An Integrated Measurement and Modeling Approach to Improve Estimates of Water Exports within the East River Watershed

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Abstract:

Evaluation of temporal and spatial changes in water budget components is one of the most critical issues facing water security in mountainous regions. In the East River watershed, efforts within the Water Priority of the Watershed Function SFA have focused on 1) ascertaining sources of uncertainty in water budget quantification, and 2) improving characterization and predictions of water exports in response to disturbances and climatic stressors. To the first point, significant uncertainty is attributed to evapotranspiration (ET) rates. To this end, our efforts have focused on (a) reconciliation of various ET methods used at the East River to identify critical sources of uncertainties, and (b) development of ET benchmarking platforms and datasets to reduce uncertainties. Our synthesis efforts indicate that ET estimates do show some variability across applied methods (e.g., flux tent, water mass-balance, and sap-flow); however, there is consensus regarding transitions between water and energy limited systems across locations and years. Our model and data analyses further indicate that lysimeter-based SMARTSoils testbeds are important

benchmarks to improve consensus across these methods, especially in analyzing the differences in evaporation and transpiration. In addition, a 34-year long analysis on potential ET and aridity index using climatic variables shows temporal shifts in behavior that are distinct but not insignificant across 17 meteorological stations spread across the East River watershed domain (Faybishenko et al., in review). Taken together, these analyses provide key information for identifying critical locations, measurements and modeling approaches for scaling high resolution, local scale ET measurements to the entire watershed with reduced uncertainty.

To the second point, efforts were carried out in the past year to quantify variations in partitions and drivers for streamflow using hydrological modeling and stable isotope approaches. Stable water isotope observations of snow water indicate elevation is a dominant control on the temporal variability of snowmelt input to the subsurface and that streamflow is in fact dominated by snowmelt water (>90 %) throughout the year. These analyses combined with five years of groundwater observations from multiple deep wells are providing evidence that the upper subalpine region is a preferential recharge zone in mountain systems (Carroll et al., in revision). In order to better assess the variability in streamflow generation and identify recharge zones under disturbance, future efforts in the Water Priority are geared towards distributed sampling through isotopes, Snow/Soil Distributed Temperature Profiling, and integrated modeling within and across functional zones.

Carroll, R.W.H., Deems, J., Maxwell, R., Sprenger, M., Brown, W., Newman, A., Beutler, C., Bill, M., Hubbard, S., Williams, K.H. Variability in observed stable water isotopes in snowpack across a mountainous watershed in Colorado, *in revision*, Hydrological Processes.

Faybishenko, B., B.Arora, D.Dwivedi, E. Brodie. Statistical Framework to Assess the Temporal and Spatial Climate Changes: East River Mountainous Watershed case study, *in review*.