Changes or resistance? Multi-proxy studies of plant population shifts during the late Holocene in Arctic Alaska

Due to recent climate warming Arctic ecosystems experience more pronounced changes than others in various parts of the globe in recent decades. Observational studies document expansion of the some flora and fauna species. Especially visible is expansion of shrub communities (e.g. birch, willow, and alder), that are increasing in cover and height.

Thanks to the presence of peat forming species and accumulation of the peat layers, peatlands in the Arctic are important archives of palaeoenvironmental data, that took place over last thousends years. Reconstruction of the past environmental changes is possible thanks to application of the multi-proxy detailed long-term palaeoecological studies of permafrost peatlands. They allow to improve our understanding of relationships between plant populations and climate, pollution, fire, and hydrology, with implications for elucidating the response of high-latitude vegetation to climate warming that were documented during Late Holocene. In our paleoecological studies we focus on the late Holocene (the last ca. 5000 years) because this period contains several phases of marked climate change. During the time covered in this study, warm periods such as the Roman Period and Medieval Climate Anomaly and recent warming were separated by cold intervals (2.8 kyr event, Migration Period and the Little Ice Age).

Our study area is located in Arctic zone in northern Alaska, from the northern foothills of the Brooks Range, toward Prudhoe Bay. In this project we plan work to conduct the first comprehensive multiproxy late Holocene palaeoecological studies (plant macrofossils, pollen, non-pollen palinomorps, testate amoebae, charcoal, and geochemics) supported by detailed radiocarbon and lead dating on 14 peat monoliths, taken at 10 sites, represent various peatland habitats (e.g. bog, poor fen, rich fen) in one region in order to examine the temporal and spatial vegetation structure in this poorly researched area. We want to reconstruct the local vegetation changes since peatland initiation or permafrost layer and explore the relationship among the different species. In addition we want to evaluate the relative importance of regional climate, impact of potential long-distant air pollution, dust and fire and local autogenic succession in the development of the peatlands and plants ococuring there along a small-scale continental gradient. We postulate that some of plant communities respond to this factors. However, some of plant population developed in peatlands ecossytems can be resistant to climate changes and plant succession remain unchanged over thousand years.

Our temporal perspective, multiproxy long-term approach, and high resolution, contiguous sampling approach allows the identification of the time of the appearance, expansion, and retraction of local plant taxa. Due to detailed paleobotanical studies we will be able to create a model of the plan succession in this region to species level. Understanding how these organisms may respond to conditions projected by climate models is important for understanding the future of petland ecosystems in the Arctic zone. By analysis peat monoliths from Alaska and gathering valuable paleodata about plant succession in this region, we will have the opportunity for intercontinental comparison of artic vegetation development and determine similarities and differences in the vegetation responses to climatic changes in N America, Europe, and Asia.