Using water infrastructure to manage ecohydrologic impacts of climate change in the upper Green River basin

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Abstract. Water management is challenged with weighing competing agricultural, urban and industrial demands for water against the environmental flows necessary for sustaining healthy rivers, and with a changing climate, information on future flows in rivers will be crucial for managing possible ecological impacts. To better understand how future hydrologic conditions might impact riverine species, we used Indicators of Hydrologic Alteration (IHA) to analyze the potential effect of climate change on ecologically important properties of streamflow in the upper Green River basin of Wyoming. We used multiple climate projection models (World Climate Research Programme's Coupled Model Intercomparison Project phase 3 multi-model dataset) to evaluate the response of streamflow to varied future temperature and precipitation patterns. We applied a semi-distributed hydrologic model (Stockholm Environment Institute's Water Evaluation and Planning System) to 79 subwatersheds defined by topography, climate and land use, generating weekly hydrographs for 167 reaches on which we computed IHA for 1970-1999 and 2030-2059. Our hydrologic model included water infrastructure (6 dams and 41 diversions) with which we explored multiple scenarios for managing future ecohydrologic impacts. These scenarios included strategies aimed at restoring "natural" flows, maximizing the existing storage capacity or irrigation delivery, and releasing environmental flows to minimize the establishment and spread of non-native species. Our application of IHA, with a GIS-derived geomorphic valley classification, will then be used to assess the potential future risk of species invasions in the upper Green River basin, and how water management might mitigate that risk.