Triple oxygen isotope variations in precipitation from southeast China and its hydrological significance

Pengzhen Duan1, Sasadhar Mahata1, Lijuan Sha1, and Hai Cheng1,2

1School of human settlements and civil engineering, Xi’an Jiaotong University, Xi’an, China (duan2008qq@stu.xjtu.edu.cn)
2Department of Earth Sciences, University of Minnesota, Minneapolis, USA

High precision triple oxygen isotope measurement of meteoric water is a newly added tracer in hydrological and paleoclimate research. However, it is prerequisite to study the controls on precipitation $^{17}$O-excess for proper application of it. Here we report two years highly precise precipitation data from Nanjing, a southeast China station dominated by Asian monsoon. All the water isotopes ($\delta^{17}$O, $\delta^{18}$O and $\delta$D) reported here are based on mass spectrometer measurements and optical measurements (cavity ring-down spectroscopy). Nanjing receives moisture from different vapor sources and experiences different rainout mechanisms during various monsoonal sessions. Combined use of above parameters can help us to delineate processes occurring during evaporation, transport, condensation and re-evaporation. Year to year $^{17}$O-excess variability is observed in the obtained dataset and no notable seasonal variation is observed. However, the $^{17}$O-excess seasonal amplitude is little larger in the first year than the subsequent year. So far, it is known that the precipitation $^{17}$O-excess depends on three values: $^{17}$O-excess of the source water bodies, amount of $^{17}$O-excess gain during evaporation and $^{17}$O-excess loss during raindrops evaporation. During dry months $^{17}$O-excess gain is balanced by $^{17}$O-excess loss, which might lead to the near absence of seasonal cycle at Nanjing. From the comparison of observed data and model simulation, the amount of re-evaporation on falling raindrop is estimated to be about 10% at Nanjing. In addition, correlation with available meteorological parameters has been discussed. Except temperature no significant correlation has been found with other meteorological variables (relative humidity and rainfall amount). This study will serve as a baseline to understand some of issues in paleoclimate that have puzzled the scientific community for years.