

# Lake Effect winter precipitation and regional ground water hydrology: perspectives from stable isotopes

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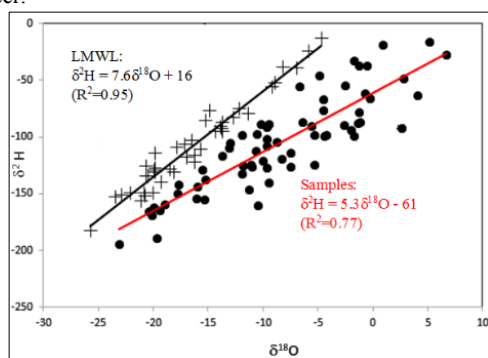
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Precipitation is the ultimate source of surface and groundwater recharge. The use of stable isotopes to understand regional hydrology has a long history and is well understood [1]. Mid-latitude regions like our study area (Kalamazoo, MI, 42.3°N, 85.6°W) show strong isotopic seasonality in precipitation, and isotope ratios of groundwater clearly demonstrate the fractional contribution from summer and winter precipitation [2]. Winter precipitation which is mostly snow is also influenced by the so called “Lake Effect” which has its own isotopic signature.

Useful baseline data exists from the present study area in terms of isotope values for summer and winter precipitation [2]. Our present research on 2013-2017 snow samples involved laser based isotope analysis and has been consistent with past work aside from several of the winter samples of 2013-2014 that show an unusual isotopic pattern for the study area. This winter is also known to be the worst winter in recorded history accompanied by frequent southward shifts of the Arctic Polar Vortex [3].

Anomalies are shown in Fig 1 where the Local Meteoric Water Line (LMWL) is also shown. These appear to be driven by global warming and are likely to occur more. This needs to be considered when using isotope techniques in regional hydrology, especially while using the *d*-excess as a tracer.



**Figure 1:  $\delta^2\text{H}$  vs  $\delta^{18}\text{O}$  plot of winter samples from 2013-14. Samples marked by filled circle deviate from LMWL.**

[1] Clark, I.D., and Fritz, P. (1997) Environmental isotopes in hydrogeology. CRC press. [2] Machavaram, M. &, Krishnamurthy, R.V. (1995) Geochim Cosmochem Acta 59, 4279-4283. [3] Ryan, M.S et al. (2014). NOAA/NWS/Weather Prediction Center., 1-63.