Insights into daily and seasonal variations in isotopic composition of near-surface water vapour in the Easter Mediterranean.

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Stable isotopes of water are extensively used for tracking the global water cycle, estimate evapotranspiration and reconstruct paleo-climate. These applications are based on the variations in isotopic ratios of water and water vapour, associated fractionation in phase changes and diffusion and on transport and mixing patterns in the atmosphere. Using a ~10-years isotopic record of near surface water vapour above our lab in Rehovot we recently showed first, the importance of vertical mixing to quantitatively explain the observed large seasonal cycle; and second, the presence of a long-term secular decreasing trend in the data. Addressing the trend observations, it was initially suspected that this reflected effects of sampling timing and changes associated with the diurnal cycle and evolution of the PBL. This was tested by hourly sampling of atmospheric water vapour, over 17 different 24 h periods, at two different altitudes (~2 and ~50 m above ground, 70 and 120 m asl), between 23 June 2008 and 27 January 2009, accompanied by records of *in situ* relative humidity (RH) and temperature (T), and in three cases with Lagrangian moisture source diagnostic for back trajectories and averaged meteorological parameters (sea surface temperature, SST, relative humidity, RH, and wind speed at 10 m) over source areas. The diurnal sampling revealed a very weak and variable diurnal cycle in water vapour isotopes. On average, samples taken at night showed an almost perfect congruence with those taken during the day, as did those taken at the high elevation with respect to those taken at the very near surface. These findings clearly showed that the average isotopic variations on the diurnal time scale could not have produced the observed long-term isotopic trend. Several regional parameters such as SST and 10 m wind speed also correlated well with observed isotopic measurements, and suggest some effect of environmental conditions and of the source region. However, the strongest effect observed was the correlation of vapour isotopic composition with RH, which was especially prominent in dry days, when RH<60%. We therefore hypothesize that the long-term trend observed in the isotopic composition of near-surface atmospheric water vapour, reflect a decreasing trend in RH, which is supported by a weak trend in a long-term humidity record in a nearby meteorological station.