High-resolution DOC measurements indicate differences in DOC mobilization processes depending on topography

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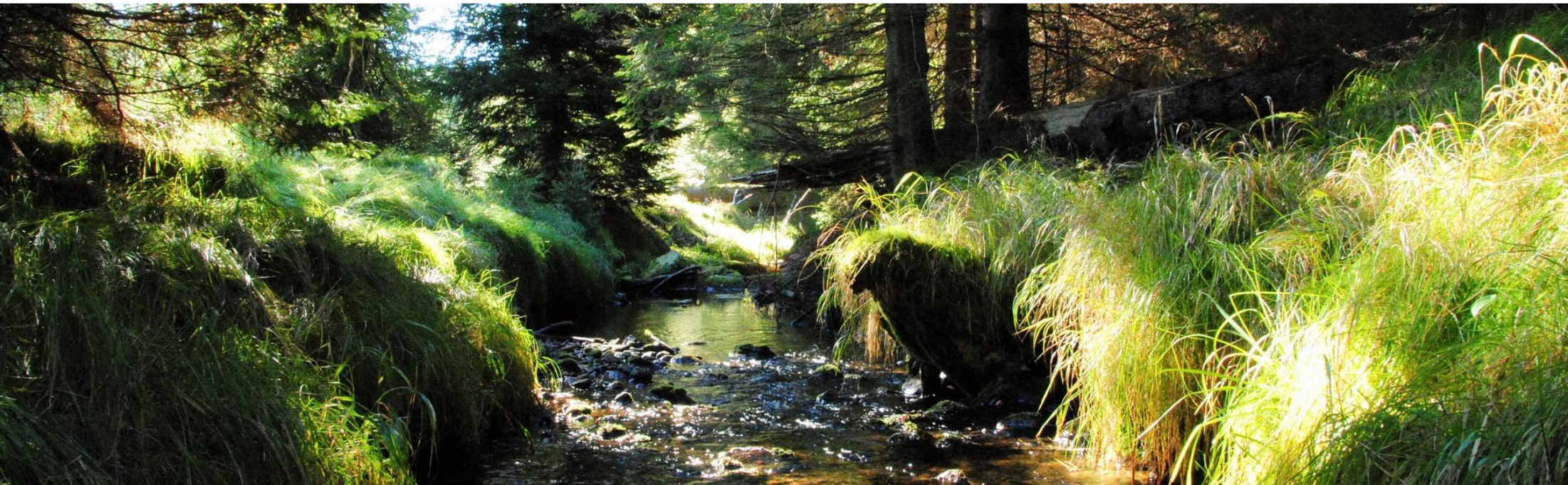


Motivation

- Since the early 1990s, an increase in DOC concentrations in rivers and lakes has been observed in catchments of the Northern hemisphere

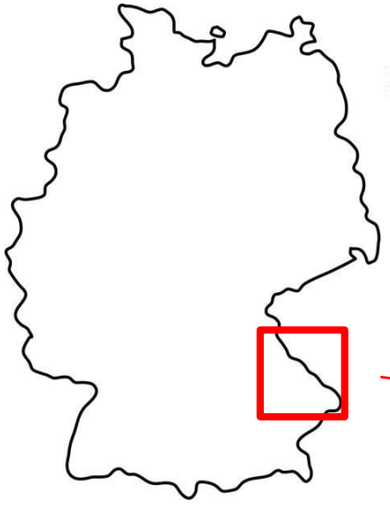
→ DOC mobilization mechanisms are unclear

Research Questions

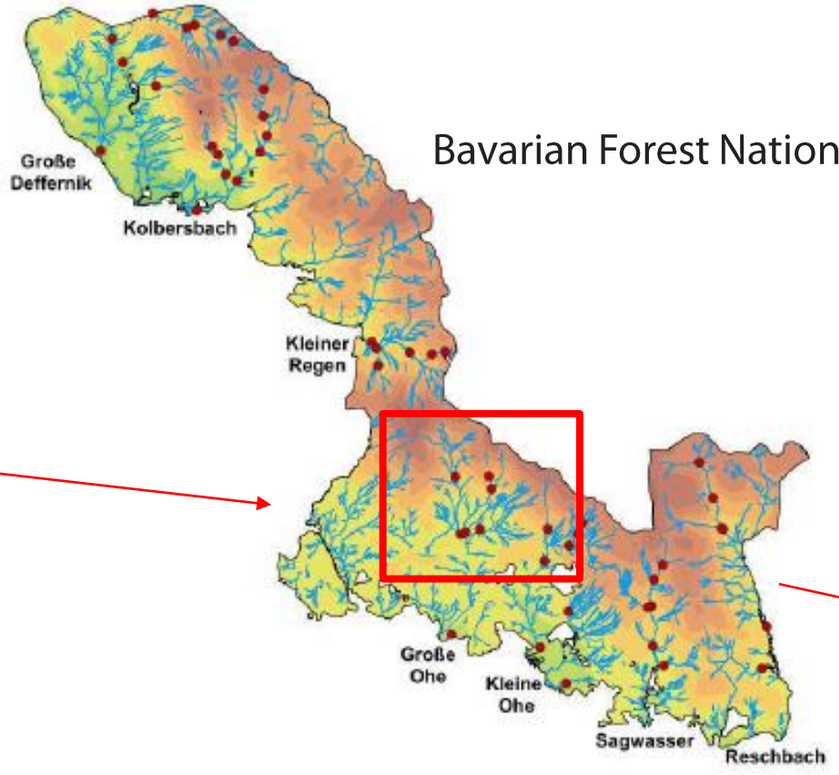
- Do different antecedent hydrological conditions lead to different release dynamics during precipitation events?

- Do different topographical positions within the catchment exhibit different DOC release dynamics during precipitation events?

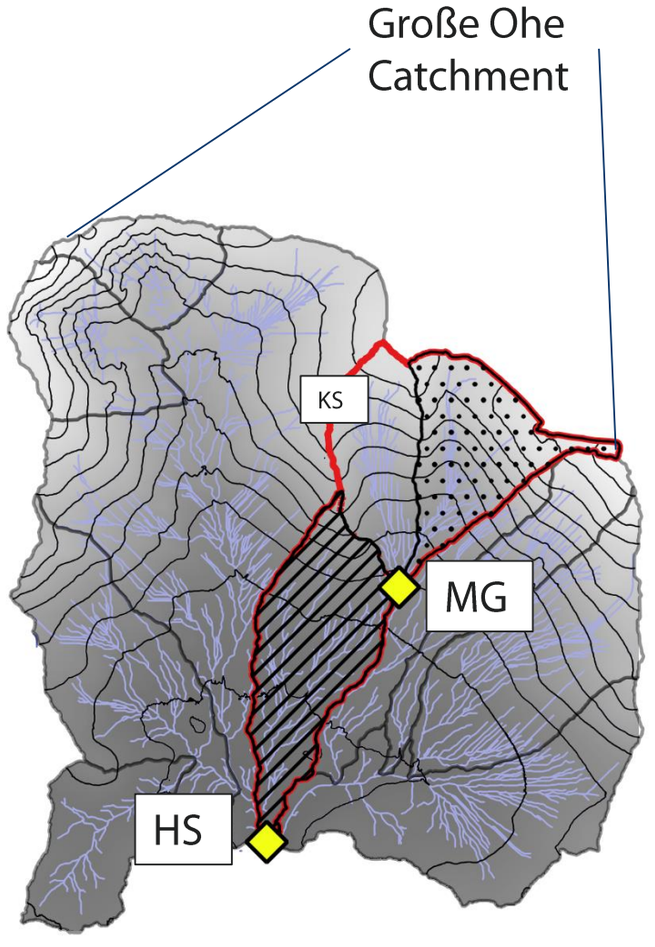
Study Site



Germany



Bavarian Forest National Park



Catchment	Große Ohe	Markungsgraben (MG)	Hinterer Schachtenbach (HS)
Area (km^2)	19.2	1.1	3.5
Elevation (m.a.s.l.)	770 – 1453	876 - 1373	771 - 1085
Mean slope (°)	11.1	16.1	7.4

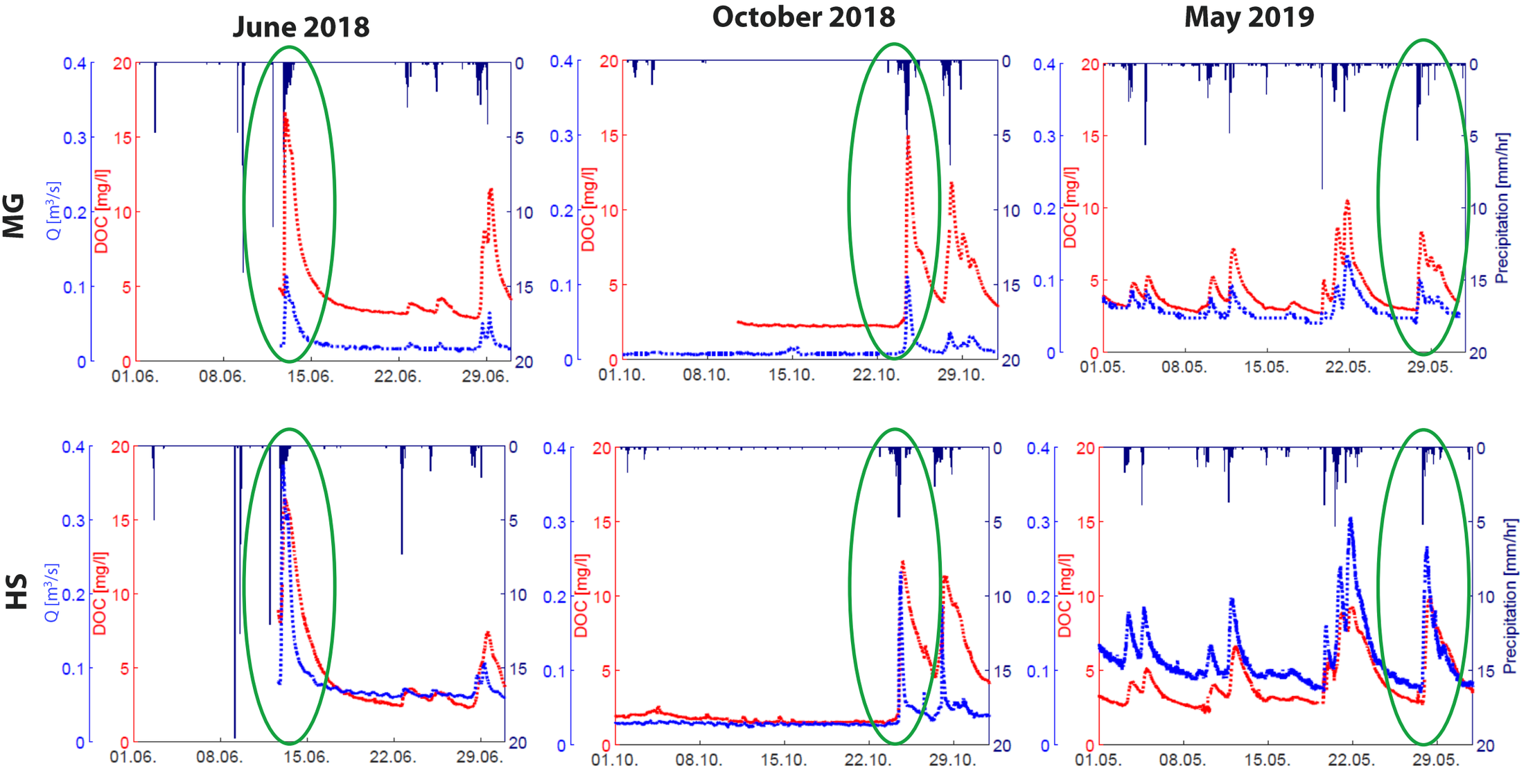
MG is representing the steeper part of the catchment.
HS is representing the flat part of the catchment including a large riparian zone.

Methods

In stream UV-Vis spectrometry (spectro::lyser, s::can Messtechnik GmbH)
→ continuous DOC concentrations at outlets of Markungsgraben (MG) and Hinterer Schachtenbach (HS) (see yellow diamonds on previous slide)

- Absorption from 200 to 750 nm in steps of 2.5 nm
- Every 15 minutes
- June 2018 – November 2018
- April 2019 – November 2019

Continuous DOC concentrations during several events with differing antecedent hydrological conditions

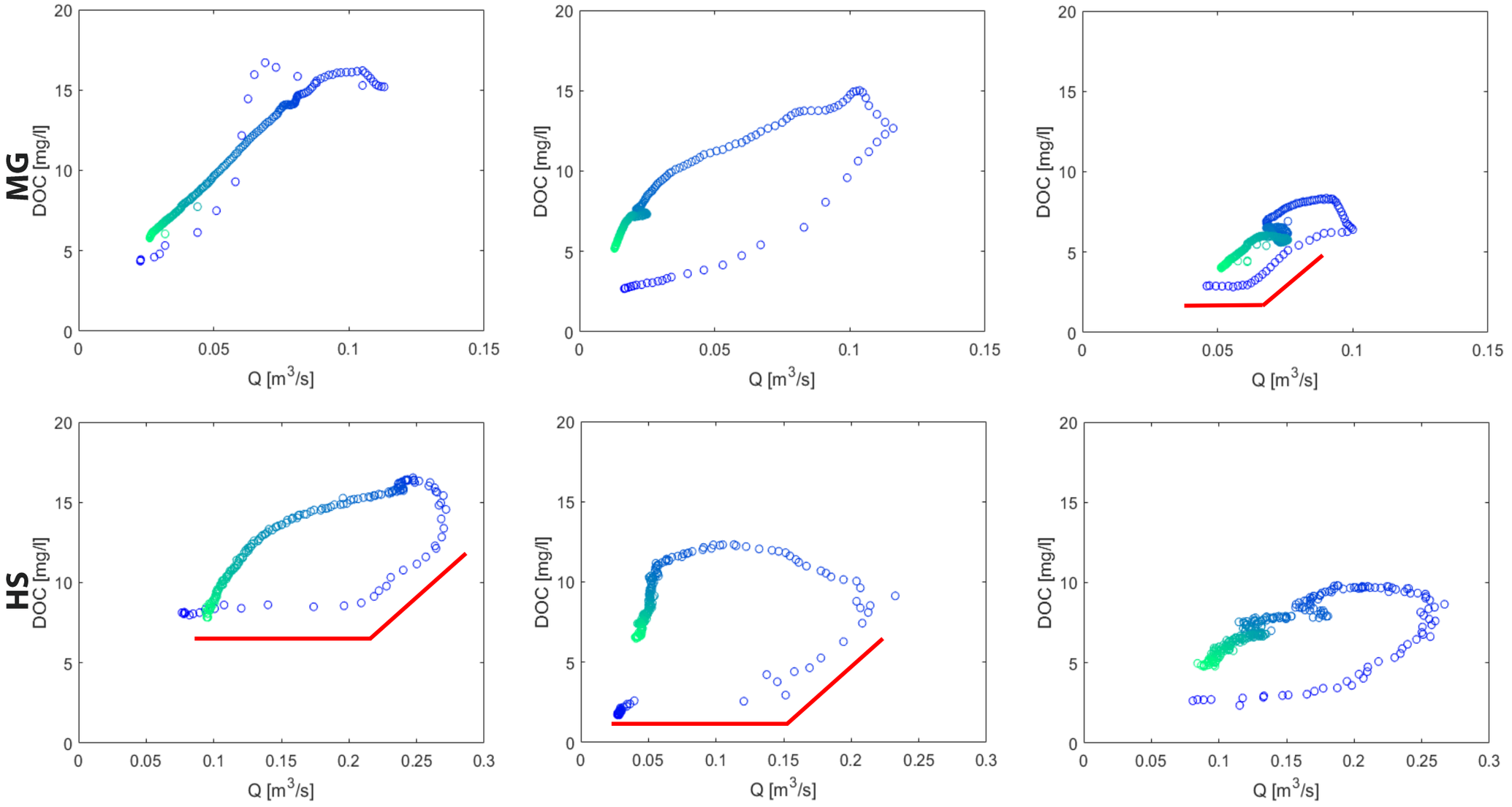


DOC-Q relationship

June 2018
P_{tot}: 29 mm
API_{14}: 110 mm

October 2018
P_{tot}: 33 mm
API_{14}: 2 mm

May 2019
P_{tot}: 24 mm
API_{14}: 45 mm



API_{14}: antecedent precipitation index, cumulative precipitation during the 14 days prior to the event
P_{tot}: total precipitation during eventt

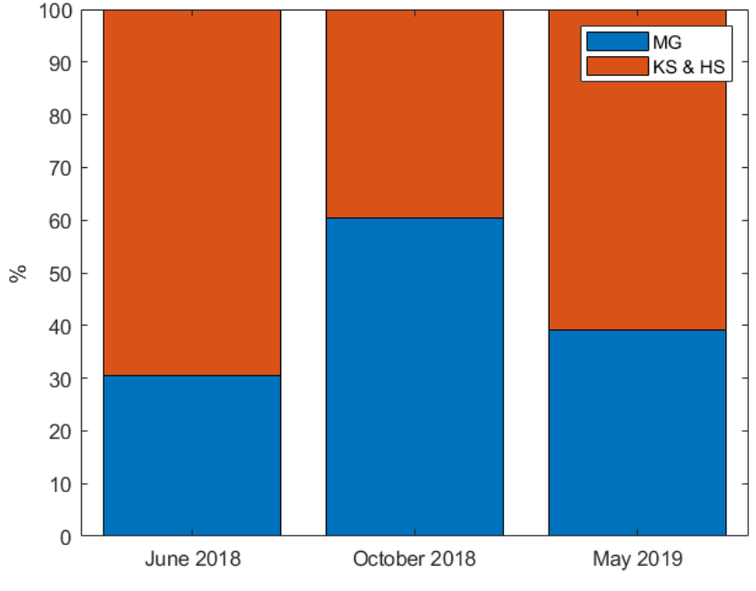
The dots represent 15-minute time steps starting from dark blue proceeding to green.

Observations: DOC-Q relationships

- Relationships show a hysteresis in anti-clockwise direciton (exception: MG in June 2018)
- Generally wider loop at HS than at MG and longer lag time between Q peak and DOC peak at HS → slower increase and decrease of DOC concentrations at HS
- At both sites widest loop in October 2018 after long dry period
- Thresholds of Q for DOC mobilization during some events?

DOC export

Start Date	P_{tot} (mm)	API_{14} (mm)	DOC load (kg)	DOC load (kg/km²)	DOC load (kg)	DOC load (kg/km²)
			HS	HS	MG	MG
12.06.2018	29	110	378	107	115	101
23.10.2018	33	2	108	31	66	58
27.05.2019	24	45	269	76	105	92



Contribution (in %) of the different sub-catchments to the DOC load arriving at the catchment outlet HS during the different events.

MG stands for the DOC originating from the sub-catchment Markungsgraben.

HS & KS stands for the difference between the DOC arriving at HS and the DOC arriving at MG and must therefore originate from the sub-catchments KS and HS.

Observations: DOC export

- DOC export in absolute numbers higher at HS than at MG due to larger catchment area
- Highest DOC export after wet conditions, lowest DOC export after dry conditions
- Relative contribution of MG changes between events: 31% and 39% of the DOC arriving at HS in June 2018 and May 2019 originate from MG. In October 2018, however, MG contributes 60% of the DOC arriving at HS.

Discussion

- After **wet season:** fast DOC mobilization with high DOC export at both sites
- After **dry season**: Delayed DOC mobilization at HS, MG contribution more important → soil needs to be rewetted to connect flow paths and DOC sources to the stream
- DOC-rich pools in the wide riparian zone of HS as a possible reason for thresholds of DOC mobilization? (see photo)

Outlook

- Analysis of DOC concentrations and quality of shallow groundwater, soil water and „pools“

→ Further insights into possible DOC sources