Geophysical Research Abstracts
Vol. 17, EGU2015-8317, 2015
EGU General Assembly 2015

Recharge estimation in a large semi-arid basin using storage – discharge relationships

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The characteristics of flow recession in the absence of precipitation have long been used to infer upstream catchment storage properties. An intriguing aspect of this storage – discharge relationship occurs when changes in flow recession occur following a rainfall event due to increased storage. The main assumption in this case is that additional groundwater recharge has increased the storage within flow systems connected to the stream, which is then reflected in the increased recessional flow. Using flow records from 4 catchments ($\sim$100 km2) across the headwaters of the semi-arid Condamine Basin (and the unconfined section of the Surat artesian groundwater basin) within central eastern Australia, we evaluate and compare storage –discharge relationships and the change in storage for large individual events. Converting this to recharge resulted in low values compared to a number of independent recharge estimation techniques (chloride mass balance, water balance, groundwater hydrograph analysis). This discrepancy may arise because of some inherent differences between the techniques, however some important assumptions in the storage – discharge analysis are worth exploring. These include: the impact of evapotranspiration (ET) on the flow recession, which is largely unaccounted for, and is likely to be significant in semi-arid environments, and the bias towards larger events within the analysis, which is related to the difficulty associated with incorporating the large number of small events within automated time series analysis. We propose accounting for these limitations through the inclusion of remote sensing based ET estimates, and the use of multiple automated hydrograph separation techniques in extracting flow recession periods for analysis, and preferably those with lower user subjectivity. Overcoming these limitations is essential if catchment storage – discharge analysis techniques are to be more broadly applied to groundwater recharge estimation problems, especially in data poor semi-arid areas where the need for a better understanding of available water resources is only increasing.