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A robust decision making framework for identifying dominant controls on indicators of hydrologic alteration under environmental change

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Projecting streamflow under environmental change (including climate and land use change) has become increasingly important for decision making related to long-term water resources planning. Most strategies for estimating these projections simply propagate downscaled climate change projections through hydrologic models. While such approaches shed light on possible changes in future streamflow, several studies have now pointed out that uncertainty is under-estimated in most cases. Moreover, studies provide conflicting results on the importance of different sources of uncertainty – parametric, downscaling approach, GCM projections used etc. Finally, inclusion of all possible sources of uncertainty may render any projection to be of limited practical value. In order to address these problems, we explore an alternative strategy for robust decision-making. Rather than analyzing forward projections of individual scenarios, we search the feasible climate-land cover space for conditions that exceed critical societally relevant thresholds defined by carefully chosen hydrologic indicators. Using available downscaled climate change data, we evaluate the probability of watersheds to transition into such vulnerable regimes with respect to the different indicators studied. This strategy allows for a better consideration of uncertainty and therefore is likely to provide information of greater value for decision-making compared to currently applied strategies. We test the proposed strategy in a medium-size watershed in the north-eastern USA.