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Responses of groundwater recharge to land-cover changes and climate variability

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It is estimated that groundwater directly provides drinking water for 1.5 billion people in the world. Anthropogenic activities during the past 200 years have led to the conversion of large areas of natural forest and grassland to cropland and pasture. Understanding and quantification of changes in groundwater recharge after surface vegetation alteration are important not only for water resource management, but also for land-use and land-cover management. On the other hand, groundwater recharge also responds to climate variability and changes. In this paper, we discuss two groundwater recharge estimation methods of different temporal resolution: chloride mass balance (CMB), and storage-discharge relationship (S-Q). Application of the CMB method over areas of historical forest clearance, or recent plantation, suffers from two difficulties: pre-clearance (or pre-plantation) recharge may have been contaminated by recharge that occurred after forest clearance (or plantation); and the post-clearance (or post-plantation) recharge may not yet have reached new chloride equilibrium. In coastal areas, strong spatial variability in chloride deposition leads to an additional difficulty in appropriately applying the CMB method. This presentation will discuss some recent development to address these difficulties. Meanwhile, an improved conceptual framework of the S-Q method for estimating seasonal and inter-annual variability of groundwater recharge is presented as well. Both are shown with case studies based at the Mount Lofty Ranges of South Australia.