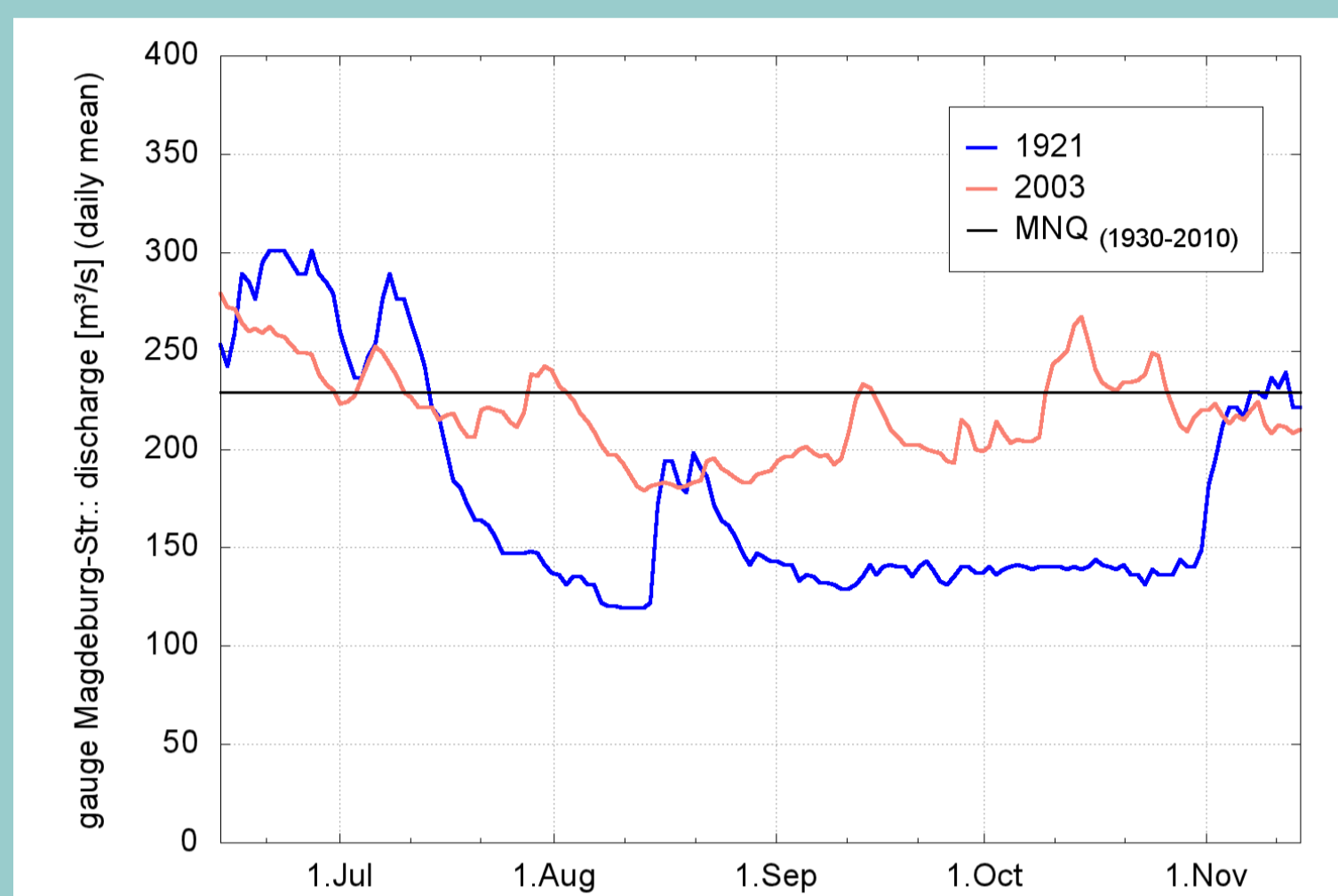


# Historical water-quality measurements during low-flow events – examples from the rivers Elbe and Rhine

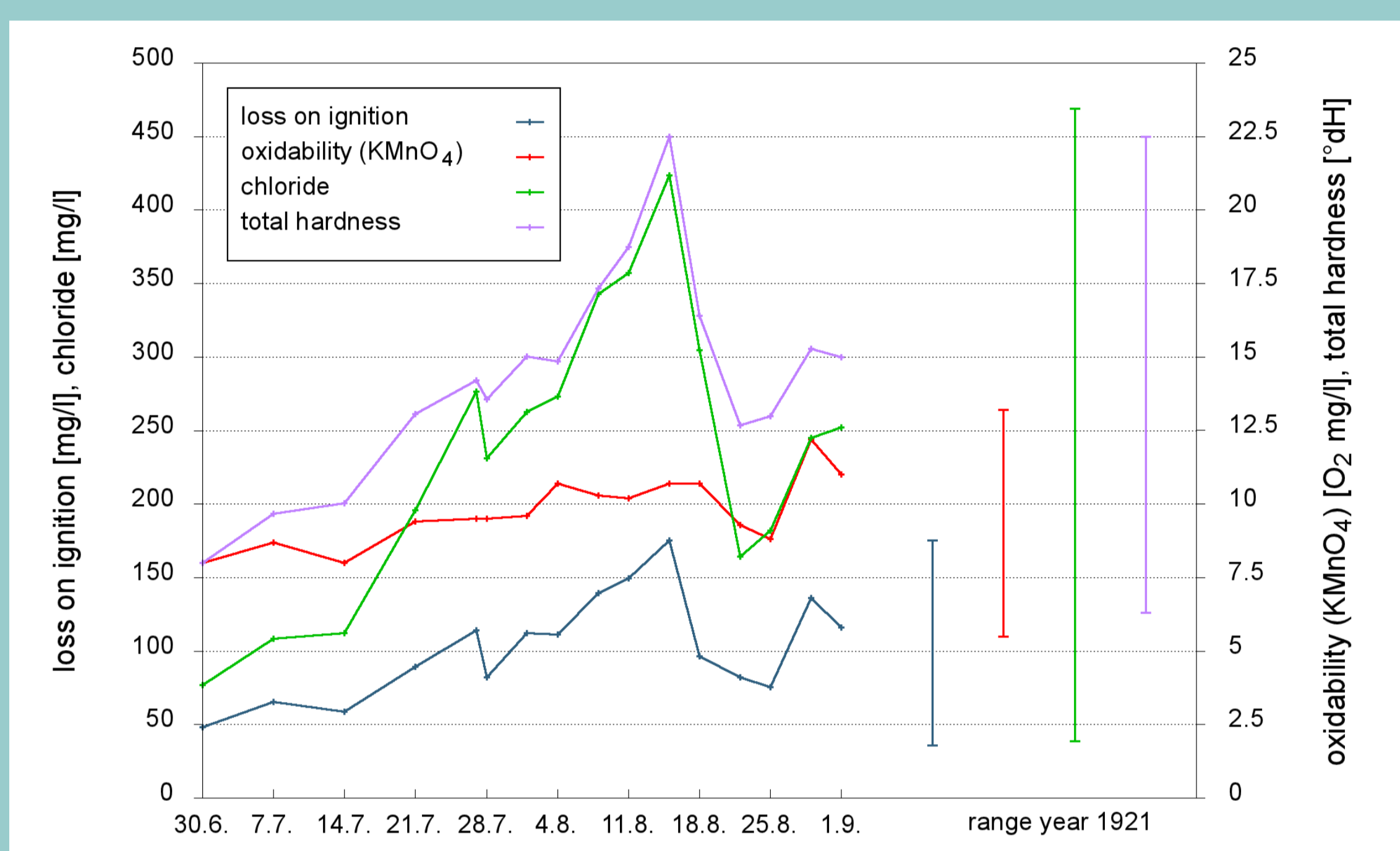
For the information system Undine (<http://undine.bafg.de>) hydro-meteorological, hydrological and water quality data about extreme low-flow events in large German rivers were collected. Water quality data could be found for the River Elbe for the historical extreme low-flow events in 1893, 1904, 1911, 1921 ... . Such events in this period of time occurred in the River Rhine only in 1908/1909 and 1921.

We concentrate on the extreme low-flow event during the dry year 1921, a coincidental event in both the rivers Rhine and Elbe. The variations of streamflow and of selected water-quality parameters are shown. The water quality during the event is compared with the historical pollution levels and with the situation in the dry year 2003.

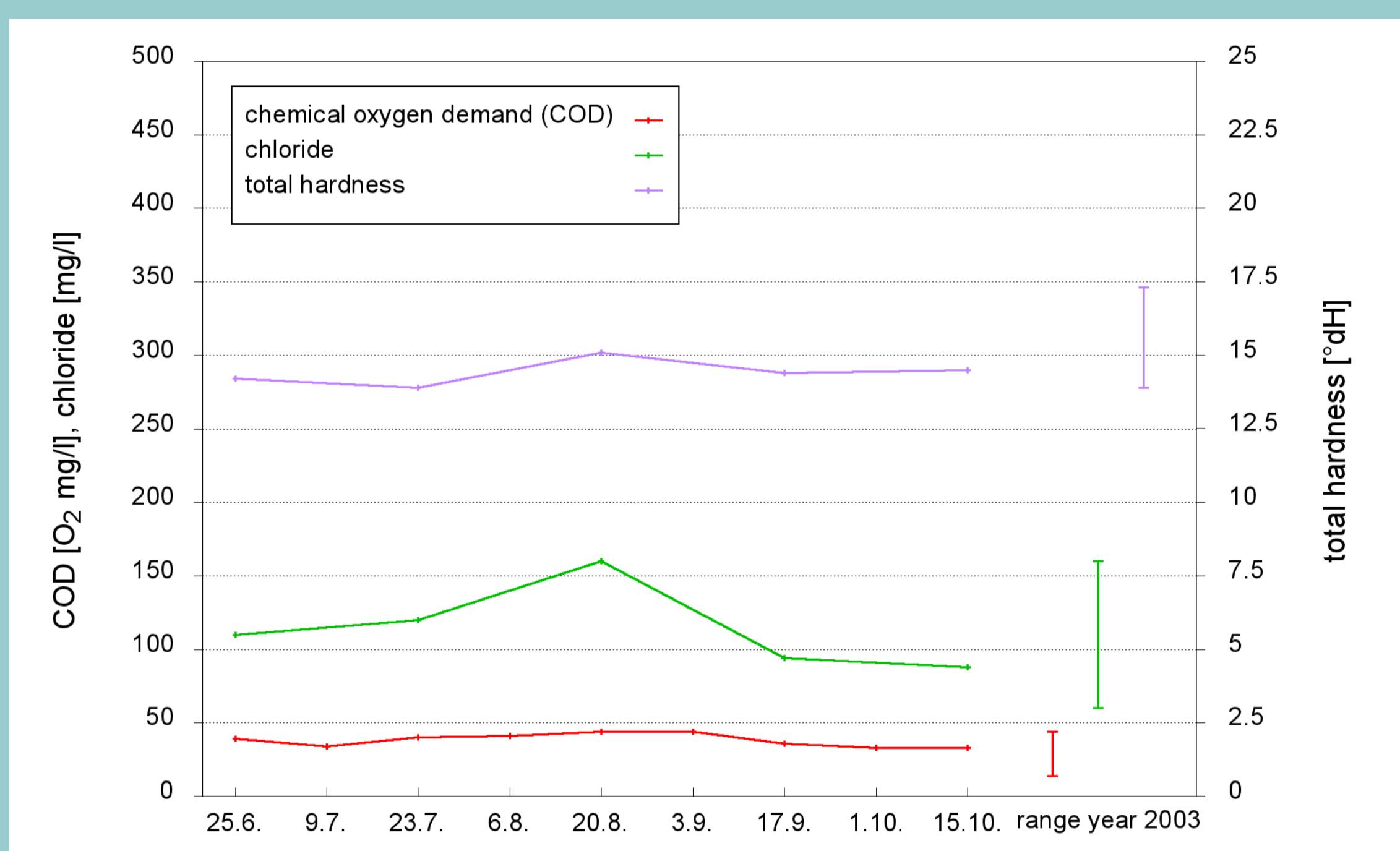
## Elbe



Discharge at gauge Magdeburg-Strombrücke during the low-flow events in 1921 and 2003 (MNQ = mean low water discharge)

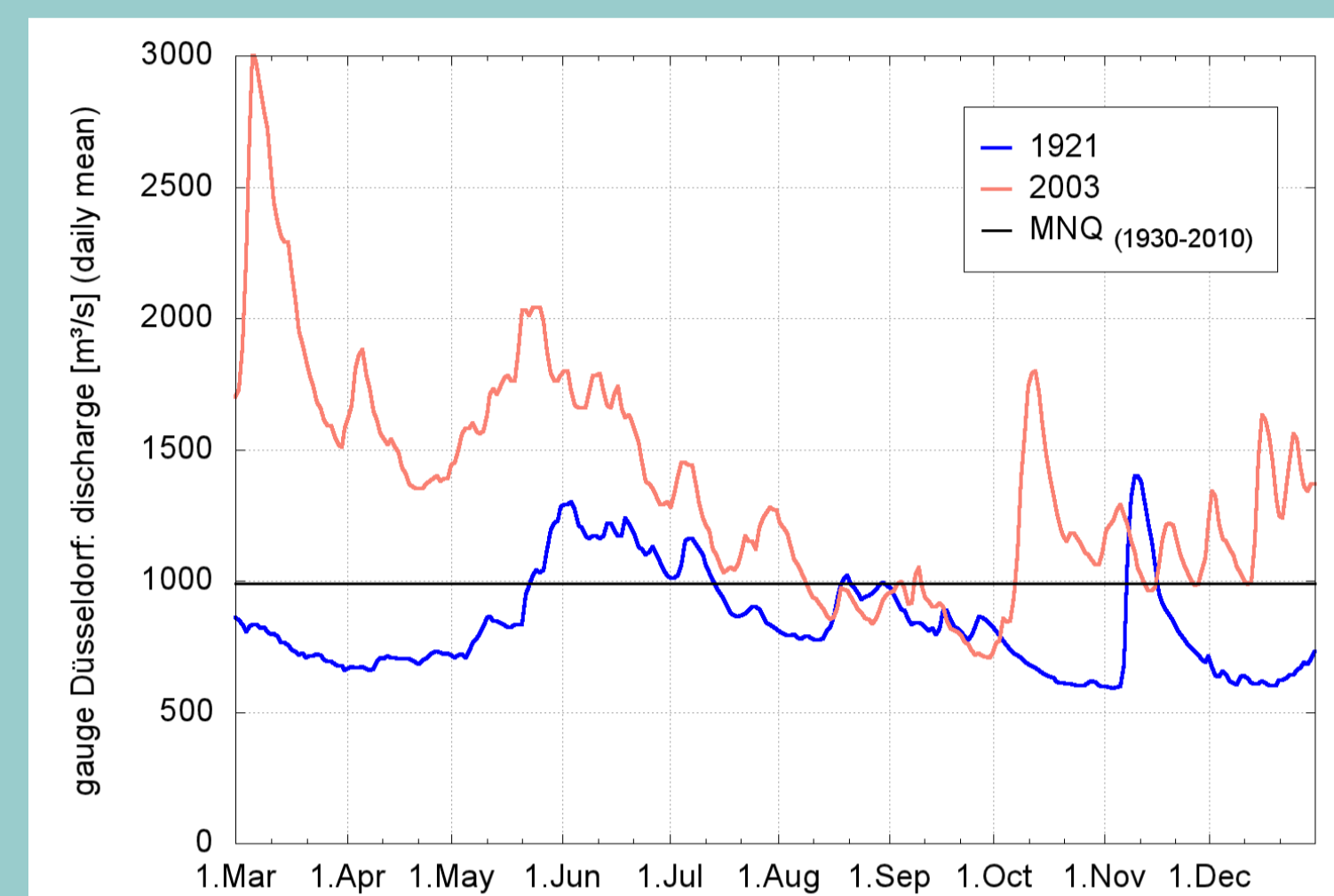


Water quality of the River Elbe at Magdeburg (right bank) in the year 1921  
Left: measured values during the low-flow period in Jul./Aug. 1921  
Right: range of measured values in the year 1921 (n = 71)



Water quality of the River Elbe at Magdeburg (right bank) in the year 2003  
Left: measured values during the low-flow period in summer/autumn 2003  
Right: range of measured values in the year 2003 (n = 12, COD: n = 25)

## Rhine



Discharge at gauge Düsseldorf during the low-flow events in 1921 and 2003 (MNQ = mean low water discharge)

	1921 Low-flow Mar. - May/ Sep. - Dec.	1921 Average of year	2003 Low-flow Aug. - Oct.	2003 Average of year
Total hardness [°dH]	12.0	10.0	12.4	12.7
Oxidability (KMnO <sub>4</sub> ) [O <sub>2</sub> mg/l]	5.82	5.86	-	-
Chloride [mg/l]	34.3	31	71.8	65.5
Nitrate-nitrogen (NO <sub>3</sub> -N) [mg/l]	1.2	-	2.2	2.7

Water quality of the River Rhine at Düsseldorf 1921 and 2003: average for the low-flow event and for the whole year (1921: n = 52 [total hardness, oxidability] / n ≈ 4; 2003: n = 13)

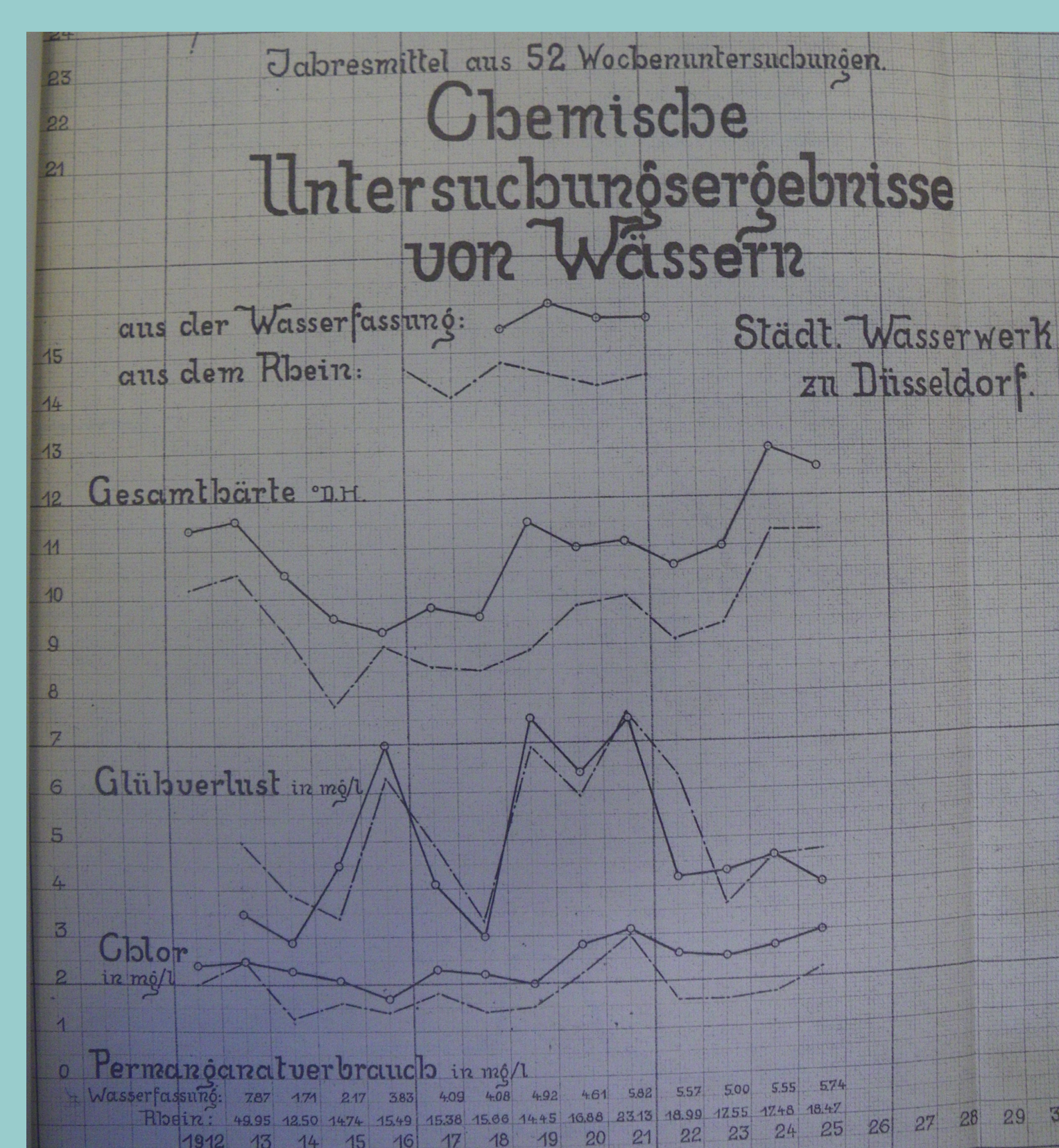
Low-flow events usually go along with extraordinary conditions of water quality. During the low-flow period in 1921 in both rivers Elbe and Rhine hardness, concentrations of salts and the pollution with oxygen depleting substances were relatively high. The upper range of the measured data in 1921 is reached. This range was in 1921 by far larger than in the year 2003, albeit the number of samples was in 1921 at least in case of the Elbe much higher than in 2003. The shown parameters demonstrate a lower pollution in the River Elbe in 2003 (especially chloride). In case of the River Rhine chloride concentrations were on a higher level in 2003.

## Monitoring of river water by municipal waterworks

Municipal waterworks that used river water directly (Magdeburg, Hamburg) or by wells near the river (Dresden, Düsseldorf, Cologne) had a vital interest in unpolluted water. Besides analyses of the drinking water they analysed river water on a regular basis (for instance oxidability, hardness, and chloride). The frequency differed between daily, weekly, ... threemonthly analyses.

Because of the early start (e.g. in Magdeburg around 1879) and the long period of time covered, these monitoring results concerning river water are very valuable in the quest for long times-series of water-quality data.

Monitoring results from the municipal waterworks Düsseldorf-Flehe for the main well and the River Rhine (Stadtarchiv Düsseldorf signature 0-1-3-18597)



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