Beyond Lees Ferry: Assessing the Long-term Hydrologic Variability of the Lower Colorado River Basin

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Abstract. The future reliability of Colorado River Basin water supplies depends on natural hydrologic variability, climate change impacts and other human factors. Natural variability is the dominant component at annual to decadal time scales and thus, capturing and understanding the full range of such variability is critical to assessing risks to near- and mid-term water supplies. Paleohydrologic reconstructions of annual flow using tree rings provide much longer (400+ years) records of annual flow than do historical gage records, and thus a more complete representation of potential flow sequences. While the long-term natural variability of the Upper Colorado River Basin has been well-captured by high-quality multi-century reconstructions of the annual flow of the Colorado River at Lees Ferry, AZ, there has been no equivalent effort for the whole of the Lower Colorado River Basin, including the Gila River. The contribution of the Lower Basin to overall basin flows is estimated to be 15% on average, but this percentage varies significantly from year to year, potentially impacting water supply risk and management for the entire basin. We present results from an ongoing effort to assess the hydroclimatic variability of the Lower Basin and to develop reconstructions of annual streamflows for the Gila River and Lower Colorado River near Yuma, AZ, commensurate with the existing Lees Ferry reconstructions. We offer a suite of modeling techniques to capture the flow of the Gila at the confluence with the Colorado River, including Principle Component Analysis (PCA) coupled with local polynomials, logistic regression on threshold exceedances, and Extreme Value Analysis, using Generalized Pareto Distribution (GPD). We also present reconstructions of intervening flows on the Lower Colorado River. Future work will use these reconstructions of the Lower Basin flows to facilitate more robust estimation of water supply risk to support water resource planning and management.