Fire History Reconstruction and International Multiproxy Paleo-fire Database (IMPD) Data Types

Contents

I. Introduction

Fire history information is provided through two types of proxy data: tree-ring based records and sediment-based records. These data sources describe fire regimes at multiple temporal and spatial scales. Tree-ring data provide temporally precise, short-term reconstructions of fire events, usually spanning the last 400 years or less. By carefully cross-dating and examining the tree rings, the exact year and often the season in which the fire occurred can be determined. These data offer a high level of spatial resolution in a fire reconstruction in that the location of fire-scarred trees identifies the exact location of particular fires. Although tree-ring methods extend back to the age of the oldest living tree, the records attenuate back through time as older trees are less abundant.

Charcoal records from sediments can reconstruct much longer fires histories, but with less temporal and spatial precision than tree-ring records. Because charcoal particles can be carried aloft to great heights and transported great distances, the source of the charcoal may be from distant fires as well as local fires. Charcoal accumulation may continue for a few years after a fire because of transportation and redeposition of secondary charcoal. This process tends to blur the exact age of a fire, even when the charcoal particles are directly dated by radiocarbon dating, which itself has a dating precision of +/- 5%, and the date reflects when the plant was growing, not when it burned. Additionally, the charcoal deposited may represent more than one fire within the area, or fires from more than one year. As a result, fire episodes are referred to as one or more fires occurring in the time interval of interest, rather than individual fires.

The International Multiproxy Paleo-fire Database (IMPD) is an archive of fire history data derived from natural proxies such as tree scars and charcoal and sediment records. The IMPD was established to provide a permanent repository for high-quality paleofire records from around the world. For access to the IMPD visit:
https://www.ncei.noaa.gov/products/paleoclimatology/fire-history

II. Tree-ring based fire histories

Fires that injure, but do not kill, a tree often leave distinctive scars that can be used to determine when the fire occurred. Additionally, high-severity fires may kill all the trees in an area, particularly if the dominant species has a low fire resistance. Establishment dates of even-age tree stands can, under certain conditions, be used to identify the minimum age of the last stand-replacement fire. However, because the lag in tree establishment after a fire is highly variable, establishment dates represent only an upper limit for the date of the fire, and uncertainties in determining tree age at sample height can also reduce the temporal precision of derived fire dates. Most studies using age structure as a proxy for fire combine it with other lines of evidence to determine the timing of fire.

Details of Tree-Ring Fire Event data and metadata file naming conventions and formats are located at: https://www.ncei.noaa.gov/pub/data/paleo/firehistory/tree_event_info.pdf. This file also contains links to open access software programs to create, read, and use Fire History Exchange Format (FHX) files, a sample Fire History Exchange Format (FHX) file (Appendix A), and a list of the Fire History Exchange Format (FHX) codes (Appendix B).

III. Charcoal-sediment based fire histories

Charcoal is produced when a fire incompletely combusts plant matter. Charcoal analysis quantifies the accumulation of charred particles in sediments during and following a fire event. Stratigraphic levels with abundant charcoal (so-called charcoal peaks) are inferred to be evidence of past fires. These peaks must be distinguished from background charcoal in the stratigraphic record, which may be introduced through secondary processes such as erosion. The size of the charcoal particles can provide clues to the location of fires, since smaller particles are apt to travel further. But any interpretations of fire location, size, and intensity requires an understanding of the processes that influence charcoal production, transport, and deposition. Annually laminated (i.e., varved) sediment permits the age of a fire episode to be established to the year, while in non-laminated sediment records, the age of a fire event is established by interpolation from a series of radiometric ages determined by ^{210}Pb and/or radiocarbon dating.

Details of Charcoal Sediment data and metadata file naming conventions and formats are located at: https://www.ncei.noaa.gov/pub/data/paleo/firehistory/charcoal_sediment_info.pdf