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.

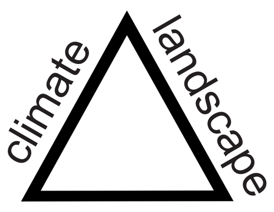
Natural influences on fire regimes

- 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



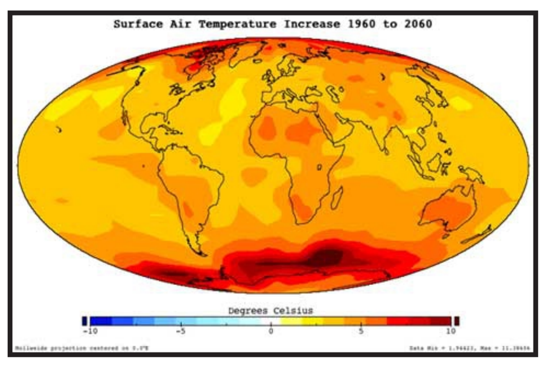
Climatic Influences

Landscape Influences

Fuel Characteristics

Anthropogenic influences

- Effects on Microclimates
- Global climate change



- Land-use changes
- Infrastructure, irrigation

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

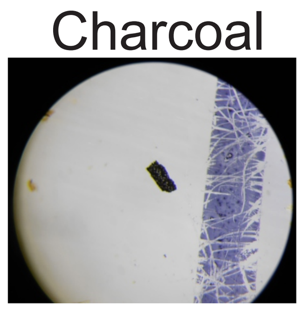
Approaches

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 (**Fig.2C**), and integrate data from the social sciences (**Fig.2D**). 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.

2A Develop new palaeoenvironmental reconstructions from sediment cores

Pollen

Charcoal



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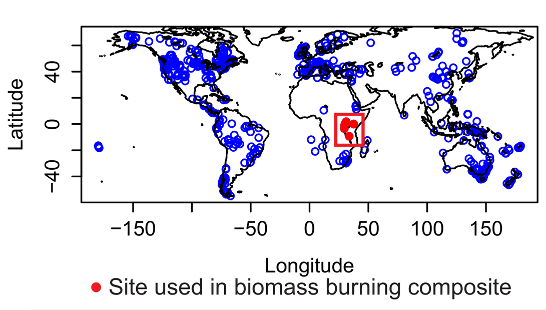
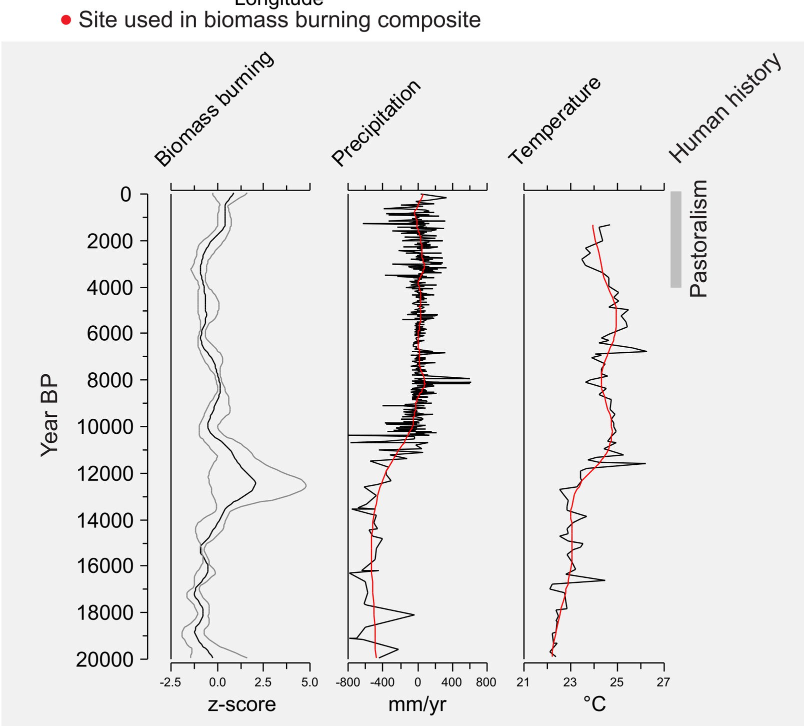
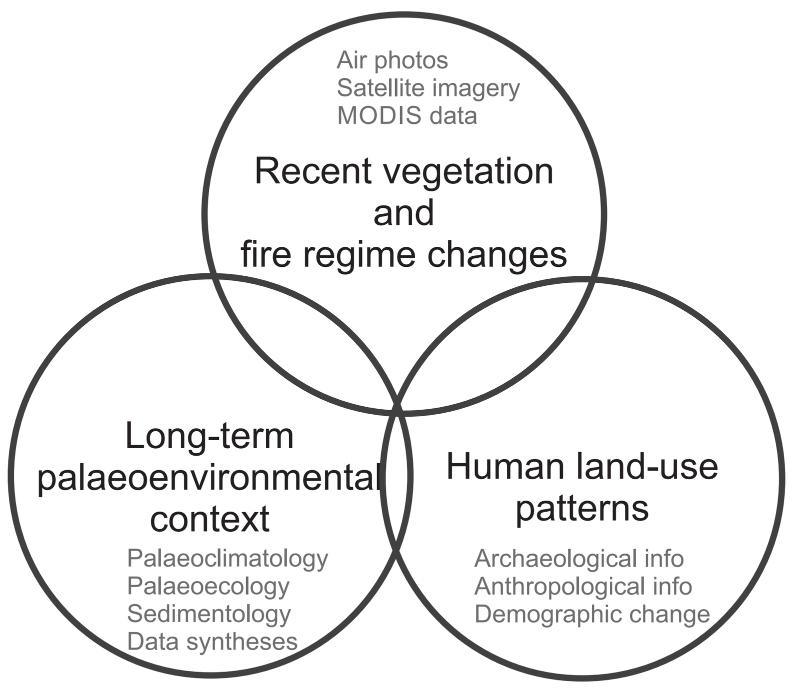


GLOBAL PALAEOFIRE WORKING GROUP



2B 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)**.

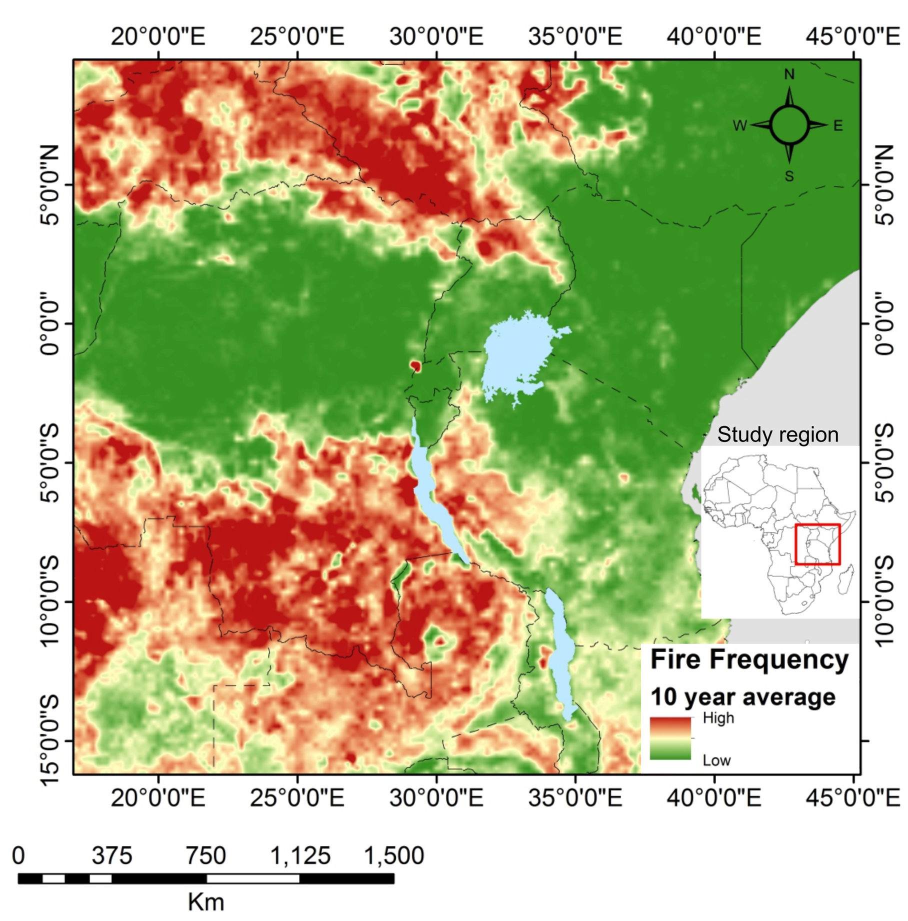
Integrated approach to understand the drivers of vegetation, fire and land cover changes



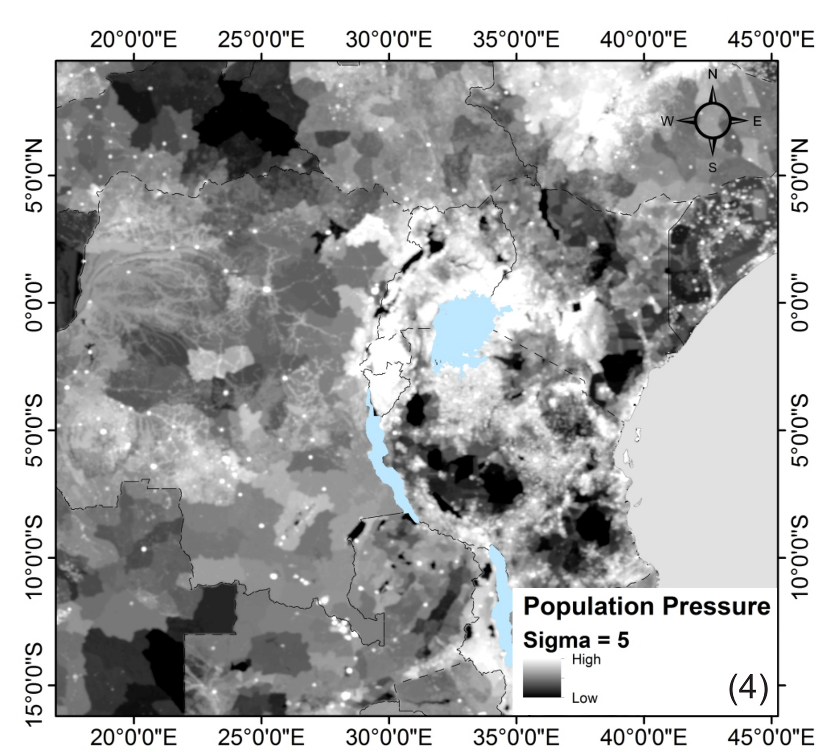
Lines of inquiry and major toolsets

African Pollen Database (APD)

2C MODIS satellite fire activity products.
annual fire hotspots; 10 year averages (>50% confidence; 2001-2010) **(3)**.



2D Population pressure exerted on the landscape
(distance decay function, σ = 5) **(6)**.



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(2) Tierney et al, 2010. A molecular perspective on Late Quaternary climate and vegetation change in the Lake Tanganyika basin, East Africa. Quaternary Science Reviews 29: 787-800.
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