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Impacts of Climate Change on Drought Characteristics in the Northwest U.S.

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Several impacts of climate change on the duration, severity, and intensity of hydrological droughts in the Upper Klamath River basin in southern Oregon and northern California are evaluated in this study. The joint behavior of dependent drought variables is analyzed within the recently applied multivariate distribution functions, the Copula functions, in the complex hydrological systems with correlated variables. Streamflow Drought Index (SDI) with different time windows (3, 6, and 9 months) is employed to establish the primary drought analysis for the historical time period of 1920-2009. Evaluation of historical events shows that duration-severity and duration-intensity have respectively the most and the least correlation among other variable pairs. To analyze the impacts of climate change, the dataset of the five Global Climate Models (GCMs) under A1B emission scenario for the time period of 2020-2090 is obtained from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison study Project phase 3 (CMIP3). Substituting the streamflow volumes in the SDI with the simulated runoff by a hydrological model, the Standardized Runoff Index (SRI) is used to recognize the future drought characteristics. Evaluation of future droughts indicates that the study area will be exposed to overall less severe droughts with shorter duration when comparing to the historical events. The GCM products of GFDL-CM2.1 and CSIRO-MK3.0 contribute the future wettest and driest conditions, respectively; while none of the five applied GCM projections are found to make drier conditions than the historical events. Drought duration will not exceed 5 months in future time period while the 8-month droughts are discerned among historical events. Furthermore, the analysis of bivariate and trivariate return periods indicated that the future droughts will be less frequent than the historical droughts which is consistent with an overall wet condition for the study basin in the future time period.