Title: **Carbon transformation and transport in a high elevation mountain catchment**

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Project: Advancing a Watershed Hydro-biogeochemical Theory: Linkage between Water Travel Time and Reactive Rates Under Changing Climate [University project, lead PI, Li Li, Penn State)

Project Abstract:

Mountain areas are warming up faster than lowland places, imposing tremendous implications to soil biogeochemical reactions, water availability and chemistry, and climate-carbon feedback. Dissolved organic and inorganic carbon (DOC and DIC), as well as soil CO_2, are produced in soils and exported from soils to streams, where CO_2 evasion emits a sizable portion of CO_2 comparable to the emission of soil CO_2 to the atmosphere. The magnitude and drivers of dissolved carbon in the fast-warming mountain areas however are poorly understood[1, 2]. Here we ask the question: how and to what extent does warming affect flow paths, carbon biogeochemical reactions, and its export in mountain streams? To address the equation we used watershed-scale reactive transport modeling and stream flow and chemistry data collected every other day for multiple years in a high elevation mountain watershed, Coal Creek, in Colorado. Analysis of stream data reveals occurrence of high DOC concentrations during high flow times and high DIC concentrations during low flow times. The watershed-scale reactive transport model was used to simulate flow paths, soil respiration, and carbon decomposition in the subsurface, and to understand and quantify rates and drivers of carbon transformation and transport. Modeling results suggest significant DOC and soil organic matter mineralization in longer and deeper groundwater flow paths, resulting in reduced DOC and increased DIC concentrations in deep ground water compared to shallow soil water. Results indicate carbon transformation in the deep subsurface can contribute substantially to the dissolved carbon in deep ground water and in streams. This suggests that even though oxygen and organic matter availability are lower in deep subsurface, carbon decomposition may be still significant due to its longer flow paths and longer water residence time for processing carbon.

Publications:

1. Zhi, W.; Williams, K. H.; Carroll, R. W. H.; Brown, W.; Dong, W.; Kerins, D.; Li, L., Significant stream chemistry response to temperature variations in a high-elevation mountain watershed. Communications Earth & Environment **2020,** 1, (1), 43.
2. Zhi, W.; Li, L.; Dong, W.; Brown, W.; Kaye, J.; Steefel, C.; Williams, K. H., Distinct Source Water Chemistry Shapes Contrasting Concentration-Discharge Patterns. Water Resour. Res. **2019,** 55, (5), 4233-4251.