The Processes Controlling Stream Water Chemistry at the Terrestrial-Aquatic Interface, Great Lakes Region, USA

*Fengjing Liu[1], Veronica Porter[1]

1. Michigan Technological University

The diagnostic tools of mixing models (DTMM) and concentration-discharge (C-Q) analysis were applied to understand the processes that control stream water chemistry at the terrestrial-aquatic interface in Great Lakes region, USA. Streamflow discharge and chemical data from 2005 to 2008 at eight sub-catchments (ranging in size from 0.5 to 168 km^2) were acquired from the US Geological Survey, including major ions, nutrients, and trace metals. The results of DTMM showed that specific conductance (SC), Ca^{2+}, Mg^{2+}, Na^+, HCO_3^-, Si, Al, As, Ba, and U in stream water behaved conservatively and their concentrations resulted from mixing of two end-members in eight catchments. Significant ($p < 0.01$, $n = 10$) C-Q power-law relationship occurred in all catchments for these conservative solutes above, further suggesting that the concentrations of these solutes in two end-members were relatively constant and their contributions to streamflow were persistent over time. Both DTMM and C-Q analysis indicated that K^+, Cl^-, SO_4^{2-}, DON, and Mn were conservative only in some catchments mostly at larger scales but NO_3^-, P, Cr, Co, Cu, Fe, Pb, Ni, Se, and Zn were strongly impacted by chemical equilibrium in stream water in all catchments. These analyses enable us not only to develop two end-member mixing models with constant but distinct chemical signatures in end-members for all catchments at various scales but also to help understand the fate of nutrients and trace metals in stream water.

Keywords: Stream water chemistry, Diagnostic tools of mixing models, Concentration-discharge analysis, End member mixing, Great Lakes Region

