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

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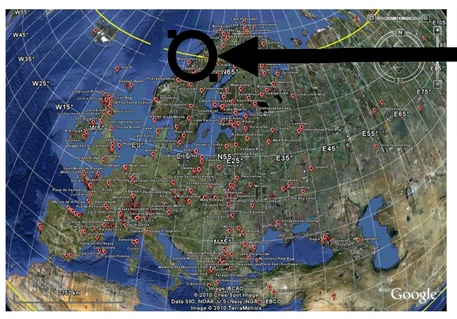
Scientific requirements

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;

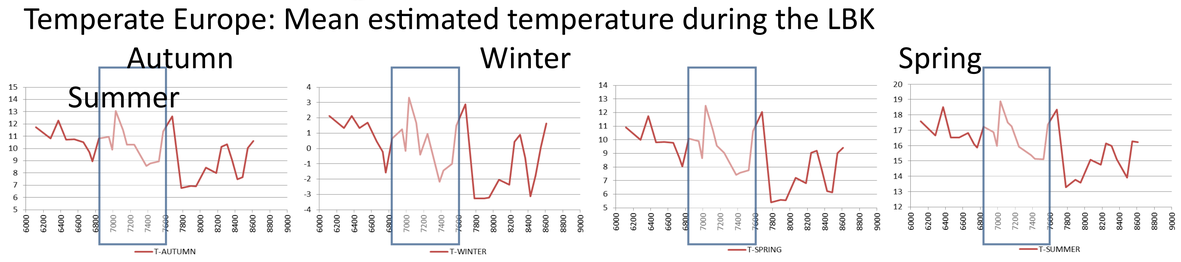
Reconstitution of climate temporal dynamics



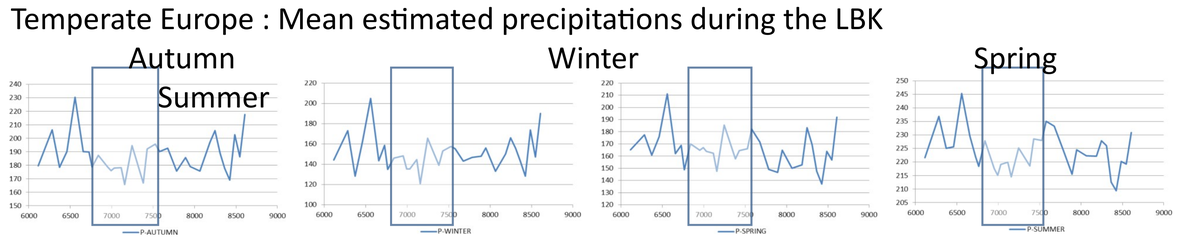
WAPLS 2 Analysis of the Marine Sequence of Norway MD99-2292 (Ortu, 2013)

- ❑ Norway: more P & T extremes & variability
- ❑ LBK period: climate dynamics of northern & central Europes 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

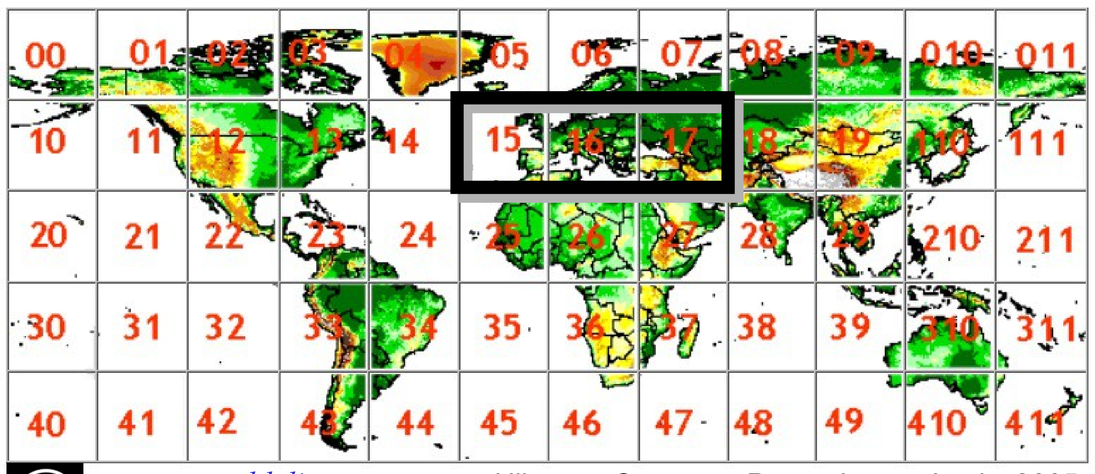


Temperate Europe : Mean estimated precipitations during the LBK

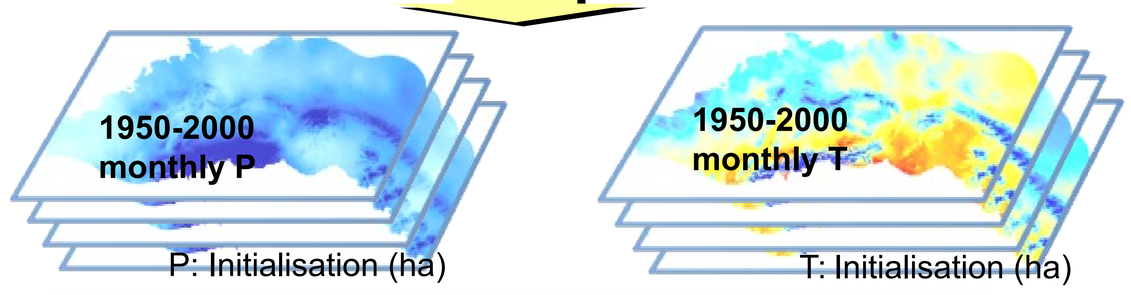


LBK P & T climate temporal dynamics for central Europe

Spatial Reconstitution

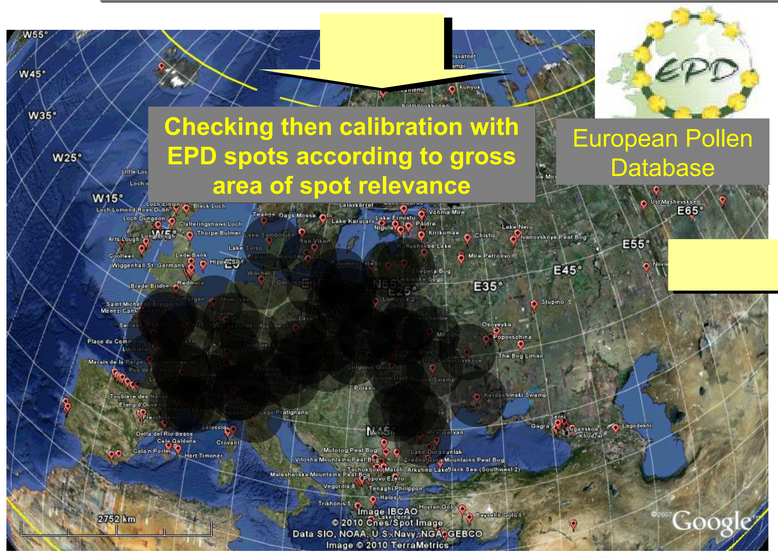


www.worldclim.org *Hijmans, Cameron, Parra, Jones, Jarvis, 2005.*



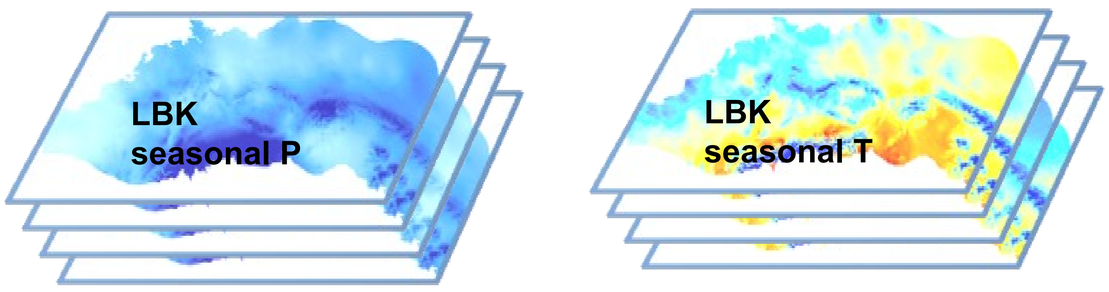
P: Initialisation (ha) T: Initialisation (ha)

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

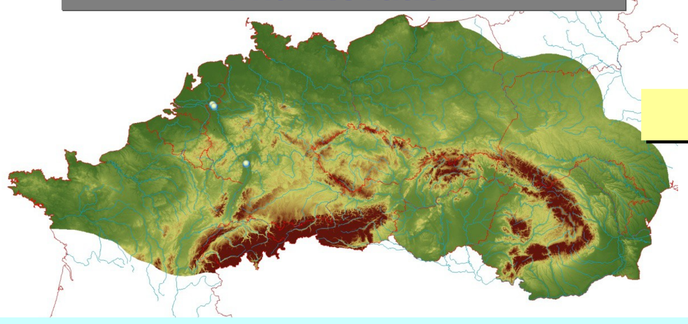


Spatially calibrated LBK P & T climate temporal dynamics for central Europe

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



1 ha Elevation



Integration of the impact of Elevation on Temperature

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

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-environnemental 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

Saqalli et al. 2014: Revisiting and modelling the woodland farming system of the early Neolithic Linear Pottery Culture (LBK), 5600–4900 B.C., Veget Hist Archaeobot (2014) 23 (Suppl 1):S37–S50
Saqalli et al. 2014: Reconstituting human past dynamics over a landscape: pleading for the co-integration of both micro village-level modelling and macro-level ecological socio-modelling, SPUHH Simulating the Past, ESSA Conference, Barcelona, España.