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Effects of Climate Change on Indicators of Eco-hydrologic Alternation in Nakdong River Basin

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Hydrologic regimes play a major role in determining the biotic structure, composition, and function of aquatic, wetland, and riparian ecosystems. However climate change may be substantially altering such hydrologic regimes around the world. Appropriate quantifiable assessments of climate change-induced eco-hydrologic changes are required to support ecosystem management and restoration plans and to progress investigation on the biotic consequences of eco-hydrologic alteration. The fourth assessment report of Intergovernmental Panel on Climate Change suggests studies that increase the spatial resolution to solve the scale mismatch between large-scale climatic models and the catchment scale while addressing climate change impacts on aquatic ecosystems. Impacts occur mostly at the local level, though potential changes in the hydrological cycle and eco-hydrologic processes are more difficult to model and analyze at this scale. The difficulties are even greater for studies on monsoon climate river systems, which require the modeling of hydrological processes in greater seasonal detail. This presentation describes the modeling of climate change impact on runoff across southeast Korea using a conceptual rainfall-runoff model TANK and presents the results and assesses the eco-hydrologic alteration of climate change on the Nakdong river main stream. The future climate time series is obtained by scaling the historical series, informed by 4 global climate models and 3 greenhouse gas emission scenarios, to reflect a 4.0 °C increase at most in global average surface air temperature and 31.7 % increase at most in annual precipitation, using the spatio-temporal changing factor method that considers changes in the future mean seasonal rainfall and potential evapotranspiration as well as in the daily rainfall distribution. Although the simulation results from different global circulation models and greenhouse emission scenarios indicate different responses in flows to the climate change, there are obvious deviations of the river flows and various eco-hydrologic alteration indicators computed for all the scenario cases from the averages of the base period with current conditions. The majority of the modeling results show that there will be more runoff in southeast Korea in the future. However, there is substantial uncertainty, with the results ranging from a 4.2 % decrease to a 52.8 % increase in the mean annual runoff averaged across the study area according to the corresponding climate change scenarios. We then assess the hydrologic perturbations associated with ecologically significant features by comparing measures of central tendency and dispersion for each eco-hydrologic indicator between “present” and “future” time frames. Such an analysis is intended for use in planning ecosystem management adaptation strategies, and in setting and measuring progress toward conservation or restoration goals.