Urban landscapes and legacy industry provide hotspots for riverine greenhouse gases

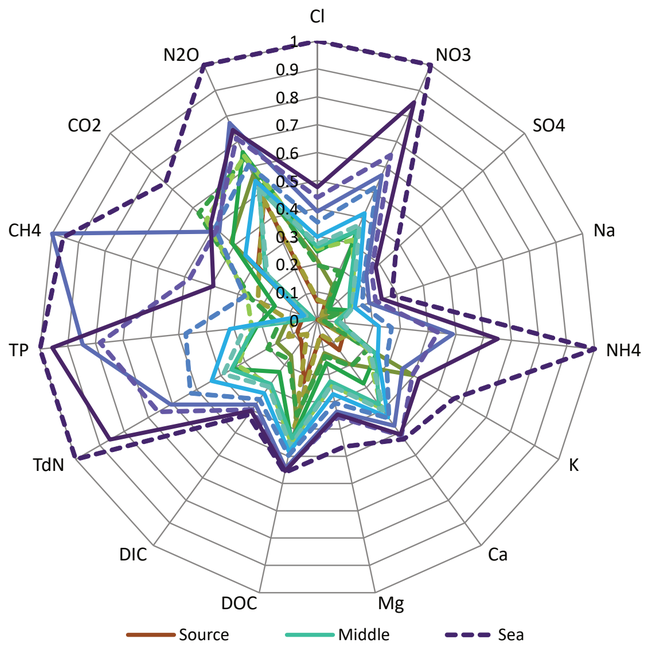
A source-to-sea study of the River Clyde, Scotland

Background

There is growing global concern that greenhouse gas (GHG) emissions from water bodies are increasing due to interactions between nutrient levels and climate warming.

Study

- Two years of water quality and greenhouse gas measurements from source-to-sea on the River Clyde, Scotland
- Twenty-six measurement locations were selected on the River Clyde and its major tributaries
- The Clyde, a large temperate catchment where land-cover transitions from semi-natural, through pastoral and arable agricultural to urban (including legacy industrial), is representative of many urbanised catchments globally.



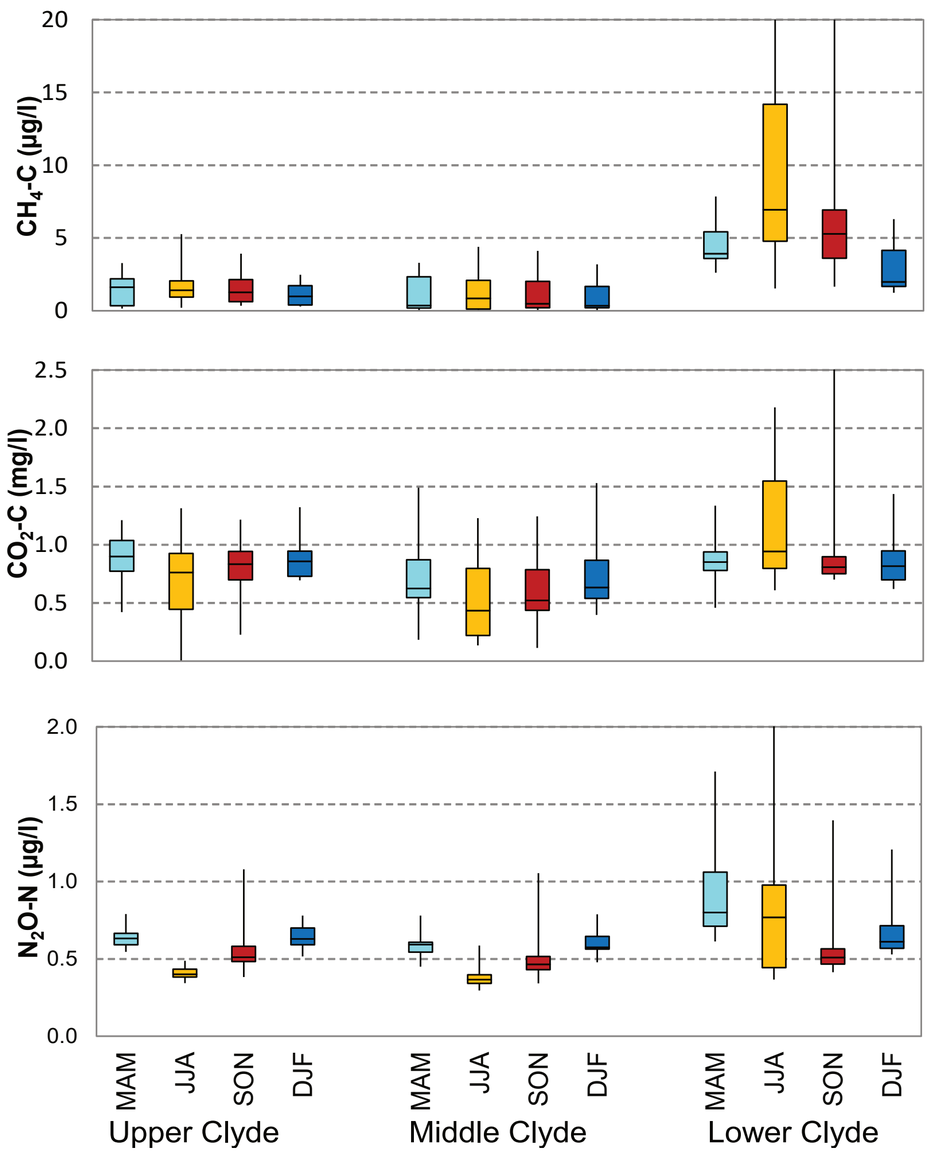
Examples or urban and legacy pollution

Wastewater overflow

Acid mine water inflow

Scum and debris build-up

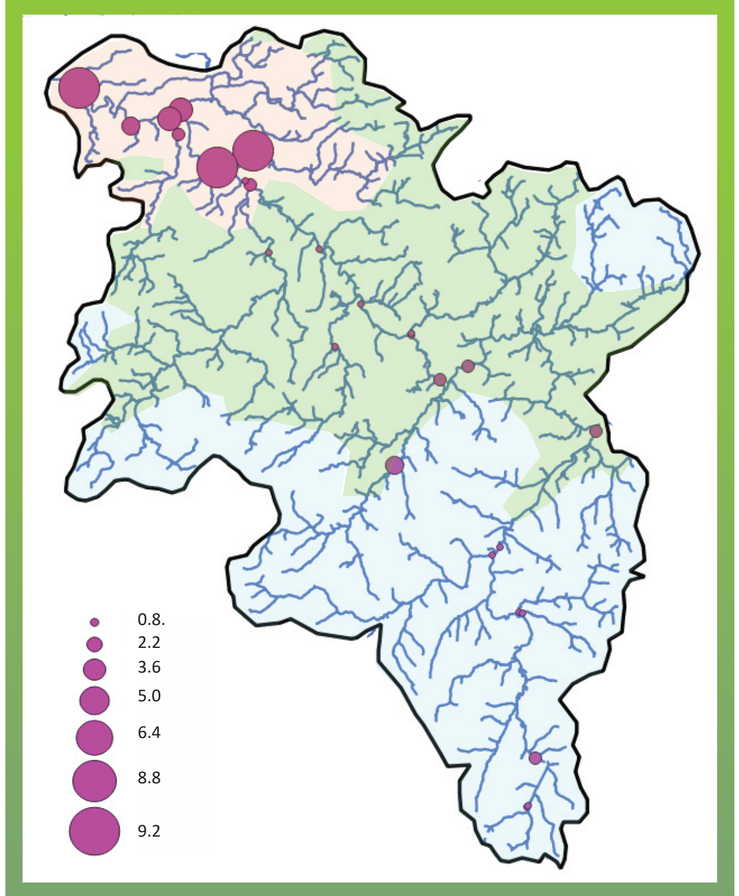
Impact of changing environment on GHG concentrations



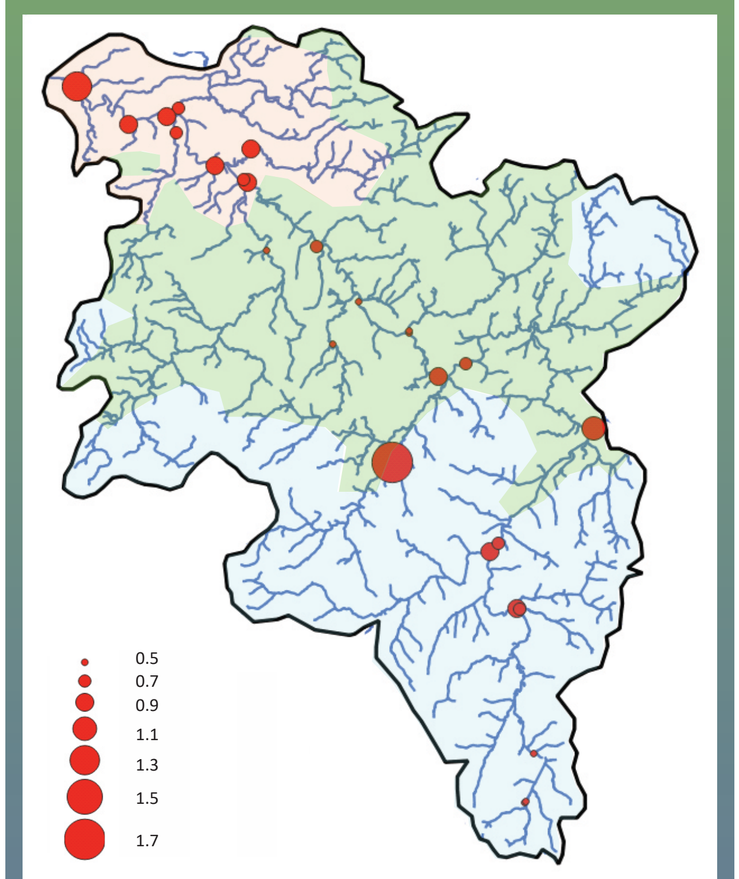
Summary

- Riverine GHG concentrations were consistently over-saturated with respect to the atmosphere.
- CH_4-C concentrations between 0.1 - 44 µg l^{-1}.
- CO_2-C concentrations between 0.1 - 2.6 mg l^{-1}
- N_2O-N concentrations between 0.3 - 3.4 µg l^{-1}
- High riverine concentrations of methane were associated with point source inflows from urban wastewater, lakes and abandoned coal mines.
- Concentrations of carbon dioxide and nitrous oxide were mainly driven by nitrogen concentrations, dominated by diffuse agricultural inputs in the upper catchment and supplemented by point source inputs from urban

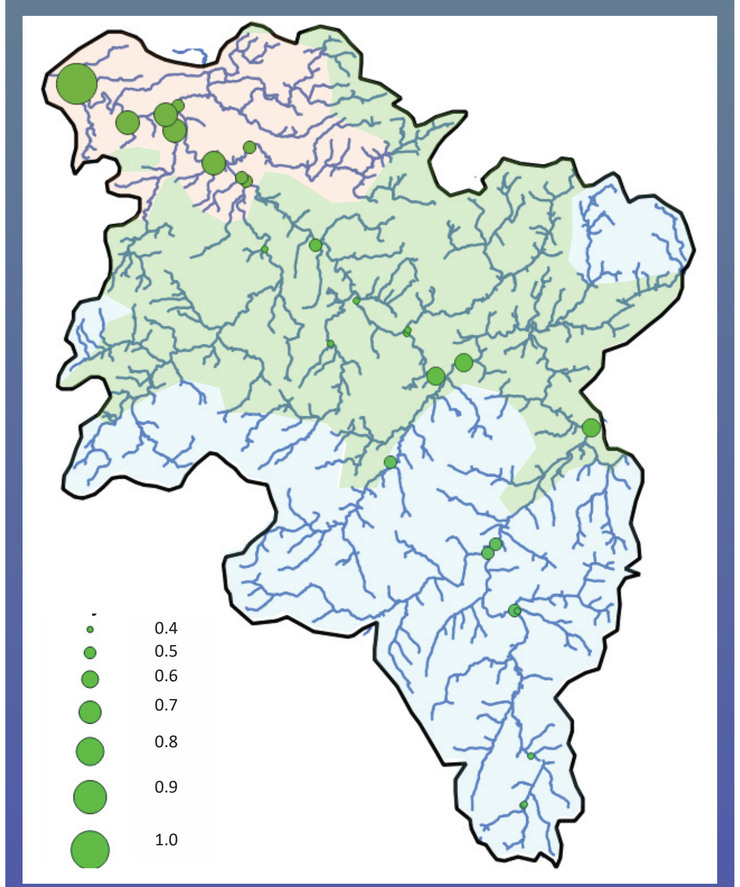
Methane-C Concentration (µg/l)



Carbon Dioxide-C Concentration (mg/l)



Nitrous Oxide-N Concentration (µg/l)



Land-cover
- Urban
- Agricultural
- Semi natural

Conclusions

- This study confirms hydrology and nutrients availability as dominant controls on GHGs, with urban nutrient sources disproportionately increasing GHG concentrations in summer.
- This source-to-sea investigative approach was effective in tracing changes in the riverine environment, particularly as GHGs were not conserved but outgas in turbulence.
- Load appointment modelling was effective at distinguishing point and diffuse sources by , which enabled separation of the seasonal temperature and water level impacts.
- Understanding riverine GHG generation and dynamics helps to improve our knowledge of their release to atmosphere

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