

## **Groundwater–surface water exchange in alpine and subalpine watersheds: a review of recent field studies**

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**Abstract** The possibility of a significant role for groundwater exchange with mountain streams and lakes has led to a steadily increasing number of field studies over the past decade. This review is focused on groundwater–surface water (gw–sw) exchange processes in headwater watersheds, mostly in alpine and subalpine areas. It reports on: (i) what field methods have been used or developed over the past decade, and (ii) how field studies over this period have contributed to our understanding of these processes and their effects on hydrology and aquatic ecology. While a number of chemical and thermal methods have been developed, combining these with physical hydrological methods is probably needed to fully realize the finer details of gw–sw exchange in mountainous areas. General conclusions drawn from the assemblage of field studies include that groundwater commonly contributes a substantial amount to alpine streams and that groundwater exchange can also be significant for alpine lakes. Also, locations of gw–sw exchange over many scales tend to be strongly controlled by topography and geology, with coarse deposits (e.g. talus, moraine) playing a dominant role for base flows.

**Key words** alpine lake; groundwater; headwater; hydrology; mountain

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