosystem and climate, whereby the ecosystem has created sufficient buffer to overcome the variability of the local climate.

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