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Temporal variations of atmospheric water vapor δD and δ18O above an arid artificial oasis cropland in the Heihe River Basin

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The high temporal resolution measurements of δD, δ18O, and deuterium excess (d) of atmospheric water vapor provide an improved understanding of atmospheric and ecohydrological processes at ecosystem to global scales. Isotope ratio infrared spectroscopy has recently allowed high-frequency in situ measurements of atmospheric water vapor isotopic ratios in China (Wen et al., 2008, Journal of Hydrology; Wen et al., 2012, Journal of Atmospheric and Oceanic Technology). For our group, in situ and continuous observations of δD, δ18O, and d of atmospheric water vapor have been performed at the surface air in Beijing (Wen et al., 2010, Journal of Geophysical Research–Atmospheres; Zhange et al., 2011, Journal of Geographical Sciences), a winter wheat and summer maize cropland in Luancheng (Wen et al., 2012, Oecologia; Xiao et al., 2012, Global Change Biology), a grassland in Duolun (Hu et al., 2014, Journal of Geophysical Research– Biogeosciences), a spring maize cropland (Huang and Wen, 2014, Journal of Geophysical Research–Atmospheres) and a subtropical coniferous plantation (Yang et al., 2015, Agricultural and Forest Meteorology).

In this study (Huang and Wen, 2014), δD, δ18O, and d of water vapor and their flux ratios were continuously measured from May to September 2012 using an in situ technique above an arid artificial oasis in the Heihe River Basin, which has a typical continental arid climate. The monthly δD and δ18O increased slowly and then decreased, whereas the monthly d showed a steady decrease. δD, δ18O, and d exhibited a marked diurnal cycle, indicating the influence of the entrainment, local evapotranspiration (ET), and dewfall. The departures of δD, δ18O, and d from equilibrium prediction were significantly correlated with rain amount, relative humidity (RH), and air temperature (T). The "amount effect" was observed during one precipitation event. δD and δ18O were log linear dependent on water vapor mixing ratio with respective R2 of 17% and 14%, whereas d was significantly correlated with local RH and T, suggesting the less influence of air mass advection and more important contribution of the local source of moisture to atmospheric water vapor. Throughout the experiment, the local ET acted to increase δD and δ18O, with isofluxes of 102.5 and 23.50mmolm-2 s-1‰ respectively. However, the dominated effect of entrainment still decreased δD and δ18O by 10.1 and 2.24‰ respectively. Both of the local ET and entrainment exerted a positive forcing on the diurnal variability in d.