Caves: observatories of Australia's diffuse groundwater recharge history

Andy Baker[1], Pauline Treble, Dr.[2,1], Martin Andersen, Dr.[1], Monika Markowska,[1,2], Katie Coleborn,[1], Ingrid Flemons[1], Kempsey Speleological Society
1. Connected Waters Initiative Research Centre, UNSW Australia, Sydney 2052.
2. Australia Nuclear Science and Technology Organisation, Lucas Heights 2234.

Quantifying the timing and extent of diffuse groundwater recharge is crucial for our understanding of groundwater recharge processes. However, diffuse recharge is notably difficult to quantify. Our novel approach is to use caves as natural observatories of the diffuse recharge process, with the aim of improving our understanding of diffuse recharge in the context of climate change and climate variability. Since 2010, funded by the NCRIS Groundwater Infrastructure project, researchers from UNSW and ANSTO have established a long-term, national monitoring program of infiltration into caves using automated loggers. Five karst regions, in semi-arid, temperate, sub-tropical and montane climates from southwest WA to the mid- north coast of NSW, have been instrumented with automatic infiltration loggers. Over 200 loggers (between 10 and 40 per cave) have collected data on the timing and amount of diffuse recharge, from sites of contrasting limestone geology, starting in 2010. We present empirical data on the timing and relative amounts of diffuse recharge from 2010 to present. Caves with a range of depths from 0-40m show decreasing frequency of diffuse recharge events with depth below ground surface. Event-based rainfall intensity is confirmed to be the primary driver of diffuse groundwater recharge at all fractured rock sites, whereas annual rainfall amount is the primary driver at a site with high primary porosity. Inter-annual variability in the frequency and relative amount of recharge is compared to climate forcing variables such as the ENSO and surface temperature. Groundwater recharge is via both direct (river recharge) and diffuse processes. With anthropogenic global warming, increased temperatures will increase evaporation, and will likely change ENSO patterns, both of which will affect diffuse groundwater recharge. Our cave observatory system helps improve our understanding of the diffuse recharge process and provides a baseline monitoring network during a period of climate change.