

Trends in DOC in boreal and temperate water bodies - from headwaters to large rivers

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Acknowledgements

- DOMQUA- Drinking water treatment adaptation to increasing levels of DOM and changing DOM quality under climate change (Nordic project)
 - Salar Valinia¹, Gesa A. Weyhenmeyer², Kari Austnes¹, Martyn N. Futter³, Dag O. Hessen⁵, Hjalmar Laudon³, Pirkko Kortelainen⁴, Antti Räike⁴, Jussi Vuorenmaa⁴ (1 Norwegian Institute for Water Research, Oslo; 2 Uppsala University; 3 Swedish University of Agricultural Sciences; 4 Finnish Environment Institute, Helsinki; 5 Oslo University)
- ICP Waters (www.icp-waters.no)
 - Don Monteith¹, John Stoddard², Jens Fölster³, Jussi Vuorenmaa⁴, Jakub Hruska⁵, Suzanne Couture⁶, Jiri Kopacek⁷, Andrew Paterson⁸, Salar Valinia⁹, Chris Evans¹
 - 1-CEH, UK; 2-EPA, US; 3-SLU, SE; 4-Syke, FI; 5-CGS, CZ; 6-EnvCan, CA; 7-ASCR, CZ; 8-OntMECC, Ca; 9-NIVA, NO
- Convention of Long-range transported pollutants (LTRAP, 'acid rain' convention)
- Funders and managers of long-term monitoring networks (including water treatment plants)



Sulfur deposition



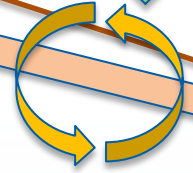
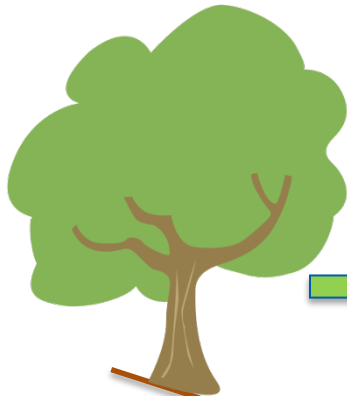
Seasalt



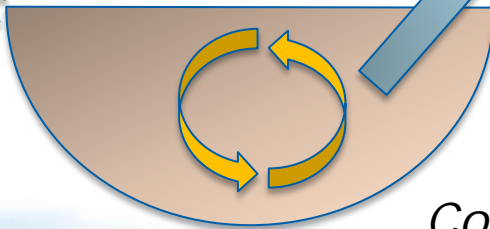
Precipitation



Light
Temperature

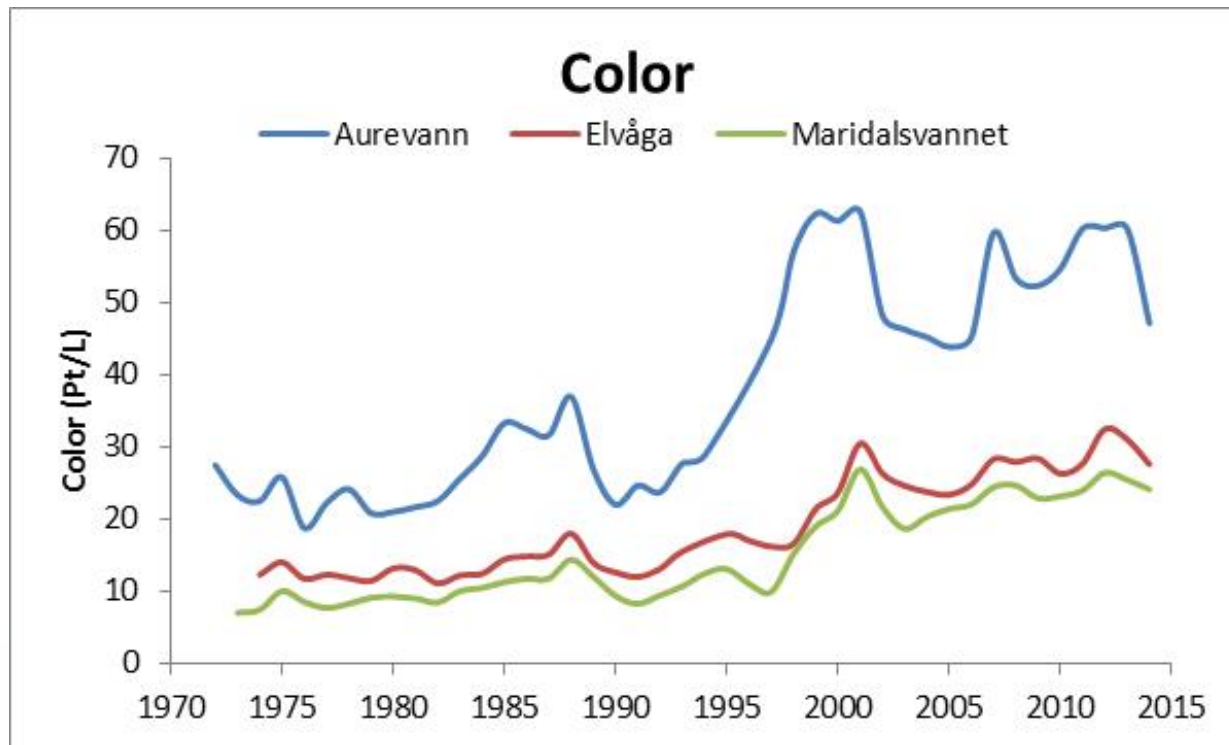


*Decomposition
Hydrology
Sorption-desorption*



*Consumption
Photo-oxidation
Sedimentation*

Tripling of color since 1980

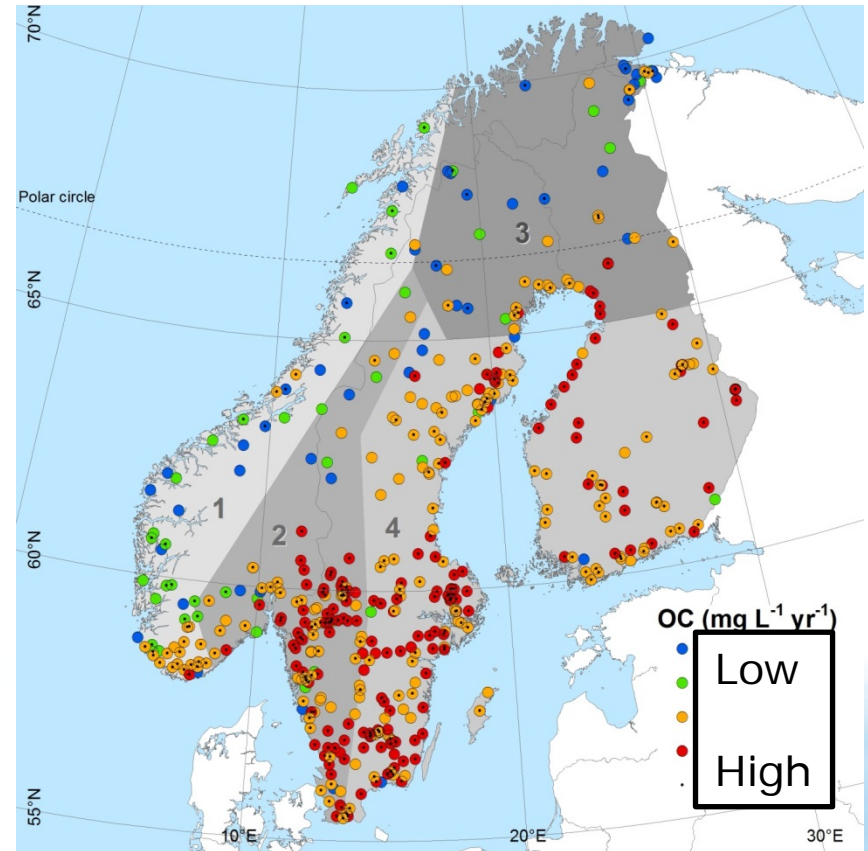


Structure

1. Does catchment size matter for trends?
2. Are trends in DOC levelling off?
3. What are current drivers of DOC?
4. Future levels of DOC

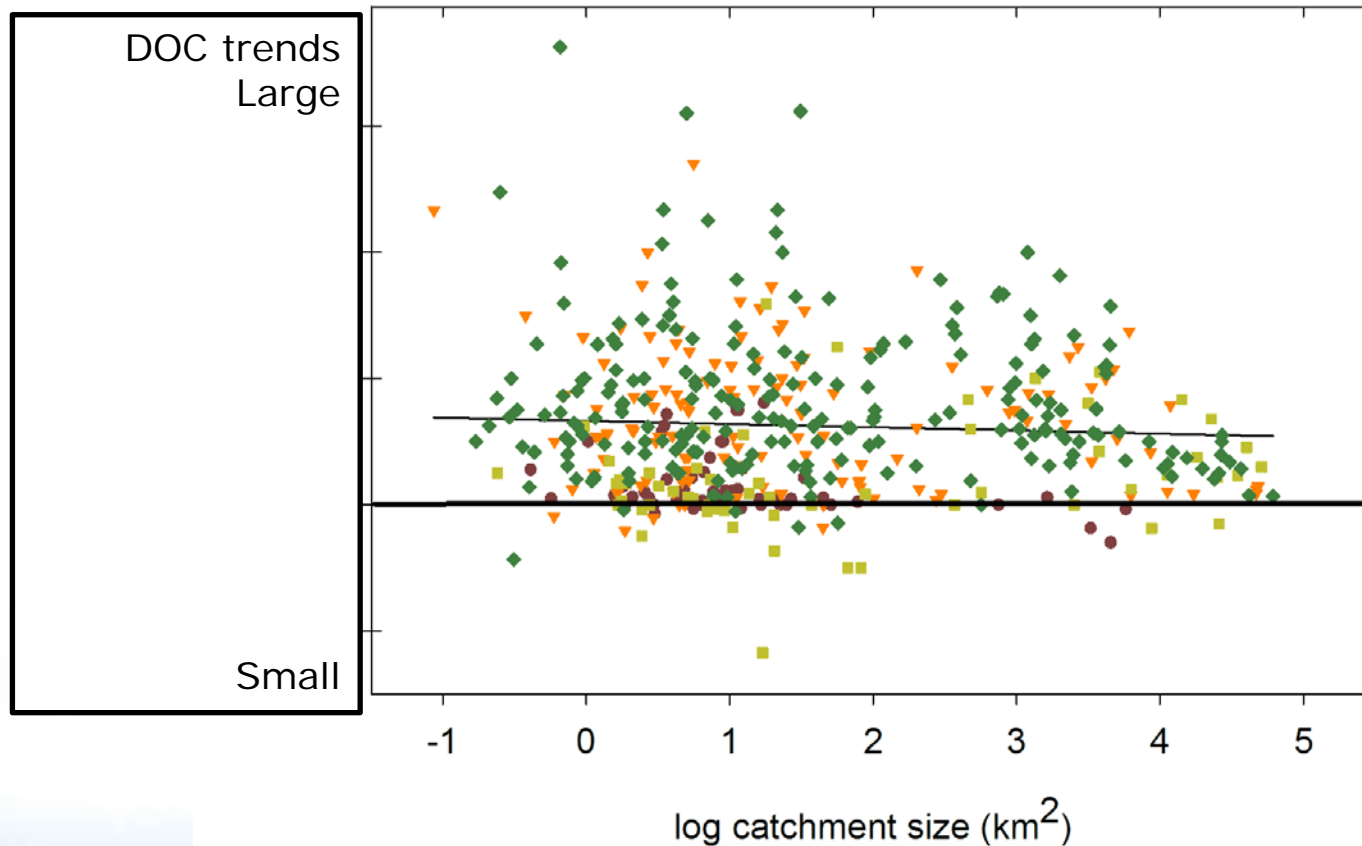
DOC trends in Nordic countries

- 1990 to 2012
- From headwaters to large river basins



De Wit et al., submitted

DOC trends uniform across catchment size



De Wit et al., submitted

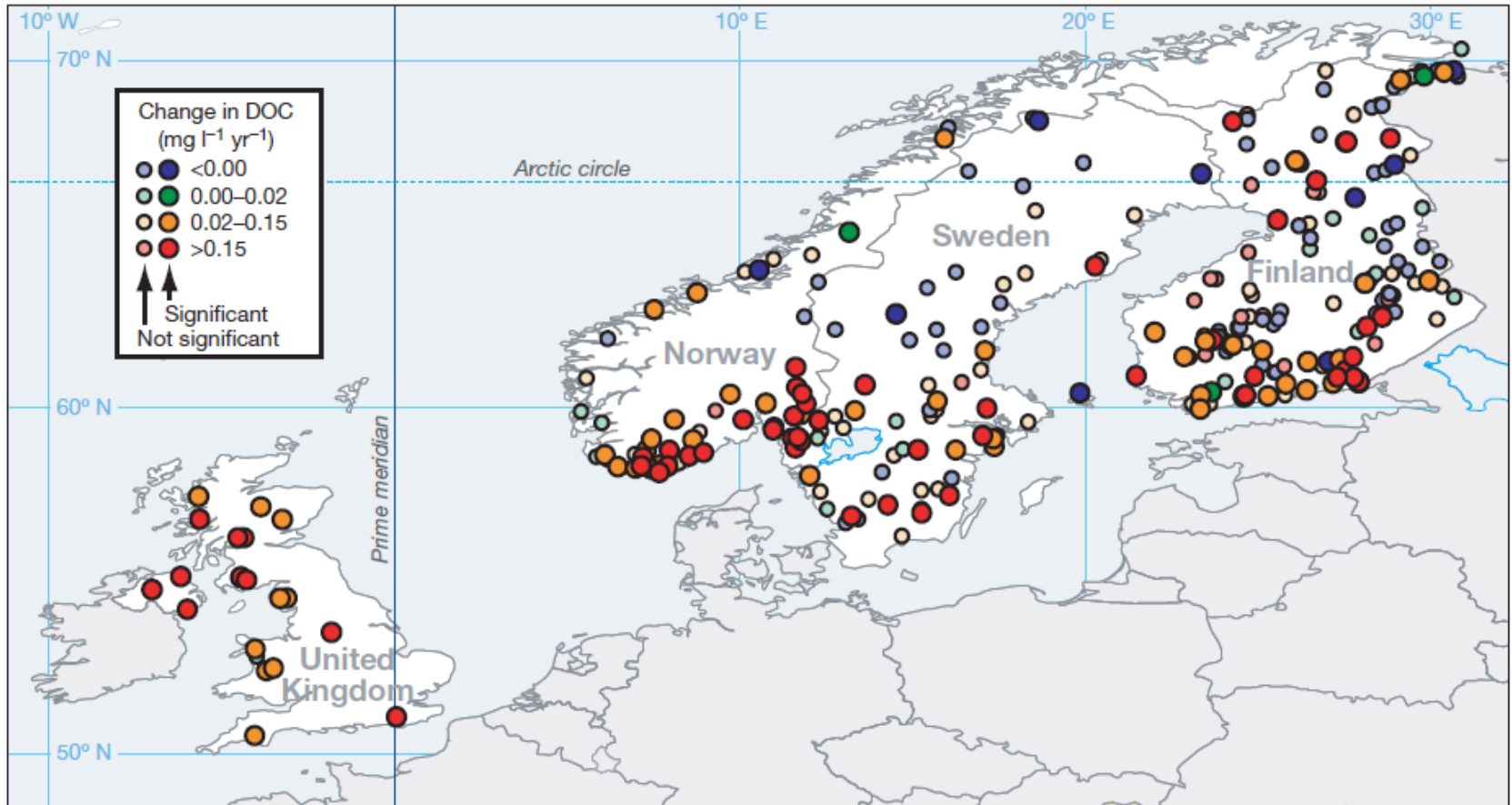
DOC increases everywhere

- Headwaters, lakes, large rivers
- Regional rather than local (management, catchment disturbance) causes increases in DOC
- All drivers (climate, deposition) promote browning?

Structure

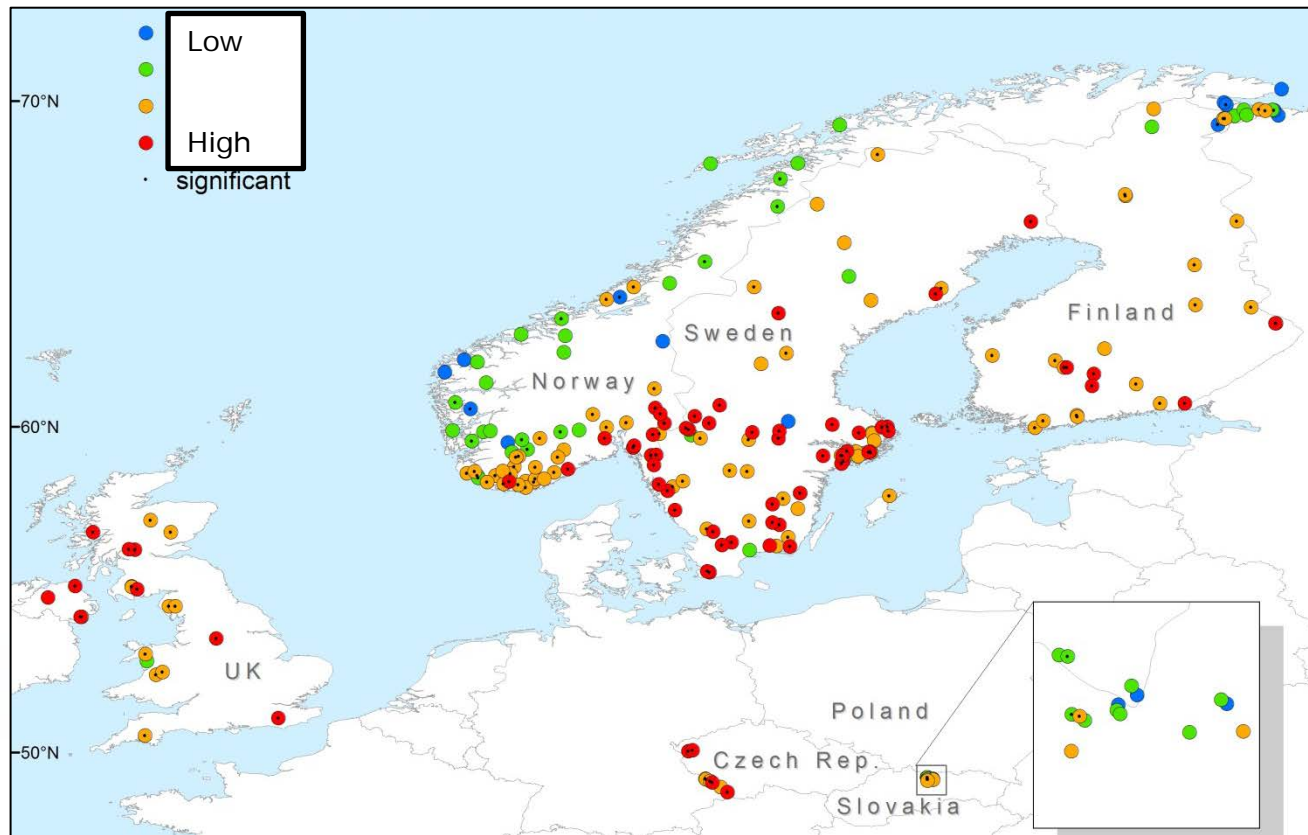
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Significant browning of boreal headwaters observed for 1990-2004



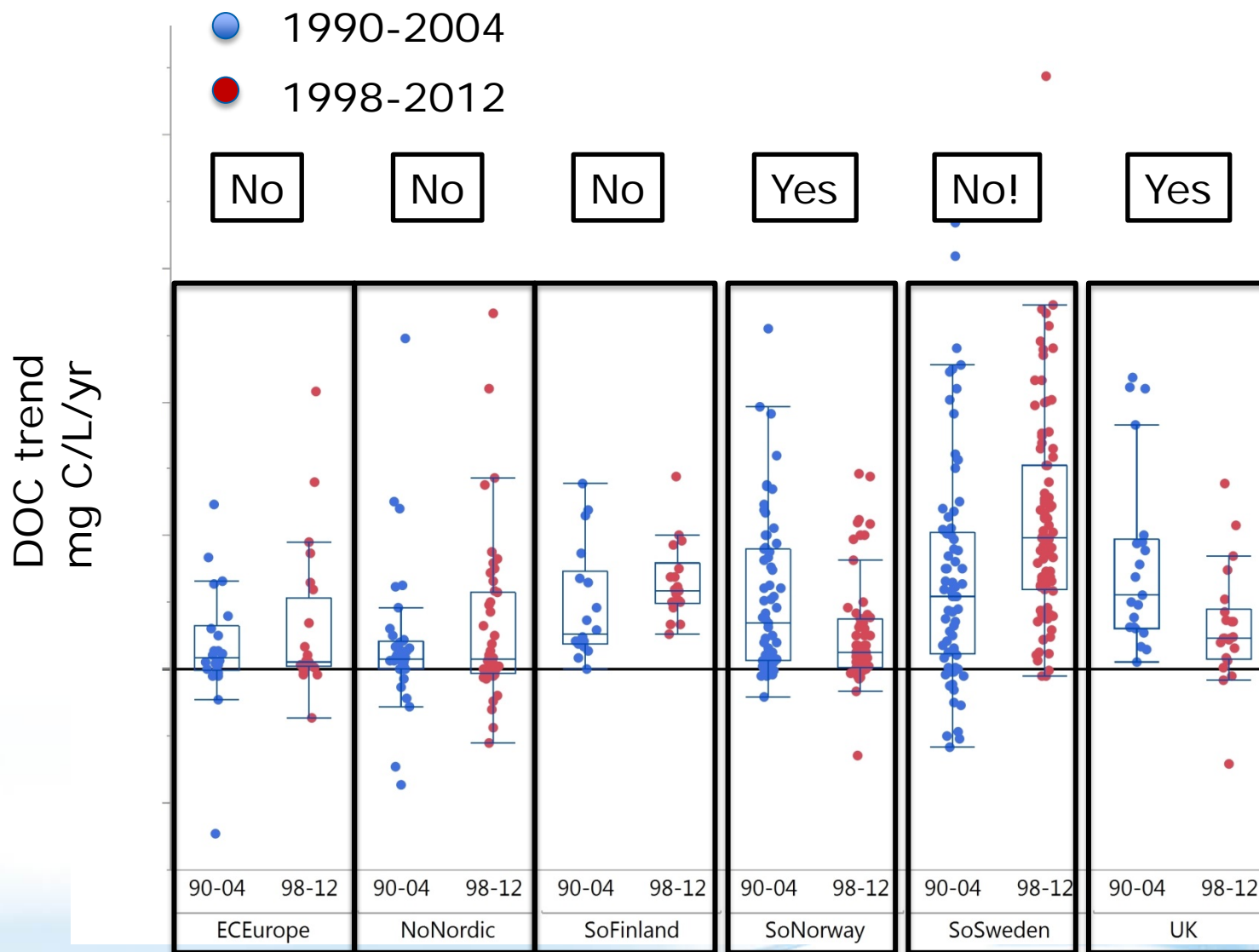
Monteith et al. 2007, Nature

Trends 1990-2012



De Wit et al, unpublished

Are trends levelling off?



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1990-2004

1998-2012

DOC trend mg L/yr

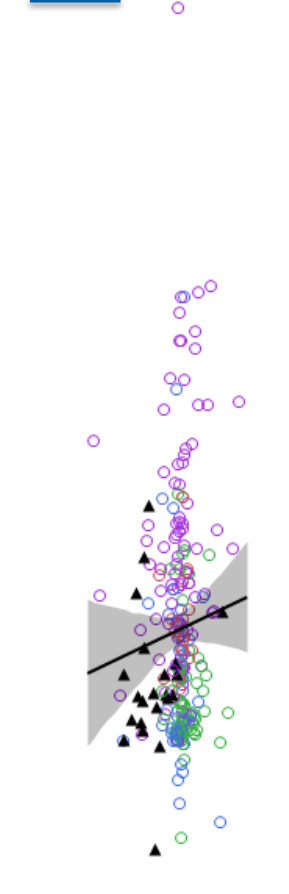
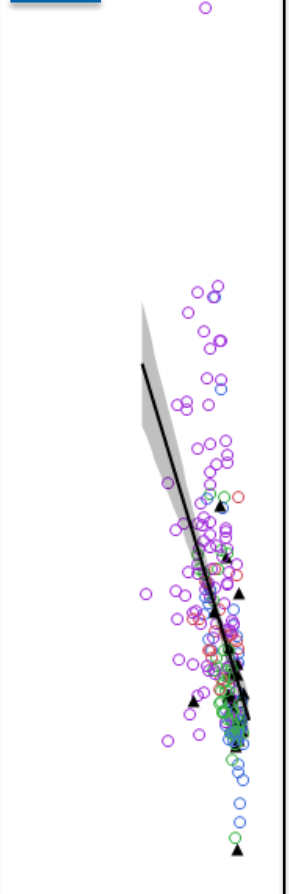
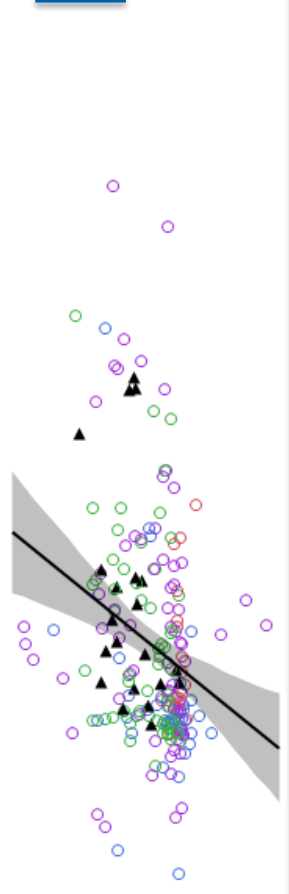
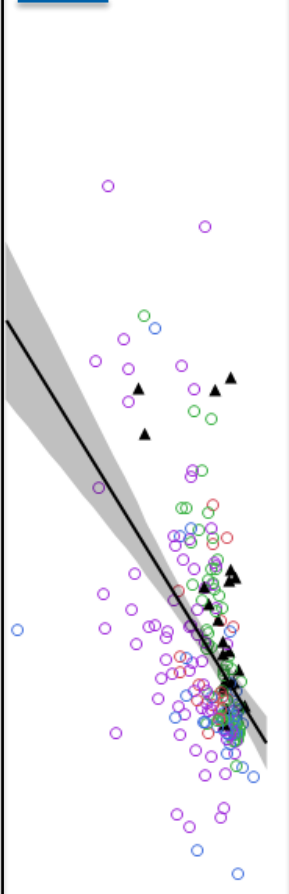
$Y = 0.03518 - 0.02152 * X$
 $R^2: 0.242$

$Y = 0.07867 - 0.01398 * X$
 $R^2: 0.065$

$Y = 0.04128 - 0.04404 * X$
 $R^2: 0.239$

$Y = 0.1293 + 0.008229 * X$
 $R^2: 0.006$

- ▲ UK
- NoNordic
- SoFinland
- SoNorway
- SoSweden



Trend in non-marine sulfate

Trend in chloride

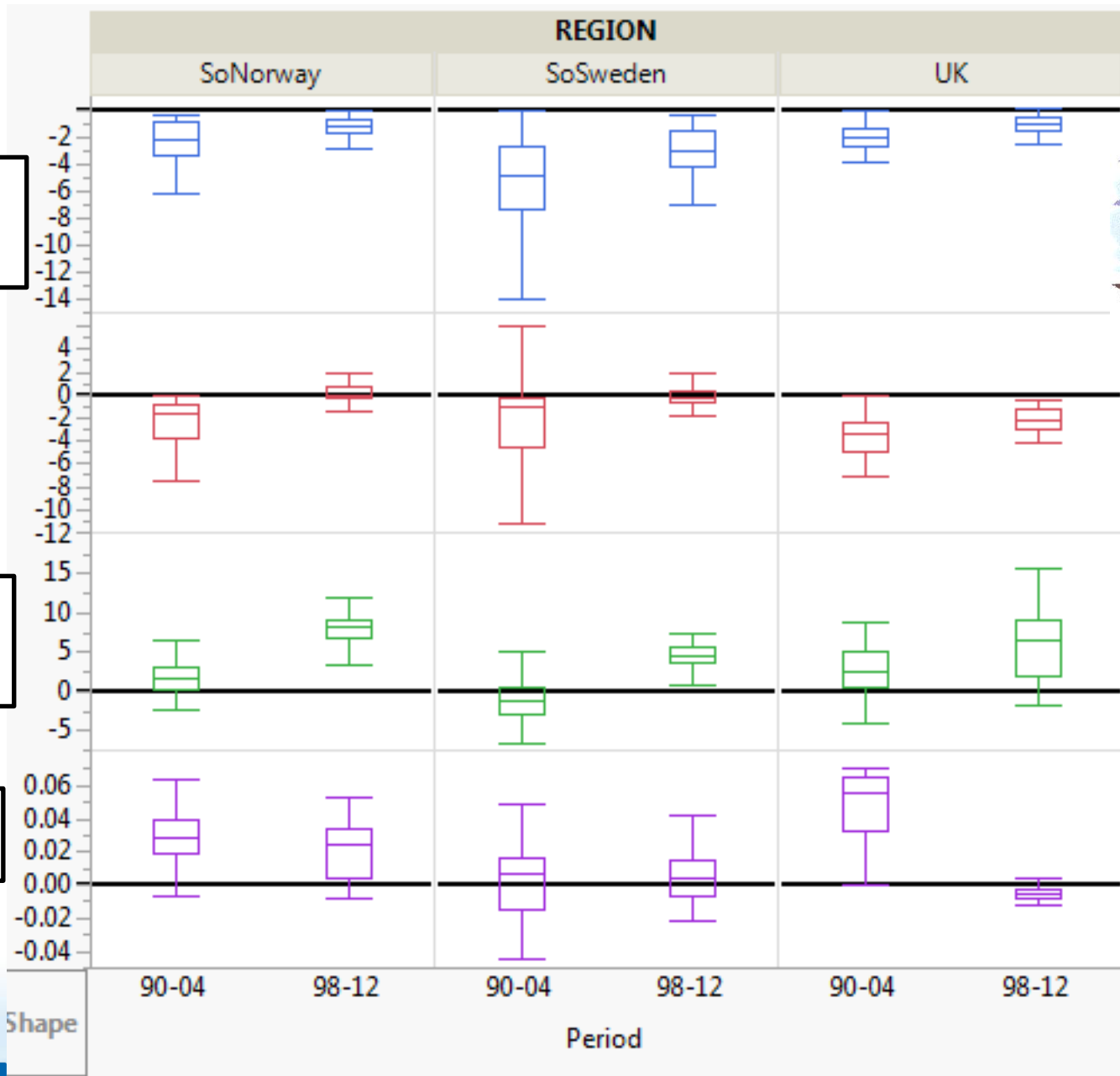
Trend in non-marine sulfate

Trend in chloride



Drivers of DOC

- Decline in sulfate deposition (from air pollution policy) remains a strong driver also after 2000
- Seasalt deposition (from storms) seems not a strong driver of DOC trends after 2000



Trend in non-marine sulfate

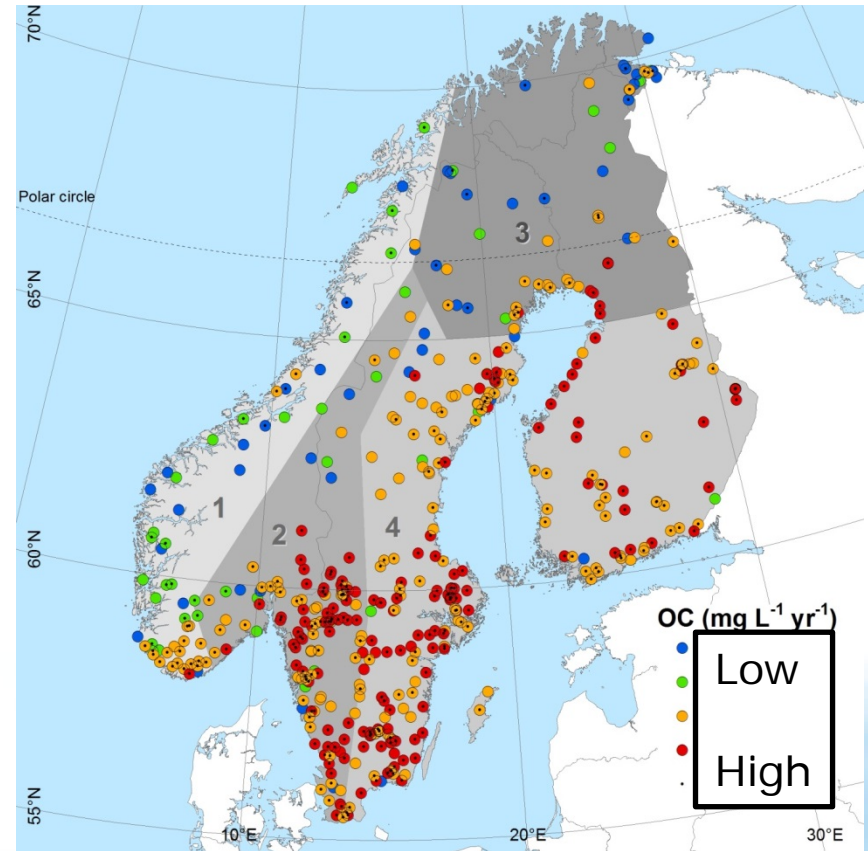
Trend in chloride

Trend in summer precipitation

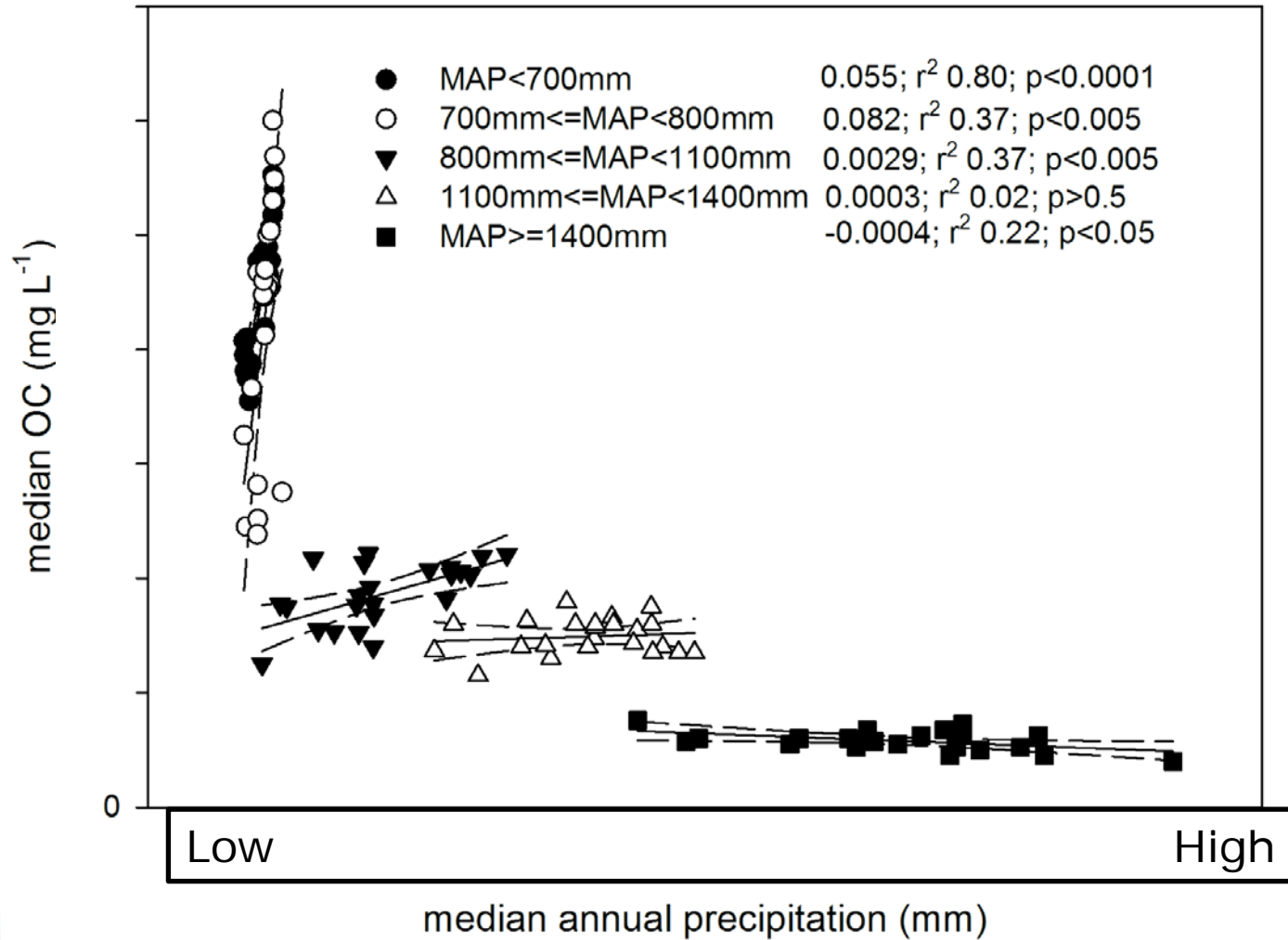
Trend in temperature

Rainfall as driver of DOC

- Strong gradients of precipitation in Fennoscandia
- Group sites according to 'wetness'
 - Oceanic to 'dry'
- Study interannual variation in DOC and precipitation



MAP= mean annual precipitation



De Wit et al, unpublished

Summarizing

- Browning of surface waters continues
 - From small to large water bodies and catchments
 - During 1990-2004 mostly because of reduced sulfur deposition
 - Regional and temporal variation in browning could be related to seasalt deposition (storminess) and precipitation (trends and interannual variation)
- Climate warming so far too limited to detect clear effects

Future water color

