Hydrological risk assessment in an abandoned coalfield: ten years of monitoring in Liège (Belgium)

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Abstract

Mining activities can affect the environment decennia after extraction activities stopped. One of the major environmental changes observed after mine closure are the changes in groundwater flow and the coupled stress redistribution in the underground. Flooding of the mined voids starts as soon as the extensive pumping required for the mining activities stops. This process called "ground water rebound" continues until the mine water levels equilibrate with the regional ground water surface or reaches a point of discharge, e.g. a drainage adit (Wolkersdorfer, 2008). Consequently, outbreak, flooding and/or stability problems can occur in the surrounding area (Wolkersdorfer, 2008).

Mining risk management is thus essential to ensure public safety where extraction activities were intense during several centuries, e.g. in Wallonia (Pacyna and Salmon, 2012). To assess these risks, flow rates and groundwater levels have been monitored for 10 years in exploited voids and drainage adits of the area of Liège. A statistical study is performed on the long term data, aiming at understanding groundwater behavior and improving the monitoring network. Trend decomposition of these time series allows extracting seasonal cycles from general trends and random variation. To evaluate if groundwater rebound is still active or not, the general trend is analysed. Auto-correlation functions are calculated for each time series to determine the memory effect of the data. This analysis shows that some locations are influenced by slow recharge processes in contrast to other locations which are sensitive to shorter recharge periods, i.e. induced by rain events. This is also proven by cross-correlation functions which allow one to understand connections between the exploited areas and to calculate retardations between rain peaks, groundwater peaks and drainage peaks. Based on these results the monitoring network can be improved and further research will be undertaken to verify if periods of low infiltration are the only periods leading to low discharges in the adits.

References:

Wolkersdorfer, C., 2008. Water Management at Abandoned Flooded Underground Mines: Fundamentals, Tracer Tests, Modelling, Water Treatment, Springer, 465 p.

Pacyna, D. and Salmon, M., 2012. Mining risk management in Wallonia (Belgium): The WebGIS tools in the service of prevention. GESRIM 2012 Colloque "La gestion des rejets miniers et l'après mine".

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