
Assessing seasonal climate implications for the Vosges (France) during the LGM from ice sheet paleo-extents and GRISLI modeling

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Résumé

Glaciers are key hydro-climatic indicators and markers of atmospheric changes in the past, making them essential tools for reconstructing glacial paleoenvironments and paleoclimates. The Last Glacial Maximum (LGM, 26–19 ka BP) represents a climatically stable period, drastically different from today (e.g., (1), (2)). As such, this period is widely used as a benchmark for evaluating climate sensitivity (i.e., a key parameter linking atmospheric CO to temperature), since it is well documented with several archives providing estimates of atmospheric temperature changes.

A typical archive used to reconstruct past temperature changes is pollen assemblages since they display a good spatial coverage. However, notably in Europe, there is systematic mismatch between simulated temperature and reconstructions. An alternative archive to pollen data is dated glacier extent.

In this work, we used an inverse approach to reconstruct LGM temperature using a compilation of ¹⁰Be cosmogenic exposure ages ((3)) in the Vosges Mountains (NE France). Temperature is indeed a critical variable to estimate the surface mass balance of glaciers (i.e., the difference between accumulation and ablation). It is then possible to confront the results of a surface mass balance model (e.g., positive degree day, PDD, (4)) with geomorphological evidence to reconstruct temperature and precipitation.

PDD-based ice sheet models in central Europe ((5)) indicate stronger LGM cooling than pollen reconstructions (e.g., (1)), a mismatch likely linked to seasonal biases given the high sensitivity of glaciers to seasonal temperatures ((6)). Yet, seasonal LGM reconstructions remain scarce, and recent syntheses highlight marked inconsistencies in seasonality anomalies across European glaciated regions, including the Vosges ((7)).

Using new constraints on glacier extent in the Vosges during the LGM ((8)), this study investigates the impact of LGM seasonality on simulated glacier extents using the GRISLI ice sheet model ((9)). We identify the combinations of LGM cooling and seasonality that best reproduce observed glacier extents and compare these with pollen-based paleoclimatic

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reconstructions ((7)).

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- (6) Oerlemans and Riechert, <https://doi.org/10.3189/172756500781833269>
- (7) Fénisse +, in prep

Mots-Clés: GRISLI model, LGM cooling and seasonality, Maximum glacier extent, Inverse approach, Vosges, Last Glacial Maximum (LGM)