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Distinguishing between mountain-front and mountain-block recharge in (semi) arid basin aquifers

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Many basin aquifers in arid and semi-arid regions are recharged from adjacent mountains. This recharge can occur through losing rivers in the mountain front zone (mountain-front recharge, MFR) or through groundwater flow from the mountain (mountain-block recharge, MBR). The distinction between MFR and MBR is important. These two mechanisms imply quite different flow paths, groundwater age and groundwater quality, therefore greatly affecting the overall conceptualization of the system. Moreover, the two processes also imply different vulnerability to land and water management practices as well as to climate change. However, although conceptually well understood, these two recharge systems remain difficult to distinguish. We present an approach that uses hydraulic head, chloride and electrical conductivity (EC) data to distinguish between MFR and MBR. These variables are inexpensive to measure, and may be readily available from hydrogeological databases. Hydraulic head data support identification of groundwater flow directions and stream-aquifer interactions, while chloride concentrations and EC values can be used to distinguish between different water sources if they have a distinct signature. The approach is tested through application to the Adelaide Plains basin, South Australia. The recharge mechanisms of this basin have long been debated, in part due to difficulties in understanding the hydraulic role of faults. Results show that both hydraulic head and chloride (equivalently, EC) data consistently indicate that streams are gaining in the adjacent Mount Lofty Ranges and losing when entering the basin. The data further show that not only the Quaternary aquifers but also the deeper Tertiary aquifers are recharged through MFR and not MBR. This finding has significant relevance for the water resources management in the region.