Impacts of Climate Change on Surface and Groundwater Resources and their Management

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Abstract

As global warming is expected to intensify over the 21st- century, corresponding large changes on the various components of the hydrological cycle are to be anticipated which may lead in its two opposite extremes to either water scarcity in the form of droughts or surface water surpluses in the form of flood events. In either case, specific measures have to be taken for an appropriate water management which dampens these adverse effects on the water resources in the wake of climate change. Since climate change impacts will not only reduce the available water resources, but also increase the water demands by crops, i.e. will negatively impact agricultural production, the first unavoidable step to prepare affected societies for this water crisis and to evaluate these adverse water resources impacts is the identification of the climate variations, followed by a prediction of the hydro-climatic conditions for the future. All these hydrological consequences of climate change are significantly accentuated by ongoing population growth, increased urbanization and agricultural development just in those third-world or emerging countries which are already nowadays afflicted by water resources extremes, namely droughts. This holds particularly for the Mediterranean and arid climate zone across the northern hemisphere. Countries in southeastern Asia, such as Thailand, are, moreover, affected by large seasonal and inter-annual fluctuations of the precipitation pattern, leading to strong cycles of very dry or wet (flood) hydrological conditions. Water and hydrological disaster management in the wake of climate change should then attempt to primarily smoothen the extreme variations of surface and groundwater discharges. It is for that reason that the future use of groundwater resources becomes particularly important, as the groundwater aquifer acts as a low-pass filter of recharging effective rainfall and can act as a buffer to extreme short-term variations of water resources availability. In the first part of this review the general observations and predictions of climate change by GCM-models via downscaling methodology with possible hydrological impacts will be presented, which is followed in the second part by regional cases studies of the author and co-workers across the globe on issues of managing local water resources in the wake of climate change.