

## Abstract

The Quaternary period is characterized by alternating phases of cooling, known as glaciations, and warming, referred to as interglacials. Marine Isotope Stage 11 (MIS 11) is particularly interesting among the Middle Pleistocene interglacials due to a similar orbital configuration as in Holocene. The substage "c" is commonly associated with the Holsteinian Interglacial. During MIS 11c, the climate exhibited relatively stable warm and moist conditions, with a global temperature increase of approximately 1.5–2°C above pre-industrial levels. This period potentially experienced a sea level rise of 6–13 meters due to the melting of the Greenland Ice Sheet. In the Polish record, the Masovian Interglacial is considered an equivalent of the Holsteinian Interglacial. The pollen succession during MIS 11c in Poland reveals the simultaneous presence of *Picea-Alnus* and *Carpinus-Abies* pollen, as well as a significant proportion of *Taxus* pollen. Additionally, there is a high abundance of thermophilic taxa such as *Pterocarya*, *Celtis*, *Juglans*, *Ilex aquifolium*, *Carya*, *Parrotia*, *Buxus*, *Vitis*, *Brasenia*, *Trapa*, and *Azolla filiculoides*.

The Holsteinian Interglacial is characterized by two major oscillations: the Older Holsteinian Oscillation (OHO) and the Younger Holsteinian Oscillation (YHO), identified based on the Dethlingen record in Germany. Detailed documentation of climate oscillations in MIS 11c may be essential to a better understanding of global climate changes, including those currently occurring in the Holocene.

This study aimed to describe vegetation changes during the Masovian Interglacial using high-resolution palynological data from five new profiles in Eastern Poland. Particular attention was paid to the periods of climatic oscillations and its possibly the most detailed recognition. All geological profiles analysed in this study are located in the Southern Podlasie Lowland, an area that is characterised by an abundance of MIS 11c lacustrine deposits. In addition to the traditional palynological approach, the study employed the REVEALS model to accurately depict the vegetation changes occurring during the Mazovian Interglacial. The results were analysed using Non-metric Multidimensional Scaling (NMDS) to better understand temporal changes and compare records across all study sites. The oscillation periods were of particular interest in order to gain a deeper understanding of the observed vegetation changes.

Based on new materials, especially from the Krępa site, the study proposed a revised timespan for the Masovian Interglacial. The warm phase of the MIS 11 stage in Northern

Europe lasted 18,000 years and can be correlated with most of MIS 11c. By correlating the cold stadial events from the Krępa record with Lake Ohrid cold oscillations, the study established a more probable date of 418 kyr for the Older Holsteinian Oscillation (OHO). Furthermore, the study suggests that the Early Liviecian Glaciation, previously described as MIS 10, should be placed already within late MIS 11c in the Polish stratigraphy. The use of the REVEALS model allowed for a more accurate reconstruction of vegetation during the Masovian Interglacial. Key differences were observed, including the greater significance of *Larix* and riparian communities during the early Interglacial, possibly dominated by *Fraxinus*. The REVEALS model also confirmed the dominance of *Abies* during the Younger Holsteinian Oscillation (YHO), indicating its expansion in the area and its ability to thrive in nutrient-depleted soils. The results of the NMDS analysis suggest that YHO caused the redevelopment of oak-hornbeam forests towards a more thermophilic variant.

Overall, the topic of climatic oscillations remains open, and further studies applying different proxies and a more robust time model are necessary. However, the obtained palynological data can serve as a solid basis for more advanced studies. Besides the Lublin Upland, another promising area for research is Northeast Poland, where older interglacial sediments, such as the Augustovian (MIS 21-19) and Domuratovian (MIS 17), can be found.