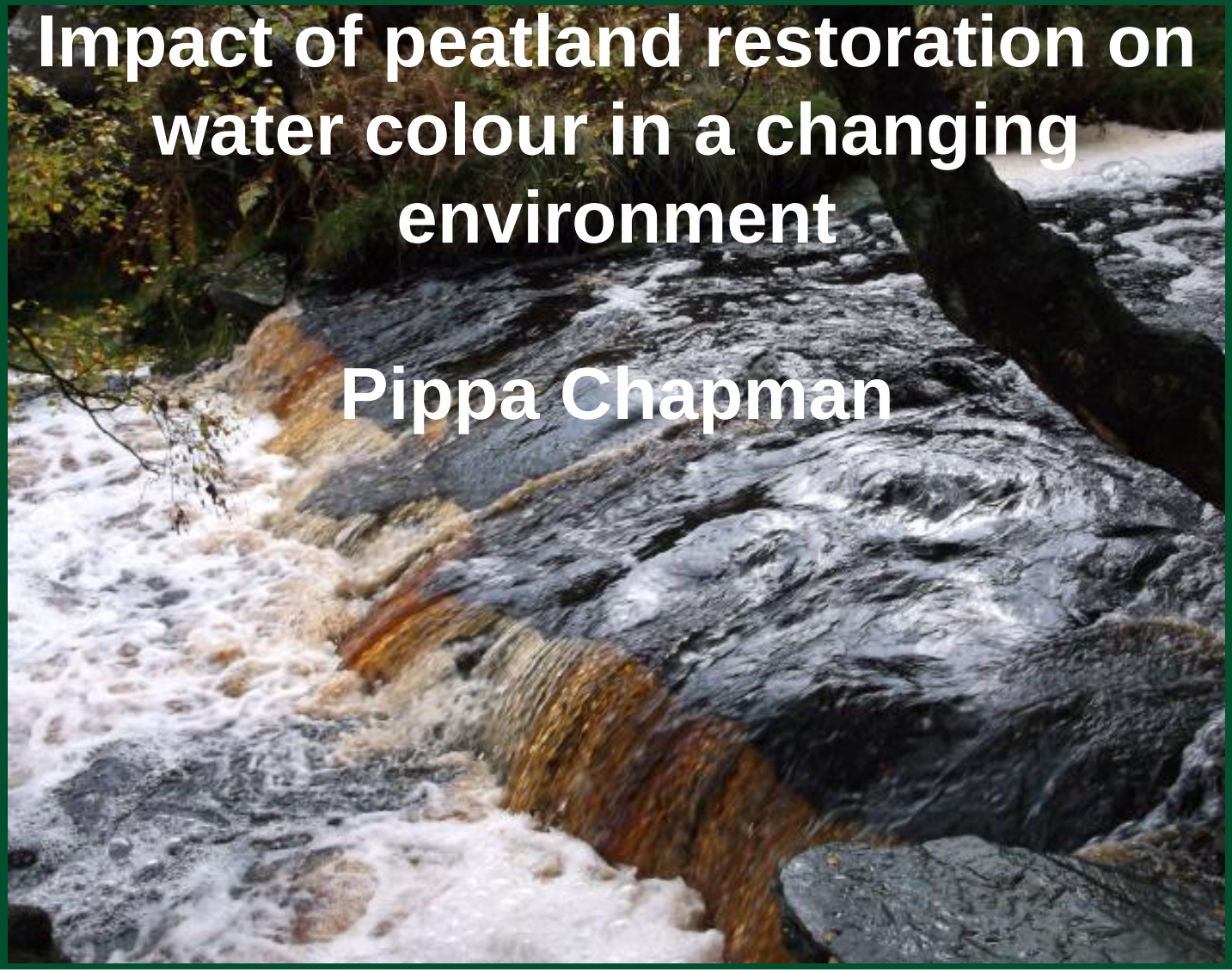
School of Geography
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

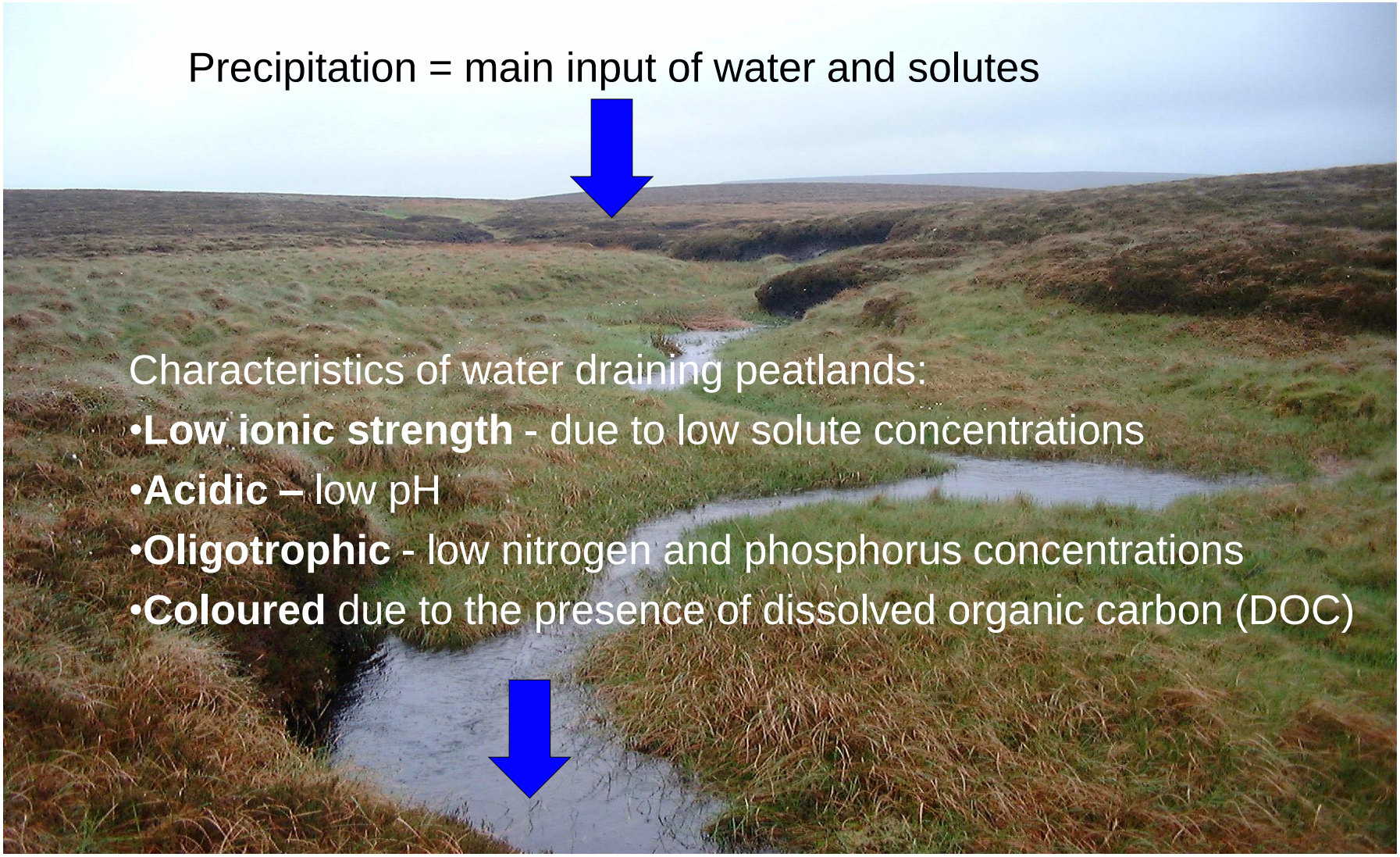
Impact of peatland restoration on water colour in a changing environment



Pippa Chapman

Structure of presentation

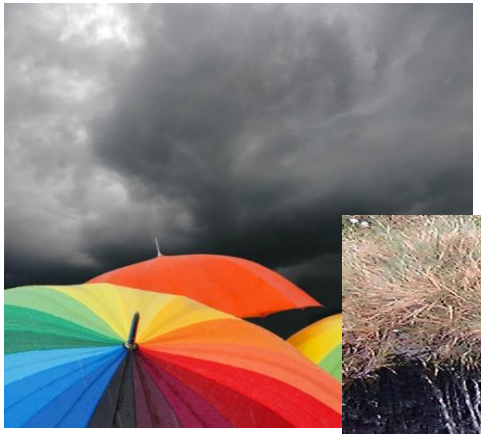
- Peatlands and regulation of water quality
- How water colour has changed over last 30 years
- Why water colour is an issue
- Impact of peatland restoration on water colour versus other environmental changes in the UK uplands
- Conclusion


Precipitation = main input of water and solutes
Characteristics of water draining peatlands:
•Low ionic strength - due to low solute concentrations
•Acidic – low pH
•Oligotrophic - low nitrogen and phosphorus concentrations
•Coloured due to the presence of dissolved organic carbon (DOC)

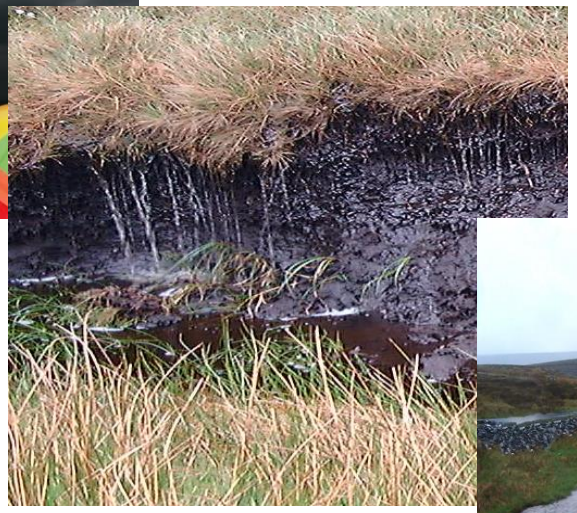
Ecosystem services of peatlands with regard to regulating water quality

1. In the UK 11.4 million people rely on peatlands for their drinking water
2. Source of potable water due to
   - High rainfall amount
   - Low evapotranspiration
   - Remote location
   - Low intensity land use
   - High water quality

3. Peat retains pollutants
4. Source of dilute water: can be used to dilute pollutants in other water sources

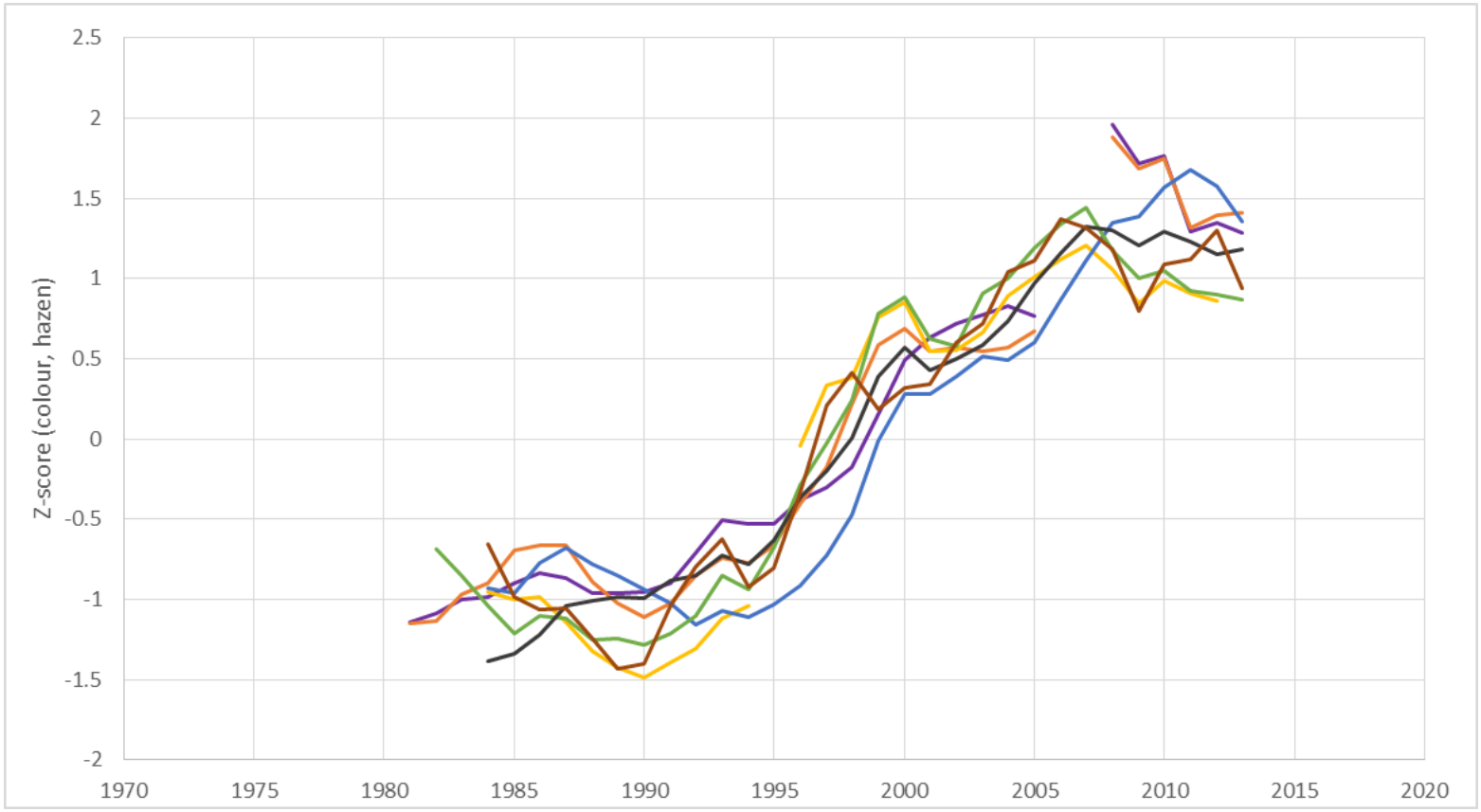


Water picks up colour (dissolved organic carbon) as it passes through the peat



Water treatment removes colour so that customers receive a colourless water

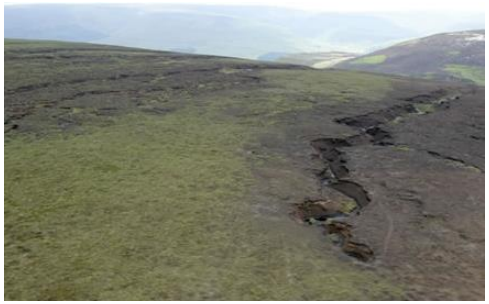
Water colour has increased over 20 years

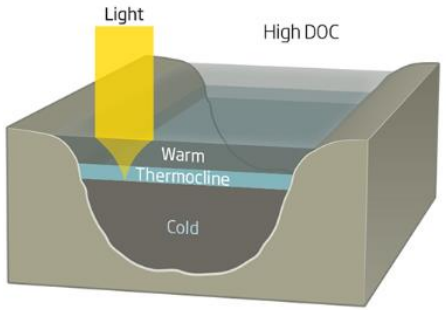


Trend in colour at Water Treatment Works in the southern Pennines

Environmental Implications of increasing water colour

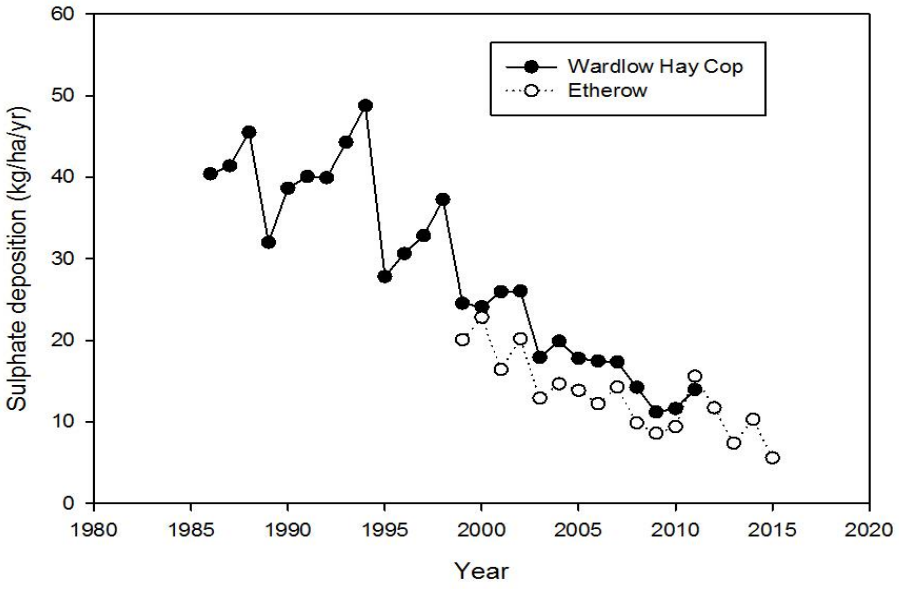
- **Depletion of terrestrial carbon stores**, increasing fluxes into more reactive pools (riverine, marine and ultimately atmospheric).
- **Impact for water treatment works** (increased cost) and potential effects on drinking water quality (production of carcinogenic disinfection by-prodcuts).
- **Local effects on water quality**: Water transparency; water temperature, acidity; heavy metals; ecology.

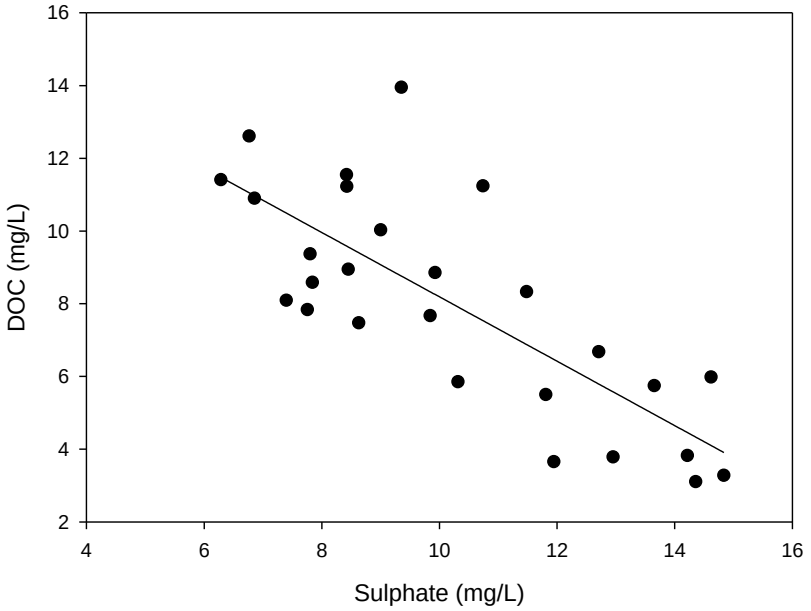


Why has water colour increased?

Decline in Acid Rain

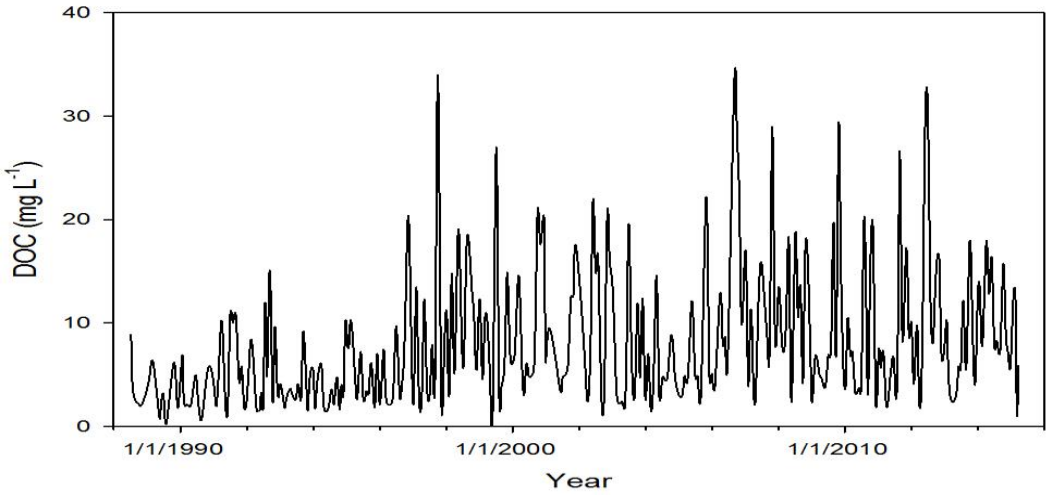


Carbon more soluble as acidity declines



Can peatland restoration help?

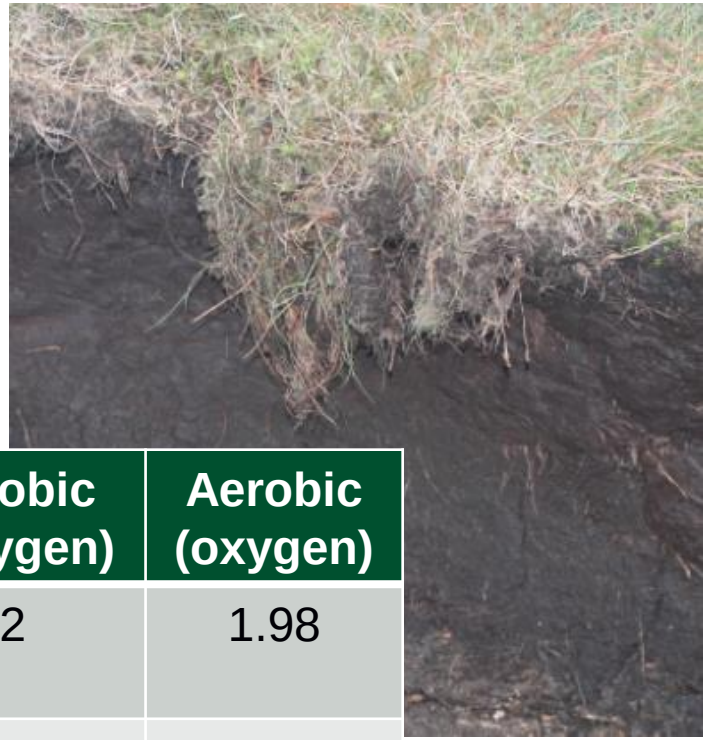
- YES but often hard to detect from sampling stream water alone due to seasonal trend and long term trend



Influence of water-table position

High water table

Low water table



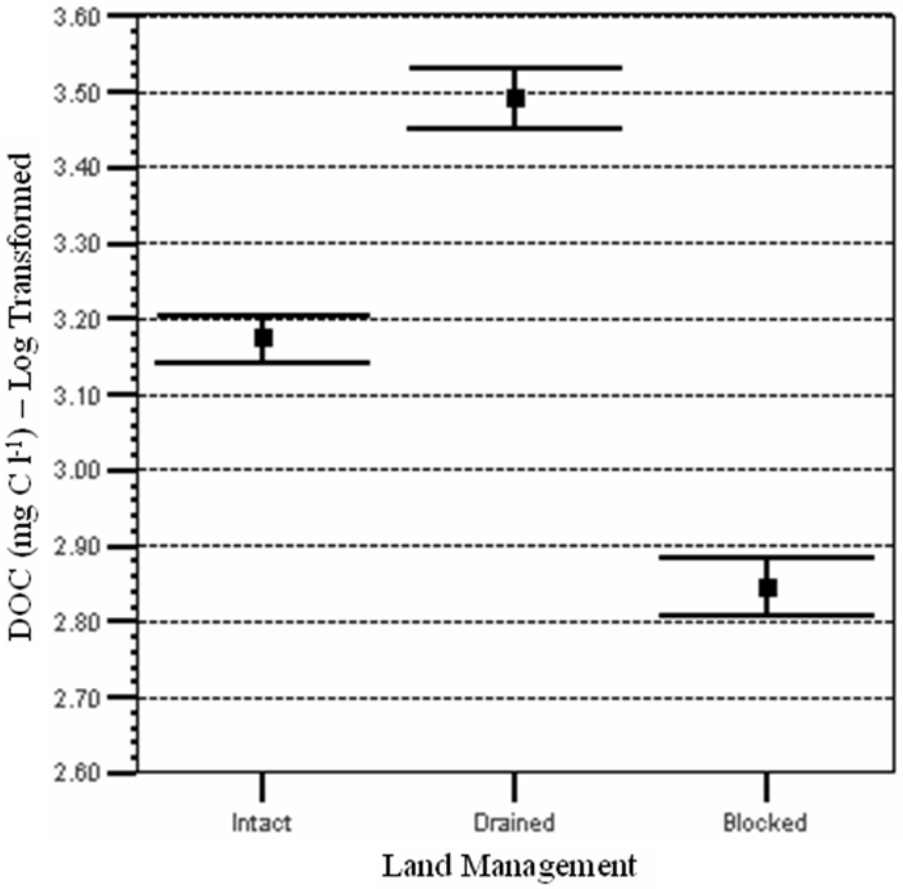
	Anaerobic (no oxygen)	Aerobic (oxygen)
DOC µg/g soil/day	0.52	1.98
DOC Q10	1.84	3.53

Less colour produced

More colour produced

Clark et al., 2009. Global Change Biology

Drainage and water colour/DOC



Wallage et al., 2006. Science of the Total Environment.

Impact of drain-blocking on water colour

- Many studies observed **an increase in colour shortly after blocking** (e.g. Worrall et al. 2007).
- Large study showed that blocking **generally reduced colour** (Armstrong et al., 2010). But not always - Impact of local conditions
- Re-vegetation of gullies reduces loss of peat to freshwaters

Re-vegetation of bare peat at Bleaklow

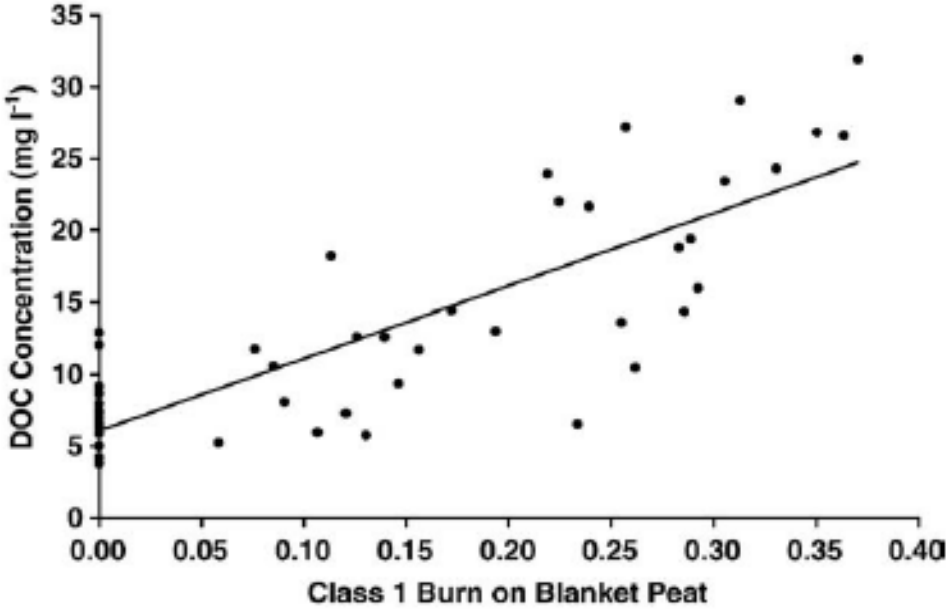
	DOC flux
	t C km^{-2} yr^{-1}
Bare peat	34.4 – 72.1
Restored	13.1 – 57.7
Vegetated	13.0 – 95.6

More peat and colour lost from bare peat

less peat and colour lost from vegetated peat

Worrall et al. (2011)

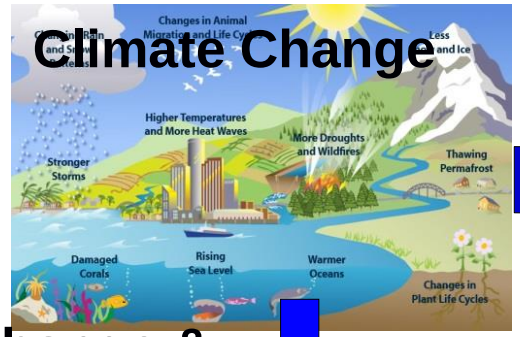
Heather Burning and DOC



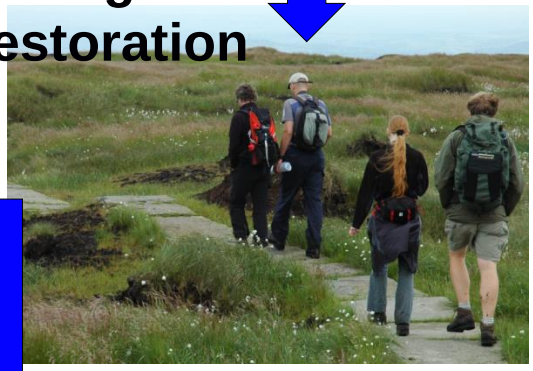
Yallop & Clutterbuck, 2009. Science of the Total Environment

However, plot scale experiments have not observed an increase in soil solution DOC following burning (e.g. Clay et al., 2009; 2010).

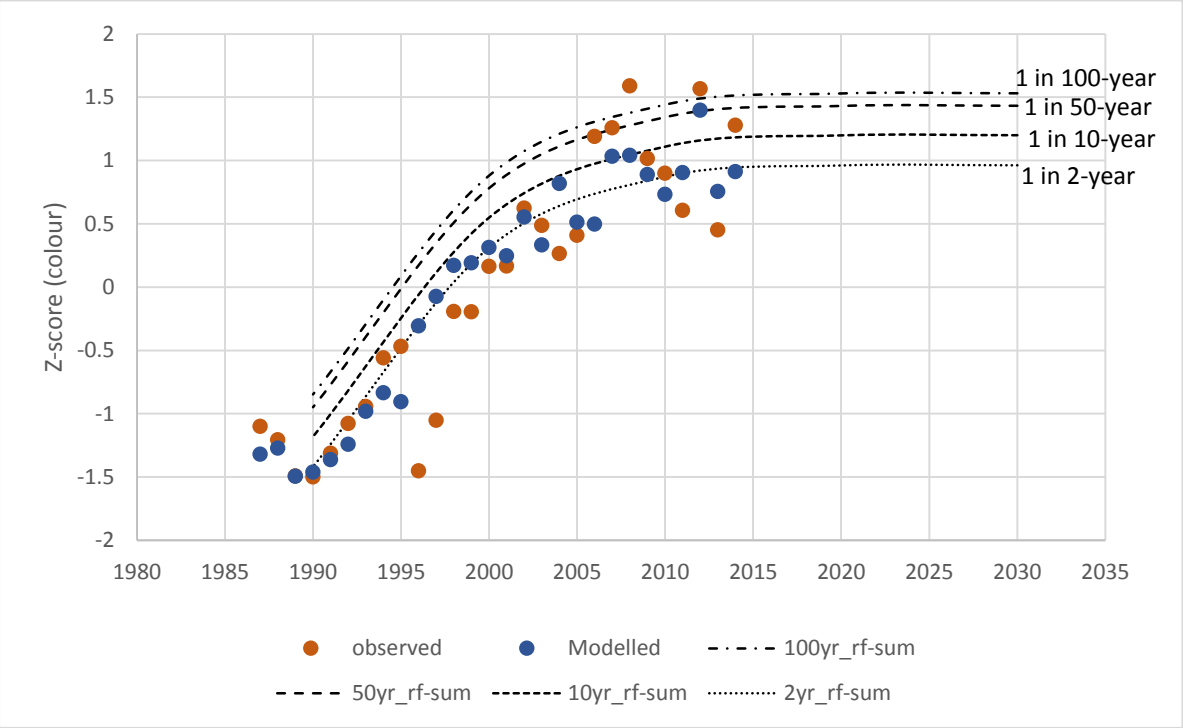
How will water colour change in the future?



Land Use Change &
Peatland Restoration



Water colour over next 10 years



Major impact of recovery from acid rain has happened
Climate change and land use change/restoration will have more influence

A restored peatland is more resilient to climate change

Any Questions?

Acknowledgments

- Yorkshire Water – data and funding for research
- UK Uplands Water Monitoring Network – River Etherow data
- Sheila Palmer, Brian Irvine, Joseph Holden