AN INTEGRATED FRAMEWORK OF DOWNSCALING METHODS GENERATING BASIN-SCALE CLIMATE CHANGE ESTIMATES FOR HYDROLOGIC IMPACT ASSESSMENTS

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The outputs of general circulation models (GCMs) even those projected under high resolution (e.g. HadCM2 model) are unreliable to drive the hydrologic processes at the basin scale with complex orography and convective precipitation. The scale gap between GCMs outputs and hydrologic data requirements can be bridged at an efficient level by using the downscaling methods. The main downscaling methods are (1) the nested regional climate models of high resolution (RCMs), (2) the weathering-typing techniques, (3) the stochastic approaches, and (4) the regression (statistical) techniques. The RCMs simulate the GCM time-varying atmosheric boundary conditions at a specific domain of 20-30 km horizontal spacing having the advantage to resolve the small scale atmospheric features (e.g. orographic precipitation). The weathering-typing techniques link the synoptic-scale atmospheric circulation patterns (i.e. the climate) to weather at a local scale. However, they have some difficulties with the extreme events simulation and the stationarity of circulation-to-surface climate conditioning. The most known stochastic downscaling approaches modify the parameters in the conventional weather parameters such as the Weather GENeration program (WGEN) of Richardson. The WGEN program can accurately reproduce the climate statistics but it relates arbitrarily the model parameters, which are changed for future climate conditions. The regression downscaling techniques involve empirical relations between synoptic and local scale. They include linear and non-linear regression, artificial neural networks, canonical correlation, etc. These methods are sensitive to the choice of predictor variables but they are capable to reproduce realistic spatial-temporal sequences of predicted fields. Various forms of the four downscaling approaches have been applied for climate change impacts on hydrological processes. The timing and magnitude of hydrologic results showed differences from method to method and from basin to basin under present and future conditions. Due to the different physiography and the different prevailing weather systems that drive the hydrology of the worldwide spread basins there is great sensitivity to the choice of downscaling methods. Thus, there is need to apply several downscaling techniques to the same basin and compare the results in order to have an integrated scheme of future hydrologic scenarios.