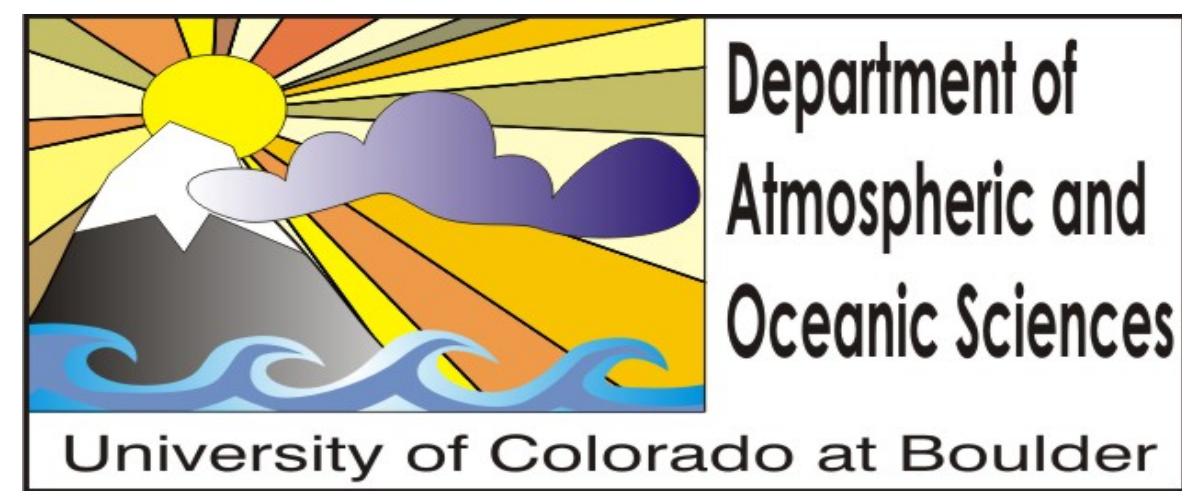


Three years of stable water isotope data at the Boulder Atmospheric Observatory: Insights into atmosphere-land surface water fluxes



Aleya Kaushik^{1,2*}, Max B. Berkelhammer³, Michael O' Neill^{2,4} and David C. Noone^{1,2,5}

¹ Department of Atmospheric and Oceanic Sciences, University of Colorado at Boulder. *Email: aleya.kaushik@colorado.edu

² Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder. ³ Department of Earth & Environmental Sciences, University of Illinois.

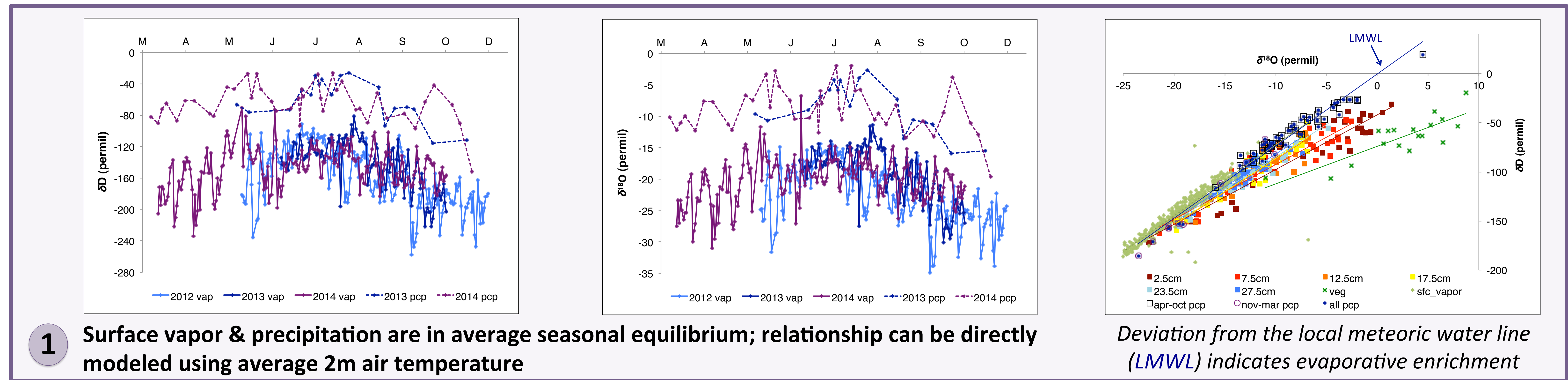
⁴ NOAA Earth System Research Laboratory, Global Monitoring Division, Boulder. ⁵ College of Earth, Ocean & Atmospheric Sciences, Oregon State University.



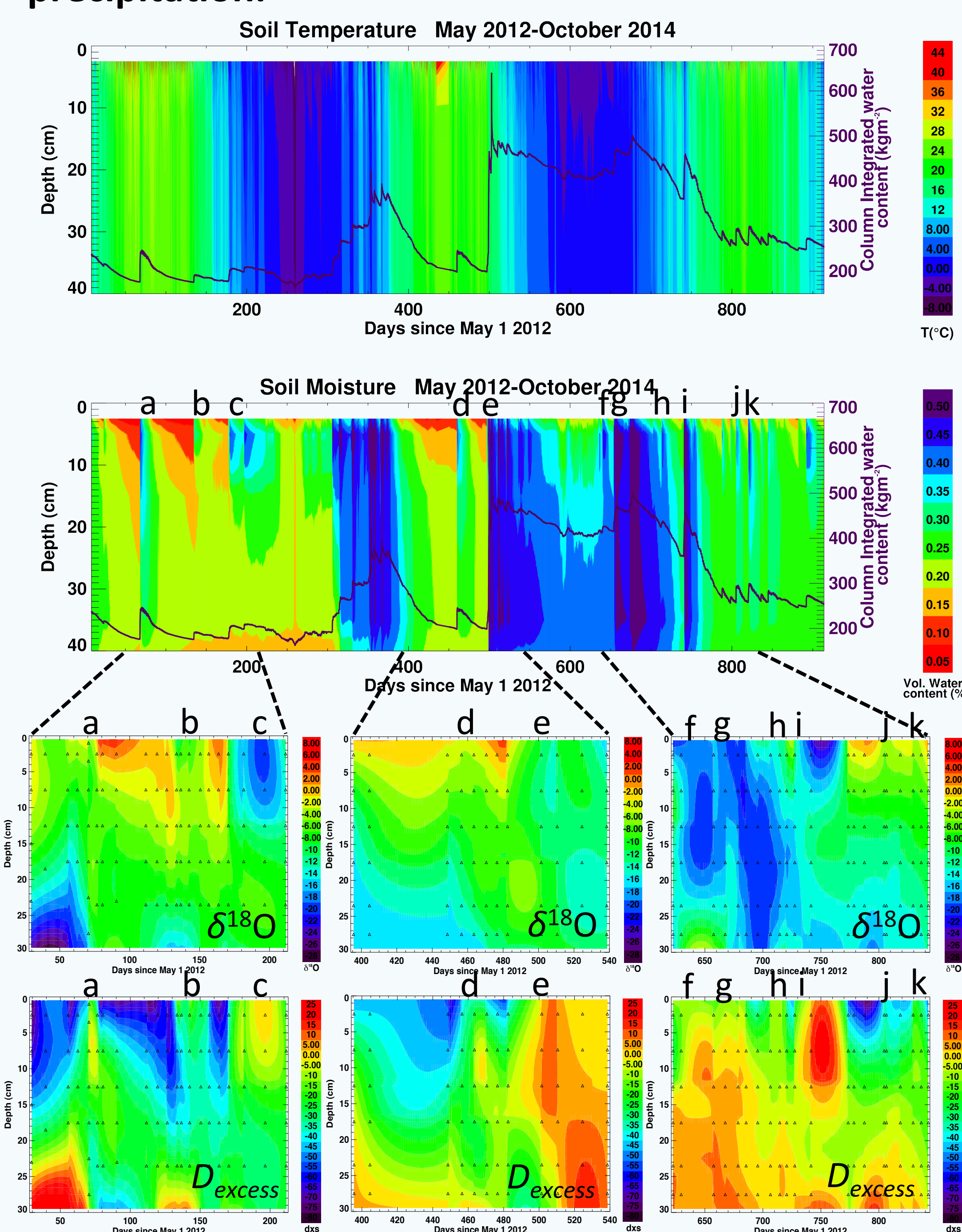
Summary

An observational data set of stable water isotopes in surface water vapor, sub-surface soil water and precipitation is presented over a 3-year period. Our goals are to: (1) use the observations to constrain the relative influences of precipitation inputs and evapotranspiration losses in setting the isotopic ratio of soil water, and (2) use this formulation to refine the parameterizations used in land-surface exchange models.

- 1 Surface vapor & precipitation in average seasonal equilibrium; vegetation & soil show evaporative enrichment
- 2 Soil water isotope ratios are controlled by evaporative fluxes following precipitation events
- 3 Resolving water vapor gas exchange in soil better describes fluxes in semi-arid regimes



Soil temperatures show clear diurnal and seasonal cycles. Soil moisture input is dominated by precipitation.



Soil water and Craig-Gordon (CG) model of evaporative flux

Gradient profile method used to extrapolate surface isotopic value δ_{ET}

$$ET = E + T$$

$$R_{ET}ET = R_E E + R_T T$$

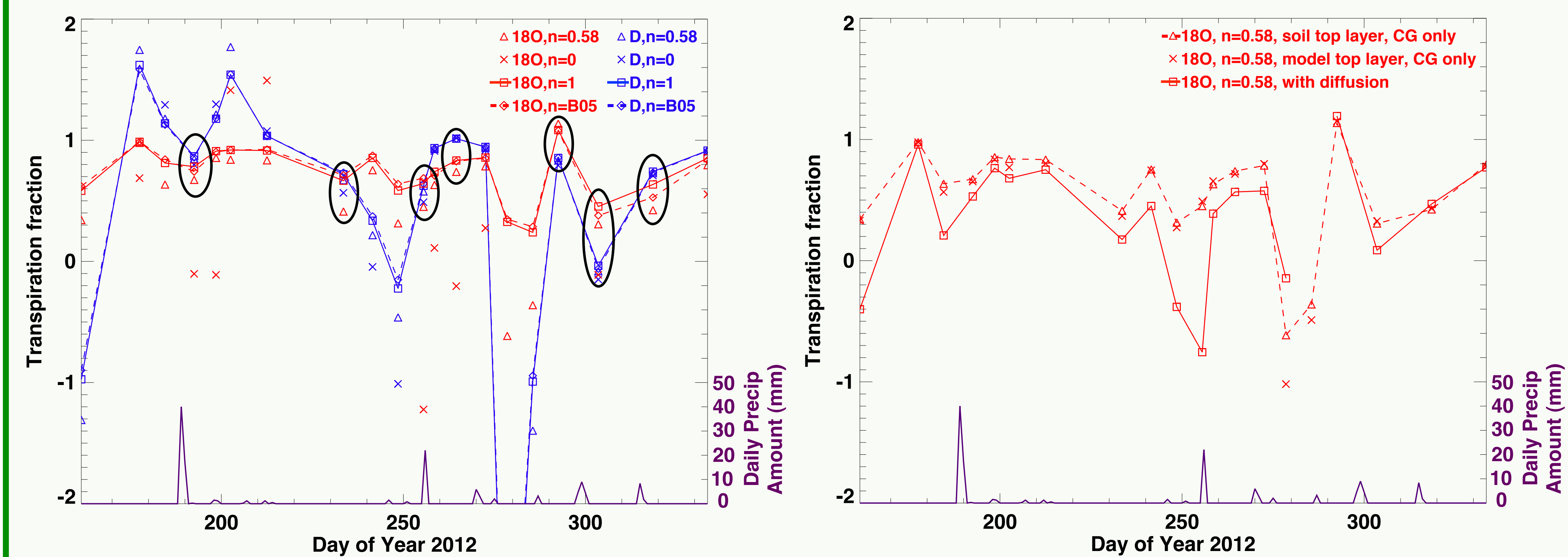
$$R_{ET} = R_E(1 - f_T) + R_T f_T$$

$$R_E = \frac{\alpha_k \times \left[\frac{R_{soil}}{\alpha_{eq}} - R_{vap} \times h \right]}{[1 - h]}$$

$$R_{spt} = \left[\frac{\delta}{1000} + 1 \right] \times R_o$$

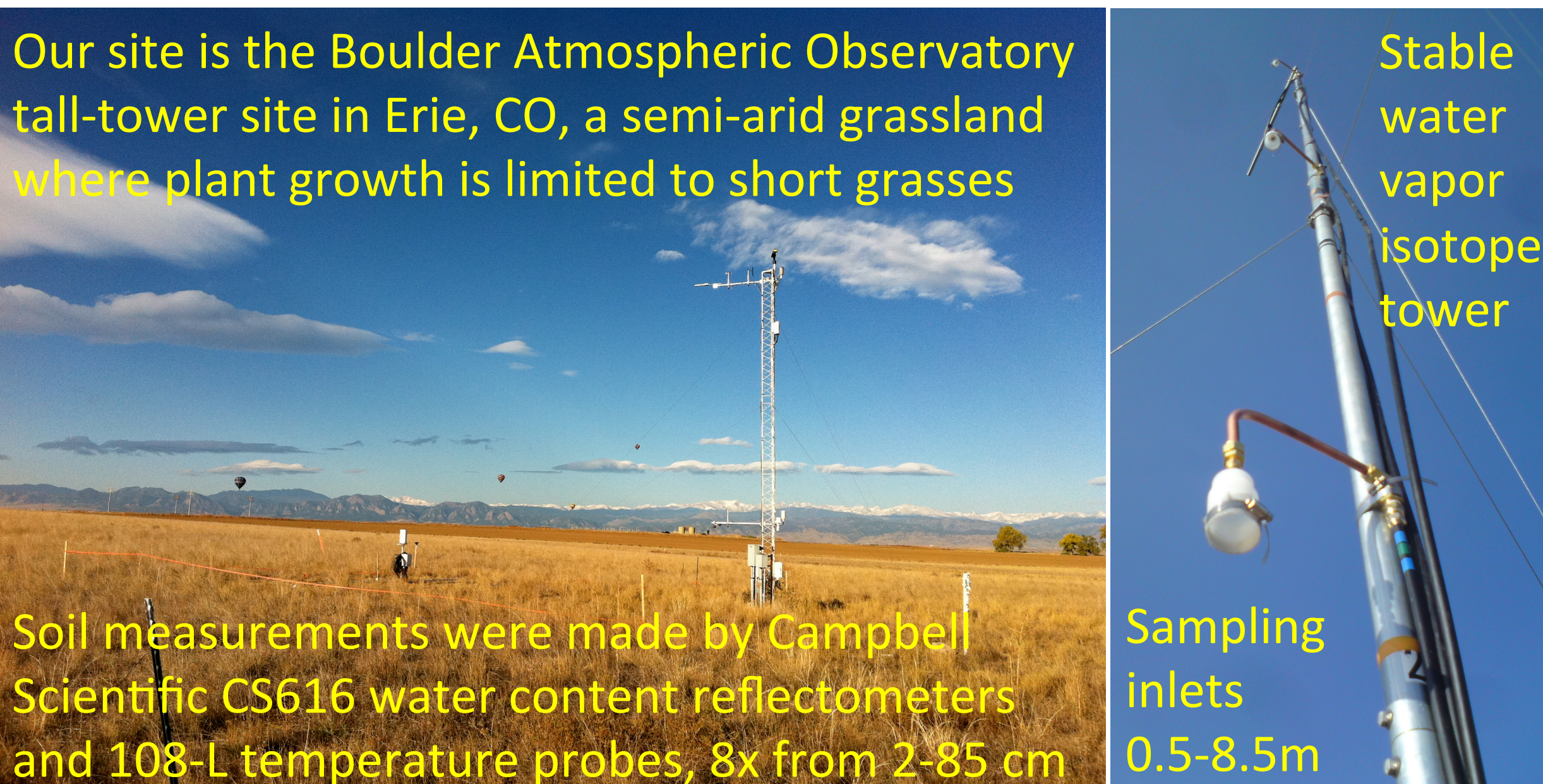
$$\alpha_k = \left(\frac{D_i}{D_{H_2O}} \right)^n$$

$$f_T = \frac{(R_{ET,18O} - \alpha_{k18O} X_{18O})}{(\sum_5^{20} R_{soil,18O} - \alpha_{k18O} X_{18O})}$$

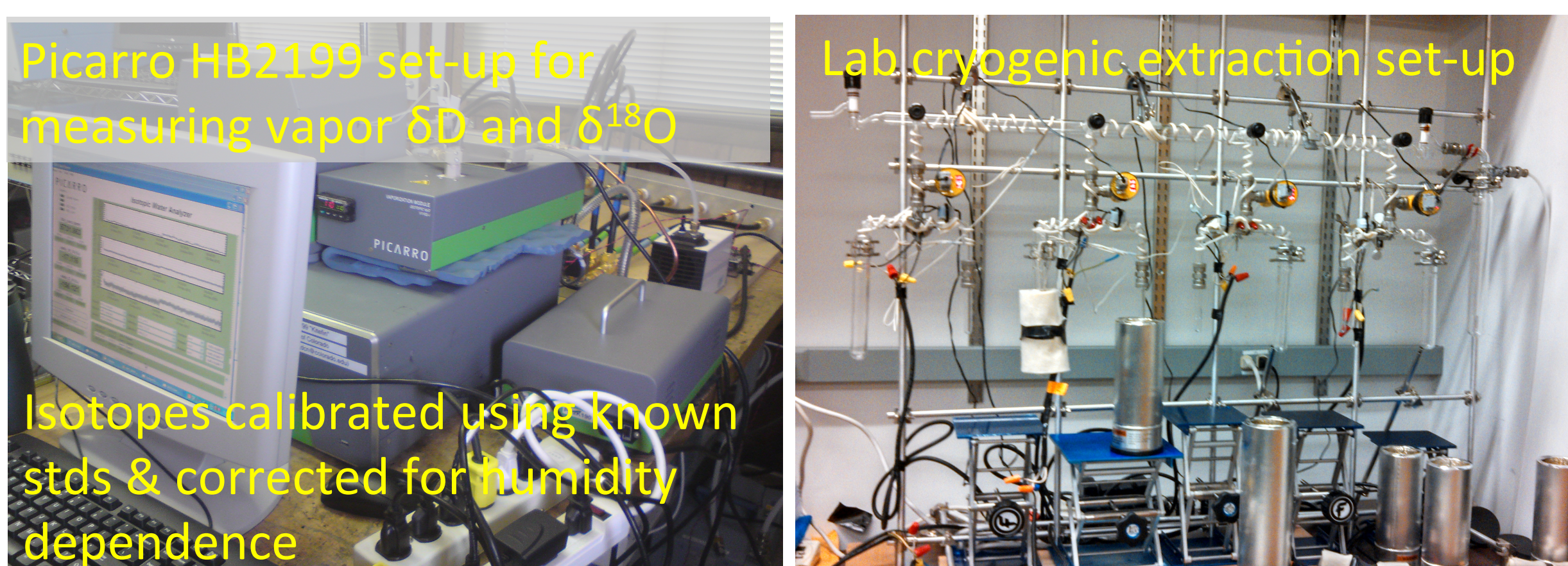


Conclusions & Future work

- Existing methods for calculating kinetic fractionation factor and transpiration fraction do not work under drier conditions and must be modified.
- The mechanism that sets soil water isotope values has implications for interpreting paleo-proxy records of stable water isotopes, e.g. tree rings or cave deposits. Modeling key processes (evaporation, sub-surface diffusion, transpiration) is important.
- New parameterizations will be tested with an isotope-enabled land-surface model, and eventually coupled to an isotope-enabled atmospheric global circulation model.



Soil measurements were made by Campbell Scientific CS616 water content reflectometers and 108-L temperature probes, 8x from 2-85 cm



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