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Hydrological process investigation by field developed automated high-frequency water isotopic analysis system in agricultural paddy system

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Water-saving strategies need to be developed for water-demanding agricultural systems. In order to achieve this, it is important to have a deep understanding of the hydrological processes in irrigated agricultural fields. We developed a field scale in situ, automatic sampling system to measure high-resolution (sub-hourly basis) stable isotope of water (18O and 2H) in the surface and groundwater. The experiment was carried out in crop rotational irrigated paddy field including wet rice, dry rice, and maize during two seasons (dry and wet).
Results indicated that there is a clear and distinguishable seasonal and crop effect on isotopic composition in surface ponded water and groundwater were mainly driven by the evaporation. Thereby we calculated the relative extent of evaporation from each season. We estimated significantly higher evaporation (63–77%) during the dry season as compared to the wet season (27–36%). As a novelty, we further investigated sub-daily fluctuations in isotopic compositions and found the nighttime values are more depleted not only in surface water but also in groundwater with high confidence levels. Analysis showed the sub-daily fluctuations are controlled by the meteorological conditions such as air temperature and relative humidity. This highlights the importance of the sampling time of the day to avoid systematic errors in the process of measuring.