Looking at the nutrient future of Windermere

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UKCEH

Our planet. Decoded.

Environment Agency

Aim

To understand how climate change and changing nutrient loading might impact the phytoplankton of Windermere and Esthwaite Water



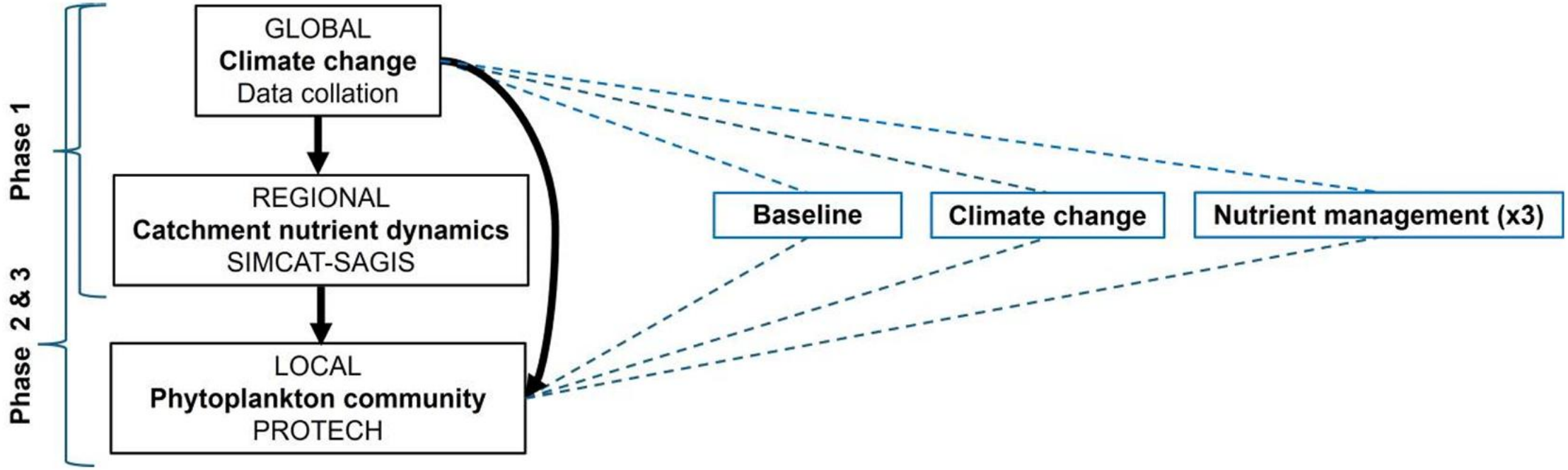


Approach

- Modelling

EA: SIMCAT-SAGIS, Catchment nutrient dynamics

UKCEH: PROTECH, Lake phytoplankton community



Approach

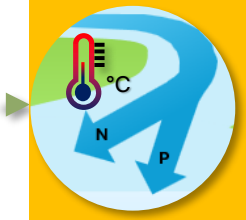
- Scenarios

1. Baseline



Simulates conditions close to present day (2014-2018)

2. Climate change



Simulates responses to future climate change (2076-2079)

Nutrient management scenarios

3. AMP8



Models the climate change scenario but assumes all water company nutrient reductions scheduled for completion by 2030 are in effect

4. Low agricultural diffuse



Models the AMP8 scenario but assumes significant reductions in diffuse nutrient inputs from the agricultural sector

5. No sewage



Models the climate change scenario but assumes complete cessation of nutrient inputs from wastewater treatment

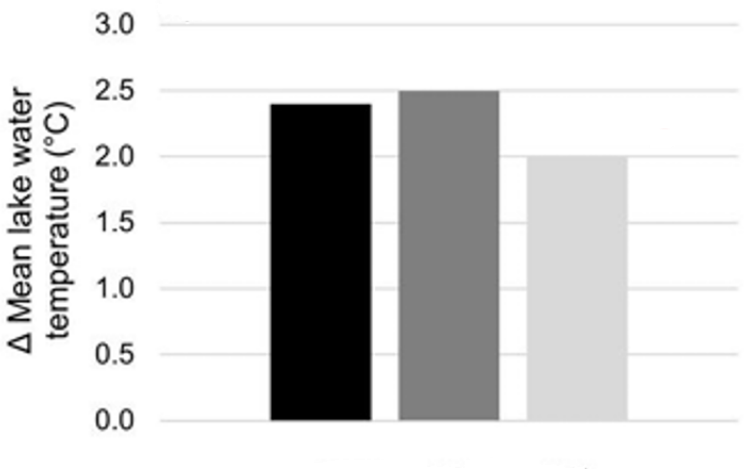
Climate change

Simulates responses to future climate change (2076-2079)

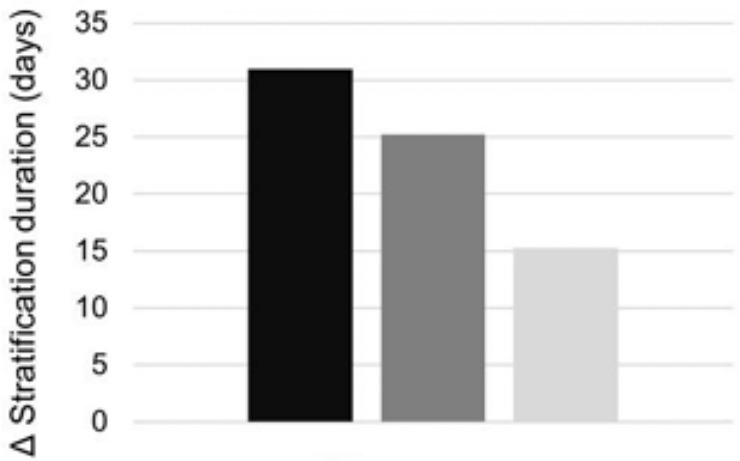
Results

- Climate change impacts – the lake

Water temperature



Stratification



Windermere North Basin Windermere South Basin Esthwaite Water

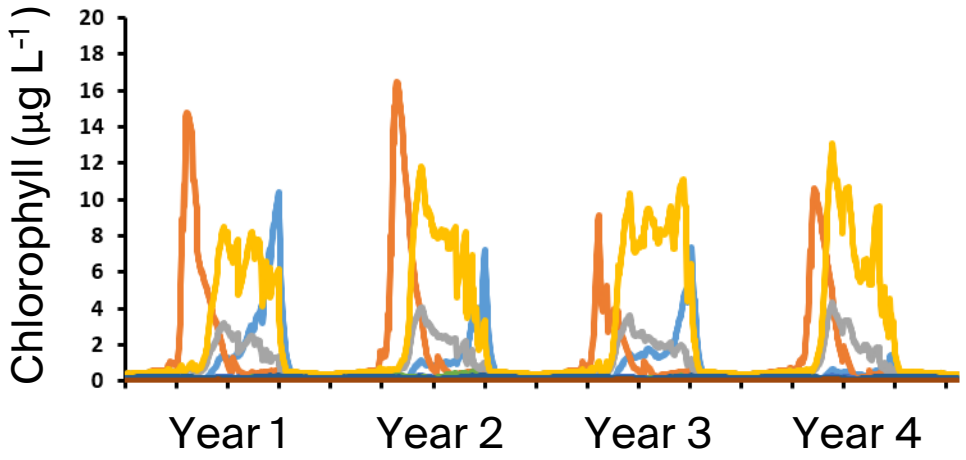
Results – An example

Climate change

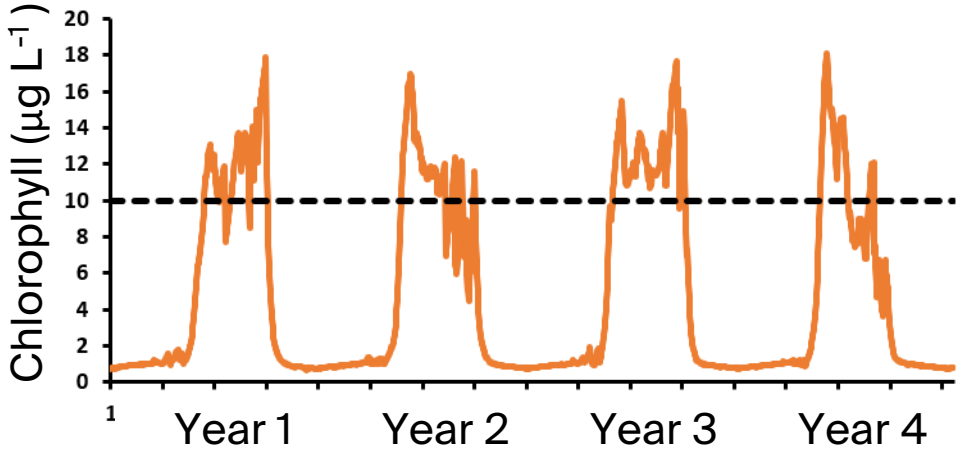
Simulates responses to future climate change (2076-2079)

- PROTECH output – South Basin Windermere Baseline

Community chlorophyll



Cyanobacteria chlorophyll



Climate change

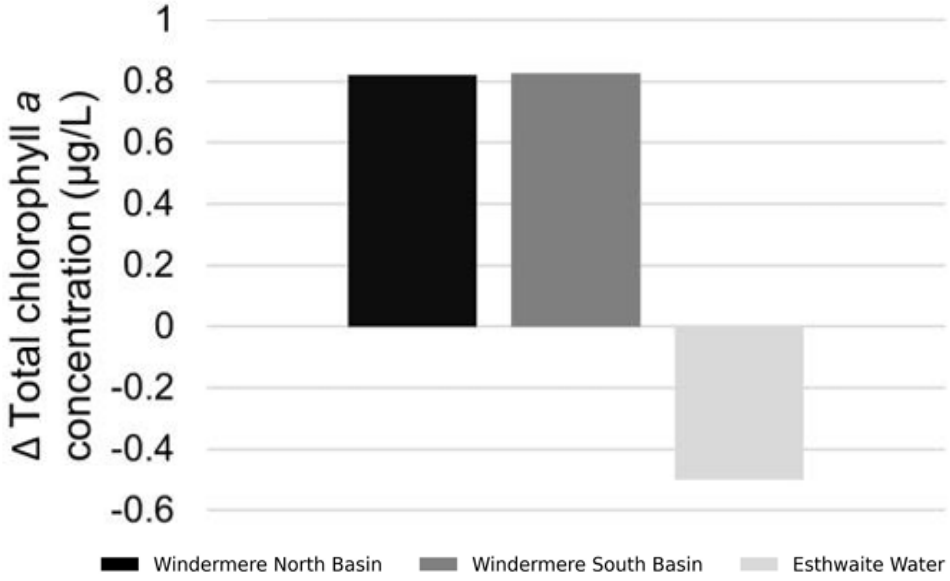


Simulates responses to future climate change (2076-2079)

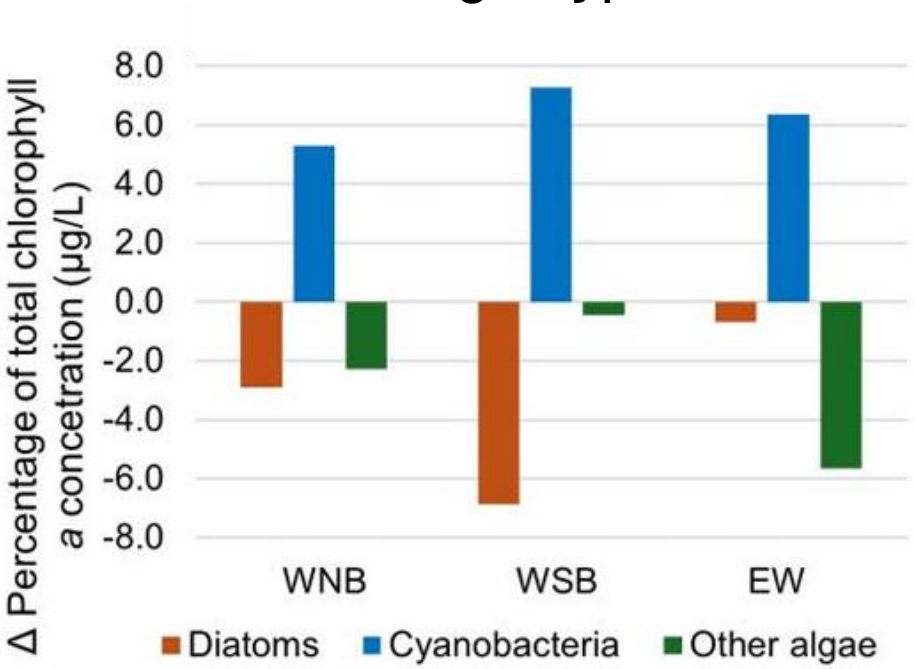
Results

- Climate change impacts – the phytoplankton

Total chlorophyll



% algal type



WNB = Windermere North Basin
WSB = Windermere South Basin
EW = Esthwaite Water

Results

Climate change



Simulates responses to future climate change (2076-2079)

- World Health Organization thresholds

Annual average number of days the WHO cyanobacteria 10µg L^{-1} threshold was exceeded in baseline and climate change scenarios.

Scenario	Windermere North Basin	Windermere South Basin	Esthwaite Water
Baseline	8	50	159
Climate change	36	92	167
Difference	+28	+42	+8

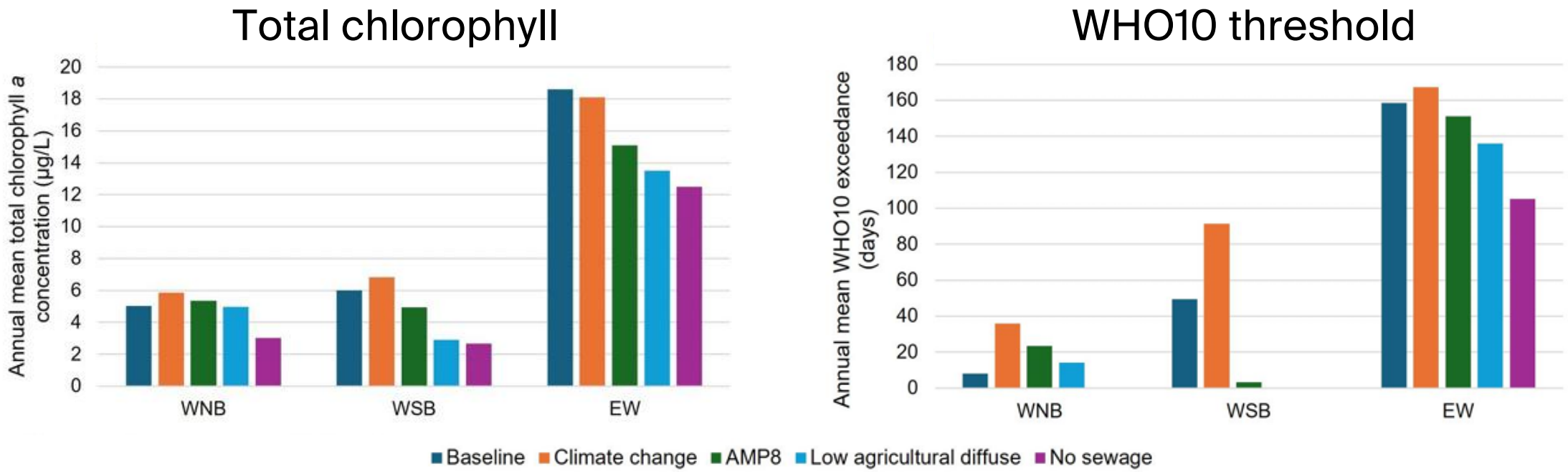
Results

AMP8
Models the climate change scenario but assumes all water company nutrient reductions scheduled for completion by 2030 are in effect

Low agricultural diffuse
Models the AMP8 scenario but assumes significant reductions in diffuse nutrient inputs from the agricultural sector

No sewage
Models the climate change scenario but assumes complete cessation of nutrient inputs from wastewater treatment

- Nutrient scenarios (with climate change)



WNB = Windermere North Basin
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Conclusions

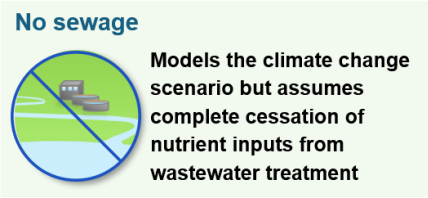


- Climate change

  Climate change caused an increase in water temperature and stratification duration – dependent on lake.
  Cyanobacteria increased their dominance of the community and WHO10 thresholds were exceeded more times.

- Nutrient scenarios

  Nutrient load reduction countered these changes, increasing in effect as load reduction increased.
  The No Sewage had the greatest impact.



Next step:

- Only Rainwater into Windermere

AMP8



Models the climate change scenario but assumes all water company nutrient reductions scheduled for completion by 2030 are in effect

No sewage



Models the climate change scenario but assumes complete cessation of nutrient inputs from wastewater treatment

Run follow up simulations in the present day for scenarios like AMP8 and No Sewage

Help inform the decision process for the project.



Thank you.

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