The fire, burned areas and charcoal - charcoal-data modelling of burned areas, cross-validation of the fires and charcoal signal

Fire is one of the fundamental factors that drive and shape the functioning of many of the world's ecosystems, directly influencing changes in vegetation and biodiversity, as well as ancient societies. Recent decades have shown how wildfires and related global relationships affect the acceleration of climate change through changes in vegetation, permafrost conditions, and the release of trace and greenhouse gases and aerosols. The IPCC report (2022) indicates that the area of Europe is characterized by an increase in fires caused directly by the current climate change. Moreover, forecasts for the next century indicate a steady rise in air temperature, which may result in an increase in the number and intensity of fires. In this context, very questions arise: what will be the societal and environmental impact of future sudden climate events, and how might an exacerbation of fires affect the potential for accelerated global warming?

During a fire, not only fuel is burned, but smoke, particles and various chemical compounds are also released into the atmosphere, which have a detrimental effect on human health. Due to these ramifications, it is important to understand what influences the occurrence and severity of fires. Reconstructions of paleofires are useful for studying the effects of climate change and vegetation on fires in periods when human impact was less than today. Charcoal particles collected in archives such as peat and lake sediments have been used successfully as geographic patterns in shifting fire regimes. However, charcoal records, as many publications show, provide only partial estimates of changes in biomass combustion.

Therefore, the aim of the project is to indicate and verify the relationship between the fire and its record in peat and lake sediments. For this purpose, burnt areas will be designated 40 km away from 10 test sites (lakes and peatlands), and the intensity of each fire will be assessed using data on the fire (i.e. type of fire: ground, surface or crown), fire indicators (burnt area, weather conditions, wind speed and direction), fuel information (ecosystem type, forest age and species structure), obtained from the State Forests. Past fires and regional vegetation will also be reconstructed using cores collected from lakes and peatlands using a palynological analysis, as well as an analysis of charcoal and charcoal morphotypes in six fractions (100, 150, 200, 300, 400, 500) with high sampling resolution (0.5-1cm). In turn, μ-XRF scanning will be used to detect erosive and redisposition processes. The chronology will be based on varvochronology, radiocarbon (AMS) dating and caesium – 137 dating. In addition, the project aims to cross-verify the relationship between the fire and its recording in lake and peatland sediments, on the basis, a model of charcoal dispersion from the burned area will be built. We hypothesized that the amount of charcoal deposited on the surface of the lake and peatland is directly related to the distance of the fire, the burnt surface and the intensity of the fire. As part of this project, we want to make progress in the interpretation of reconstructed fire events. This research could be the next step to better understand the fire signals preserved in our archives and to improve the interpretation of paleofires.