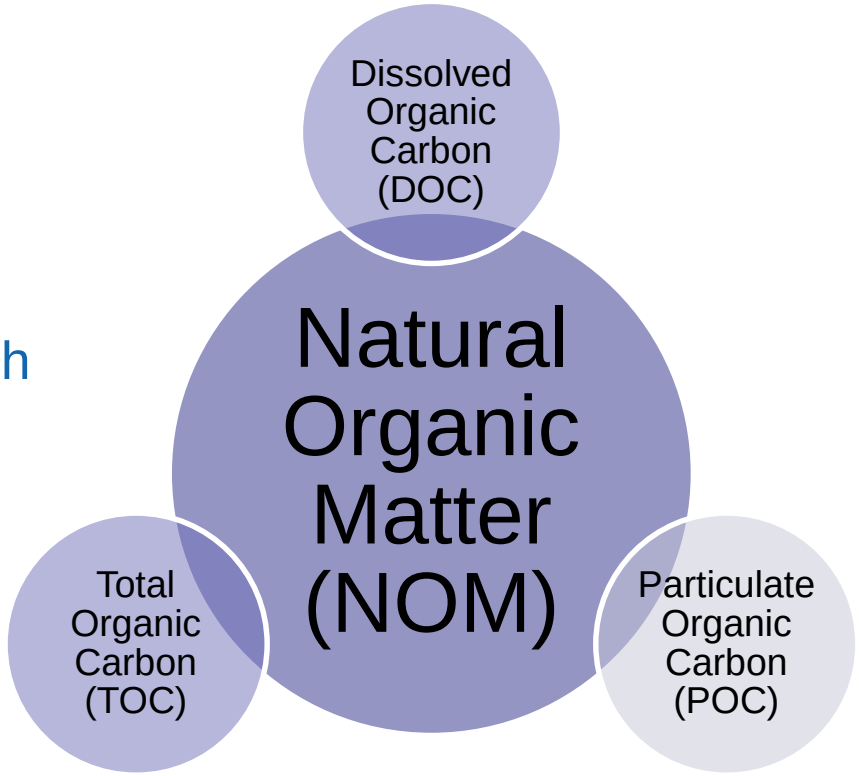
Natural Organic Matter in Drinking Water Catchments

Dr Zoë Frogbrook

Scottish Water

Outline

- The Problems
- The Impact
- Scottish Water's approach
- Project outputs



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Why is NOM important to Scottish Water?

Over 50% of the land that supplies us with water has organic rich soils

This is often in a range of conditions

Why is NOM important to Scottish Water?

Water Treatment Works are designed to treat water within a certain “ water quality envelope”

Water high in organics can cause issues with the water treatment process

- Affects colour, taste & odour
- Increased chemical & energy use
- Increases biofilm formation & regrowth potential
- Increase of material to land fill

Risk

Increases the risk for

- Exceeding asset capability
- Increasing Disinfection By-Product formation - THMs

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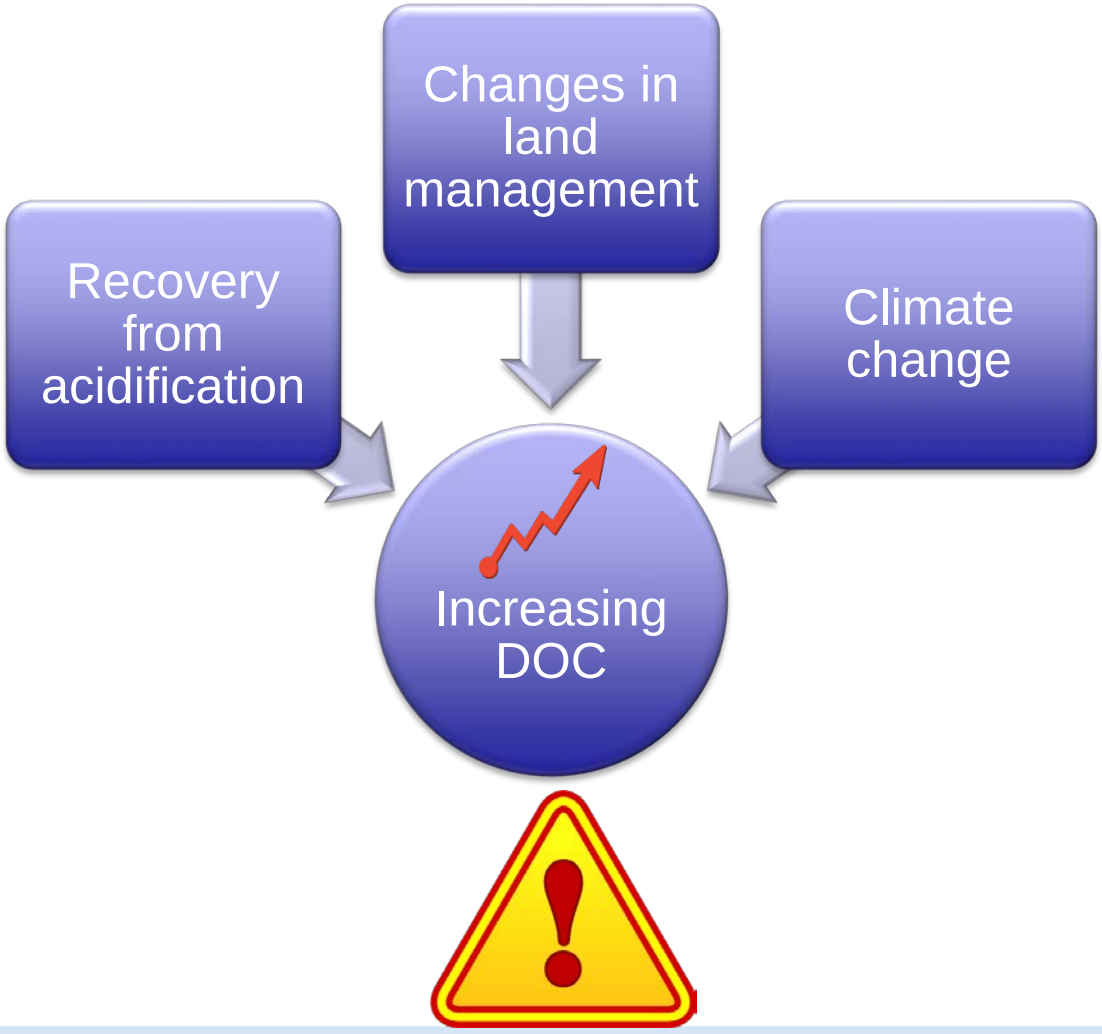
Changing patterns: Dissolved Organic Carbon



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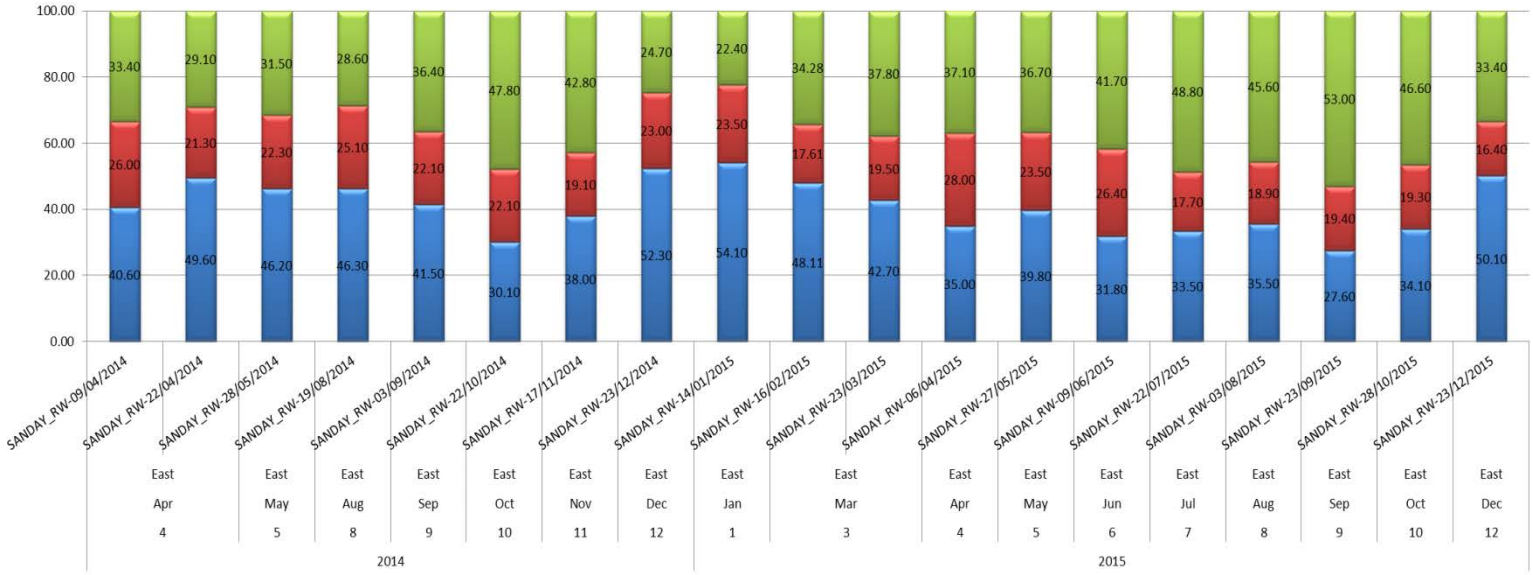
Different fractions, different problems

NOM % Distributions



Categories of polarity

Hydrophobic

Transphilic

Hydrophilic

Increasing difficultly to remove through the treatment process

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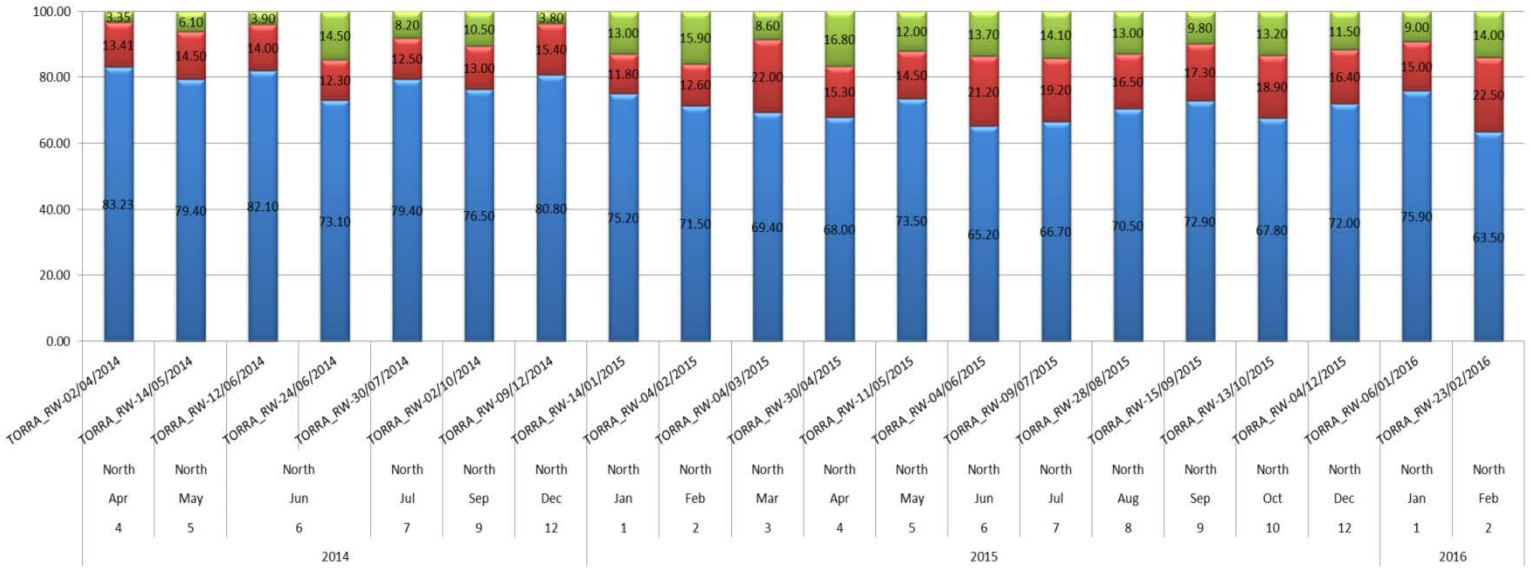
Different fractions, different problems

NOM % Distributions



Categories of polarity

- Hydrophobic
- Transphilic
- Hydrophilic

Increasing difficultly to remove through the treatment process

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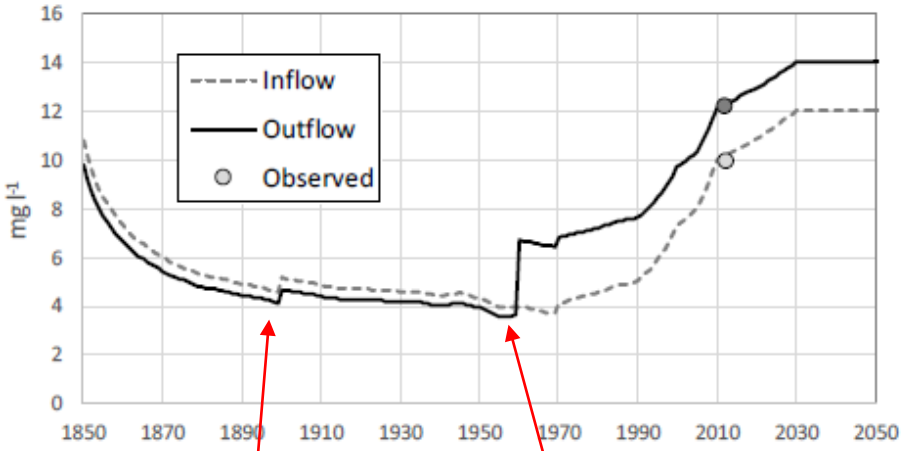
How will this impact us?

- Modelled the inflow and outflow of DOC for 5 reservoirs and included
  - Atmospheric deposition
  - Catchment management (drainage, forestry, moorland, nutrient inputs)
  - In-reservoir processes (DOC breakdown & formation of aquatic DOC – hydrophilic material)

- Modelled annual mean DOC
  - Did not include any dynamic climate effects

Modelling DOC in reservoirs

West water

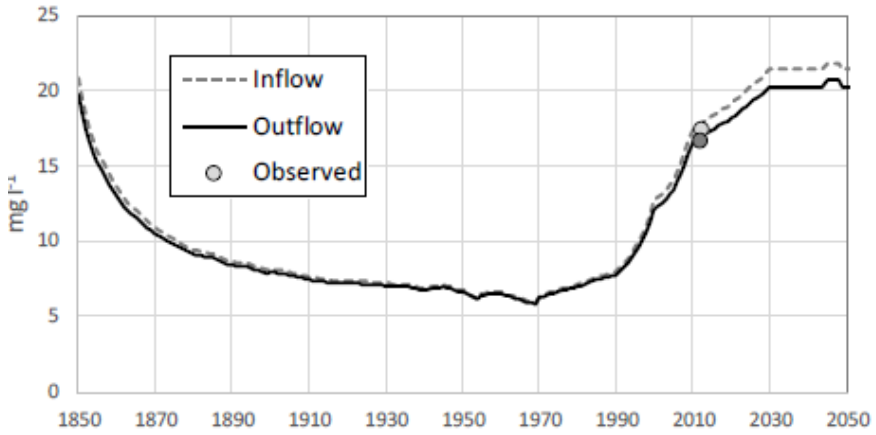


Approx.for burning

Approx. for Agricultural P inputs

Outflow higher than inflow due to aquatic DOC formation

Glenlatterach



Slightly lower outflow suggesting some DOC breakdown in reservoir

Evans *et al.* 2016

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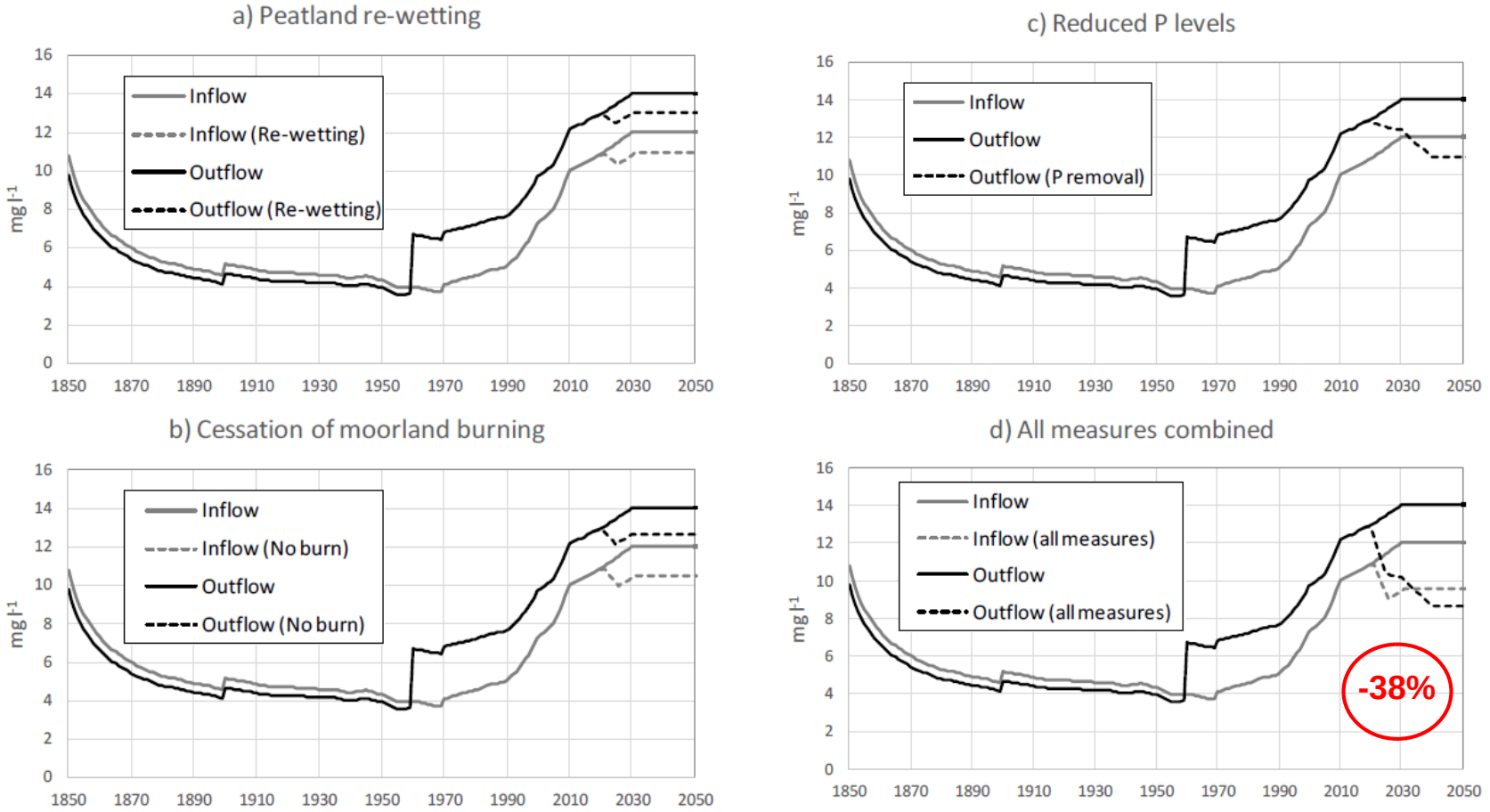
Modelling land-use change scenarios

- How can catchment management help?
  - Has poor management contributed to high DOC?
  - Can improved management achieve economically viable reductions in DOC?

Modelling land-use change scenarios

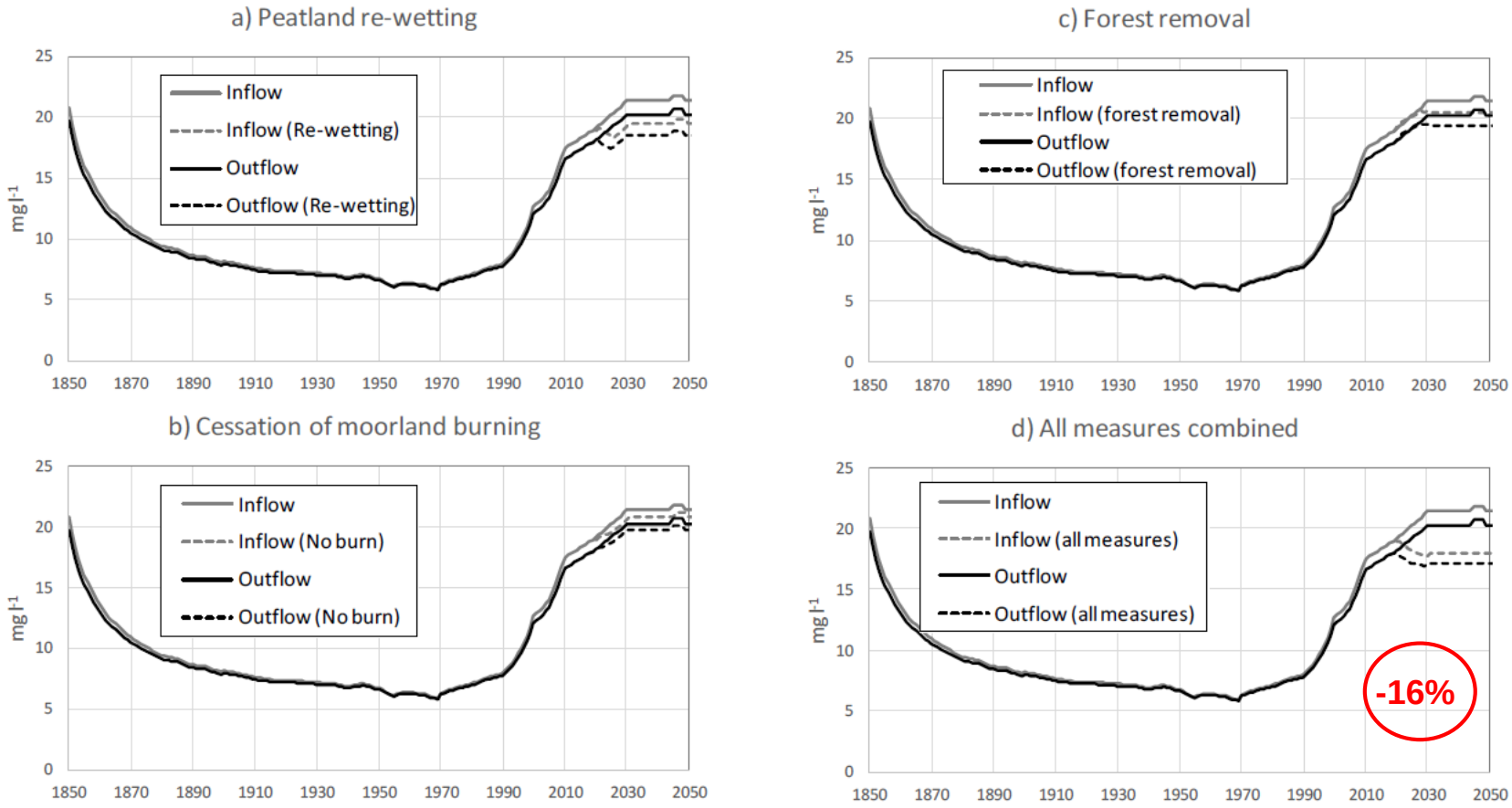
West Water



Evans *et al.* 2016

Modelling land-use change scenarios

Glenlatterach



Evans *et al.* 2016

Strategic Research Plan for DOC: What do we need to know?

Priority Question

- How will DOC change in the future?
  - How will quantity change?
  - How will the fractions change?

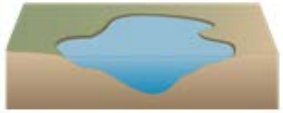
Key Question

- How will climate change alter current trends?
  - Will the quantity change?
  - Will it vary spatially?

Key Question

- How does land management impact DOC release?
  - Can it reduce it?
  - Can it increase it?
  - Will it change the fractions?

Key Question



- Can we identify new sources with low potential DBP formation?
  - Is extent of organic soils critical?
  - Is the type of waterbody key?

Strategic Research Plan for DOC: What knowledge are we currently gathering?

CREW: Catchment management Project

Output

- Predictions of DOC to 2030
- Potential for hydrophilic DOC formation
- Impacts of land management change

REZATEC: Remote sensing

Output

For all organic rich catchments

- Extent of drainage
- Extent of burning
- Peatland integrity
- Water quality risk

Forest Research: Impacts of forestry on DOC

Output

- Literature review
- Data analysis
- Recommendations for policy changes

PhD Projects

- DOMAINE: Catchment characteristics for THM formation
- STREAM: THM fractionation and spatial distribution
- Hydro Nation: Safeguarding and improving raw water quality

Additional Projects

- Mapping DOC research relevant to sustainable catchment management (CLAD, University of Glasgow
- Muirburn and water quality (RSPB Scotland & Leeds University)

Rezatec

Remote Sensing for assessing peatland condition

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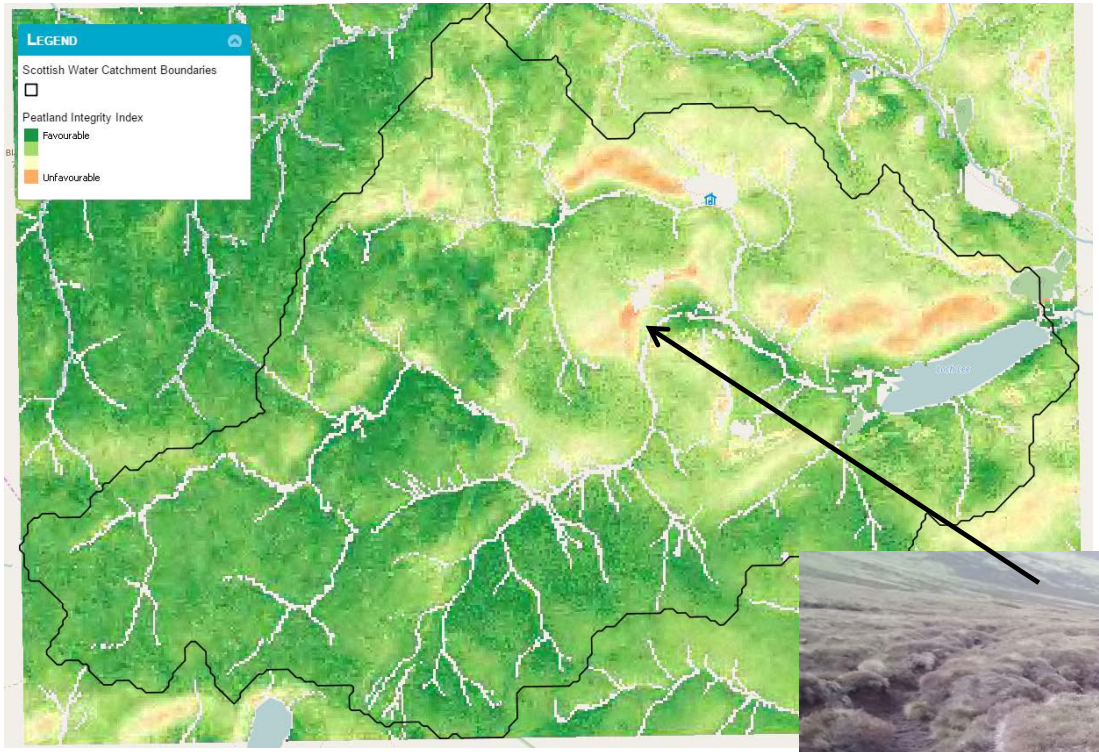
Loch Lee Catchment

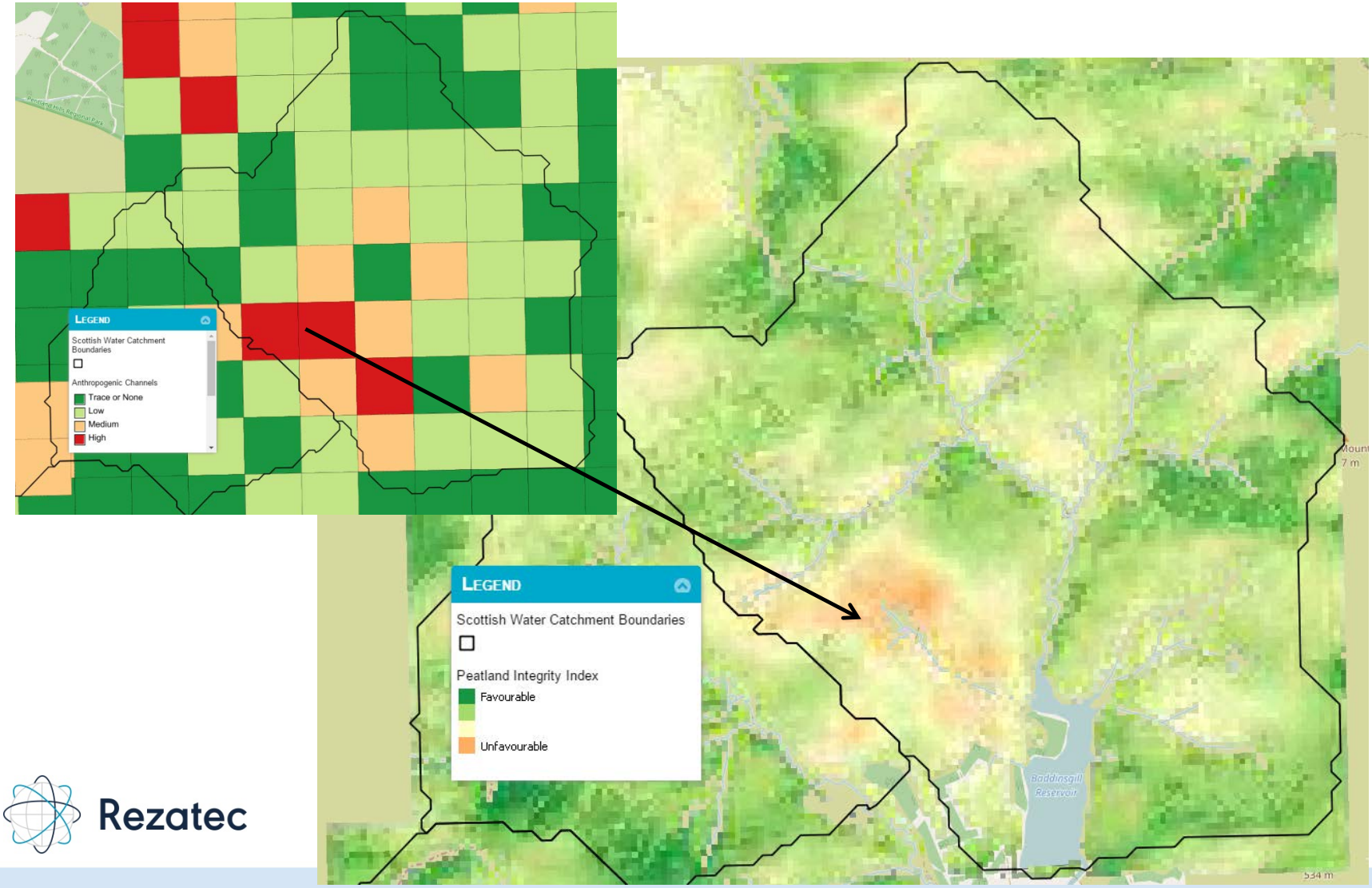


Rezatec


LEGEND
Scottish Water Catchment Boundaries
Upland Vegetation Management
Absent
Present

Rezatec

Baddinsgill reservoir



Rezatec

Mapping DOC research relevant to sustainable catchment management

- Analysis undertaken on what research is available to answer the four key questions
- Looked at UK and RoI only
- Analysis identified 419 published articles & 24 published databases
- Not a literature review
- Workshop will be held to review this & plan future needs

CLAD Carbon Landscapes and Drainage

University of Glasgow

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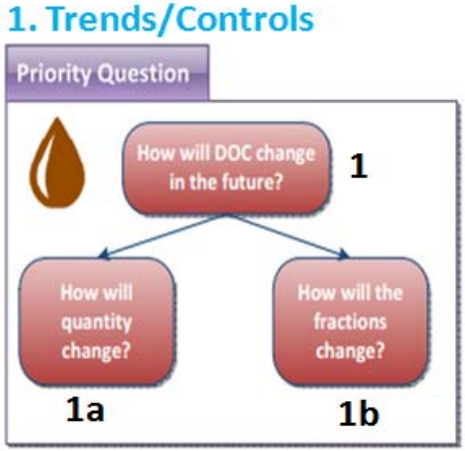
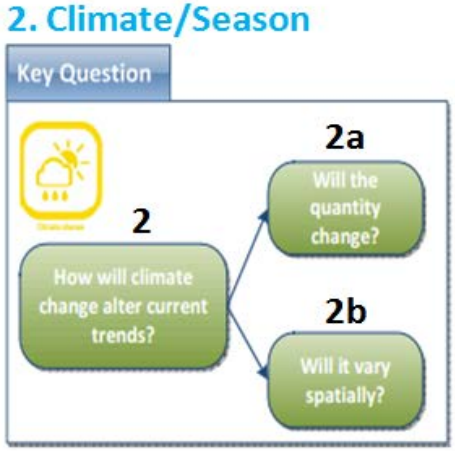
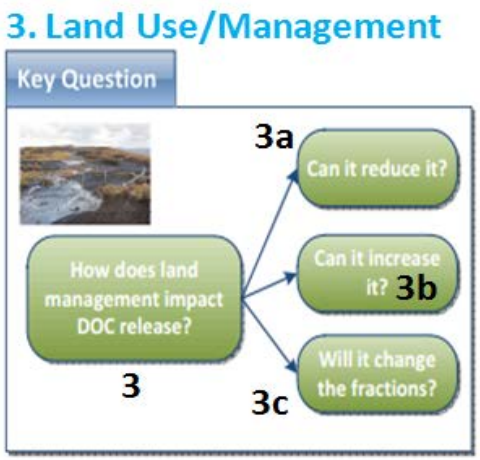
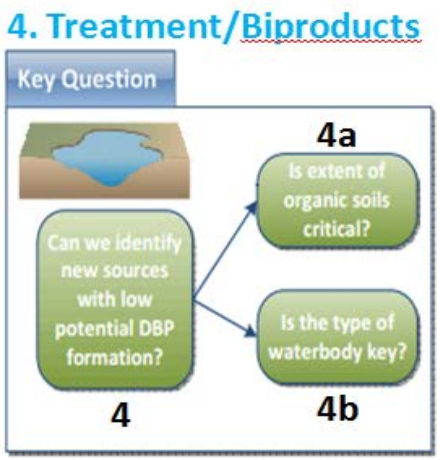
Mapping DOC research relevant to sustainable catchment management









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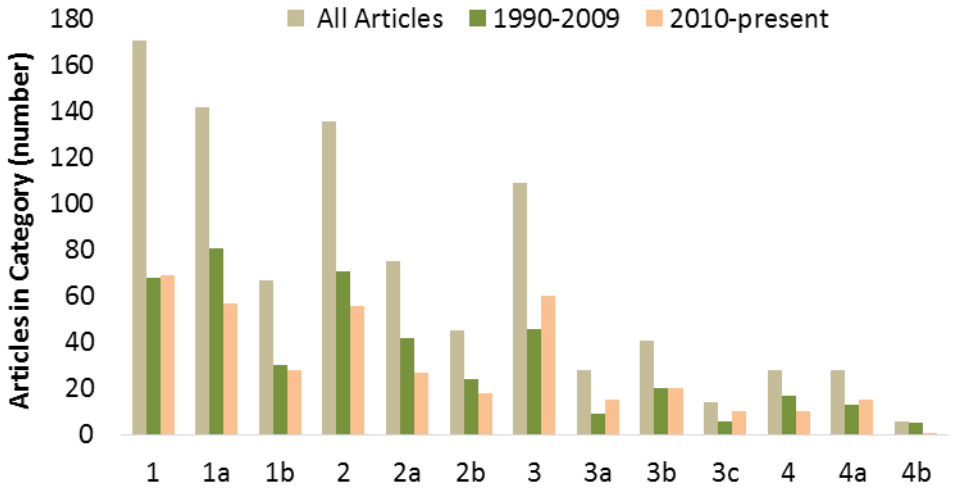

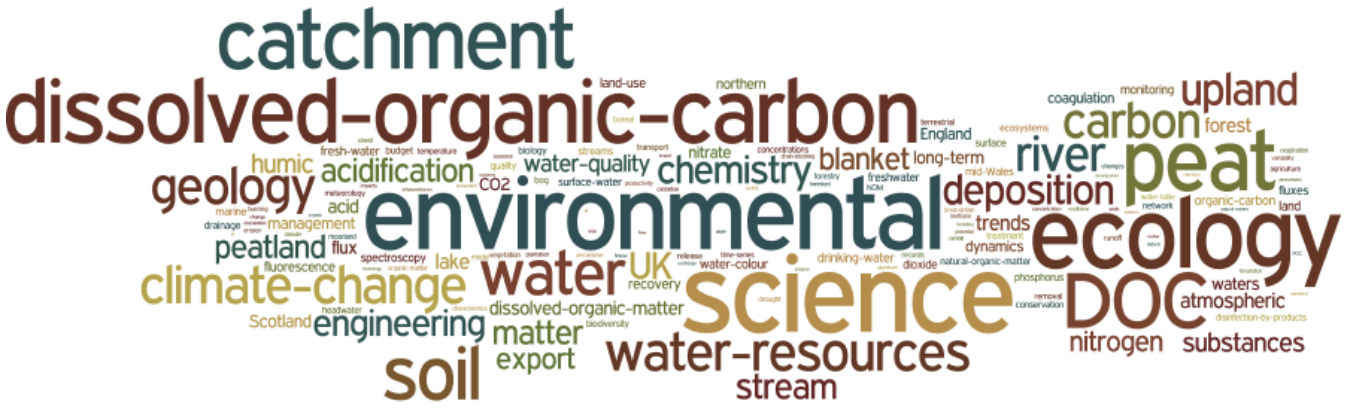

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