In-situ measurements of the stable isotopic composition of atmospheric water vapour using FTIR spectroscopy

Stephen Parkes (1), David Griffith (2), Alastair Williams (1), Adrian Element (1), Scott Chambers (1) and Matthew McCabe
(1) Institute for Environmental Research, ANSTO, Sydney, Australia (stephen.parkes@ansto.gov.au),
(2) School of Chemistry, University of Wollongong, Wollongong, Australia
(3) School of Civil and Environmental Engineering, University of NSW, Sydney, Australia

The stable isotopic composition of atmospheric water vapour is related to the hydrological processes that occur along the back trajectory of an air mass, including evaporation at the moisture source, atmospheric mixing and precipitation. Thus, by collecting continuous measurements of the stable isotopes in water vapour a record of the hydrological history of air passing a site can be compiled. To collect such a record a FTIR instrument capable of making real-time in-situ measurements of the stable isotopes in water vapour has been developed. The instrument has been deployed at a site near Sydney, Australia for approximately 18 months. During this time we have shown that the FTIR instrument compares well with laser based analysers that are capable of making similar real-time measurements. In addition to the comparison between the different analysers, we have been investigating some of the large signals that are observed in the time series of isotopic measurements. The analysis of the dataset indicates that the lowest isotope values are generally associated with cold fronts that pass over the South East of the Australian Continent and then over the Sydney region. When a cold front passes over or near the measurement site, the deuterium isotope value can be observed to change by up to 100 per mille within the space of a few hours. In addition, cold frontal passages with contrasting moisture source and precipitation histories exhibit systematic differences in water vapour stable isotope signals as they pass over Sydney. On the other hand, higher and more slowly changing isotope values are generally associated with anticyclonic conditions. The study shows that for our site the variations in the stable isotope values are strongly influenced by the hydrological history of air parcels at a synoptic scale.