Vulnerability of Oregon Hydrologic Landscapes and Streamflow to Climate Change

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Hydrologic classification systems can provide a basis for broadscale assessments of the hydrologic functions of landscapes and watersheds and their responses to stressors. Such assessments could be particularly useful in determining hydrologic vulnerability from climate change. Wigington et al. (2012) have developed a hydrologic landscape (HL) map for the State of Oregon. The HL classification is composed of five indices that represent factors controlling the hydrologic characteristics of watersheds: annual climate, climate seasonality (the season of maximum available water), aquifer permeability, terrain, and soil permeability. The climate and seasonality indices were based on 30 year normals from 1971-2000. Here we describe changes in HL class distribution and consequent vulnerability to streamflow when the maps are reclassified using predicted normals for 2041-2070. These were based on changes in monthly temperature and precipitation using the European Centre HAMburg (ECHAM) and Parallel Climate Model (PCM) global climate change models (which represent high and low sensitivity to CO_2, respectively) and three different CO_2 emission scenarios (A2, A1b, and B1, representing high, medium, and low CO_2 levels, respectively). We examined a number of factors statewide, including changes in the HL indices (climate and seasonality) as well as the continuous variables that these indices are based on (Feddema Moisture Index and available water). Initial results indicate that 4-18% of the state's 5660 assessment units changed climate class. For realizations based on the A2 and A1b emission scenarios, the changes were always to the next drier class. For the ECHAM-B1 and PCM-B1 realizations, however, 4 and 100% of the changed areas went to the next wetter class, respectively. Areas that changed climate class are distributed throughout most of the state. For seasonality, initial results indicate that 3-9% of the assessment units experience a change in class. However, 20-68% of units with maximum available water in the spring switched to winter seasonality. In addition, 100% of the units with summer seasonality switched to spring seasonality for all realizations except for PCM-B1, where only 43% of the units switched. These preliminary results indicate a significant loss of area that is dominated by spring or summer snowmelt to winter rain, suggesting that irrigated areas in eastern Oregon are particularly vulnerable to the effects of climate change. We illustrate the utility of the HL classification for identifying hydrologic vulnerability using several case study basins located throughout the state.

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