# Long-term variation in the climatic control of fire in alpine grasslands on Mt. Kenya

**Topic:**
The vegetation changes which occurred on the high tropical mountains of equatorial Africa during the glacial-to-interglacial transition at the end of the last ice age were driven by a combination of temperature change (warming of ca. 5°C) and increasing rainfall (due to an intensifying monsoon) as well as the increase of atmospheric CO2 concentration from ca. 180 ppm during glacial time to ca. 280 ppm by the start of the Holocene period 11,700 years ago. The most important immediate cause of vegetation change in the tropics is fire, which tends to promote grassland at the expense of forest and (near the upper treeline) giant heather vegetation. This study focuses on reconstruction of the long-term (21,000-year) history of biomass burning near the upper treeline on Mt.Kenya, using variation in the concentration and flux of macrocharcoal (>150 µm) particles preserved in the bottom sediments of a crater lake at 3080 m elevation as indicator of fire frequency and intensity.

**Context:**
It can be predicted that the exact timing of vegetation changes during the glacial-to-interglacial transition must have coincided with optimal conditions for the ignition and spread of fire. But while climate warming is expected to promote fire, increasing rainfall must have hampered its occurrence; and increasing CO2 tended to promote C3 plants (such as trees and shrubs) over C4 plants (such as most tropical grasses). Consequently, the timing and magnitude of temporal variation in biomass burning is uncertain at present. The results of this study will help constrain the likely future ecosystem changes due to anthropogenic increases of CO2, increasing temperature and decreasing (or increasing?) rainfall expected to occur in equatorial East Africa during the 21st century and beyond.

**Approach:**
The recorded temporal patterns in biomass burning, derived from the recorded charcoal fluxes, are compared with independent reconstructions of regional climate and vegetation to test whether glacial-to-interglacial vegetation change follows, or coincides with, peak biomass burning, and to assess which particular combinations of temperature, moisture and CO2 tend to promote or hamper the occurrence of fire in this tropical mountain ecosystem.

**Field and/or laboratory work:**
This thesis involves no fieldwork, since the required research materials are already available. The practical work involves sieving sediment samples and counting of fossil macrocharcoal particles, followed by comparison of the recorded temporal patterns with independent reconstructions of regional climate and vegetation changes.

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