Geophysical Research Abstracts
Vol. 14, EGU2012-7027, 2012
EGU General Assembly 2012

Statistical analysis of interaction between lake seepage rates and groundwater and lake levels

P. Ala-aho, P. M. Rossi, and B. Klöve

University of Oulu, Department of Process and Environmental Engineering, Water Resources and Environmental Engineering Laboratory. Oulu, Finland.

In Finland, the main sources of groundwater are the esker deposits from the last ice age. Small lakes imbedded in the aquifer with no outlets or inlets are typically found in eskers. Some lakes at Rokua esker, in Northern Finland, have been suffering from changes in water stage and quality. A possible permanent decline of water level has raised considerable concern as the area is also used for recreation and tourism. Rare biotypes supported by the oligotrophic lakes can also be endangered by the level decline. Drainage of peatlands located in the discharge zone of the aquifer is a possible threat for the lakes and the whole aquifer. Drainage can potentially lower the aquifer water table which can have an effect on the groundwater-lake interaction. The aim of this study was to understand in more detail the interaction of the aquifer and the lake systems so potential causes for the lake level variations could be better understood and managed. In-depth understanding of hydrogeological system provides foundation to study the nutrient input to lakes affecting lake ecosystems.

A small lake imbedded the Rokua esker aquifer was studied in detail. Direct measurements of seepage rate between the lake and the aquifer were carried out using seepage meters. Seepage was measured from six locations for eight times during May 2010 – November 2010. Precipitation was recorded with a tipping bucket rain gauge adjacent to the lake. Lake stage and groundwater levels from three piezometers were registered on an hourly interval using pressure probes. Statistical methods were applied to examine relationship between seepage measurements and levels of lake and groundwater and amount of precipitation.

Distinct areas of inseepage and outseepage of the lake were distinguished with seepage meter measurements. Seepage rates showed only little variation within individual measurement locations. Nevertheless analysis revealed statistically significant correlation of seepage rate variation in four measurement locations. Result suggested that underlying hydrogeological conditions dictated the variation of seepage rates to some extent for all of the measurement locations. Correlation analysis of seepage meter measurements and water levels and precipitation indicated that seepage rates in a specific seepage measurement location were influenced by different parts of the hydrogeological system. Location and rate of inseepage were dictated by a different groundwater flow system compared to locations where outseepage were measured. In addition locations of outseepage responded differently to changes in the lake and groundwater levels. Variation of seepage rate in some locations reflected the changes in the regional groundwater system, as other responded to changes in the local flow system.

Study shows that a simple statistical analysis of temporal variability of lake seepage rates and lake and groundwater level recordings can give a valuable insight to the dynamics of lake – groundwater interaction. Such understanding is of crucial importance when effects of changes in climate, land use or water extraction needs to be understood and managed in lake - aquifer systems.

ACKNOWLEDGEMENTS
The project was financed by the 7th framework project GENESIS (226536).