Proportioning Groundwater Hydrograph Fluctuations to Rainfall Recharge and Quantifying Recharge Lag- Time Using Impulse Response Function Modelling

Mark Hocking, Associate Professor Bryce Kelly
University of New South Wales

There are numerous methods that can be employed to estimate groundwater recharge rates. The majority of these methods have high uncertainty associated with the estimate and rely on knowledge or estimates of other hydrogeological parameters, such as specific yield. This project presents an underutilised signal analysis method for proportioning rainfall recharge contributions to the fluctuations observable in groundwater hydrographs. The method also quantifies the lag time between rainfall and recharge at the water table. We analysed 255 unconfined bore hydrographs on Vertosol soils of the Condamine River Alluvial Aquifer using predefined impulse response functions in continuous time (PIRFICT) modelling (von Asmuth et al., 2012). From the PIRFICT analysis mean rain-derived groundwater recharge between 1990 and 2012 was estimated to be 4.4 mm/year. The mean response time between rainfall and recharge at the water table was 5.3 years, however the range of estimates is large: 188 days to 48 years. Over the same time period the average groundwater level declined 8.7 cm/year. Comparison of groundwater recharge rates generally agrees with published field estimates and numerical simulation estimates. This study demonstrates that PIRFICT modelling can be used to independently estimate groundwater recharge contributions to groundwater hydrograph fluctuations. Importantly, the method provides a robust statistical estimate of the lag between rainfall and recharge at the water table. To improve the management of groundwater resources the time lag between rainfall and aquifer recharge must be correctly incorporated into regional water balance models used to manage groundwater allocations and assess environmental impacts.