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Simple is beautiful? Building a simple climate model for modelling archaeological issues

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Simple is beautiful? Building a simple climate model for modelling archaeological issues

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Scientific requirements

Archaeological and paleo-environmental models do not focus on climatology dynamics but need to integrate climate evolutions within their simulations of human-environment issues. However, present-time climate models are modelling tools, i.e. they explicitly reconstitute the complexity and the interactions between climate intrinsic forces which eventually induce climate fluctuations while paleo-environmental models need only simulations, i.e. climate fluctuations.

We implemented a very simple model of the European climate for the Linear Band Keramik (LBK) period, i.e. 6000-5000 BC. The model requirements were :

- To mimic the seasonal cycle and variability of the seasons;
- To mimic the temporal variations of the climate along the LBK period;
- To mimic the spatial differentiation and variability for the whole Europe;
- To mimic a spatial precision at the operating level of the model, i.e. the hectare;
- In terms of variables, Precipitation and Temperature were the sole to be required for implementing agriculture & vegetation modules;

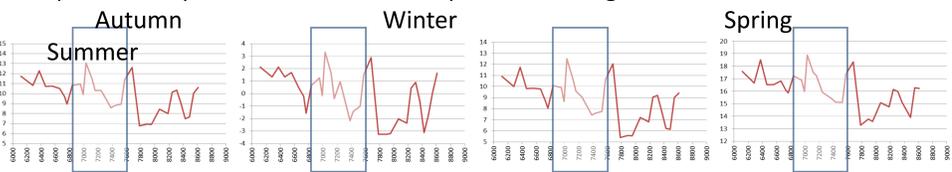
Reconstitution of climate temporal dynamics



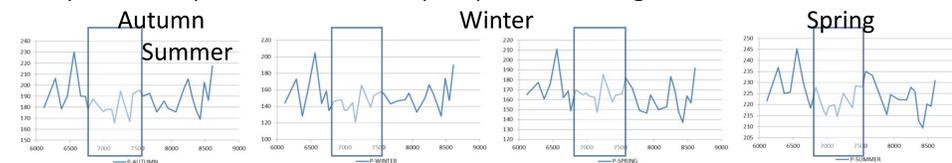
WAPLS 2 Analysis of the Marine Sequence of Norway MD99-2292 (Ortu, 2013)

- Norway: more P & T extremes & variability
- LBK period: climate dynamics of northern & central Europe were correlated.
- Palynology : Vegetation-level climate dynamics
- MD99-2292: the most detailed pollen sequence providing data for the whole LBK period

Temperate Europe: Mean estimated temperature during the LBK

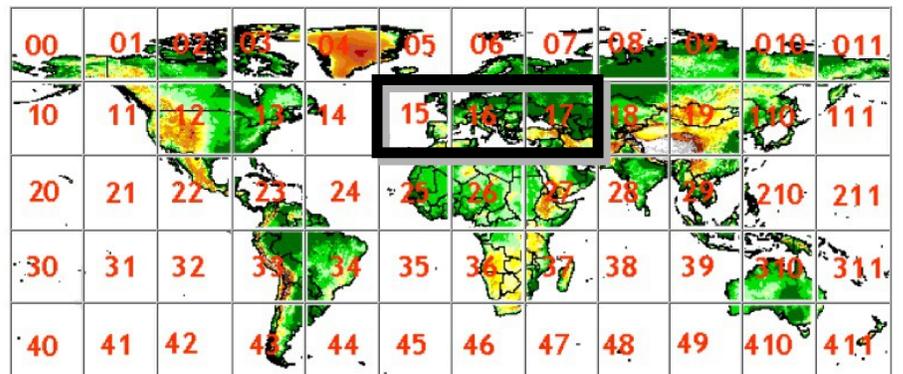


Temperate Europe : Mean estimated precipitations during the LBK

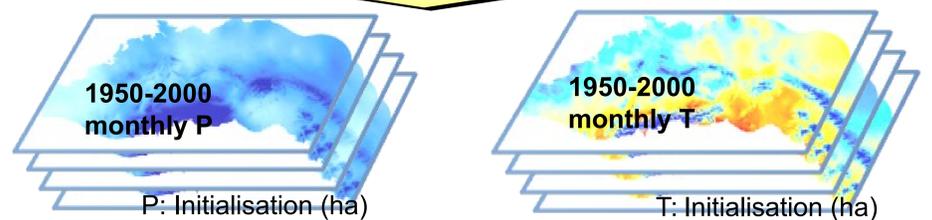


LBK P & T climate temporal dynamics for central Europe

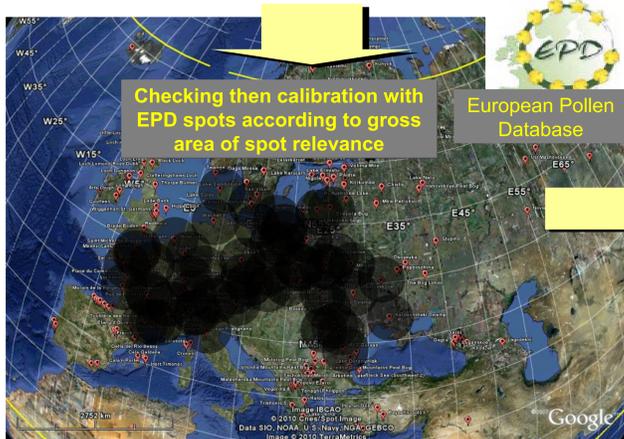
Spatial Reconstitution



www.worldclim.org Hijmans, Cameron, Parra, Jones, Jarvis, 2005.



Present-time P & T climate grids with a 1-km² spatial resolution and with a one-month temporal resolution



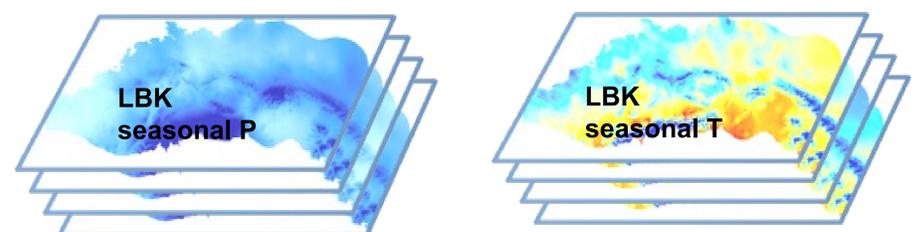
Checking then calibration with EPD spots according to gross area of spot relevance

European Pollen Database

1 ha Elevation

Spatially calibrated LBK P & T climate temporal dynamics for central Europe

Spatially calibrated LBK P & T climate grids with a 1-km² spatial resolution and with a seasonal temporal resolution providing 1K climate dynamics for central Europe



Spatially calibrated LBK P & T climate grids with a 1 ha spatial resolution and with a seasonal temporal resolution providing 1K climate dynamics for central Europe

Integration of the impact of Elevation on Temperature

Acknowledged assumptions, simplifications & errors

- Present-time climate variability applied to the LBK period;
- Northern Europe LBK climate variability applied to central Europe;
- One source of climate history, even calibrated and not the whole EPD;
- No retro-impact of vegetation on climate;
- Seasonal P & T are randomly provided to mimic means & variabilities, but no differentiation between real variability and error margins;
- No impact of wind, foehn, mountain barriers on P & T;
- No impact of elevation on rainfall;

Perspectives

- Since then, WorldClim has generated past climate data for the whole Holocene;
- There is a need for a simple climate data provider with better figures that integrates itself simply in paleo-environmental models;
- Until such a well-fitted model, this proposal can be useful as far as it is acceptable and/or improved by the (palaeo) climate community (Türing test);
- Several works may then be pursued for understanding the soft connections between human settlement dynamics and climate past evolutions