

Long-term Trends in Dissolved Organic Carbon from Fluvial Systems Across Biomes



Bianca M. Rodríguez-Cardona*, Adam S. Wymore, Pirkko Kortelainen, Alba Argerich, Sherri Johnson, and William H. McDowell



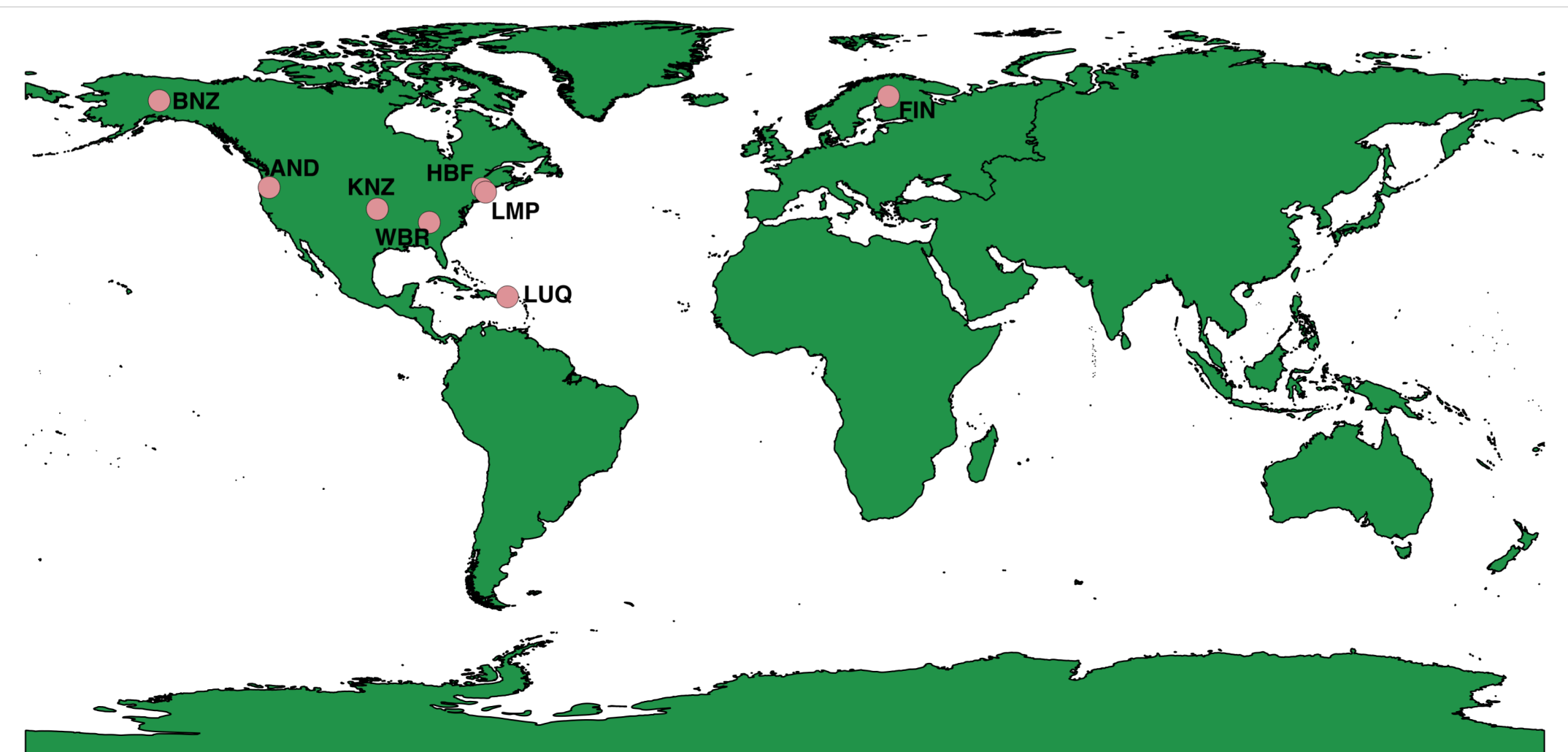
@BRodzCardona
@UNHWaterQuality

*University of New Hampshire

*bpq33@wildcats.unh.edu

Background

- Increases in concentrations of DOC observed in northern Europe due to declines in atmospheric deposition
- Changes in DOC are inconsistent and mostly reported for temperate systems
- **Are changes in DOC occurring at the inter-biome scale? If so, what are the drivers of changes in DOC?**



Site	Number of individual streams	Median DOC (mg/L)
Finland (FIN)	33	12.35
Bonanza Creek, AK (BNZ) *	9	3.64
Hubbard Brook, NH (HBF) *	5	2.21
Lamprey River Basin, NH (LMP)	10	4.78
H.J. Andrews, OR (AND) *	4	0.99
Konza Prairie, KS (KNZ) *	2	1.01
Walker Branch, TN (WBR) *	1	0.62
Luquillo Forest, PR (LUQ) *	8	1.06

* Denote LTER sites

Trends in DOC concentration were determined using seasonal Mann-Kendall test and magnitude of the trend with sen slopes based on monthly DOC concentrations per individual stream.

Results

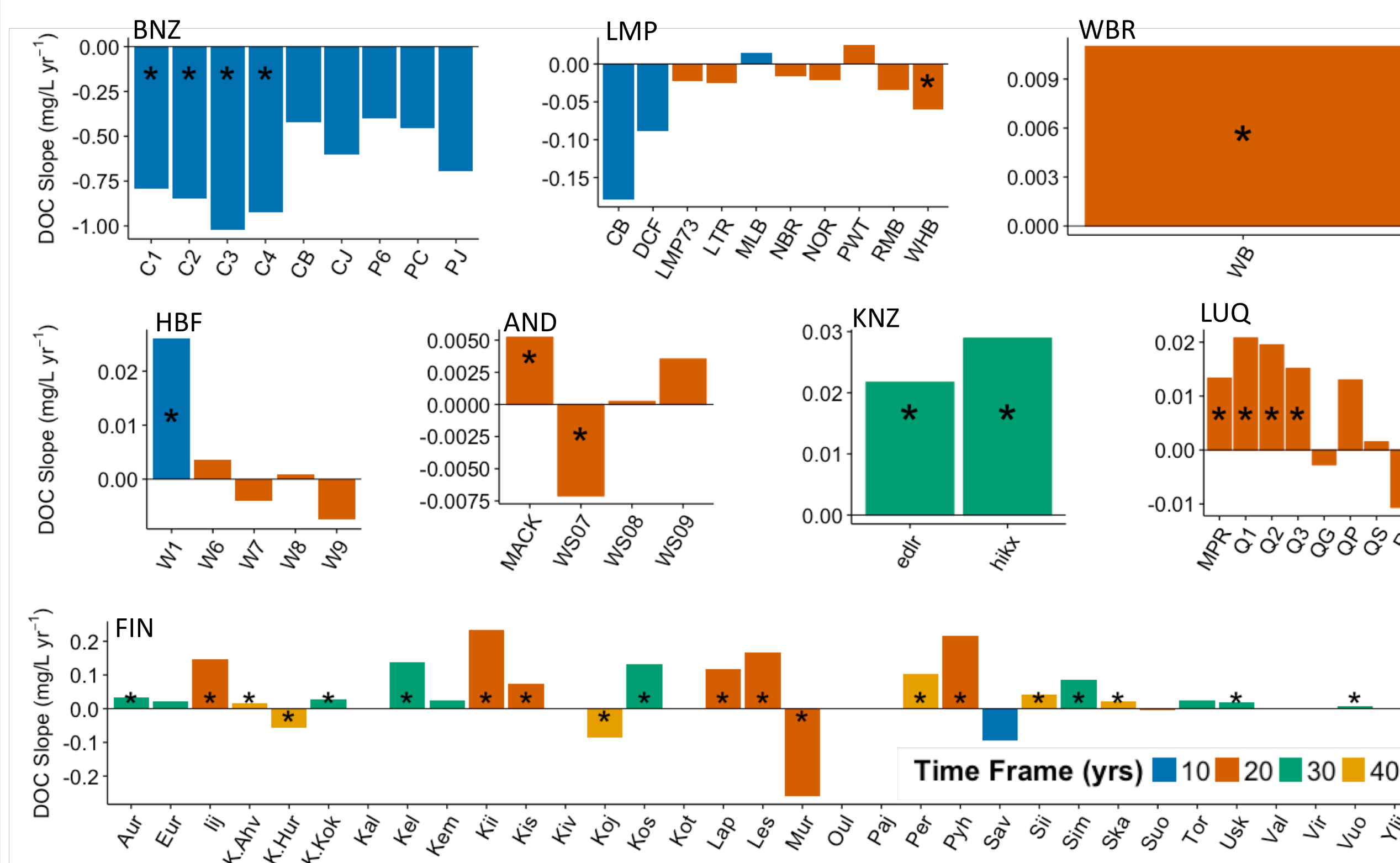


Fig 1. Slopes of monthly DOC concentrations for individual streams across sites. Blue bars represent data sets of up to 10 years long, orange up to 20 years, green up to 30 years, and yellow up to 40 years. Stars represent statistically significant slopes ($\alpha=0.05$). BNZ slopes only represent spring/summer months (May – August).

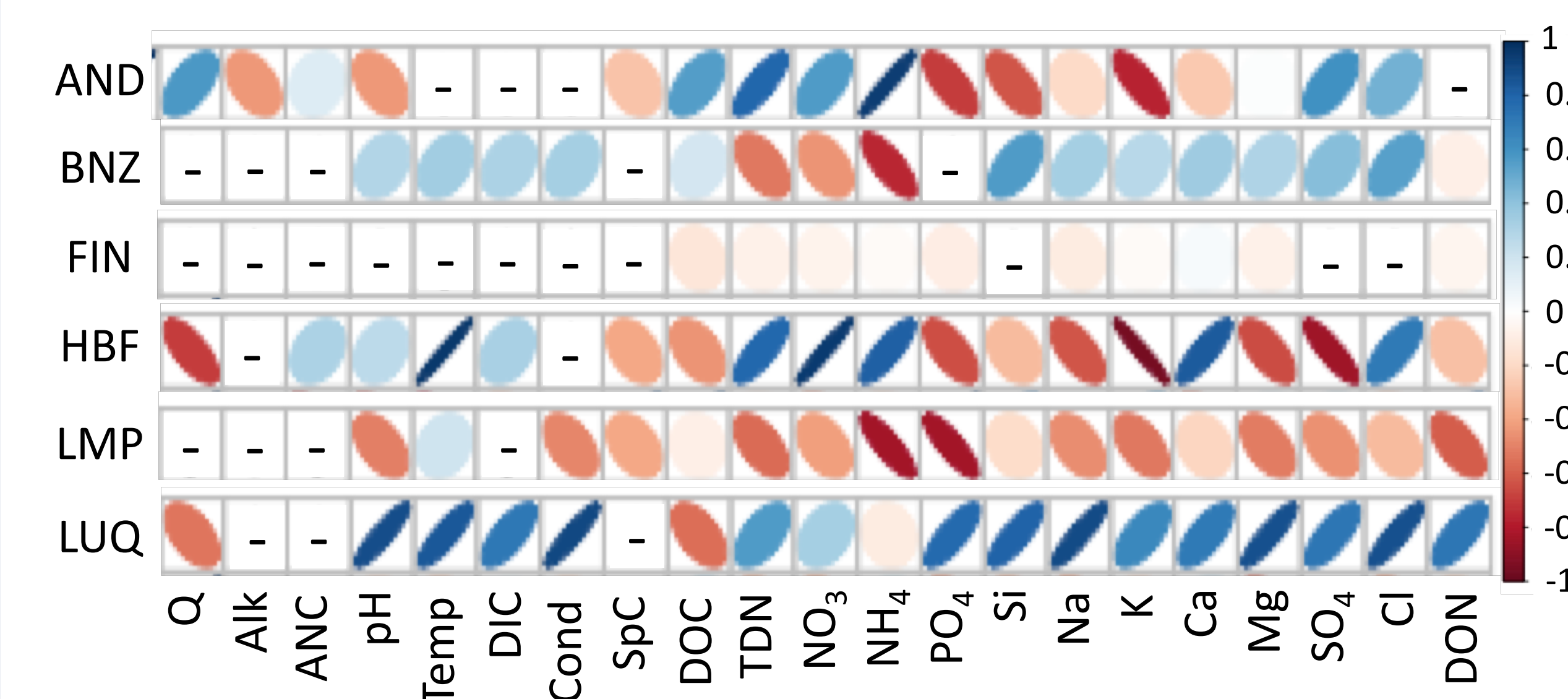


Fig 2. Correlation matrices between DOC slopes and mean discharge (Q), alkalinity (alk), acid neutralizing capacity (ANC), stream pH, stream temperature, DIC concentration, conductance (Cond), specific conductivity (SpC), and concentrations of DOC, TDN, NO_3 , NH_4 , PO_4 , Si, Na, Ca, Mg, SO_4 , Cl, and DON for each individual stream. The width of the ellipsis describes the variability where thinner ellipsis denote less variability, the slope is the direction of the relationship, blue are increasing and red are decreasing trends, and the darker the shade the stronger the correlation. - represent no data available.

Table 1. Trends in monthly DOC concentrations based on seasonal Mann-Kendall with varying periods of time where 10 years is from 2015-2005, 15 years is from 2015-2000, 20 years is from 2015-1995, 25 years is from 2015-1990, 30 years is from 2015-1985, 35 years is from 2015-1980, and 40 years is from 2015-1975. Grey boxes represent no significant trend, red boxes represent decreasing trends, and blue are increasing trends with their respective tau value of statistically significant monotonic trends ($\alpha=0.05$).

Site	Stream	Time periods (years)						
		10	15	20	25	30	35	40
LUQ	RI							
	MPR		0.17					
	QP							
	Q1		0.18					
	Q2		0.16					
AND	WS07	0.27	0.15					
	WS08	-0.20	-0.14					
	WS09	-0.30						
LMP	LMP73	-0.30	-0.13					
	W6							
	W7							
KNZ	edlr		0.13	0.32				
	hikx	-0.17	0.16	0.37				
	Aur					0.13		
FIN	lik	0.15	0.21	0.27				
	Kem	0.19		0.15	0.12			
	Kis	0.24	0.28	0.21				
	Kos	0.13	0.30	0.31				
	Koj	-0.32	-0.42	-0.29	-0.37	-0.36	-0.29	-0.29
	K. Hur	-0.26	-0.19	-0.30	-0.46	-0.47	-0.39	-0.27
	K. Ahv	-0.42	-0.46	-0.40	-0.16	0.09		
	K. Kok	-0.40	-0.44	-0.21	0.10	0.18		
	Lap		0.14	0.18				
	Oul		-0.19	-0.20	-0.12	-0.13	-0.08	
	Per				0.10	0.19		
	Pyh		0.15	0.18				
Sii	0.22					0.08		
Ska		-0.18	-0.12	-0.09			0.09	
Usk			0.11	0.09				
Vuo						0.13		

Conclusions

- Changes in DOC concentrations occurring globally but no consistent directional pattern (Fig 1)
- Low DOC sites also demonstrate changes in trends (e.g. WBR, LUQ, AND) (Fig 1)
- Within site variation in DOC trends (Fig 1)
- Length of data set can influence trends in DOC (Table 1)
- Potential drivers of DOC trends vary regionally with no clear consistent driver (Fig 2)
- Implications for watershed respiration and drinking water sources/use

Acknowledgements

Thanks to all NCEAS LTER: Stream Elemental Cycling workshop participants for contributing, acquiring, and analyzing data sets.

