Fire disturbance regimes and vegetation interactions in East Africa during the Late Quaternary

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Introduction

Fire is one of the most important disturbances to vegetation and influences ecosystem structure and function. Human use of fire on the landscape has influenced vegetation composition, biomass abundance, and biodiversity in many ecosystems. Fire management also has implications for carbon cycling and can result in a net carbon sink or source under certain conditions. There ecosystem interactions guide our research questions: **To what extent have humans influenced fire regimes and vegetation? What are the important spatial controls of fire activity (Fig.1)?**

Fig. 1: Overview of major long-term influences of vegetation cover and fire activity.

Natural influences on fire regimes

- Arid or moist conditions
- Climate-mediated changes to vegetation
- Climate variability

- Erosion
- Orientation
- Slope
- Channeling

- Plant assemblage changes
- Biomass abundance changes
- Disturbance (pests, herbivores)

Decadal-to-millennial scale controls of fire

climate, landscape, fuel

Climatic Influences

- Effects on Microclimates
- Global climate change

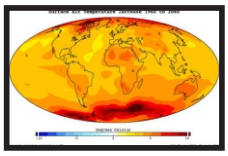
Landscape Influences

- Land-use changes
- Infrastructure, irrigation

Fuel Characteristics

- Accidental/purposeful burning
- Direct + indirect plant assemblage changes

Anthropogenic influences



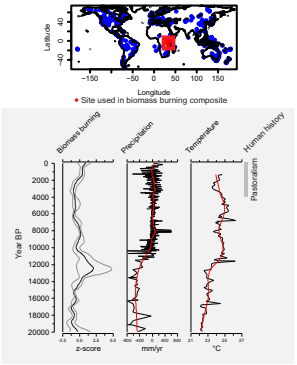
Approach

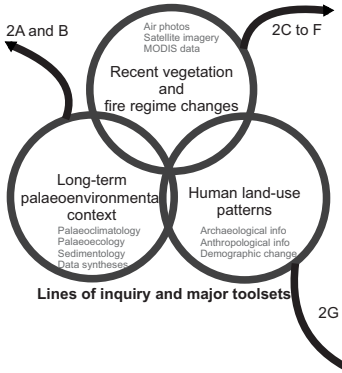
We use a blend of palaeoenvironmental approaches, ranging from establishing new proxy records from sediment cores (**Fig.2A**), synthesising available palaeoecoinformatics from large databases (**Fig.2B**), remotely-sensed data (**Figs.2C-G**), and integrate data from the social sciences. By examining the major controls of fire activity over the recent period and in long-term reconstructions of vegetation and biomass burning we will begin to constrain the signal of anthropogenic ecosystem change and understand how these environments may respond in the future.

Fig. 2: Showing the integrative study required to disentangle fire dynamics: these include **A)** coring swamp sediments for new proxy records. **B)** Synthesis of existing records, such as a biomass burning composite using 7 sites in East Africa from the Global Charcoal Database v3; reconstructed precipitation differences from modern precipitation **(1)**; and reconstructed annual temperatures from the Lake Tanganyika basin **(2)**. East African **C)** annual fire hotspots; **D)** fire radiative power (W/m^2), both as 10 year averages (>50% confidence; 2001-2010) from MODIS active fire data **(3)**; **E)** net primary productivity (kg C/m^2),10 year average **(4)**; **F)** aridity index (mean annual precipitation/mean annual potential evapotranspiration **(5)**; **G)** population pressure exerted on the landscape (distance decay function, σ = 5) **(6)**.

2A

2B





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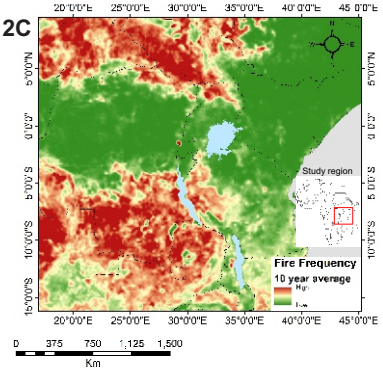

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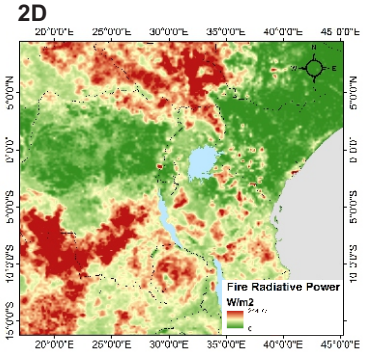

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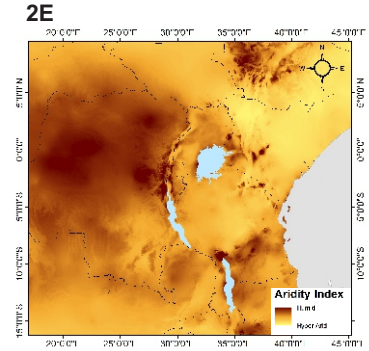

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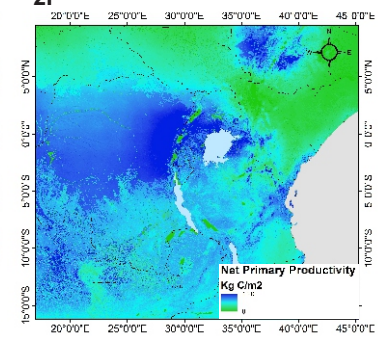

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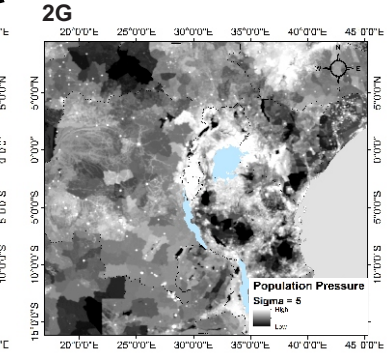

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