## Computational approaches to Final Palaeolithic/earliest Mesolithic climate change

The project considers the climate modelling part of the European Research Council (ERC) project CLIOARCH (https://cas.au.dk/en/ERC-clioarch/). CLIOARCH stands for CLIOdynamic ARCHaeology: Computational approaches to Final Palaeolithic/earliest Mesolithic archaeology and climate change. This project seeks to quantify and hence qualify human responses to rapidly changing climates, extreme environmental events, migration and adaptation in the so-called Final Palaeolithic and the earliest Mesolithic, the period between 15,000 and 11,000 years, in Europe.

The Final Palaeolithic and the earliest Mesolithic include large abrupt climate changes including the onset of the Boelling/Alleroed warming period (14.7 ka ago), and a 1,300-year-long cold period commonly referred to as the Younger Dryas (YD) starting 12,807 ± 12 bp. Several hypotheses have been proposed for the mechanism triggering the inception of the YD, including freshwater forcing, an extra-terrestrial impact and aerosol emissions from volcanic eruptions.

The Laacher See eruption (LSE) in the Eifel, Germany ranks among Europe's largest volcanic events of the Late Pleistocene. Present dendrochronological and radiocarbon measurements of subfossil trees now date the LSE to 13,006 ± 9bp, which is about two centuries earlier than the YD inception. However, a new ice core reconstruction for a 400-year interval (13,200-12,800 bp) prior to the inception of the YD identified 30 volcanic eruptions, including a distinct cluster of four bipolar events within ~110 years between 12,980-12,870 bp. It is worth noting in this respect that this cluster has an overall volcanic aerosol load greater than during volcanically active periods of the Common Era associated with distinct climatic cooling.

In this project, we will perform centennial scale transient MPI-ESM simulations between 13500 and 12750 and the new volcanic forcing data set to explore the potential mechanisms which could trigger the YD interception and which strongly impacted Final Palaeolithic/earliest Mesolithic human populations. We will focus on the role of volcanic eruptions in particular, the specific climatic impacts of the LSE. There has been renewed focus on the potential climatic impacts of the LSE as a powerful mid-latitude Northern Hemisphere eruption, not least because new models are suggesting a significantly higher contribution of volcanic eruptions to past climate change as well as to expected future climate trends.

The model data will be spatially downscaled to approach climatic variation that are humanly relevant. By default, such climate models provide a range of output parameters which can be converted into the climatic indices (such as Effective Temperature) shown to broadly drive the population densities of terrestrial hunter-gatherers. The resulting values can be used to dynamically estimate Final Palaeolithic/earliest Mesolithic population densities at any given point in time and space.