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Linking Climate Change to Environmental Impact and Adaptation Studies: Recent Advances and Shortcomings in Modeling of Extreme Hydrologic Processes

Van-Thanh-Van Nguyen
McGill University, Canada

Abstract

Climate change has been recognized as having a profound impact on hydrologic (water quantity) and environmental (water quality) processes for a local site or over an urban catchment area. Hence, global/regional climate models have been extensively used in climate change impact and adaptation studies. However, due to the current limitations on detailed physical modelling and computational capability, outputs from these models are provided at resolutions that are too coarse and not suitable for these impact studies. Hence, different downscaling methods have been proposed for linking these coarse-scale climate change projections to hydrologic and environmental processes at the required relevant space and time scales. Of particular importance for environmental engineering applications are those procedures dealing with the linkage of the large-scale climate variability to the historical observations of the precipitation and temperature extreme processes at a location of interest. If this linkage could be established, then the projected change of climate conditions given by climate models could be used to predict the resulting changes of the precipitation and temperature characteristics at the given local site. Therefore, the main focus of the present keynote lecture is to provide an overview of recent advances and shortcomings in the modeling of extreme rainfall and temperature processes in the climate change context from both theoretical and practical viewpoints. In particular, another focus of this lecture is on the recently published technical guide by the Canadian Standards Association entitled "Development, interpretation, and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners" (CSA PLUS 4013:19) to provide some guidance to water professionals in Canada on how to consider the climate change information in the design of urban water infrastructure.