Are empirical equations able to calculate stable isotopes content of vapor correctly?

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The effect of evapotranspiration on the stable isotope characteristics of vapor has been tested by comparing the isotopic contents of vapor with the values derived from the empirical equations 1 to 4 via the isotopic characteristics of precipitation (Clark and Fritz 1997).

$$\Delta\varepsilon = {}^{18}O_{\text{water-vapor}} = -14.2\,(1-h)\ ‰ \quad (1)$$

$$\Delta\varepsilon = {}^{2}H_{\text{water-vapor}} = -12.5\,(1-h)\ ‰ \quad (2)$$

$$\delta^{18}O_{\text{water}} - \delta^{18}O_{\text{vapor}} = \varepsilon^{18}O_{\text{water-vapor}} + \Delta\varepsilon^{18}O_{\text{water-vapor}} \quad (3)$$

$$\delta^{2}H_{\text{water}} - \delta^{2}H_{\text{vapor}} = \varepsilon^{2}H_{\text{water-vapor}} + \Delta\varepsilon^{2}H_{\text{water-vapor}} \quad (4)$$

To compare the simulated and real data, the isotopic values in vapor and precipitation presented by Wei *et al.* (2016) have been used (Fig.1). Due to the effect of evapotranspiration in subtropical and intensively vegetated areas such as rice paddy areas, the measured and calculated isotopic values were not matched with each other and some differences were observed. During the cold period (November to March) when temperature, precipitation, and relative humidity decreased, the role of transpiration significantly decreased and the measured and calculated stable isotopes in vapor showed approximately the same values and vice versa for hot period (April to October).

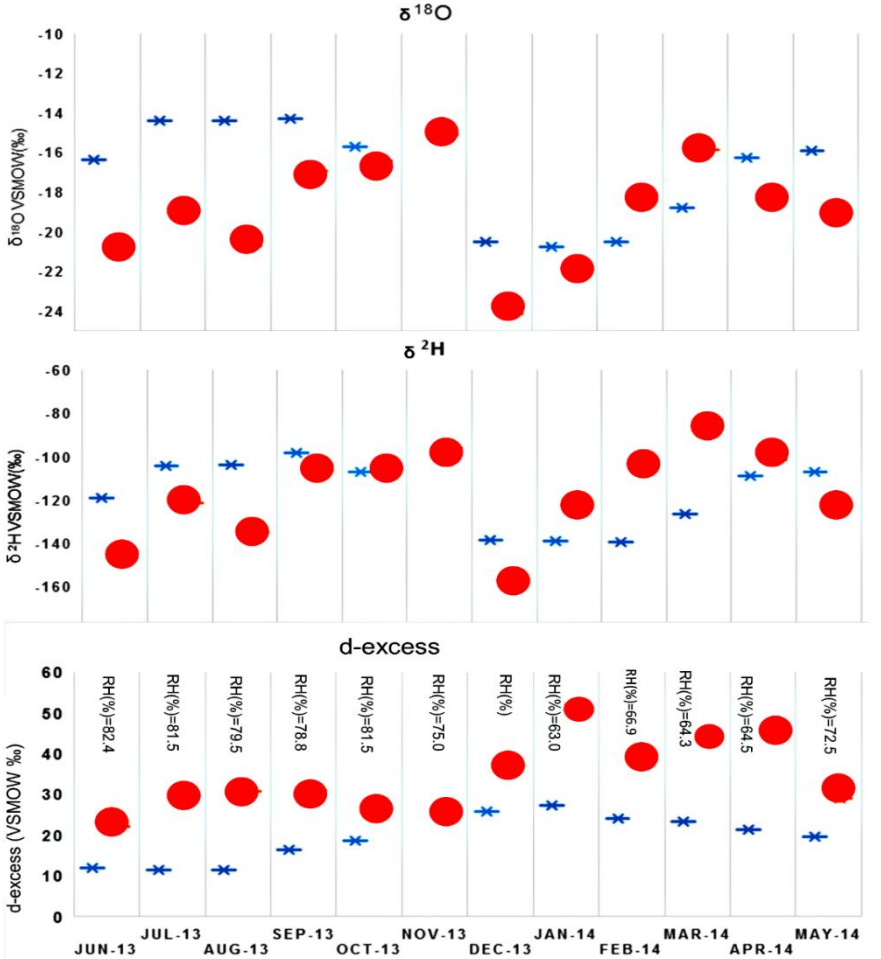

Figure 1. Plotting the calculated (red circles) and measured (blue stars) isotopic values (δ18O and δ2H) and the d-excess of precipitation vapor

References

Clark ID, Fritz P (1997) Environmental isotopes in hydrogeology. CRC Press/Lewis Publishers

Wei Z, Yoshimura K, Okazaki A, et al (2016) Understanding the variability of water isotopologues in near-surface atmospheric moisture over a humid subtropical rice paddy in Tsukuba, Japan. J Hydrol 533:91–102.