Title: **Simulating Snow Patterns and Evolution in the East River SFA with a Distributed Snow Dynamics Model**

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Project Abstract:

Spatial and temporal patterns of snow accumulation and melt exert a dominant control on hydrologic and biogeochemical flows in temperate mountain catchments. Mountain snowpack states, fluxes, and properties exhibit extreme and scale-dependent variability, complicating efficient sampling and modeling. Capabilities for evaluating the impacts of system perturbations (e.g. climate shifts, radiative forcing by impurities, forest cover change) on system water availability and nutrient cycling are contingent on robust observations and simulations of seasonal snow dynamics at appropriate scales of action.
To explore snow accumulation and melt process dynamics over the meter to watershed scales, we have implemented a physically-based snow cover evolution model (SnowModel; Liston et al., 2006) at multiple grid resolutions, using different combinations of accumulation process sub-models. We first tested the model in Senator Beck Basin, a well-instrumented study site in southwest Colorado, and adjusted wind transport parametrization the main processes influencing snow pattern distributions in mountain head catchment. The sensitivity analysis of grid resolution and wind transport showed impacts on water available for runoff at the basin scale. Higher resolution and wind transport produce slower melt with delays of 10 days for 10 m to 100 m resolution and 48 days for without wind transport, due to snow drifts that last late into summer in the simulations with wind transport.

Model wind transport parameterization obtained in Senator Beck Basin were then transferred to the East River SFA where instrumentation is less-reliable. To improve model results and system disturbances impacts analysis, we have: (i) implemented and validated the albedo decay parametrization from Deems et al., 2013. and (ii) analyzed the forest impact on wind transport and redefine a new forest type to allow for forest sheltering of adjacent areas. The simulations over a recent set of years spanning high and low peak accumulation values, were forced with data assimilation model (HRRR) output, and are compared with ground measurements as well as

snow depth and snow water equivalent (SWE) maps from Airborne Snow Observatory flights. These results help characterize the snow hydrologic system in the East River and quantify the importance of snow distribution due to wind and gravitations transport at the watershed scale, setting the stage for future snow data assimilation work and for integration with simulations of connected systems within the SFA.

References:

Liston, G.E., Elder, K., 2006. A Distributed Snow-Evolution Modeling System (SnowModel). J. Hydromet. 7, 1259–1276.

Deems, J. S., T. H. Painter, J. J. Barsugli, J. Belnap, and B. Udall. 2013. Combined impacts of current and future dust deposition and regional warming on Colorado River Basin snow dynamics and hydrology. Hydrology and Earth System Sciences 17(11): 4,401-4,413. doi:10.5194/hess-17-4401-2013.