

Streamwater DOC concentrations in the Elsterbach River following  
windthrow and bark beetle disturbances

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Terrestrische DOC-Einträge in Oberflächengewässer bewaldeter Einzugsgebiete  
31. Mai 2023, Tharandt

# Forest Hydrological Research at the Elsterbach catchment

- Located in North Hesse, southern Reinhardswald
- 418 ha surface catchment, of 402 ha (96%) forest land
- Elevation ranges from 465 m to 220 m a.s.l.
- Mean precipitation ( $\bar{\phantom{x}}$  1973-2022): 764 mm  
2021: 737 mm, 2022: 633 mm
- $T_{\text{mean (1973-2022)}}$ : 8,4 °C, 2021: 8,7 °C, 2022: 9,9°C
- Measurement of stream flow and precipitation since November 1972
- Biweekly analysis of streamwater (1984-2003)
- The Elsterbach has two affluent creeks whose catchments are very different concerning their hydrogeology and the shares in tree species ->> analysis of these streamwater 1988 - 2003
- January 2018 windthrow event on ~5 % of the forested area
- 2019 / 2020 bark beetle calamity
- Resuming of streamwater analysis in November 2020
- High-frequency measurement of DOC, TOC, Nitrate since February 2022

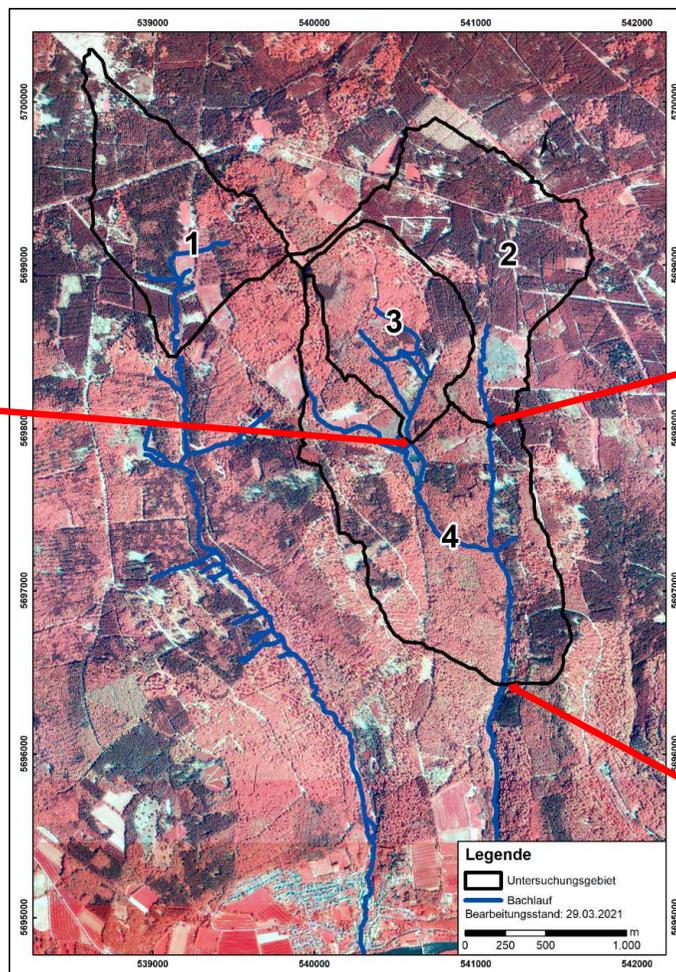


21.05.2019, runoff 502 l/s, (HQ of the day: 1804 l/s)

# Description of the catchments



May 28, 2023



May 28, 2023



January 21, 2021



May 28, 2023

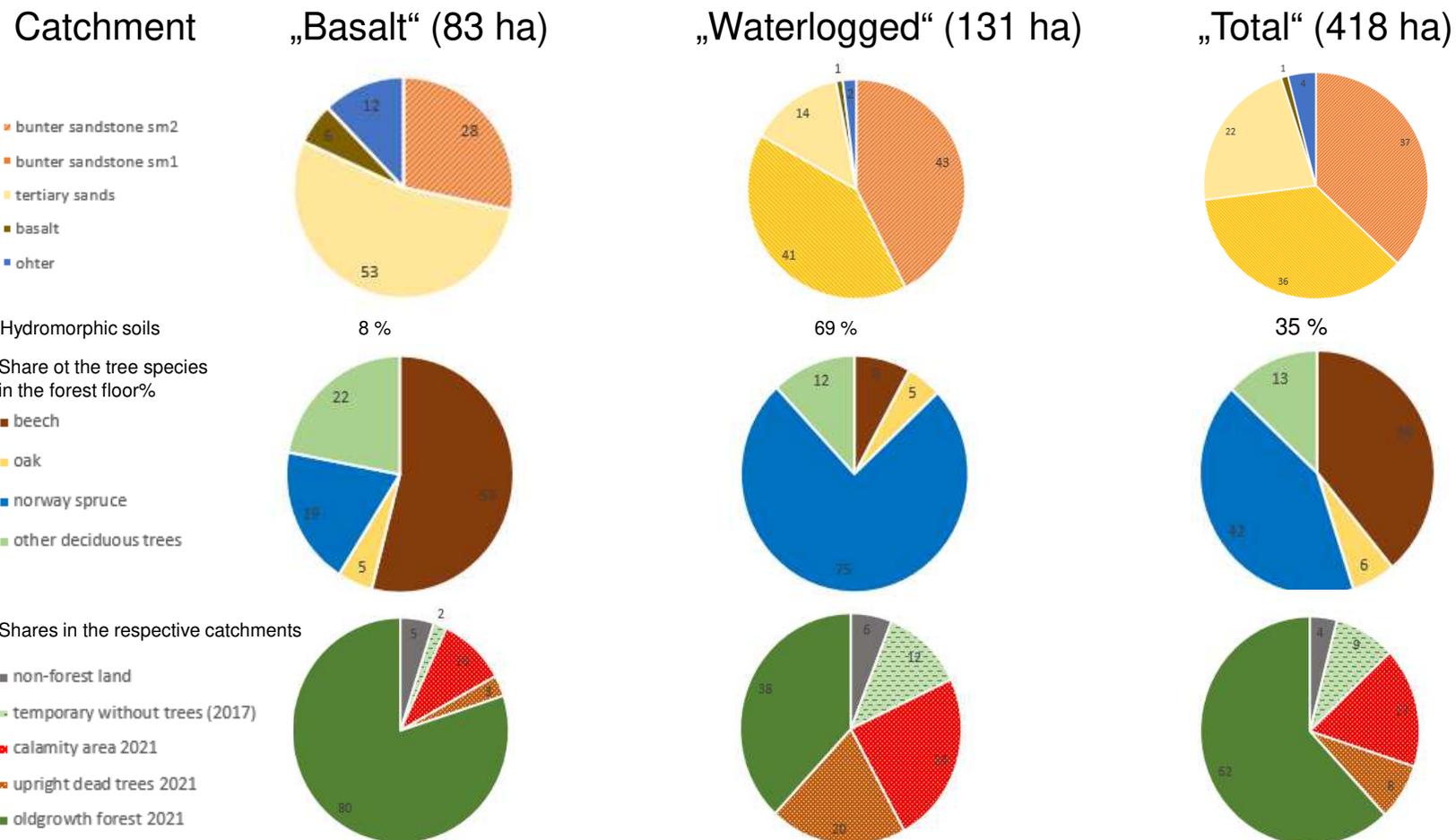


May 28, 2023



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# Description of the catchments



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Typical soils in the catchment „waterlogged“

Stagnogley soil, May 25, 2023



May 29, 2023



Pseudogley soil



February 24, 2023



May 28, 2023

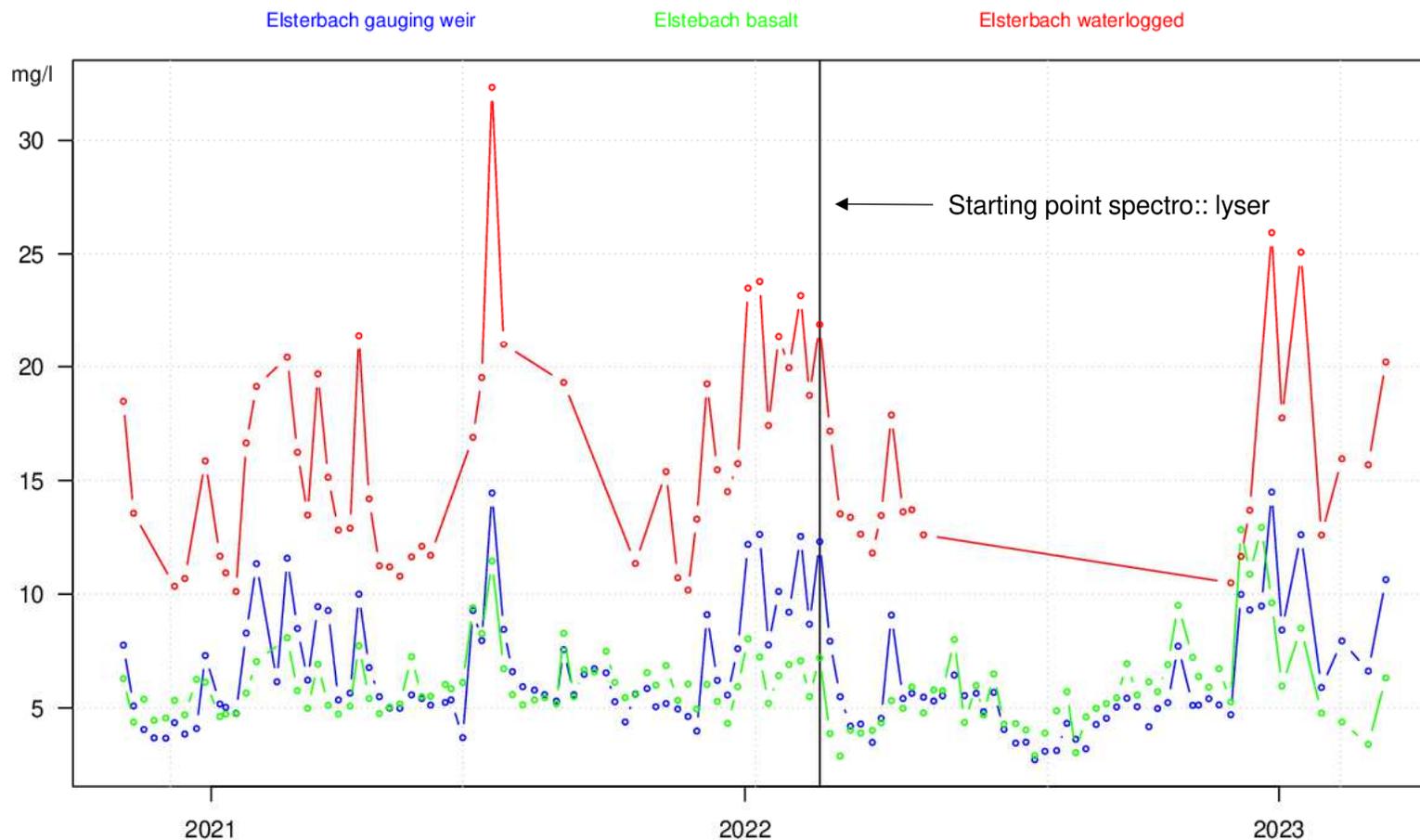
## Technical equipment

- **OTT Orpheus Mini Water Level Logger** at the Thompson weir since November 2010
  - Additional weekly to biweekly check of the water level with a point gauge
- **OTT Pluvio** – Weighing Rain Gauge
- **spectro::lyser V3.0, UV/Vis 5mm**, spectrometer probe for high-frequency measurement of DOC, TOC, nitrate and water temperature at the gauging weir (Thompson weir).



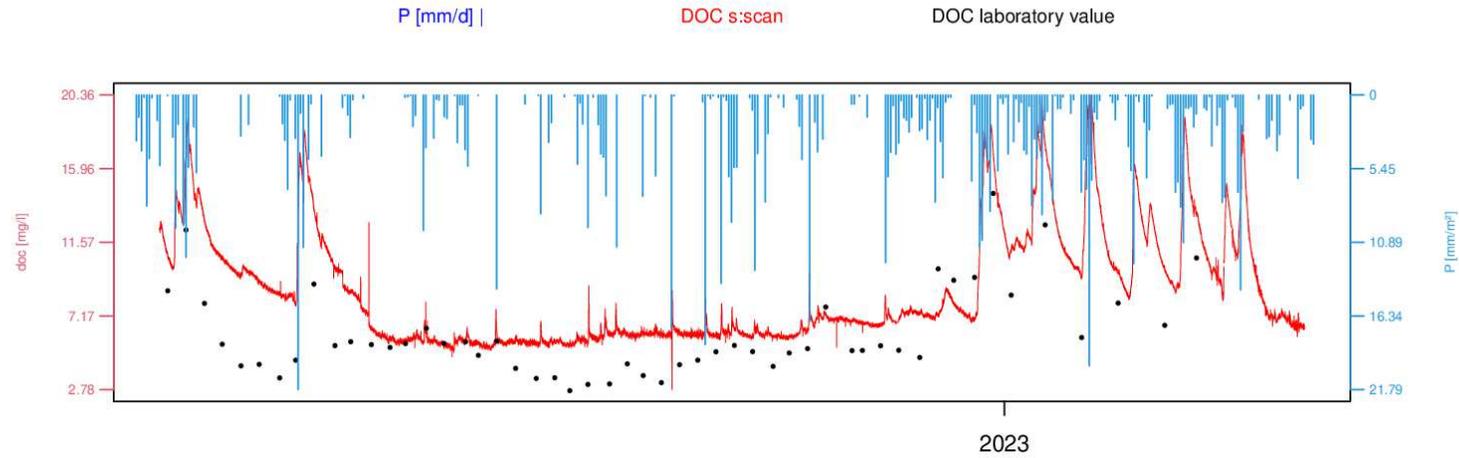
# Results

## DOC concentration of the Elsterbach and its affluent creeks

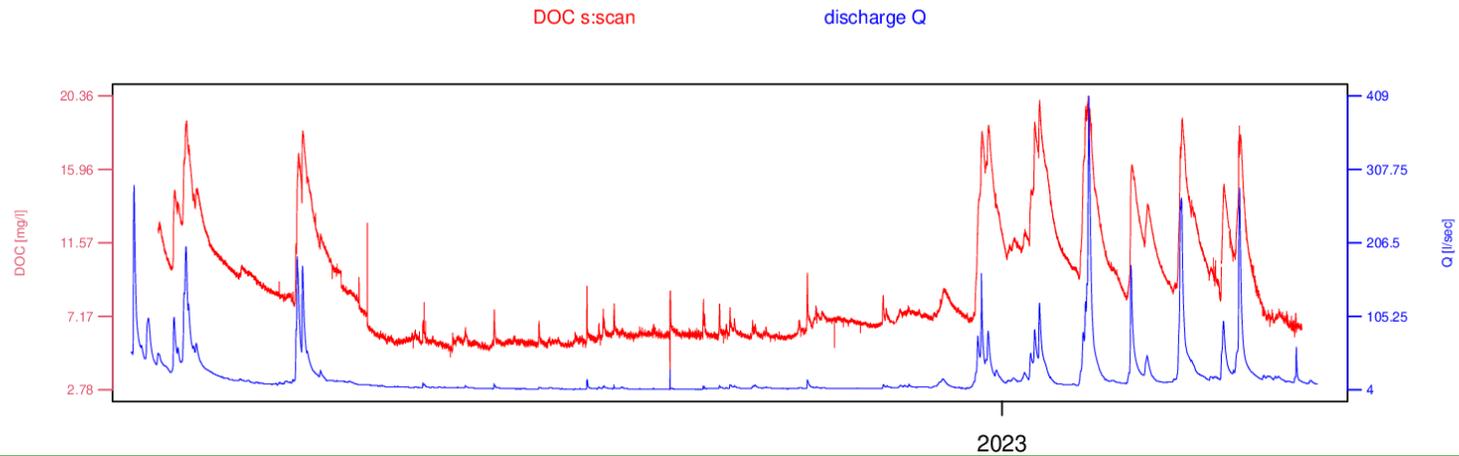


# Results

## Daily precipitation and DOC concentration at Elsterbach gauging weir



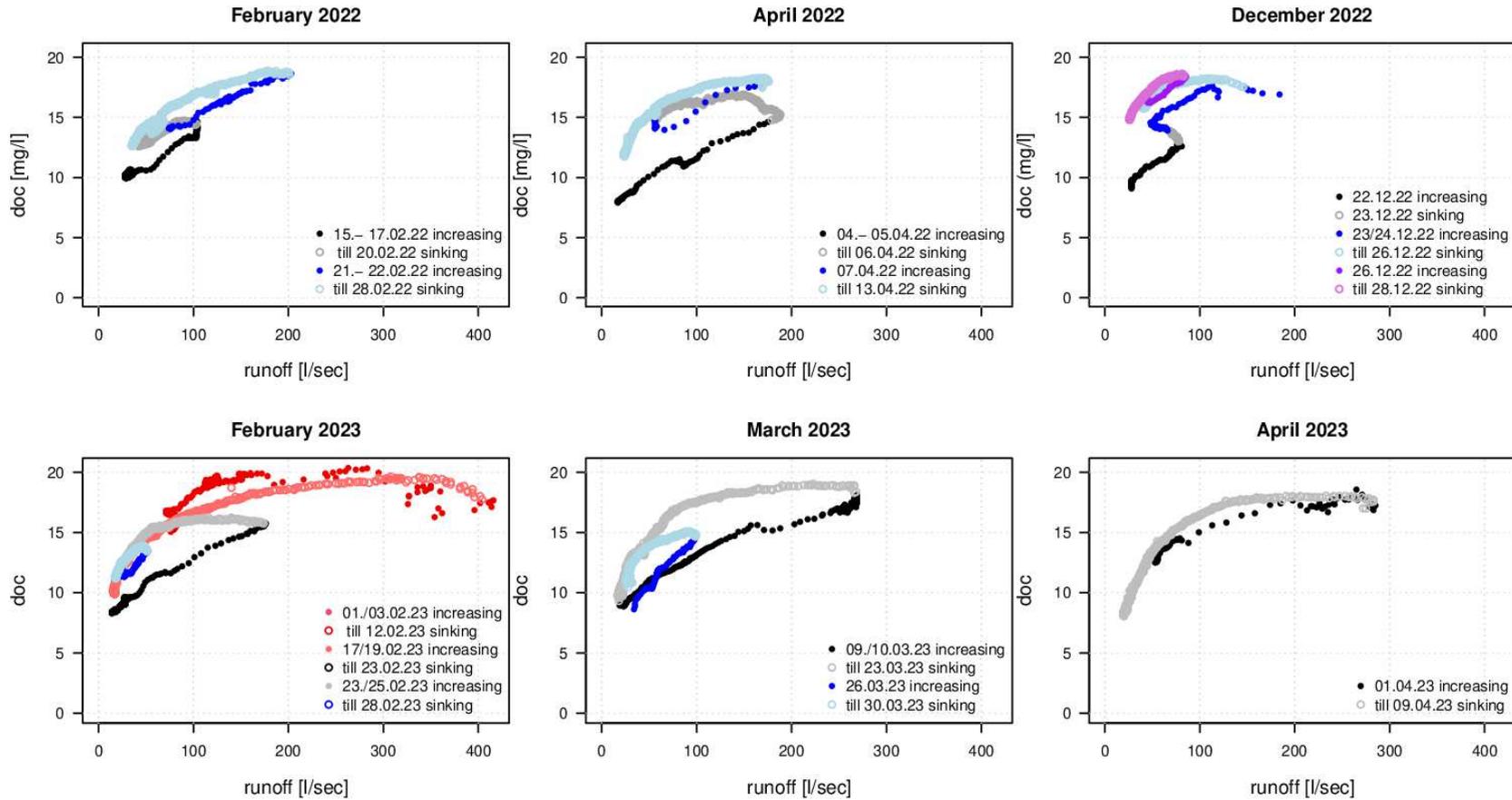
## Mean discharge per hour and DOC concentration at Elsterbach gauging weir



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# Results

Elsterbach weir: doc-concentration at increasing and sinking runoff



# Results

DOC	n	Min	1st Qu	Median	Mean	3rd Qu.	Max	period
Weir (s:can)	41822	2,78	6,05	7,24	8,71	10,68	20,36	2/22 - 4/23
	24168	<b>5,95</b>	<b>8,05</b>	<b>10,06</b>	<b>10,68</b>	<b>12,58</b>	<b>20,36</b>	hydr. winter
	17654	2,78	5,67	5,98	6,03	6,18	12,75	hydr. summer
Weir (laboratory)	118	2,72	4,96	<b>5,54</b>	<b>6,42</b>	7,77	14,49	11/20-3/23
	61	3,48	5,06	<b>6,18</b>	<b>7,14</b>	9,18	14,49	hydr. winter
	52	2,72	4,50	<b>5,33</b>	<b>5,49</b>	5,80	14,50	hydr. summer
„waterlogged“ (laboratory)	67	10,12	12,36	15,14	15,91	19,19	32,33	11/20-3/23
	55	10,12	12,86	15,39	15,92	18,94	<b>25,94</b>	hydr. winter
	12	10,79	11,57	12,36	15,87	19,36	<b>32,33</b>	hydr. summer
„basalt“ (laboratory)	117	2,88	4,87	5,58	5,94	6,59	12,94	11/20-3/23
	65	2,88	4,74	5,50	5,96	6,72	12,94	hydr. winter
	52	2,90	5,12	5,58	5,90	6,56	11,46	hydr. summer
Lange Bramke Harz Mountain	60	0,33	0,67	0,93	0,93	1,21	1,95	11/20-3/23
	35	0,33	0,53	<b>0,71</b>	0,80	0,94	<b>1,95</b>	hydr. winter
	25	0,66	0,93	<b>1,06</b>	1,08	1,29	<b>1,45</b>	hydr. summer

## Résumé

- DOC-concentrations of the „waterlogged“ creek are considerably higher than the „basalt“ creek. Overall, a strong effect on the DOC-concentrations in the Elsterbach were observed.
- At the same water level DOC-concentration is higher at sinking outflow rate than at rising in most of the observed „flood peaks“.
- In one case, however, DOC-concentrations were higher while the outflow rate is rising. This might be the result of high fraction of quick surface near run-off from the waterlogged catchment.
- Weekly analysis do not show a significant difference in DOC-concentrations (min, mean, median, max) between hydrological winter and summer.
- High resolution measurement, however, detect considerable higher DOC-concentrations during hydrological winter.
- DOC-concentrations of the Elsterbach and its tributaries are much higher than DOC-concentrations in Langen Bramke (Harz Mountain).
- The impact of deforestation after windthrow and following bark beetle disturbances on DOC-concentration in stream water cannot be assessed as there were no analysis of DOC prior to the beetle infestation in 2018.

## What is next?

- All measurements will continue
- We will investigate why there are differences between the stream and the laboratory DOC values
- Soil analysis are planned to estimate and model the carbon stock of the catchment area



Thank you very much for your attention!