

UPPER PALAEOLITHIC DEMOGRAPHY IN EUROPE FROM ARCHAEOLOGICAL DATA

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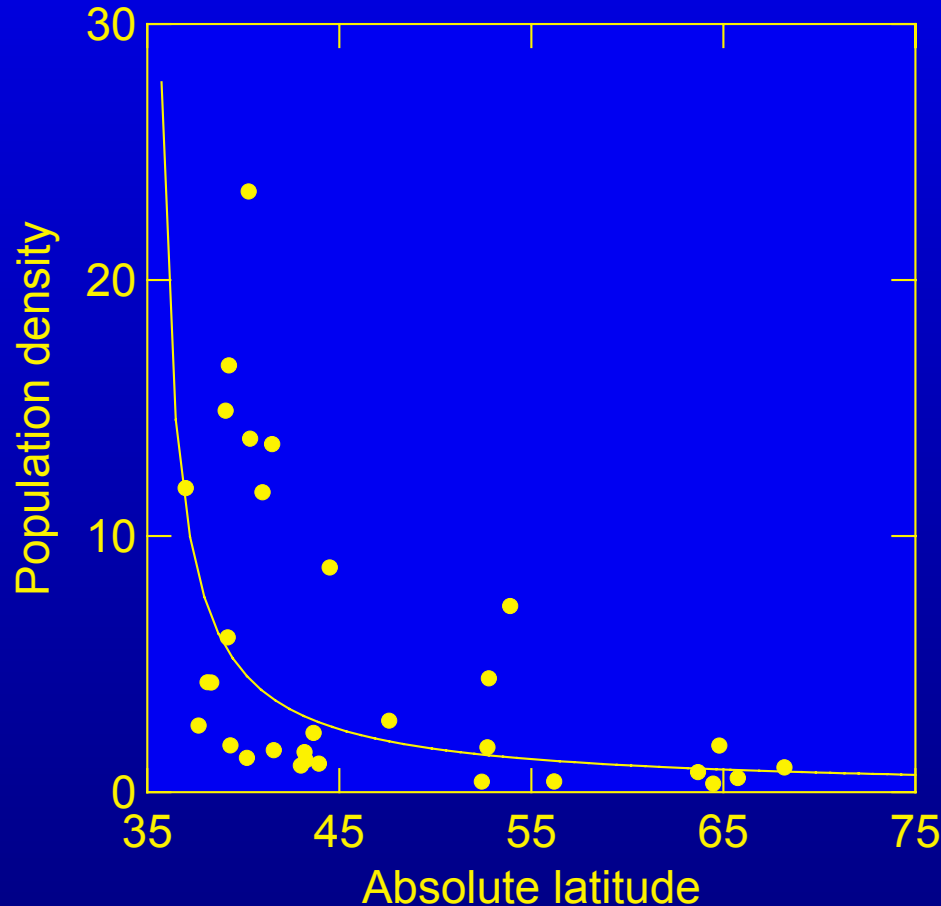
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- **INTRODUCTION**
- **THE DATA**
 - **Archaeological data**
 - **Climate data**
 - **Ethnographic data**
- **ARCHAEOLOGICAL DATA AND DEMOGRAPHIC INFERENCE**
 - **Estimation procedure of the metapopulation size**
- **CONCLUSION**

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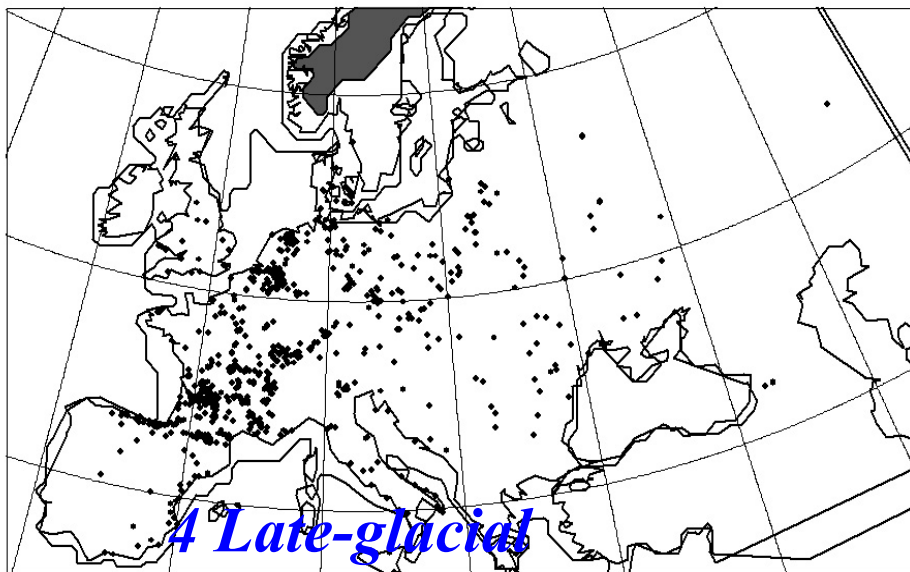
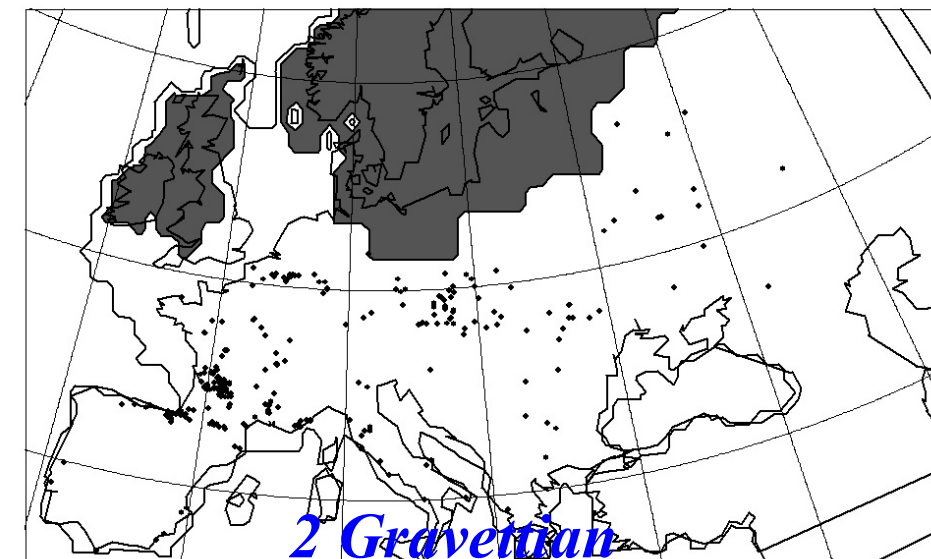
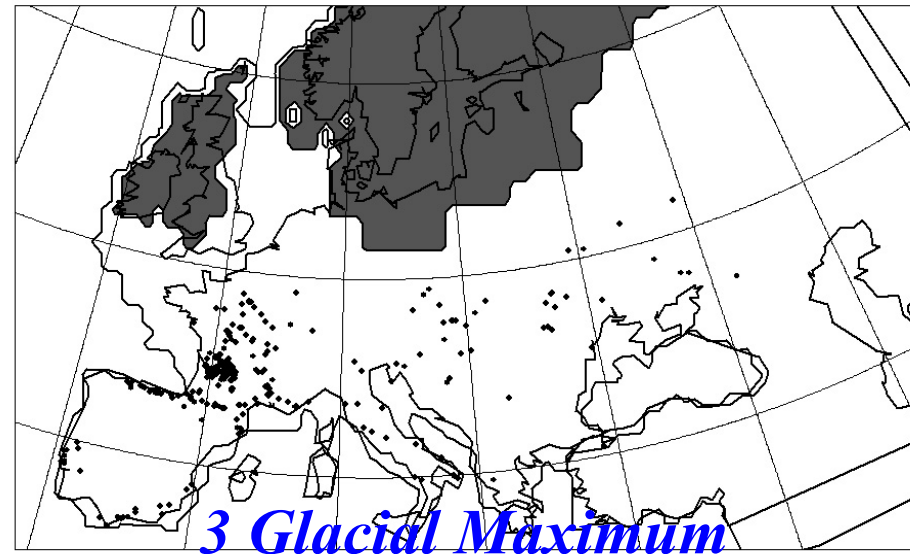
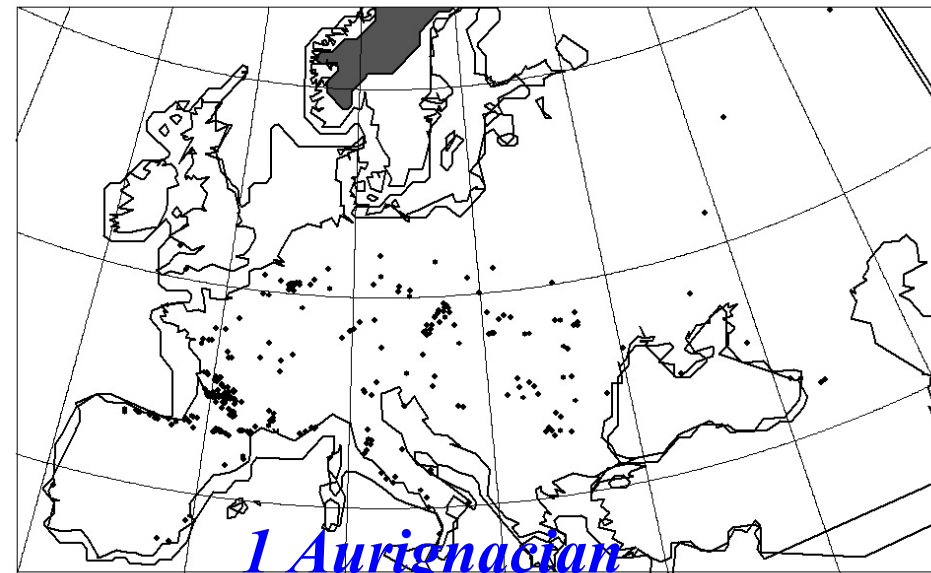
- Relationship between the ethnographically known population density of HG and climatic and ecological variables (Binford, 2001; Keely, 1995; Birdsell, 1953).



Population density vs Latitude ($ET \leq 13$, $N = 49$ HG)

- Ethnographic relationship climate-demography, is assumed to have remained roughly constant over the recent past (Uniformitarian hypothesis).
- Two approaches can be used to estimate prehistoric demography : using **reference ethnographic and environmental databases**,
 - without taking account of the archaeological data
 - with the archaeological data.

Distribution of archaeological sites (N=2961)



- From 50 ky BP on, a cooling is culminating at 21 ky BP, then is slackening



- What was the size of the hunter-gatherer (HG) metapopulation and its space-time distribution ?
- Under severe climatic constraints, what was the demographic response to the climatic variation ?
- Do geographical patterns of population distribution, as estimated from archaeological data, coincide with genetic patterns of *mtDNA* distribution and linguistic patterns of proto-language distribution prior to the Glacial Maximum?

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Archaeological data

- 2961 georeferenced sites ($\leq 40^\circ\text{E}$), subdivided into 4 chrono-typological periods :
 - **Aurignacian** (40.4-31.0 ky cal BC)
 - **Gravettian** (31.0-23.5 ky cal BC)
 - **Glacial Maximum** (= Lower Magdalenian and Solutrean) (23.5-17.2 ky cal BC)
 - **Late Glacial** (= Middle, Upper and Final Magdalenian, Hamburgian and Creswellian) (17.2-11.4 ky cal BC).

Climate data

- Simulations carried out for Europe by the “*Oxygen isotope Stage 3 project*” (IOS3) (Van Andel, 2003).
- Simulations of a typical “warm” episode, attributed to the Late Glacial.
 - *Mosaics with patchy woodland, or parkland/savannah-like vegetation with scattered individual trees, dominated across much of Europe* (Huntley and Allen 2003 : 99).
 - *The herbaceous matrix of these landscapes was apparently a no-analogue mixture of steppe, tundra and temperate grasslands. Given the **high insolation**, the relatively high **NPP** [Net Primary Productivity=Primary biomass] simulated by the model may have provided the production to support the large grazing and browsing herbivores*

- Among the simulated climatic variables :
 - insolation and warmness : *Effective Temperature ET*;
(Binford 2001; Bailey 1960)
 - *Net Primary Productivity (NPP)*

Ethnographic data

- Around 20 ky BP, the continuum of HG from the mean latitudes in Eurasia expanded into North America, carrying a relationship between demography and climate.
- Only the American side of the continuum has reached us via ethnography.
- It is assumed that the best demography-climate information for the extinct Eurasian metapopulation is provided by the surviving American part of the ethnography, via an HG ethnographic reference **sample** (Binford 2001, Helm 1981, Mooney 1928).

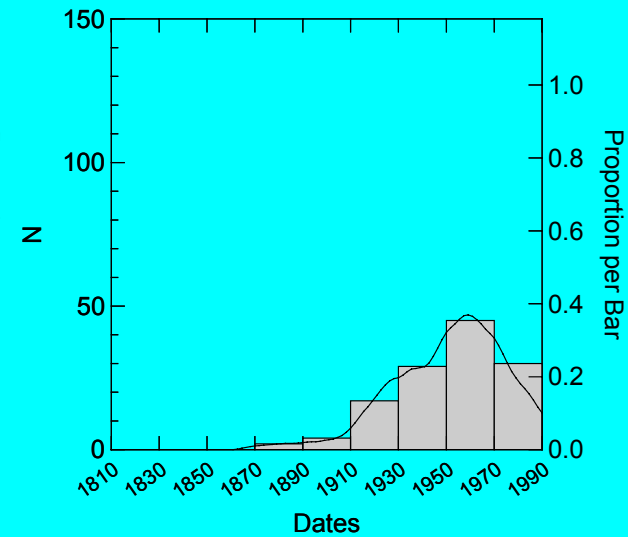
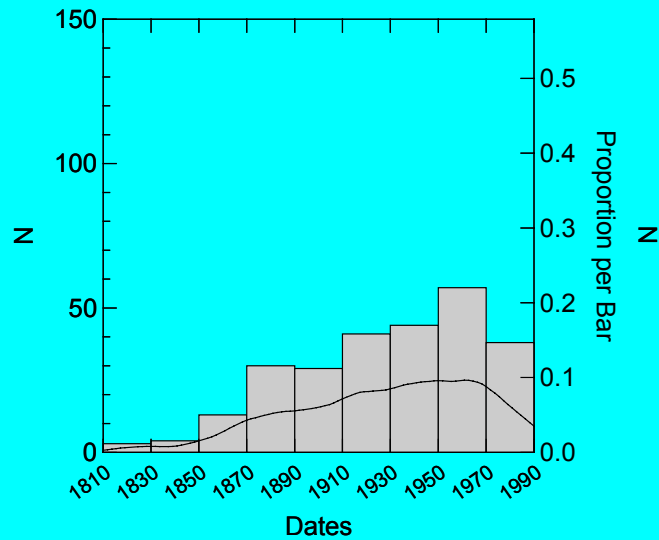
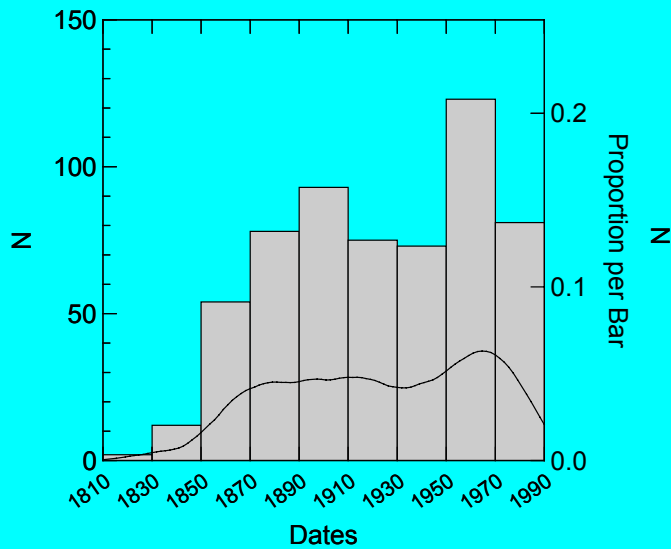
- Possible bias for two main historical reasons :
 - Contamination of the HG economic system by that of horticulturist-farmers (HF)
 - At the time of contact HG ethnographic populations were at the stage of simple sporadic exchange with HF
 - Epidemic impact of contact with the West (1492 AD)
 - A moderate impact of western contact, tending towards under-evaluation, is possible. We chose the highest demographic evaluations
 - An intensification of hunting productivity (during the 10 ky, from the Late Glacial to the XVIIth AD) might have slightly raised the ethnographic demographic density.
 - These two hypothetical moderate influences (epidemics, productivity), may have offset each other

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- After more than one century of excavations, i.e. of information extraction by archaeologists, archaeological pressure is roughly uniform across Europe;
- For an homogeneous cultural period: the density of the archaeological remains is roughly proportional to that of the population;
- There is a linear and uniform relationship between the density (numbers per unit of time) and the distribution (location on the map) of archaeological information and population density and its distribution;
- The variation in density and archaeological distribution over space and time corresponds to the variation in generating populations.

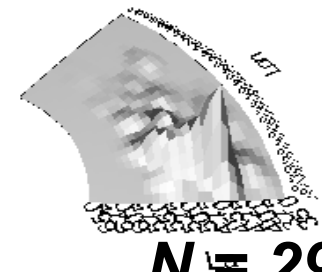
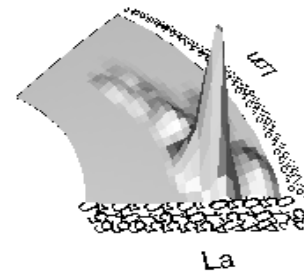
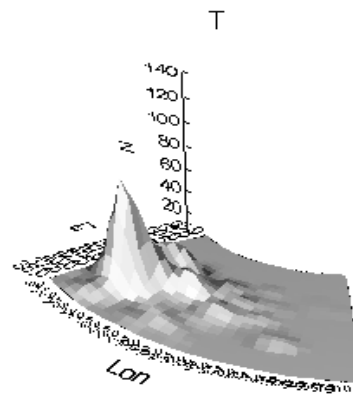
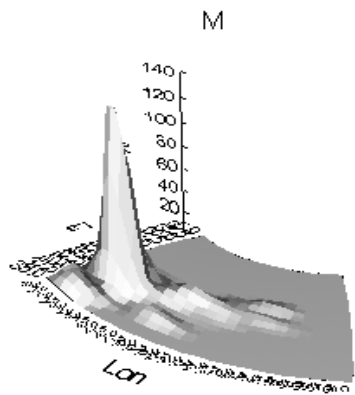
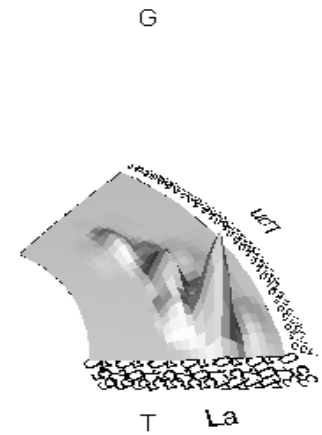
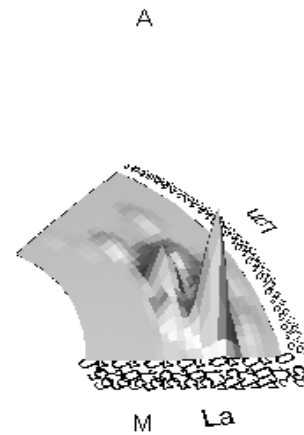
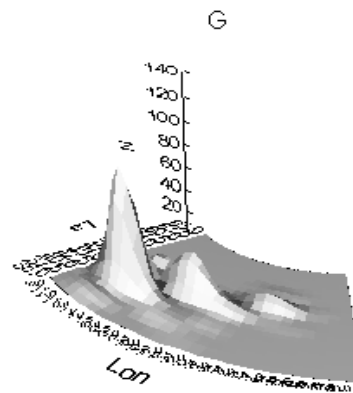
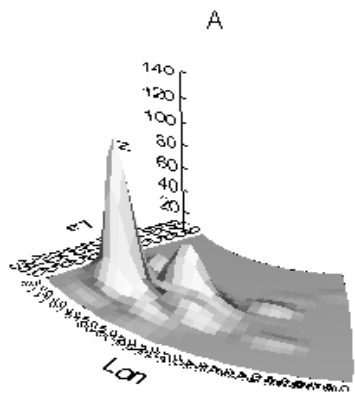
Chronological distribution of the discovery year of archeological sites from the Upper Paleolithic, in 3 major zones in Europe (N= 979).

(N : France 593 ; rest of Europe 259 ; former European USSR 127)



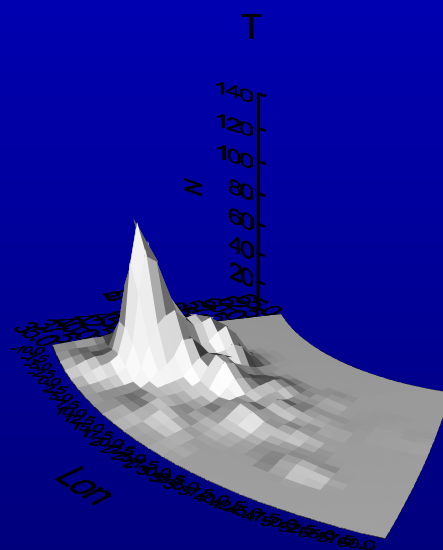
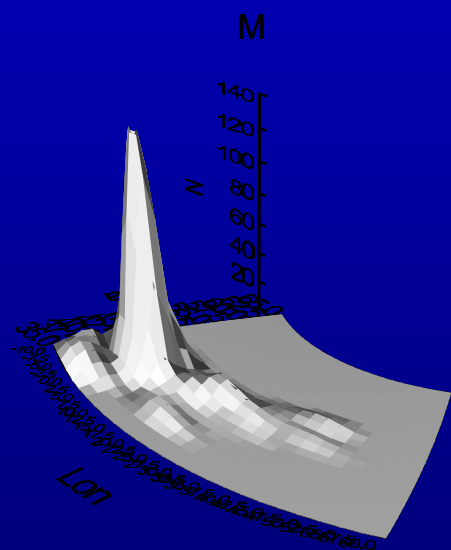
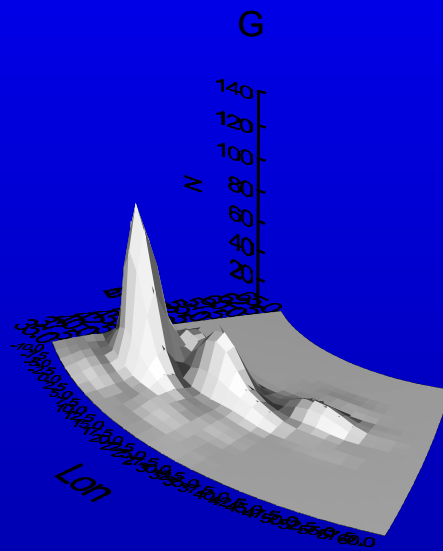
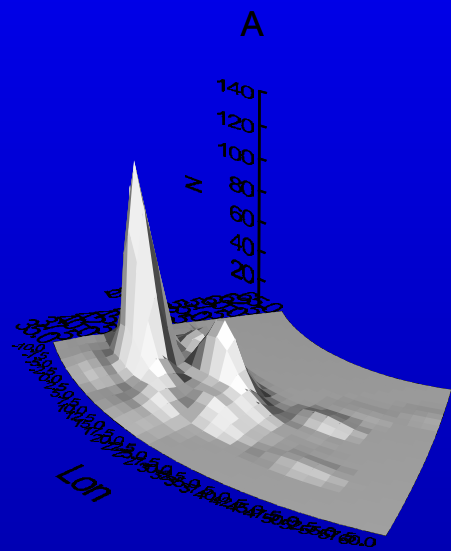
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Space-time distribution of the Upper Palaeolithic archaeological sites in Europe



N = 296

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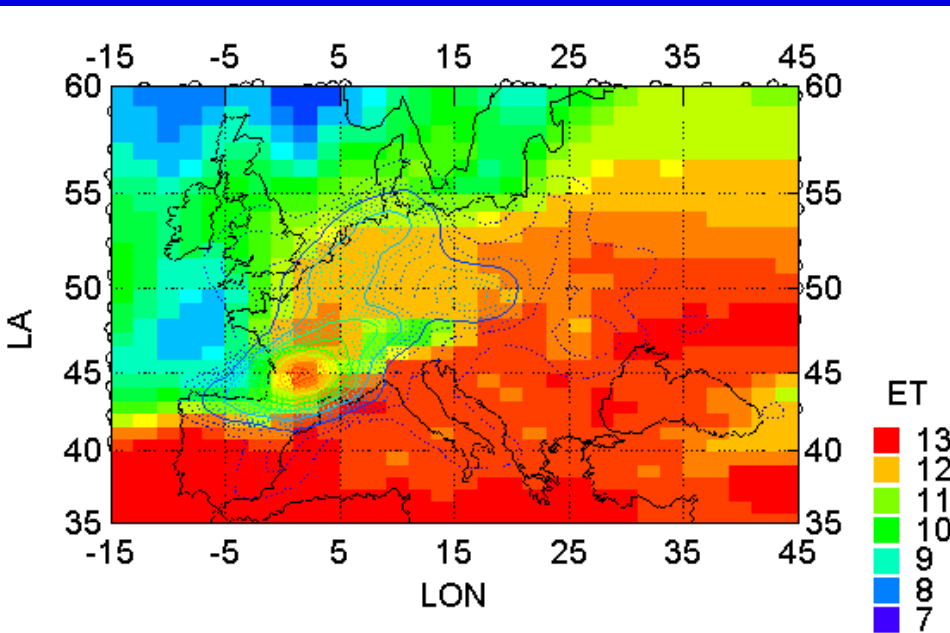
$$\text{Population size} = \text{demographic density} \times \text{territory size}$$

1. Reference Ethnographic Demographic Density (REDD) with its CI95%, assumed to represent the mid-Late Glacial
2. Growth rates of archeological site densities calculated for the three inter-periods
3. Estimated size of the 4 territories :
 1. their limits contain 90% of the modeled geographical distributions of sites (using a kernel density estimators)
 2. taking account the sea level variation
4. Back-projection of the growth rates onto the reference demographic density

Population size = demographic density × territory size

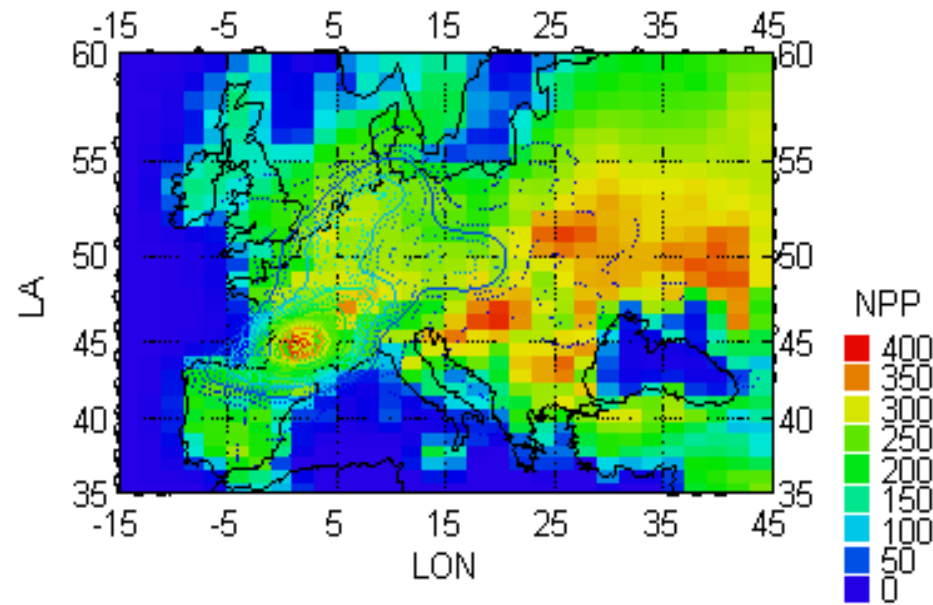
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Reference Ethnographic Demographic Density (REDD) estimated for the Late Glacial (inhab./km²)



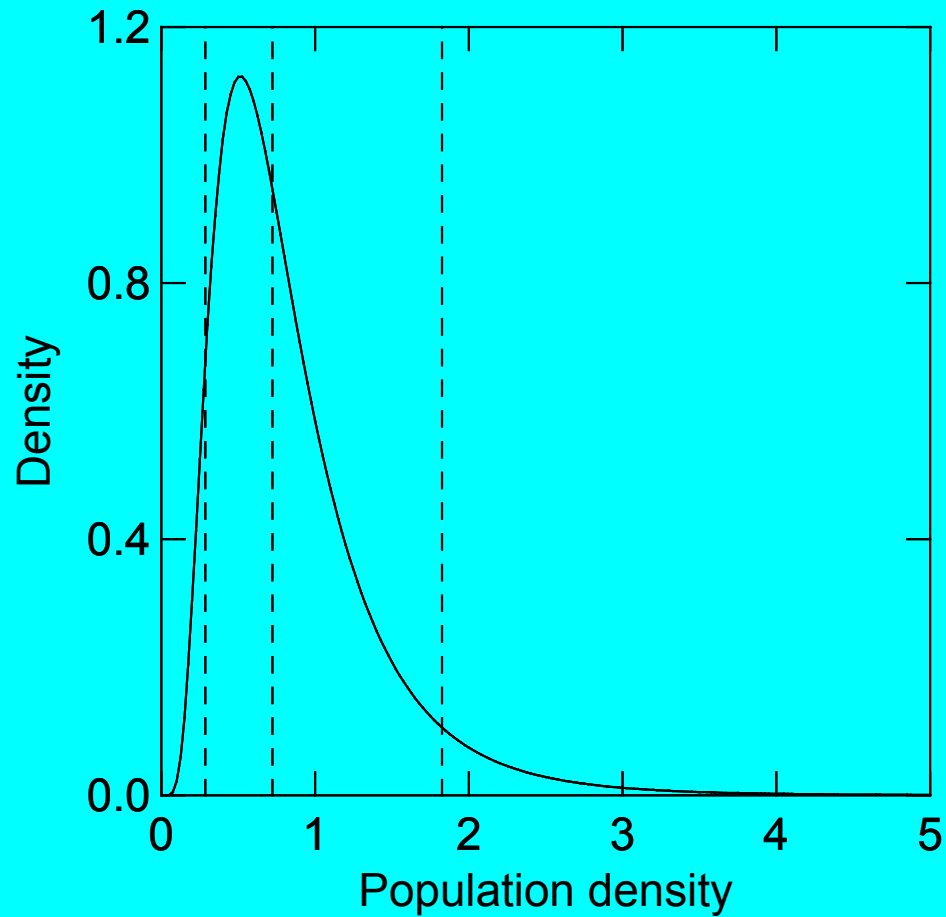
$10. \leq ET \leq 12.5$

$150. \leq NPP \leq 350$



- Average of subarctic ethnographic groups*, no mounted hunters, ($N=4$), in the range of IOS3 simulated variables (ET=insolation, NPP=primary biomass) containing 90% of the modeled archaeological site distribution
- REDD (100 km²)= 0.722 inh (IC95% : 0.285-1.825 inh)

*Binford 2001



- Comparison : 0.99 inh (100 km²) from ethnographic groups (N=10) for the vegetation class : « *Dry boreal parkland* ».

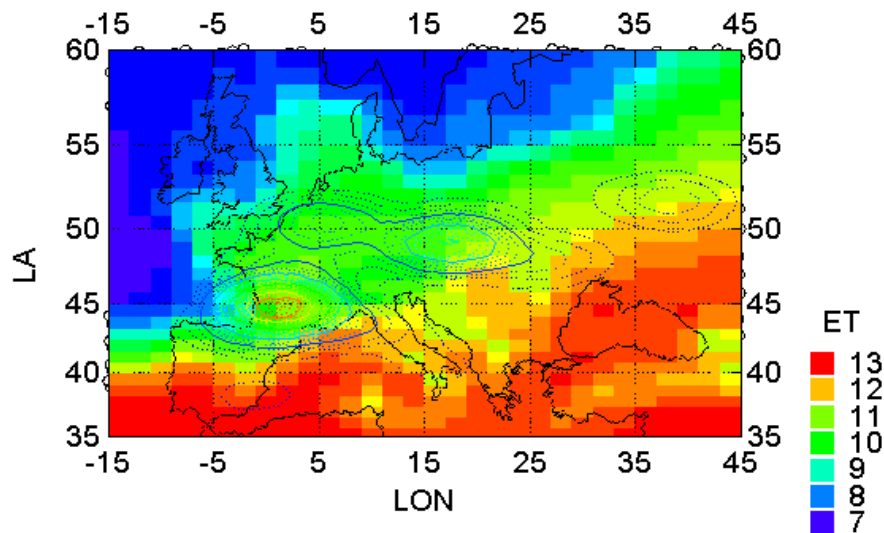
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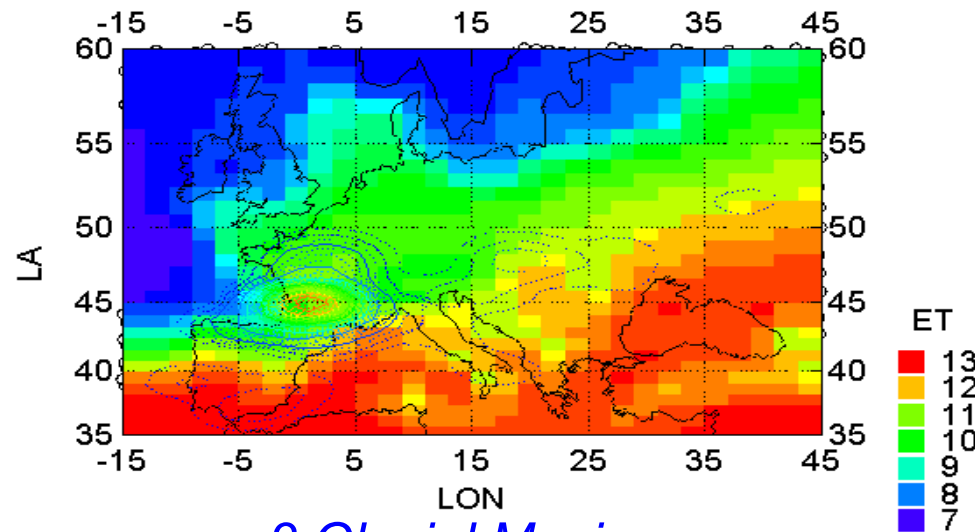
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 1. roughly identical to that of the distribution area of the archaeological sites that these populations produced (modeled)
 2. taking account the sea level variation
4. Back-projection of the growth rates onto the reference demographic density

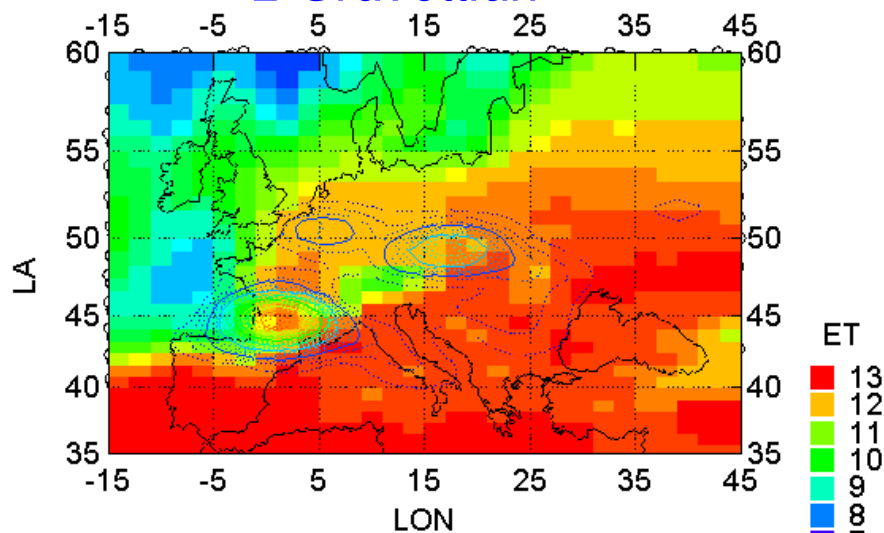
Densities of archaeological sites (and simulated ET)



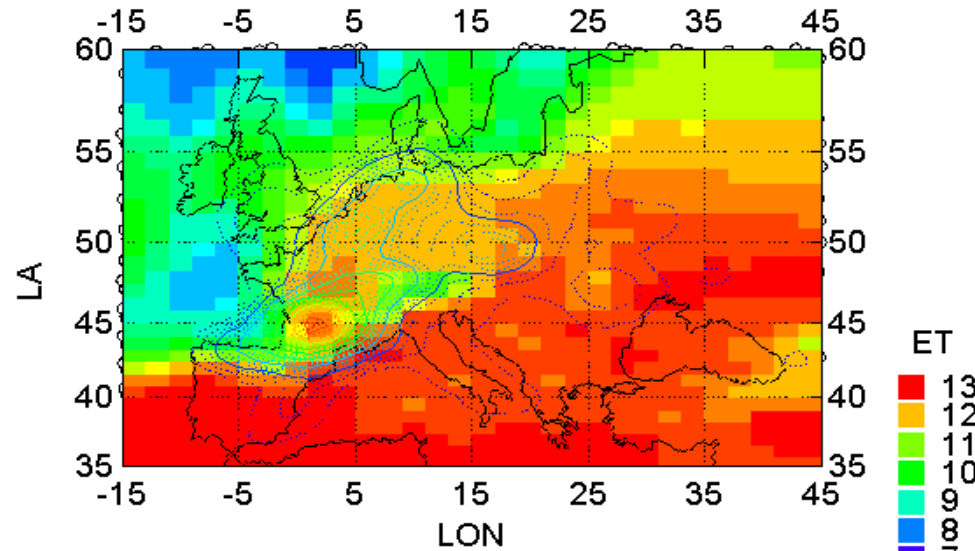
2 Gravettian



3 Glacial Maximum

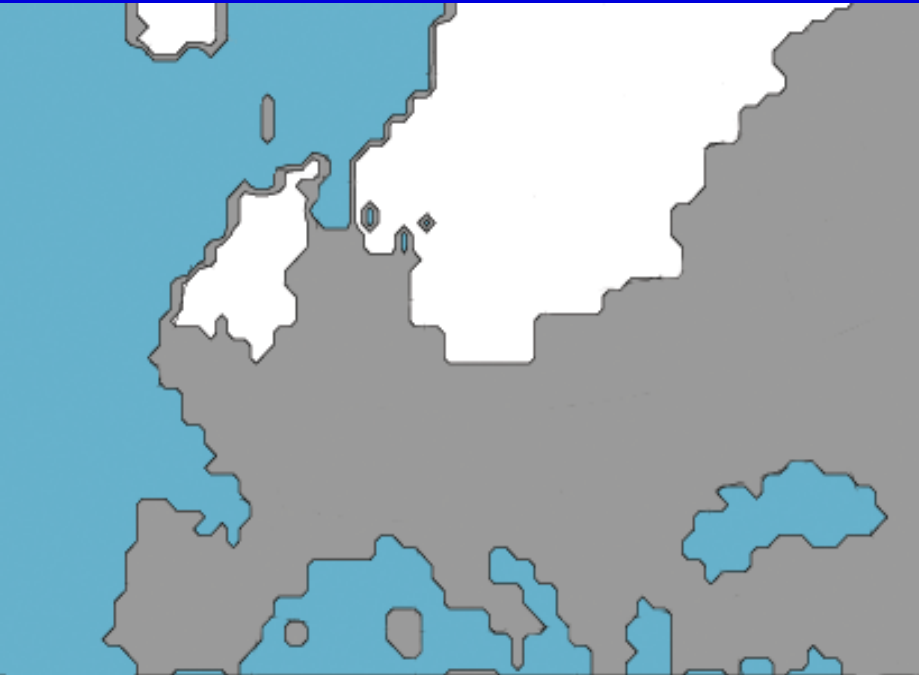


1 Aurignacian

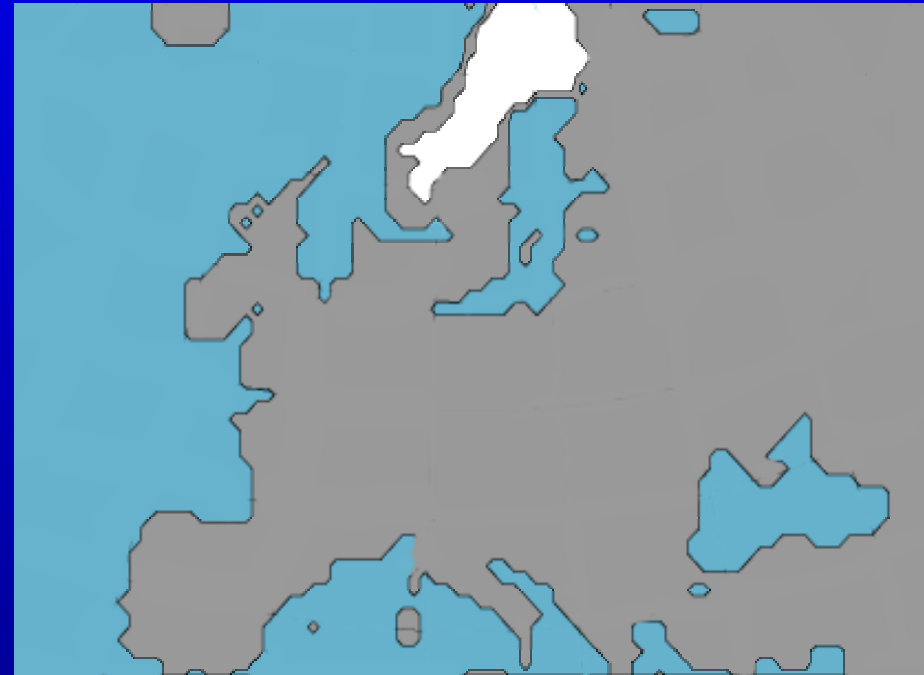


4 Late Glacial

Maps of IOS3 simulations



21 KY BP



« Warm » episode

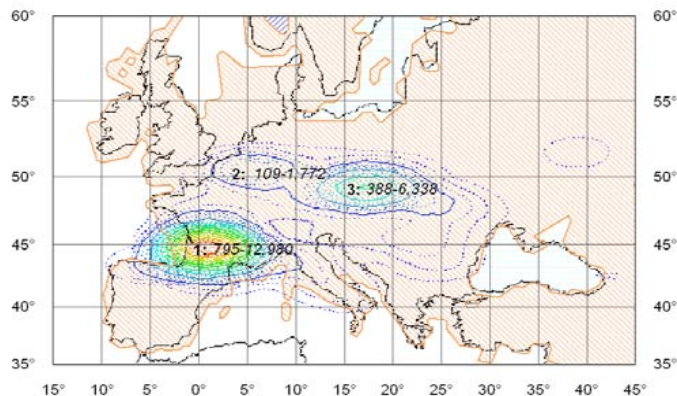
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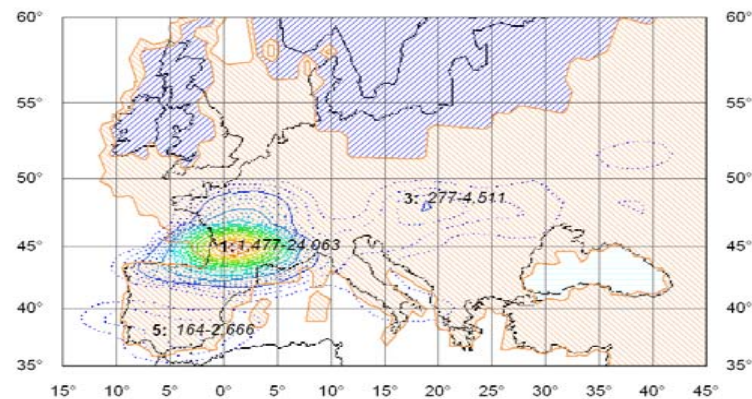
	<i>Average</i>	<i>- IC47.5%</i>	<i>+ IC47.5%</i>
<i>Aurignacian</i>	4.424	1.738	28.359
<i>Gravettian</i>	4.776	1.879	30.589
<i>Glacial Maximum</i>	5.885	2.313	37.693
<i>Late Glacial</i>	28.736	11.343	72.635

Estimates of the regional distribution of the metapopulation

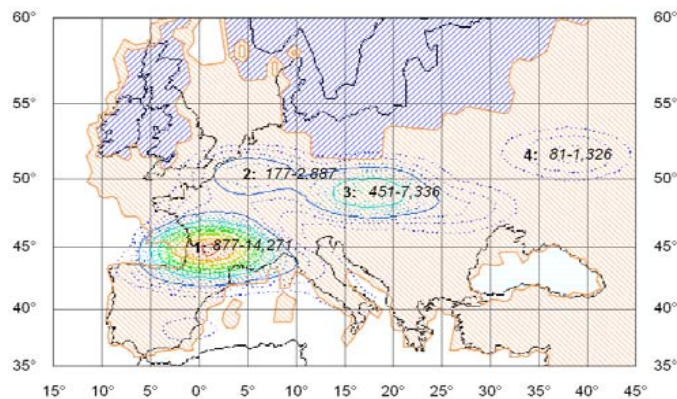
1 A



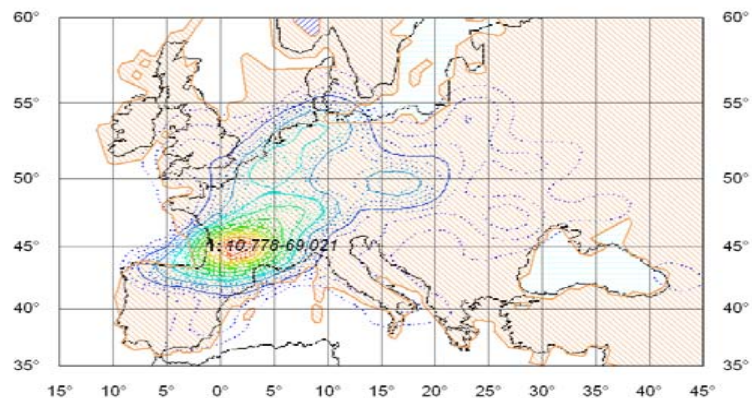
3 M



2 G



4 T



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- At the European scale, the data suggest a metapopulation numerically very small and subdivided in only 3 or 4 regional populations.
- The archaeological data show traces of a considerable population expansion during the Late Glacial. The most likely candidates as the sources of the expansion are the Aquitaine and the Cantabrian Pyrenean zones.
- The genetic and linguistic data both point to the same geographical regions. There are grounds for considering that the Aquitaine and French-Cantabrian refuge zone, may have been the principal source of Late Glacial re-colonisation.
- Palaeodemography and linguistic