Perspective
Volume 12:10, 2021

Hydrology: Current Research

ISSN: 2157-7587 **Open Access**

Impact on Watershed Hydrology and Fluid Chemistry

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Perspective

Due to the recognition of the existence of streams and groundwater (GW) as a related resource, hydrology, biological and aquatic ecology have advanced. Stream losses to GW and GW gains play a significant role in processes which alter hydrological response in watersheds and water quality and consequent effects on aquatic biota. Water exchange between streams and GW has been identified for solution and pollutant transfer as a key mechanism for the regulation of Dissolved Organic Carbon (DOC) processes in the cycling of lotic ecosystems. These exchanges take place at several levels across the countryside.

Defined smaller exchanges like those occurring across hundreds of metres and over a time frame of few minutes, and bigger exchanges like those occurring over hundreds of years. Many investigations on stream water – GW interactions focussed on minor interactions in geographical and temporal scale. We utilise this work to describe stream losses and GW gains. Our study focuses on how stream losses and increases in hydrological response, water supply contributions and stream water chemistry (as indicated above) from and to the local GW effect are translated from Mountain to Valley.

The stream-water–GW exchanges that take place in the Hyporheic Region (HZ) have been a focus of hydrologists, biogeochemists and ecologists; significant advancements have been achieved in knowledge in this field. Advances in the HZ studies were vital to the connection of streams with GW, and the HZ is now seen as integral to the stream itself. HZ interactions occur on smaller scales nested in a wider river water–GW interface.

The broader scale can be described as water loss to GW, or water gain from GW. The geographically and temporally dynamic effects of the loss of a stream (GW recharge) or recovery (GW discharge) can have a significant impact on the hydrology and solution properties of a stream. Water-GW exchange research on a wider space and time scale has frequently depended on mountain front GW with inadequate data. The Mountain Front (MFR) refers to GW's contribution to the charging of surrounding basins from mountain ranges. In arid to semiarid locations, efforts to understand and model MFR have intensified as rising populations require appropriate and sustainable water supplies, in especially in the south west of the United States.

Important GW removals have resulted in GW depletion, land subsidy, decreased fluid flow and loss of riparian habitat in the Southwest of the United States for some decades. In semiarid locations, MFR was considered to be an important component of GW recharging. MFR can occur either via the mountain blocks as percolation or as water losses from rivers leaving the mountains. The relevance of MFR stream inputs to valley aquifers in the West United States was highlighted.

Although MFR is a significant source of GW refuelling for valley aquifers in dry and semiarid areas, it remains unclear and measured. Water exchanges between streams and GW are diverse across a watershed, across various terrain components. A mountain watershed landscape includes a mountain collecting area or mountain front, an MFR area, and the valley bottom area of a mountain.

The mountain collecting zone, where the channels are created and contained by topography, is defined as the headwaters of a watershed and of an MF zone as the piedmont zone between A and B, and of the bottom of the valley as the basin-left downstream MFR. Mountain areas are usually more precipitated, less evapotranspired and have less soil growth than portions of the downhill environment.

Recent studies show that MFR is responsible for 1/3 to almost all the intermountain basin fill aquifers in the GW recharge system. However, few studies link MFR to the lower hydrology of the basin. Investigating the river and the GW hydrology in both the MFR zone and the valley bottom zone enables us to determine how river-water exchanges across different landscapes might fluctuate, and the influence of these swaps on the watershed hydrological response, river mixing, and stream soluting.

How to cite this article: Nasko, Guofang. "Impact on Watershed Hydrology and Fluid Chemistry." Hydrol Current Res 12 (2021): 369.

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Received 07 October 2021; **Accepted** 21 October 2021; **Published** 28 October 2021