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Long-term integrated river basin planning and management of water quantity and water quality in mining impacted catchments

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During the last decades, socioeconomic change in the catchment of the Spree River, a tributary of the Elbe, has been to a large extent associated with lignite mining activities and the rapid decrease of these activities in the 1990s.
There are multiple interconnections between lignite mining and water management both in terms of water quantity and quality. During the active mining period a large-scale groundwater depression cone has been formed while river discharges have been artificially increased. Now, the decommissioned opencast mines are being transformed into Europe's largest man-made lake district. However, acid mine drainage causes low pH in post mining lakes and high concentrations of iron and sulphate in post mining lakes and the river system.
Next to potential changes in mining activities, also the potential impacts of climate change (increasing temperature and decreasing precipitation) on water resources of the region are of major interest. The fundamental question is to what extent problems in terms of water quantity and water quality are exacerbated and whether they can be mitigated by adaptation measures.
In consequence, long term water resource planning in the region has to formulate adaptation measures to climate change and socioeconomic change in terms of mining activities which consider both, water quantity and water quality aspects.
To assess potential impacts of climate and socioeconomic change on water quantity and water quality of the Spree River catchment up to the Spremberg reservoir in the scenario period up to 2052, we used a model chain which consists of
(i) the regional climate model STAR (scenarios with a further increase in temperature of 0 and 2 K),
(ii) mining scenarios (mining discharges, cooling water consumption of thermal power plants),
(iii) the ecohydrological model SWIM (natural water balance),
(iv) the long term water management model WBalMo (managed discharges, withdrawal of water users, reservoir operation) and
(v) the water quality model GGM (mining related water quality parameters of lakes and river reaches).
Based on the STAR 0K scenario, only minor changes in the natural water balance are simulated, while managed discharges slightly decrease due to declining mining discharges. In the STAR 2K scenario natural and managed discharges decrease resulting in negative consequences on reservoir volumes and on water availability to the users. Additionally, the risk of a re-acidification of mining lakes and increasing sulphate and iron concentrations is much higher in the STAR 2K scenario than in the STAR 0K scenario.
In order to compensate for negative impacts on water quantity and water quality, adaptation measures were analysed. While water transfers from the River Elbe into the study region showed positive impacts on both, water quantity and water quality, potentially negative impacts on water quality can also be compensated by technical measures (e.g. in-lake-neutralisation of mining lakes).