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# The influence of extreme low water flow on the water quality of the Elbe River at Magdeburg monitoring station

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The river Elbe with a length of approx. 728 km and a catchment area of 96,932 $km^2$ in Germany is one of the large German rivers. Its main tributaries in Germany are the Schwarze Elster, Mulde, Saale and Havel.

The Magdeburg monitoring station for the Elbe river is situated near the city of Magdeburg on the left bank at river km 318. This site is part of the monitoring program of the International Commission for the protection of the Elbe (ICPE). The water quality of this section depends on the quality of the upper stretches of the Elbe (input from the Czech Republic and the Dresden industrial region) and primarily on the confluence of the polluted (for example with trace elements) tributaries Mulde and Saale. The confluences of the Mulde and Saale are, respectively, 59 km and 27 km upstream of the sampling site on the left bank. Upstream and downstream of the monitoring station, the Elbe is regulated by groynes on both sides. Characteristic flow rates at sampling point Magdeburg are 1730 $m^3/s$ at mean high water flow, 559 $m^3/s$ at mean water flow and 225 $m^3/s$ at mean low water flow.

After the century flood in August 2002 (caused by heavy rainfall in the upper Elbe and Mulde catchment) and a flood in January 2003 (originated in Saale catchment) the river Elbe saw an extreme low water period from June/July to December 2003. During this period, water samples were taken at river km 318 on a weekly base, starting at the beginning of the low flow period.

The results of water quality measurements during low water periods potentially represent an integral signal of the following processes:

- increasing sedimentation rates of SPM in groyne fields due to lower flow rate of the river water (at the same time less artefacts to the SPM transport because the shipping is hampered).
- Re-solution of trace elements from groyne field sediments due to changes in redox state of sediments during vegetation period, coupled to higher phytoplankton activity.
- higher impact of tributaries to the main stream due to changes in mixing processes.

Results from water quality measurements of suspended particulate matter (SPM), chemical physical environmental conditions, nutrients, phytoplankton (as chlorophyll-a), DOC, POC/PN and their mutual dependences as well as selected heavy metals and As were evaluated.

During low flow, elevated salt concentrations at the sampling location indicate an increasing impact of the salt polluted Saale river on the water quality e.g. chloride (Figure 1, left). SPM concentrations, total particle number concentrations (range 2 - 200 µm) and chlorophyll-a values showed a strong correlation to the water temperature (Figure 2). The contents of dissolved silicate and ammonium consumed temporary until below the detection limit by the growth of biomass (Figure 1, right). Depending on their sources of origin and their redox sensitivity trace elements showed a different behaviour relating to the re-solution out of sediments (Figure 3).

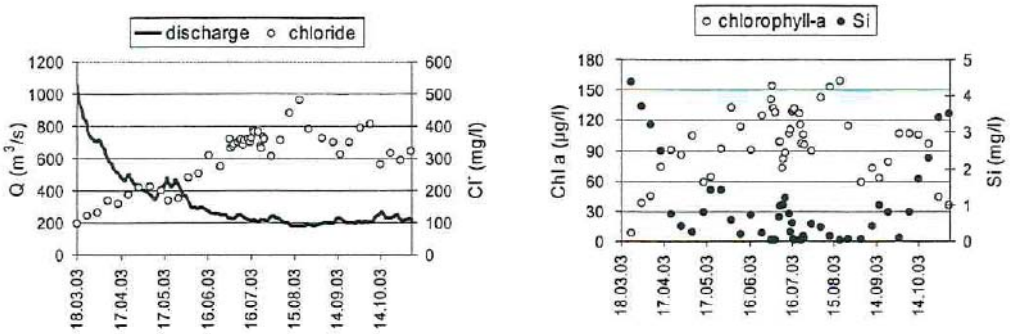


**Figure 1:** Variability of discharge (Q) and chloride concentrations ($Cl^-$) (left) as well as chlorphyll-a and dissolved silicate concentrations (Si) (right) at Magdeburg monitoring station 2003.

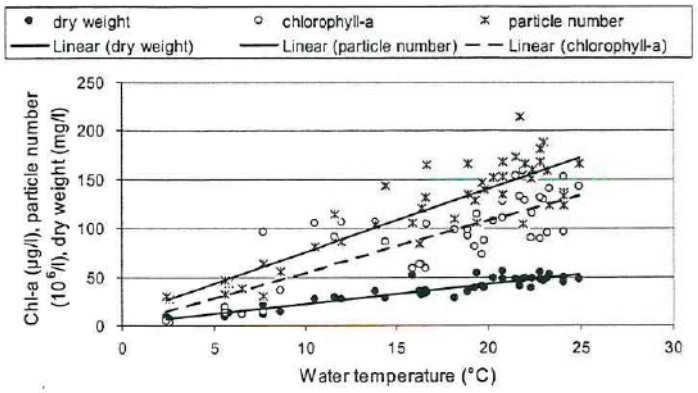


**Figure 2:** Relation between water temperature and dry weight ($y = 2{,}0279x + 1{,}9028$; $R^2 = 0{,}8606$), chlorophyll-a concentration ( $y = 5{,}2758x + 1{,}9963$; $R^2 = 0{,}6745$) and total particle numbers ($y = 6{,}4811x + 10{,}712$; $R^2 = 0{,}7645$).

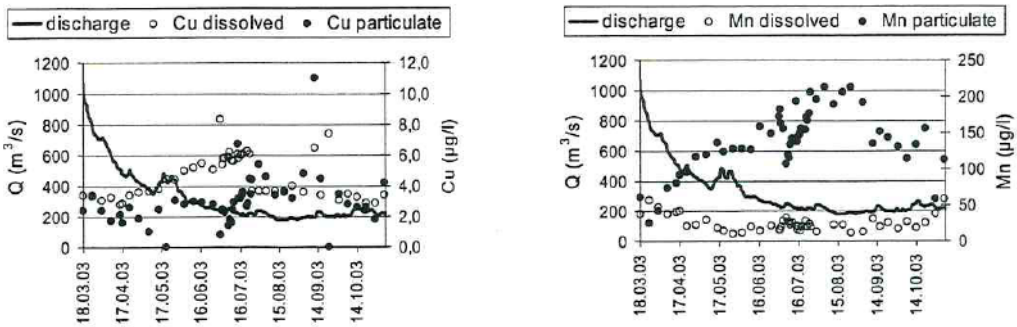


**Figure 3:** Variability of discharge (Q) and copper concentrations (left) as well as discharge (Q) and manganese (right) at Magdeburg monitoring station 2003.

The results of 2003 are compared to findings from values of a mean water period of the year 2001. Comparing to 2001 higher water temperature, higher chlorophyll-a contents and higher concentration of SPM during the vegetation period were found.

Fluctuations of pollutants during extreme periods have to be known. Increased concentrations of trace elements during long lasting low water periods are of high importance to the ecosystem. They represent a potential risk which should be considered when conducting river maintenance work (e.g. at groynes) during low flow.