The influence of groundwater abstraction on groundwater-surface water interactions in the Emmental

O. S. SCHILLING[1]*, C. GERBER[2], R. PURTSCHERT[2], R. KIPFER[3], D. HUNKELER[1] AND P. BRUNNER[1]

[1]Centre of Hydrogeology and Geothermics, University of Neuchâtel (UniNE), 2000 Neuchâtel, Switzerland (*correspondence: oliver.schilling@unine.ch).

[2]Climate and Environmental Physics, University of Bern (UniBE), 3012 Bern, Switzerland.

[3]Water Resources and Drinking Water, EAWAG, 8600 Dübendorf, Switzerland.

Pumped groundwater from the alluvial aquifer in the immediate vicinity of the highly dynamic, pre-alpine Emme River provides about 45% of drinking water for the Swiss capital Bern and its surroundings. The Emme River is the main source of recharge to this pumped alluvial aquifer. The high transience of the Emme, coupled with frequent extreme events, particularily droughts, requires a profound understanding of the local surface water-groundwater (SW-GW) interactions. This process understanding is necessary in order track water bodies and their mixing, which in turn allows optimizing groundwater abstraction, and protecting the water resources and surrounding riparian ecosystems. In a collaborative effort between UniNE, UniBE, EAWAG and the water works of the Canton of Bern (WVRB), groundwater abstraction was reduced for one week to the smallest technically possible rate (approx. 200 l/s) after a long period of high groundwater abstraction (approx. 350 l/s). This controlled transient forcing of the river-aquifer system provided an ideal framework to study SW-GW interactions, and compare a wide range of methods and approaches to monitor and quantify the exchanges between the river and the aquifer. Methods measuring the exchange fluxes, as well as the surface and the subsurface compartements separately, were applied. Besides standard chemical and physical sampling (e.g. ions, temperature, conductivity, pH and stable H2O isotopes), a number of innovative approaches were employed during the experiment: Distributed Temperature Sensing (DTS) on the riverbed to detect locations of GW exfiltration, a combination of unstable isotopic tracers (^{222}Rn ($T_{1/2}$=3.8d), ^{3}H/^{3}He ($T_{1/2}$=12.4y) and a never before employed natural tracer for SW-GW interactions (^{37}Ar ($T_{1/2}$=35.d)). Moreover, stream water gauging to measure exfiltration using a fluorescent tracer, freezecore-sampling of the riverbed, as well as geophysical measurements on the geological structure of the streambed were employed. The applied methods as well as first, preliminary results are presented.