Do fluxes of methane and carbon dioxide change with time following peatland restoration?

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1. Rationale and aim
Many peatlands, previously drained, are now being restored through drain-blocking. A raised water table should reduce carbon dioxide (CO₂) emissions due to less aerobic decomposition of the peat. However, this may also lead to increased methane (CH₄) emissions. This could ultimately cause an overall atmospheric warming effect, despite the positive effect of reduced CO₂ emissions.

The aim of this study is to establish the temporal effects of restoration on the global warming potential of peatlands.

2. Field sites
Thorne and Hatfield Moors, two lowland raised bogs in eastern England that form part of the Humberhead Peatlands, provide suitable field sites for this study. Following the end of intensive peat extraction via milling, Natural England has started restoration through re-wetting in phases over an eleven year period (1997-2008) throughout the sites.

There are four study areas across the two sites: three areas where restoration started in 1997, 2003 and 2008, and one area is a control where no restoration has occurred. Both the 1997 and 2003 areas are dominated by Eriophorum angustifolium and Eriophorum vaginatum. The 2008 site is dominated by Sphagnum cuspidatum. The unrestored site has no vegetation cover.

3. Annual CH₄ fluxes and dark chamber CO₂ fluxes

The two graphs show annual CH₄ fluxes and annual dark chamber CO₂ fluxes per season (calculated as weighted totals) from each study area.

Methane fluxes range from -0.11 to 19476.2 mg CH₄ m⁻². Summer fluxes are significantly higher (p ≤ 0.009) at each site, except the unrestored site (p = 0.23). Dark CO₂ losses range from 318.71 to 3341.95 g CO₂ m⁻². The winter and summer fluxes were significantly different (p ≤ 0.009) at each site, except at the unrestored site (p = 0.23).

4. Conclusions
This study has found no evidence that the duration of restoration management is a factor in controlling gaseous carbon fluxes in restored peatlands. Initial analysis shows water table position is an important control of CH₄ fluxes. Sites with the highest CH₄ fluxes are dominated by sedges (Eriophorum spp.) which can act to transport CH₄ or provide substrates for methanogenesis. Further detailed analysis of data from this study should reveal the impacts of soil temperature and of different plant species on gaseous carbon flux, and their interactions with the water table position.