EGU21-7706
https://doi.org/10.5194/egusphere-egu21-7706
EGU General Assembly 2021

The extent, timing and palaeoclimatic significance of Late-glacial and Holocene snowpatches and glaciers in the Marrakech High Atlas, Morocco

Benjamin Bell[1], Philip Hughes[1], William Fletcher[1], Roger Braithwaite[1], Henk Cornelissen[1], David Fink[2], and Ali Rhoujjati[3]

[1]Department of Geography, University of Manchester, Manchester M13 9PL.
[2]Australian Nuclear Science and Technology Organisation, PMB1, Menai, NSW 2234, Australia.
[3]Cadi Ayyad University, Faculty of Sciences and Technics, Georesources, Geoenvironment and Civil Engineering Laboratory, Marrakesh - Morocco.

Pleistocene glaciers were extensive in the Marrakech High Atlas, Morocco. Today, semi-permanent snowpatches survive in topoclimatic settings and there is evidence of niche glaciers as recently as the Little Ice Age and early 20th Century. However, little is known about the state of permanent snow and niche glaciers through the Holocene. One hypothesis is that Little Ice Age glaciers were the largest snow and ice masses since the end of the Late-glacial (Younger Dryas 12.9-11.7 ka). Another possibility is that snow and ice expanded to similar or greater extents at other points in the Holocene.

To test these hypotheses, moraine boulders have been sampled on moraine successions in the highest parts of the High Atlas, including moraine successions in front of the névé permanent below the north-facing cliffs of Tazaghart (3890 m a.s.l.), a semi-permanent snowpatch that survives many summers today. This site is bounded by prominent moraine ridges with no soil development and no lichens on surface boulders. Several other high-level sites have been targeted and over 40 samples are currently being processed for ^{10}Be and ^{36}Cl exposure dating. Establishing the relative difference in extent and altitude of Late-glacial and the most recent glaciers in the High Atlas is important for understanding landscape and climate evolution in high mountain areas in the subtropics (31°N).

The dated geomorphological records for late-lying snow and glaciers will be compared to high-resolution ^{14}C dated continuous parasequences from sediment cores from marshes at the Yagour Plateau and Oukaïmeden, both high-level sites in the High Atlas (~2700 m a.s.l.). The proximity of these sites (5-30 km, respectively) from the snowpatch/glacier sites will provide an important independent record of environmental change, spanning the Late-glacial and Holocene. This geomorphological record of former glaciers and snowpatches (moraines and pronival ramparts) is inherently fragmentary in time and the continuous core records from these alpine marshes will provide crucial insights into changing moisture conditions over time, which at these altitudes are closely related to the extent and volume of snowpack.

The climates associated with perennial snow cover and niche glaciers, and the associated annual snowpack melt, will be quantified using degree-day modelling. This allows melt rates to be predicted and this can be compared against observed modern climate in the High Atlas region. This involves interrogation of existing meteorological datasets from across the High Atlas and the development of algorithms for interpolation and extrapolation to ungauged higher altitudes.

Changes in the nature of the cryosphere through time in the High Atlas Mountains is crucial for understanding human activity and socioeconomic development in the wider region. Today, snowmelt from the High Atlas represents the most important ground water recharge used for a wide variety of purposes. Understanding changes in snow conditions, and as a consequence the behaviour of niche glaciers, in the High Atlas through the Holocene has important implications not only for water supply for humans but also for biological refugia and the evolution of cold-adapted flora and fauna.