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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Future streamflow regime changes in the United States: assessment using functional classification" *by* Manuela I. Brunner et al.

Anonymous Referee #1

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General comments: This paper develops a functional hydrologic classification method, applies it to a large number of gages in the continental US, and assesses future changes in hydrologic regime resulting from climate change using VIC model output driven by downscaled GCMs. The paper makes an important contribution to the literature on hydrologic classification because its use of functional data analysis, in which each hydrograph is represented as a function, addresses issues associated both with top-down classifications based on catchment characteristics (lack of process connections between those characteristics and streamflow) and with bottom-up classifications based on streamflow indices (requiring selection of indices that may not fully describe the hydrologic regime). As such, the paper provides an interesting and innovative

approach that is useful for assessing hydrologic regimes for climate-change impact assessment or to predict the behavior of ungaged catchments.

Specific comments: Line 30: It should be noted upfront that hydrologic regimes, defined here as those "described by mean annual hydrographs", can encompass a broader set of variables than those used here. In particular, the functional approach that analyzes mean annual hydrographs describes the seasonal patterns of streamflow, but not patterns that occur on either shorter timescales (e.g., flashiness) or longer timescales (e.g., interannual variability). For analyzing these types of changes in hydrologic regime, the functional analysis is less useful and particular streamflow indices must instead be used. This is important because the seasonal hydrologic regime is highly sensitive to changes in temperature in the melt region because of the snow signal, but as noted later in the paper (lines 291-292), there is no clear seasonal signal in catchments that are more sensitive to changes in precipitation to temperature. It is not that those catchments will not experience hydrologic changes due to climate change, it is just that the type of changes they experience (e.g., greater flashiness or interannual variability) are not captured by the functional analysis and its focus on seasonal changes. Also, although at the seasonal scale of analysis meteorological variables were more significant than physiographical variables in predicting class membership (lines 228-229), it is possible that physiographical characteristics would be more significant in determining class membership when it comes to flashiness or interannual variability, because of the role of land-surface characteristics like lithology, soil, and vegetation in mediating the climatic signal.

Lines 233-234: Would it be possible to include a map of nominal hydrologic class for ungaged catchments? If the random forest model can predict hydrologic class based on meteorological and physiographical variables, it should be able to apply the classification and predict hydrologic class for all the catchments in the CONUS (assuming data for the predictor variables are available CONUS-wide). That would be an interesting map to see because it would further illustrate the spatial contiguity and extent of

the hydrologic classes beyond the gaged catchments in Figure 2.

Technical corrections: Line 243: Typo: “Klomogorov” should be “Kolmogorov”. Line 298: Is “temporally” meant to be “temporarily”? That makes more sense to me.

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