Predicting seasonal precipitation partitioning into discharge and evapotranspiration as a function of climate

Abstract: Conservation planning and water resource management depend on accurate predictions of water availability as the hydrologic cycle evolves with climate change. Isotope signatures in precipitation and streamflow reveal the routing of summer and winter precipitation to evapotranspiration (ET) and runoff. While it is conventionally thought that summer precipitation disproportionately supplies ET, because summer is when most ET occurs, this may not be the case if plants disproportionately rely on subsurface water stored from previous seasons' precipitation, or if summer precipitation bypasses soil water storages via preferential flow. Consequently, by not considering these transport dynamics, we would poorly predict soil water exports to streams and vegetation vulnerabilities to summer versus winter droughts. Using isotope data from watersheds throughout the US, we will determine if and where soil-water transport parameterizations representing alternative mixing assumptions are needed.

Future applications of this research will specifically examine whether soil-water transport behavior inferred from stable isotopes can be predicted as a function of climate, topography, and remotely sensed vegetation characteristics. The remotely sensed data we use has continuous spatial coverage, which would allow us to create a map inferring precipitation partitioning for watersheds across the entire United States. When compared with climate forecasts of precipitation anomalies, this map would identify ecosystems that are particularly vulnerable to different seasons' drought. These insights would be valuable in understanding which climatological conditions may lead to land cover change, and thus also valuable in predicting changes in biodiversity and carbon cycling.