Modelling population dispersal and language origins during the last 120,000 years

Professor Harald Sverdrup

Lund Universtity, Sweden

Purpose

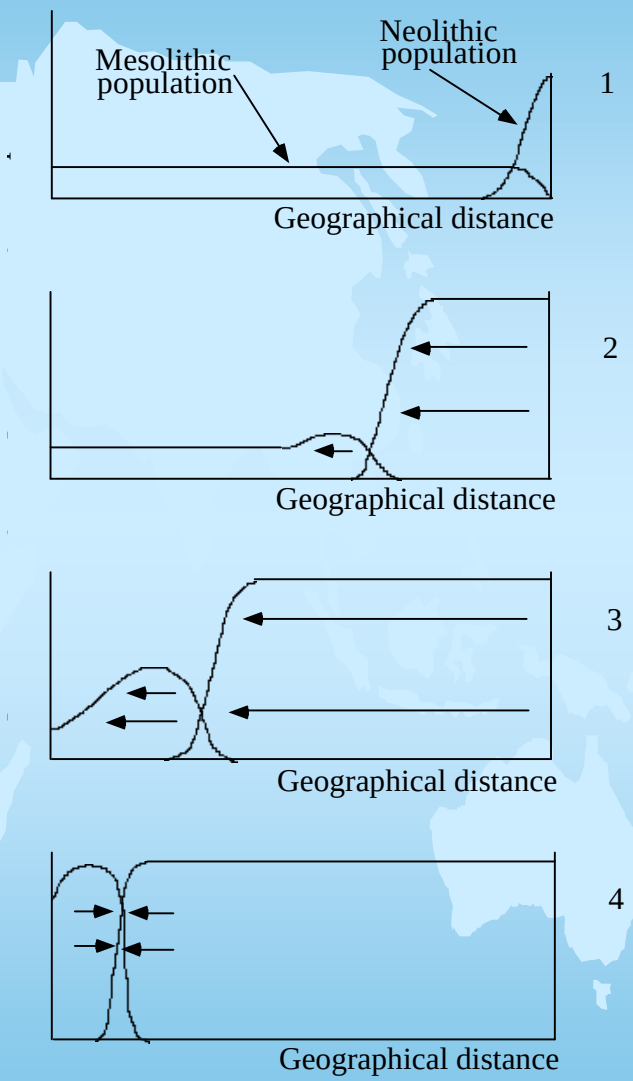
- Model the dispersal of humans out of Africa
- Model the divergence of language with time
- Investigate the impact of agriculture on archaic language distribution patterns

Method and basics

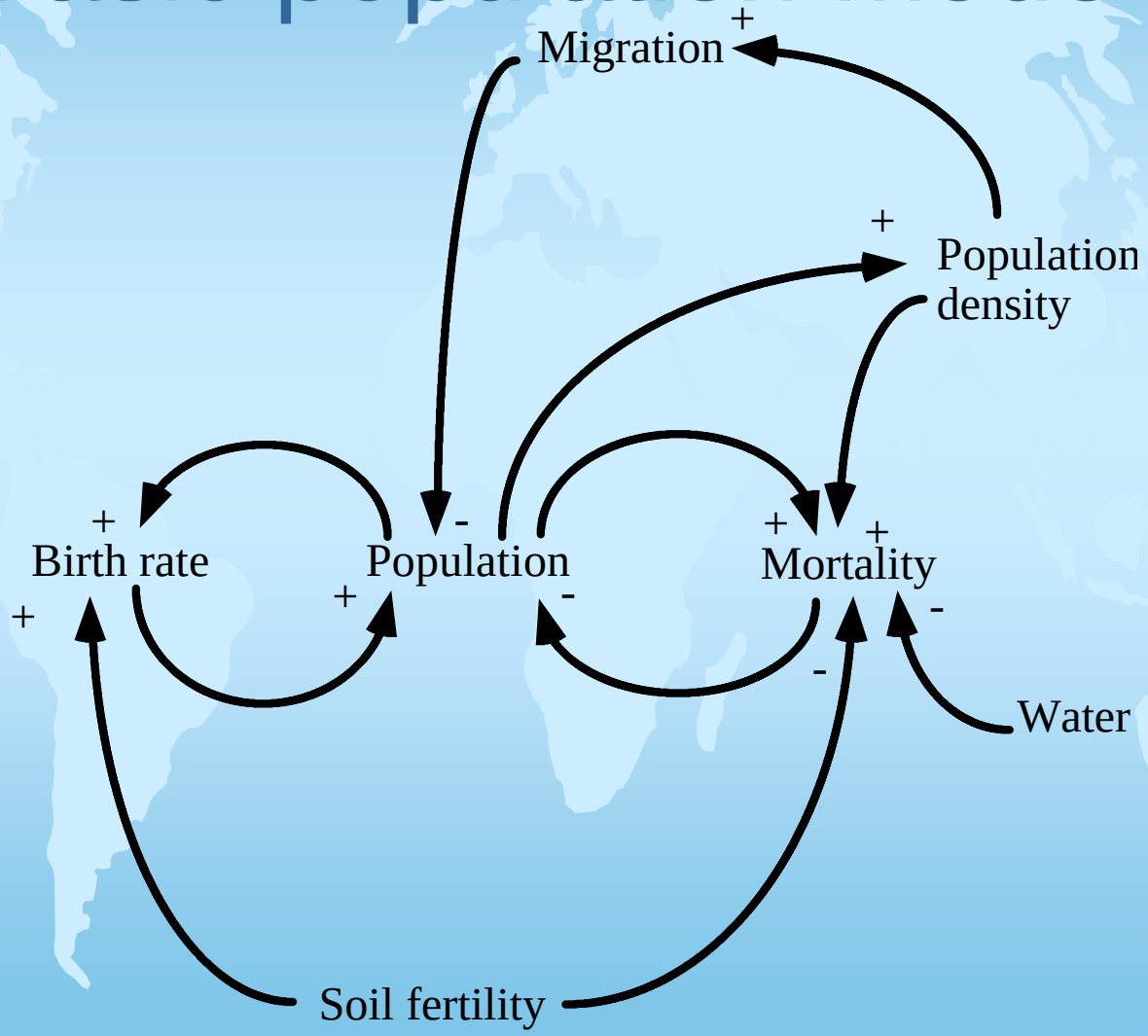
- Demic diffusion
- Substrate supported population growth
- Environmental regulation of growth intensity
- Distributed mathematical model
- STELLA modelling environment

Demic diffusion

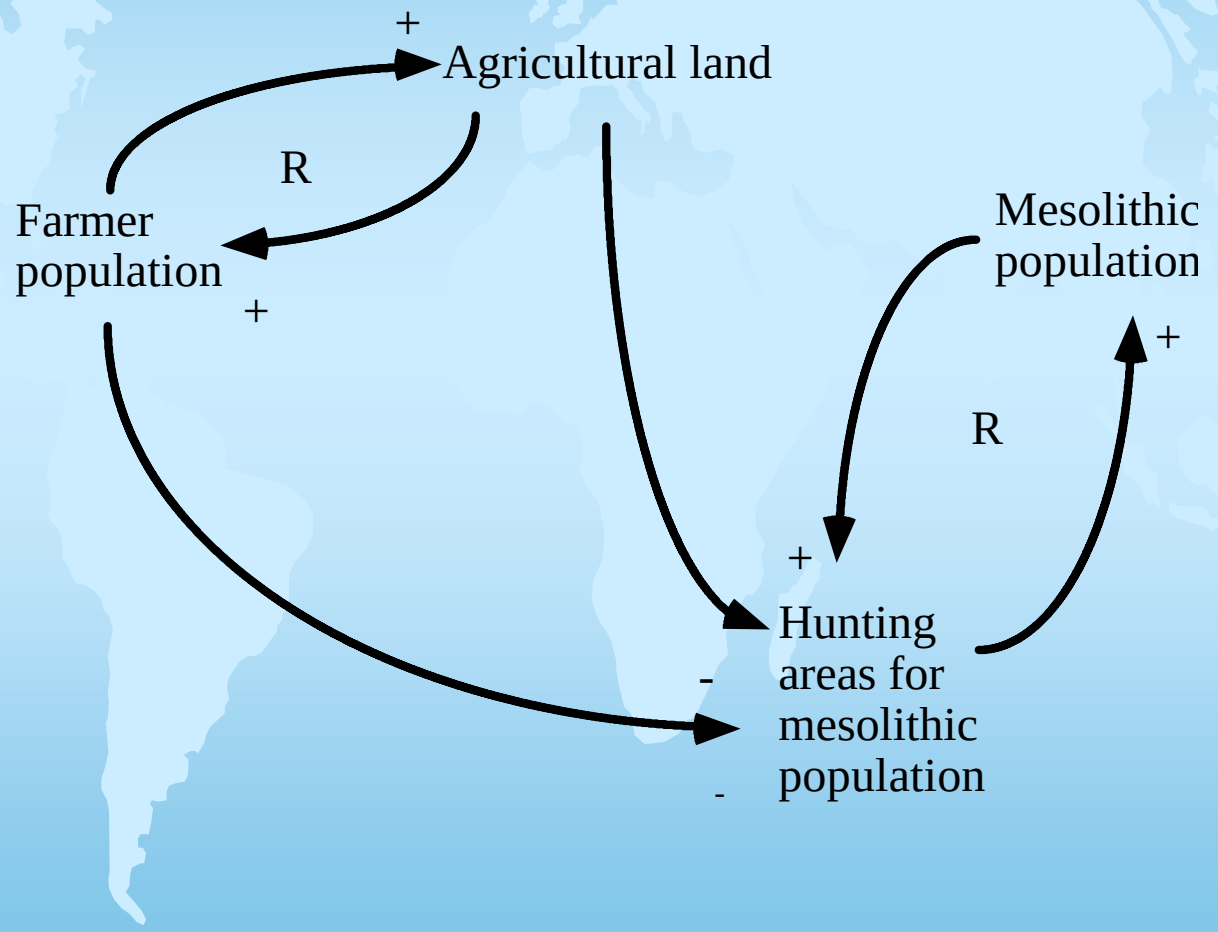
When the nucear area reaches saturation density, then a wave of advance starts to propagate Outward from the core area. The rate is approximately 1,000 km per millennium on flat plains, but the rate slows down significantly under difficult environmental conditions and rough topography



Basic population model



The competition model



Essential equations

For each geographic element, we have:

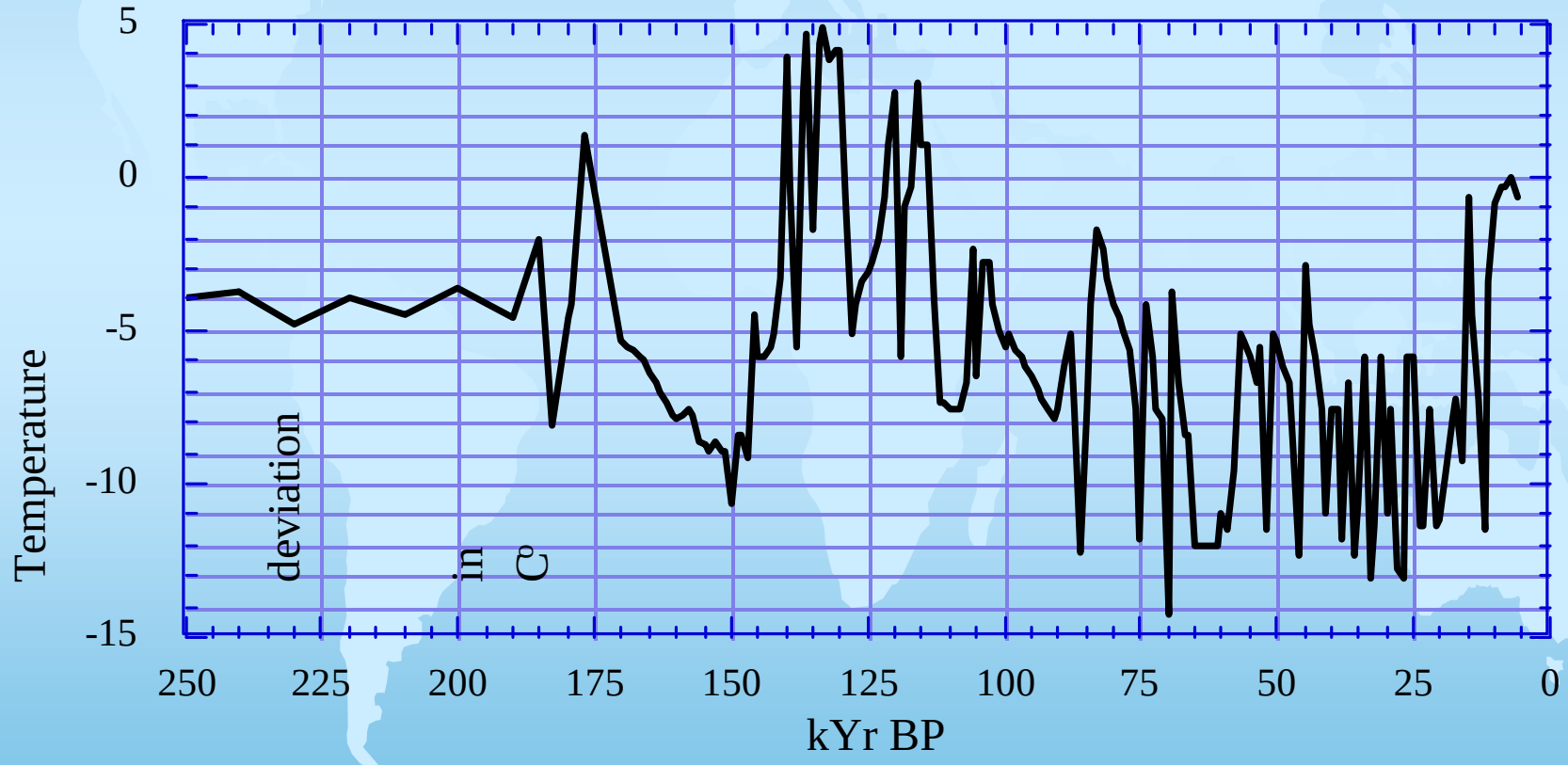
$$p/\ t = \text{increase} + D(in) - D(out) + \text{growth} + \text{migration}$$

The general equation of continuity leads to:

$$p/\ t = D * \text{nabla}^2(p) + Q * \text{nabla}(p) + r$$

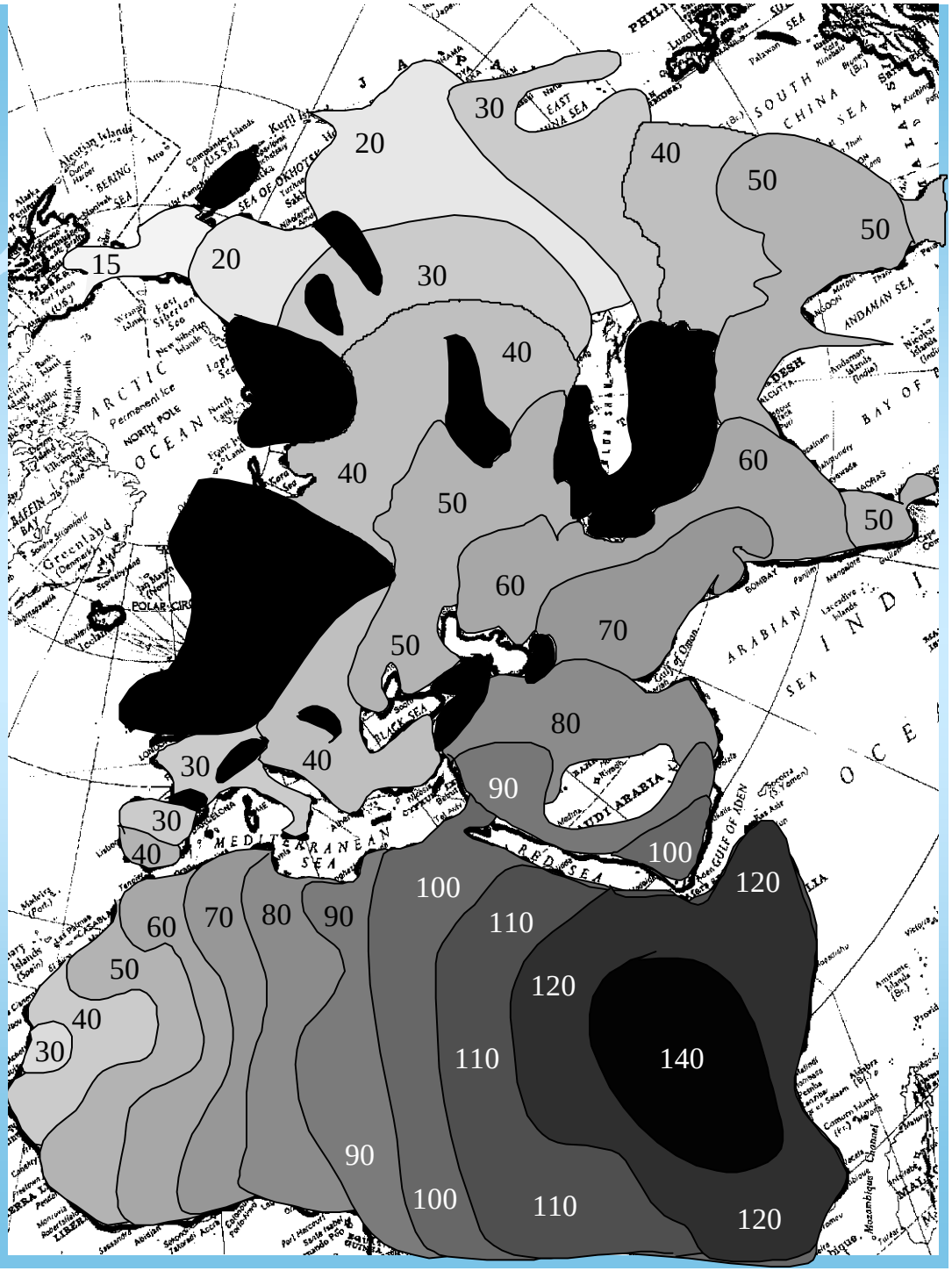
Population growth is modelled as a first order growth equation with balancing and rate modifying terms

Global temperature

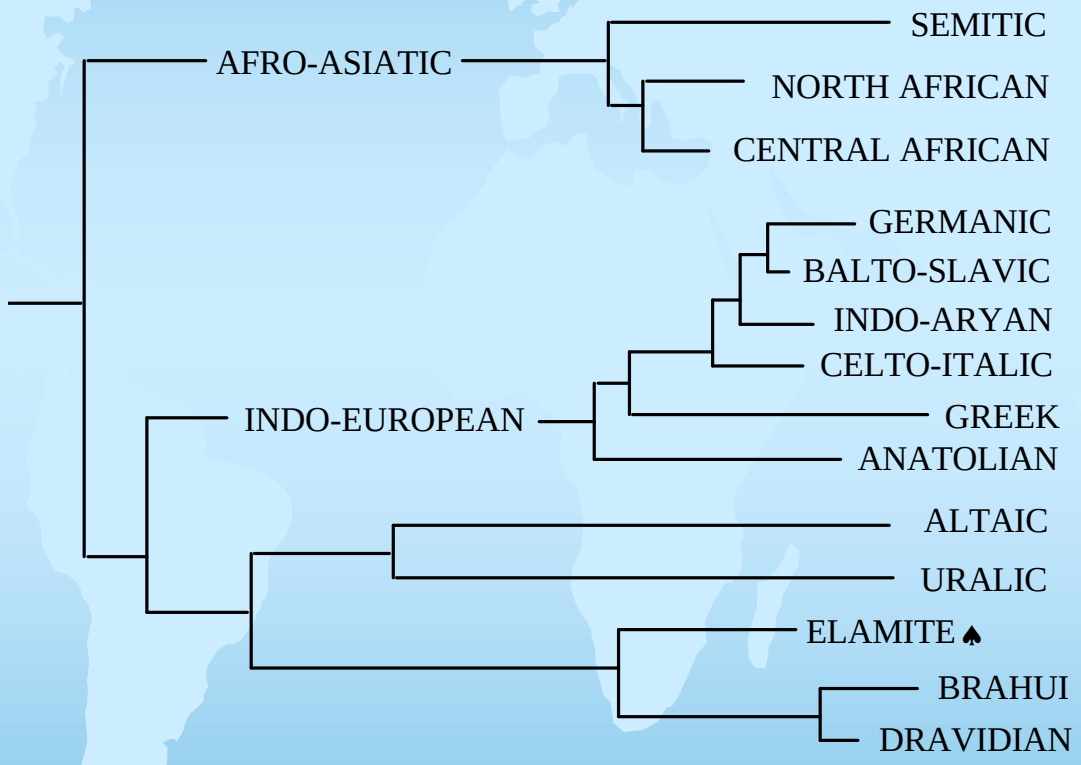


The great icesheets

Computer simulation for the time from 120,000 BC to 10,000 BC

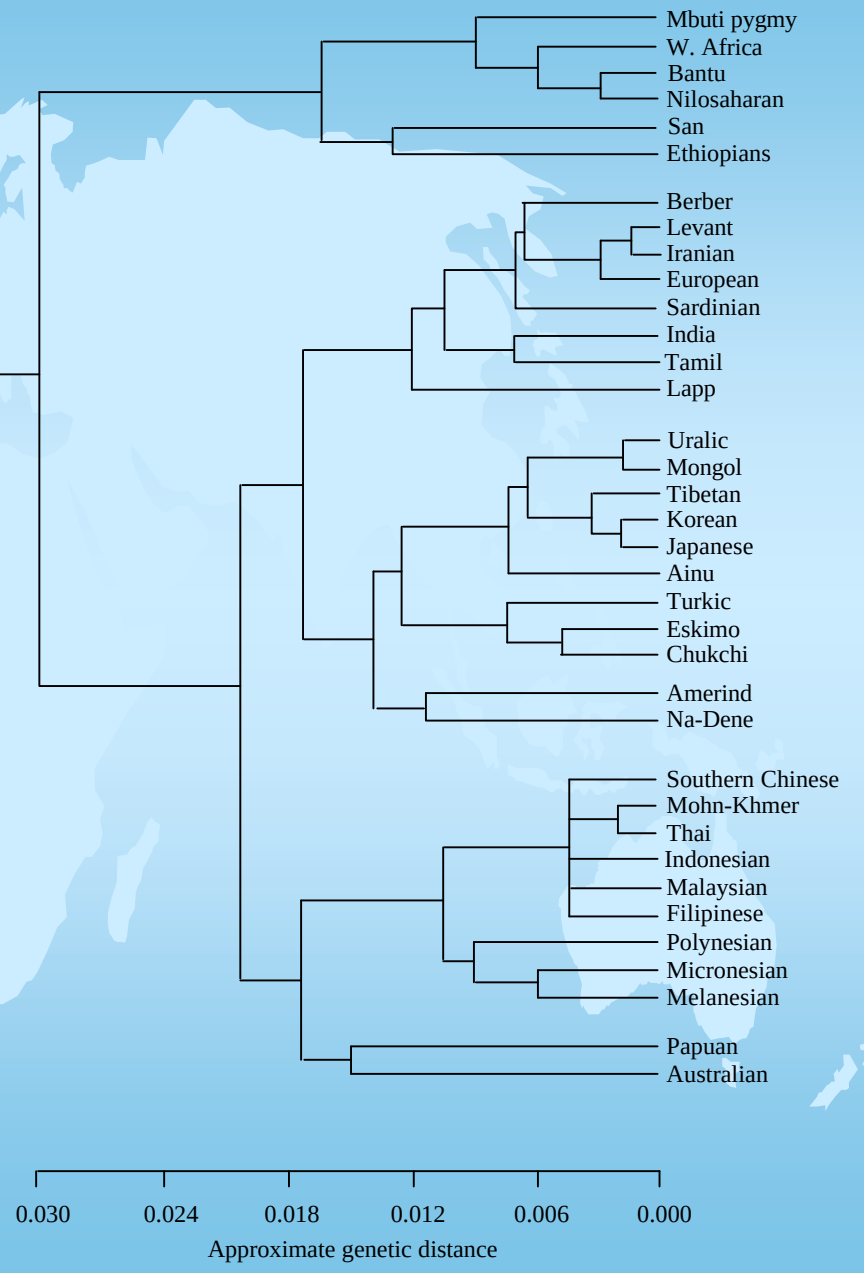


Nostratic according to model

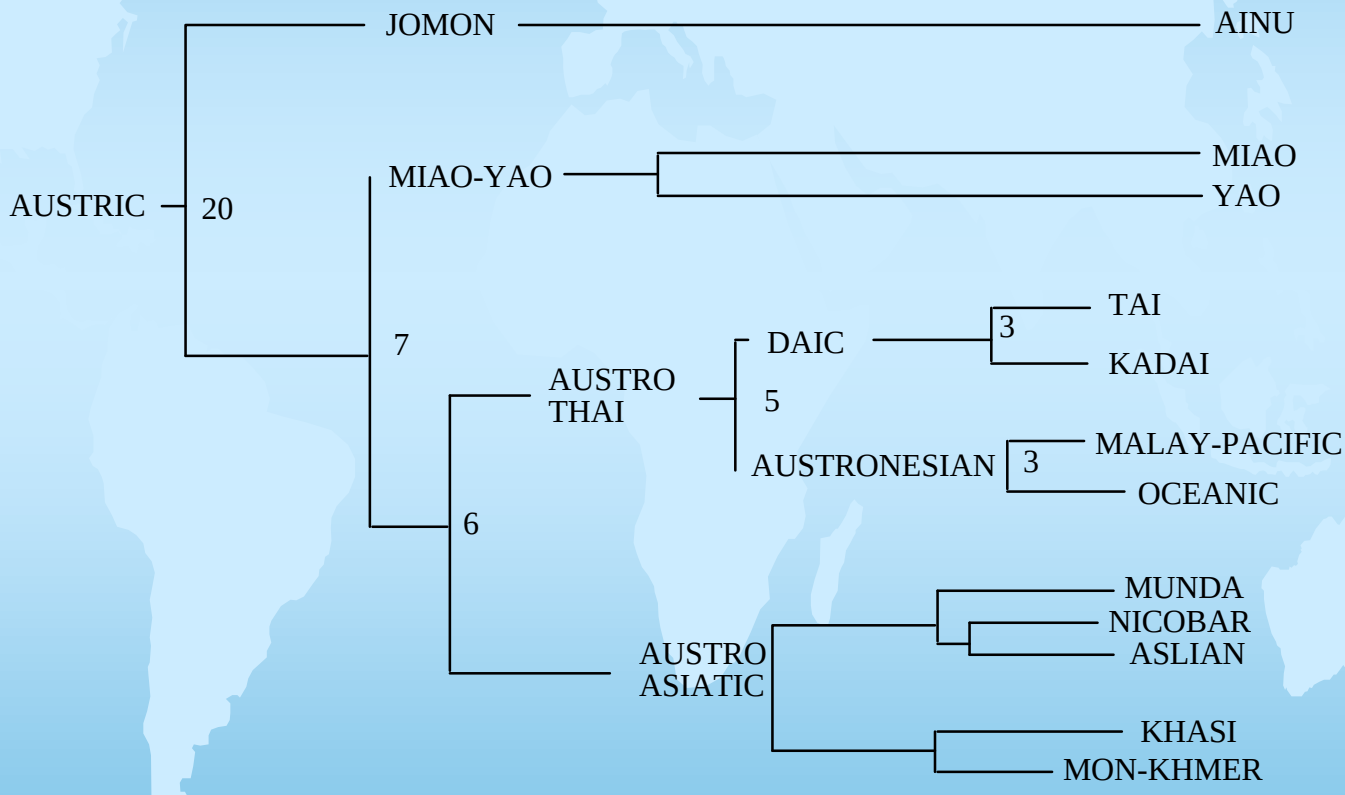


Genetic data

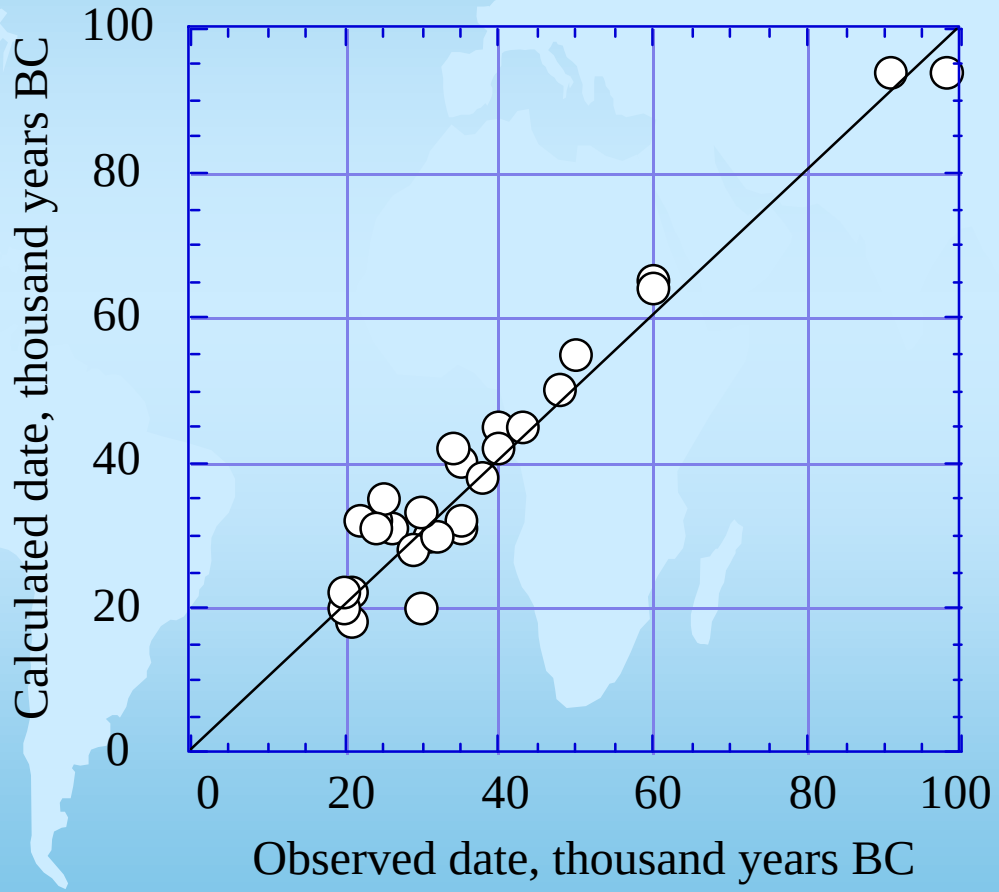
Cavalli-Sforza et al. 1994



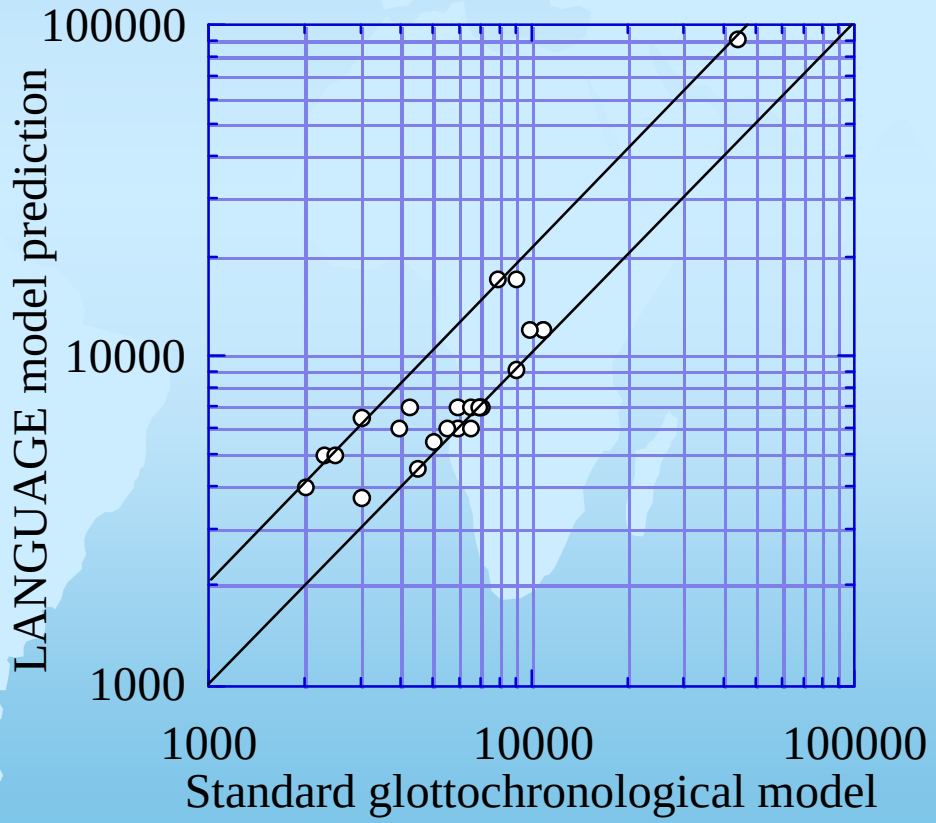
Austric according to the model



Testing on time of initial arrival to an area



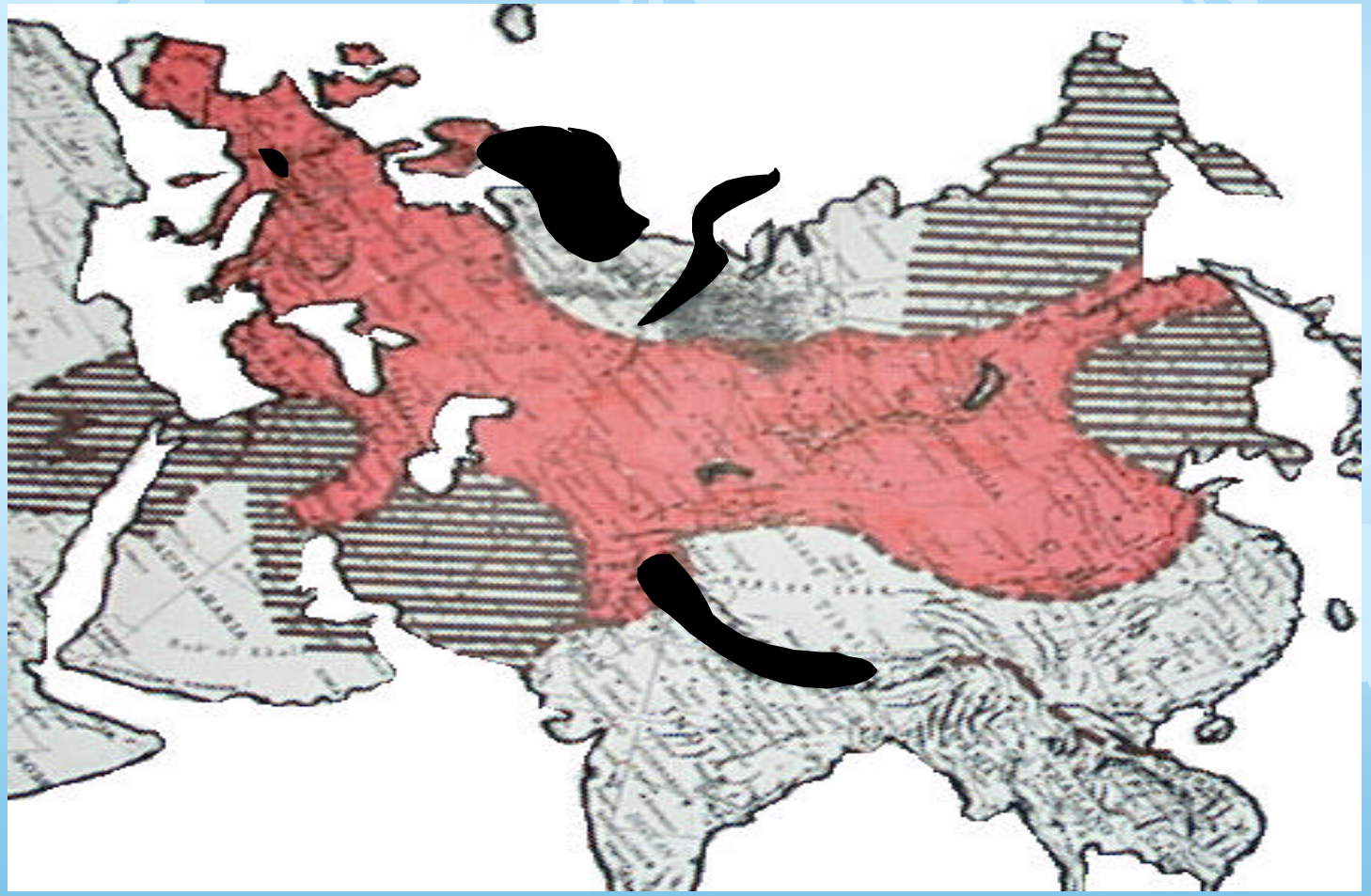
Testing against glottochronology



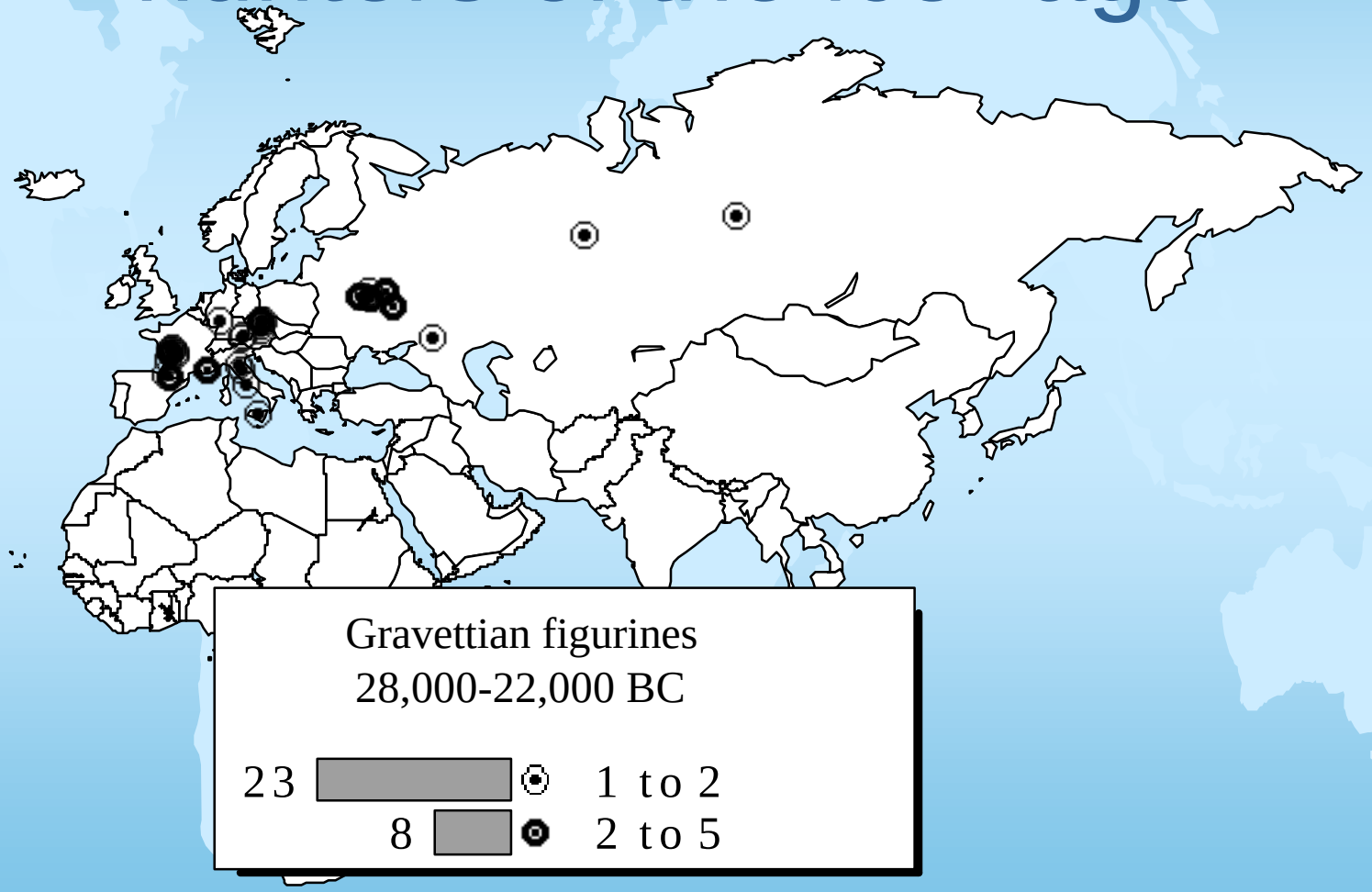
MacroCaucasian in 40,000 BC

MacroCaucasian in 30,000 BC

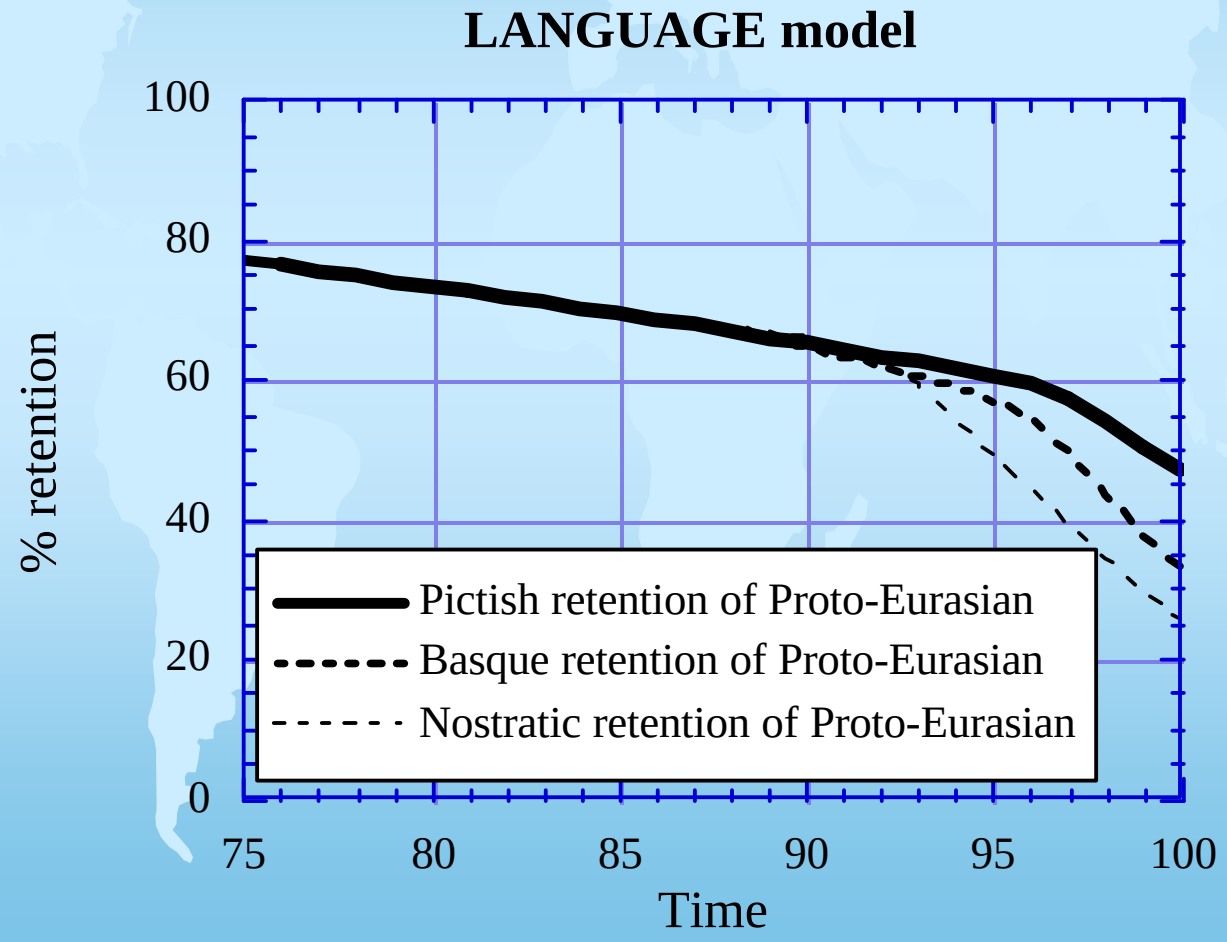
MacroCaucasian in 25,000 BC



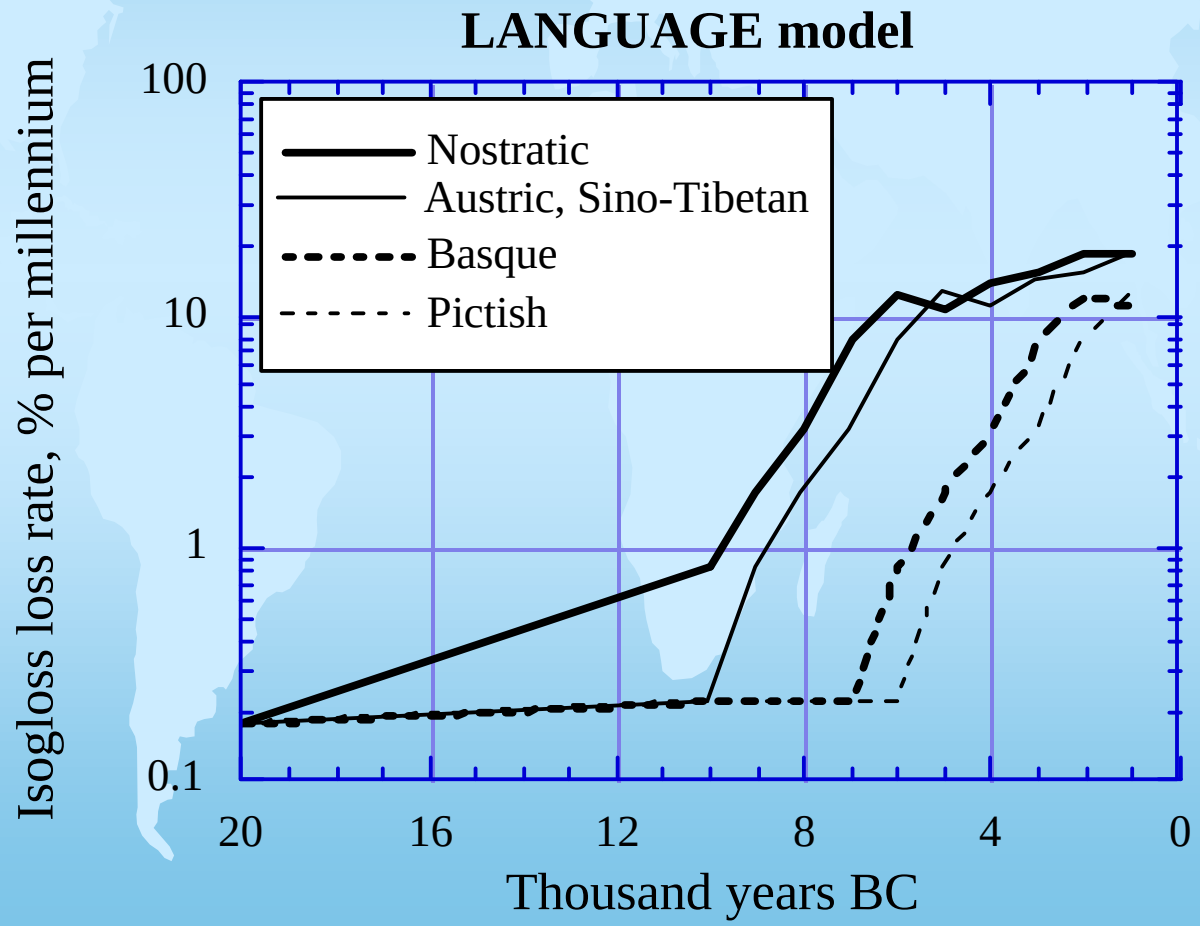
Gravettian, the reindeer hunters of the ice- age



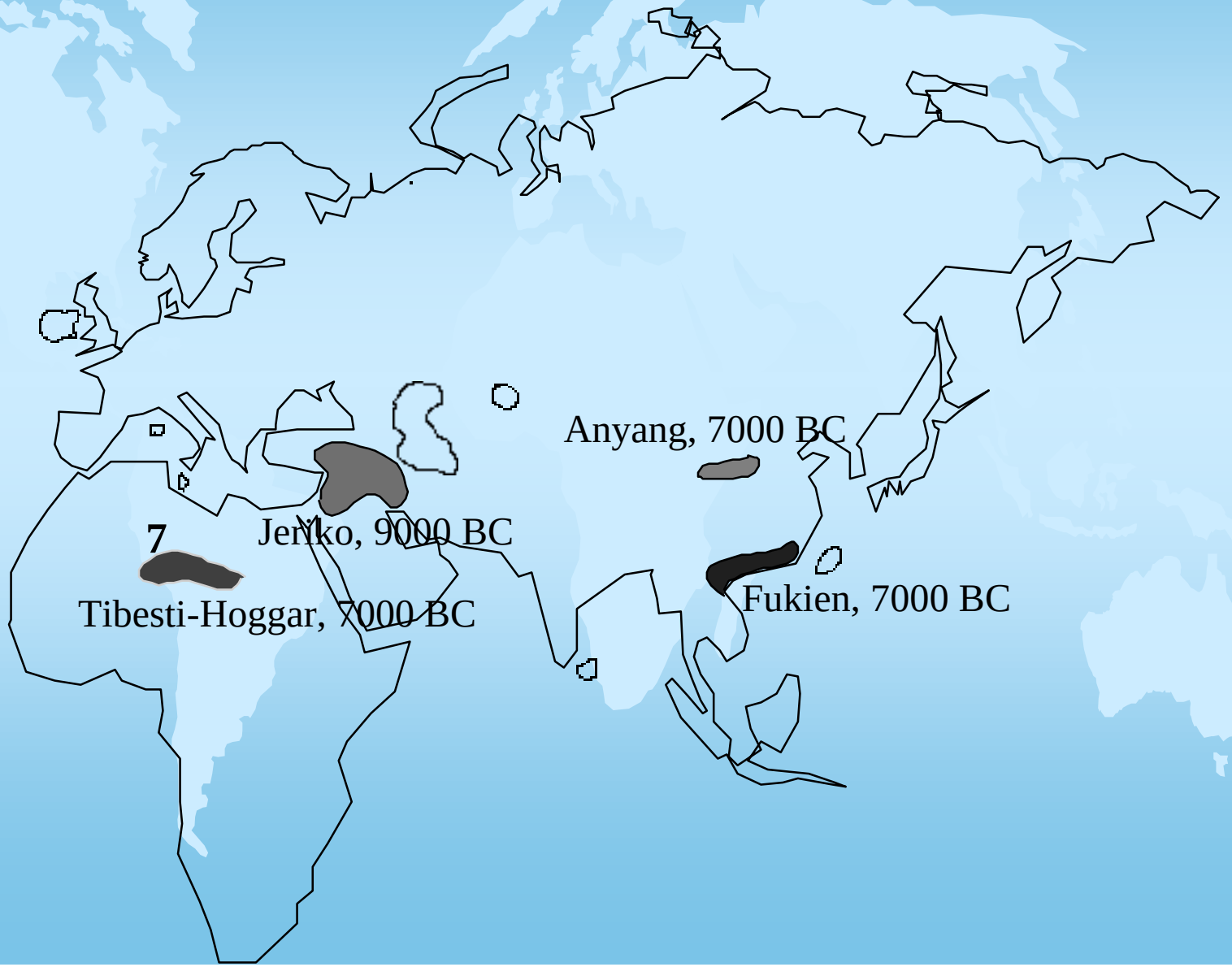
Calculated language divergence



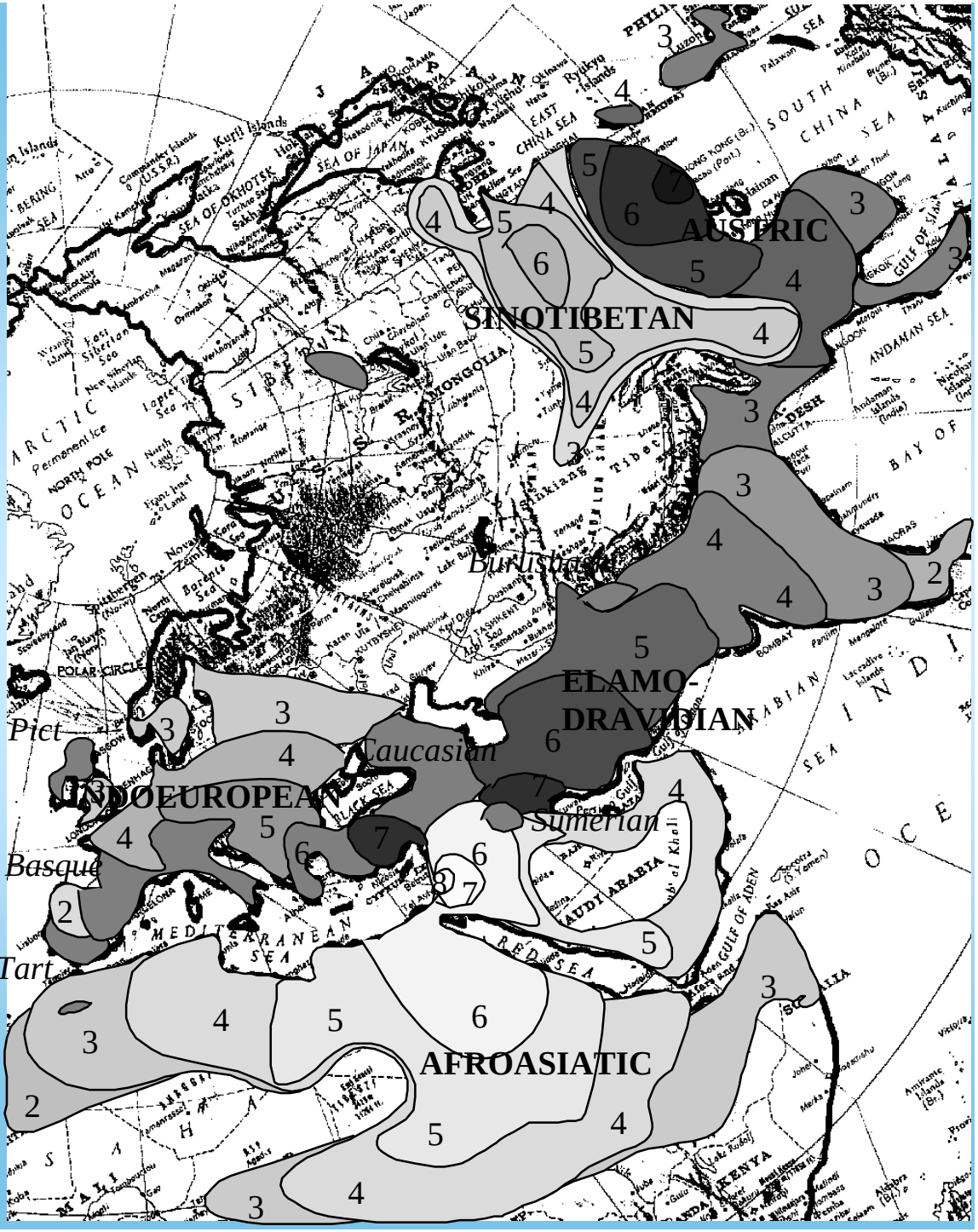
Calculation of similarity drift



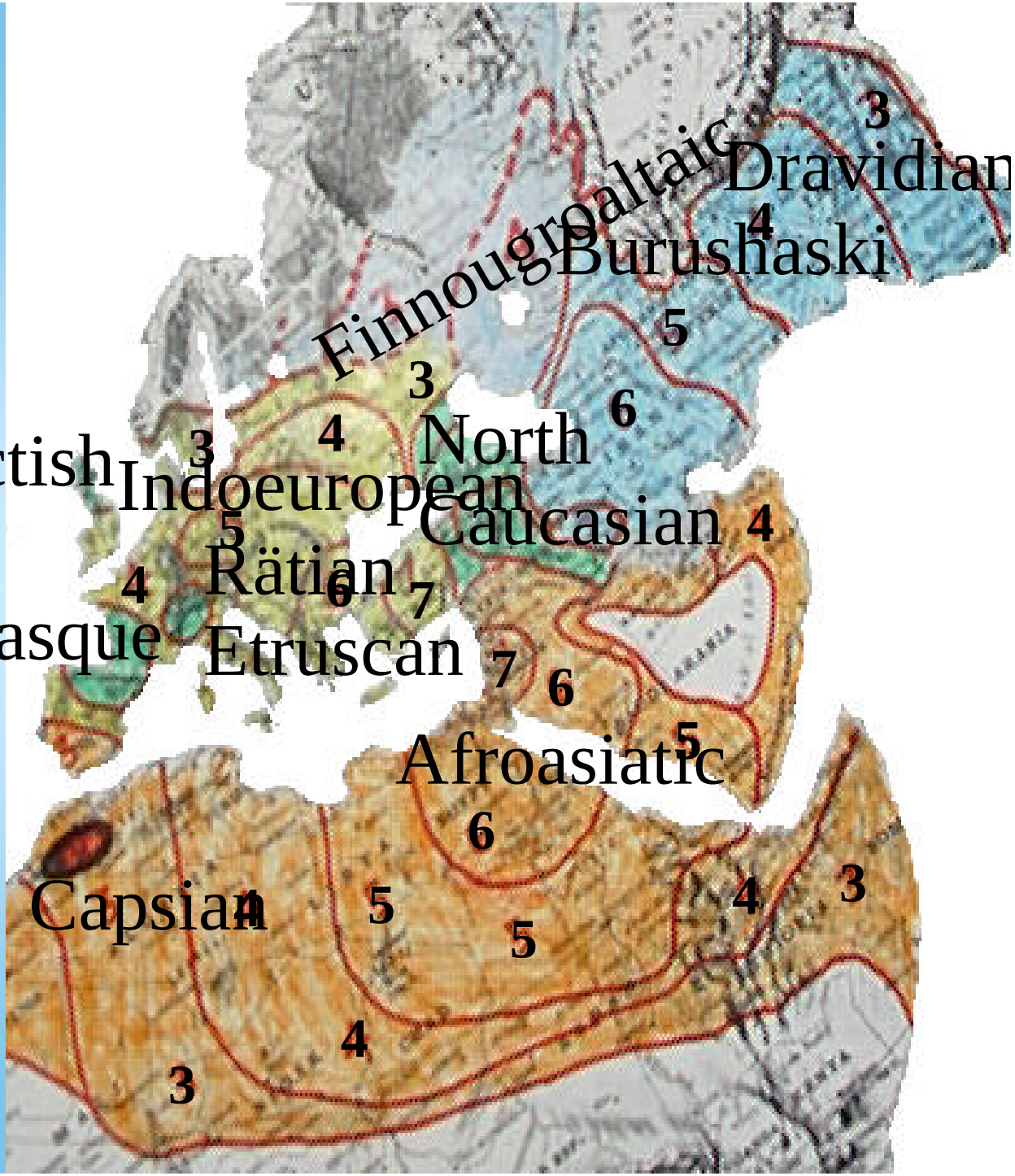
Starting positions 10,000 BC



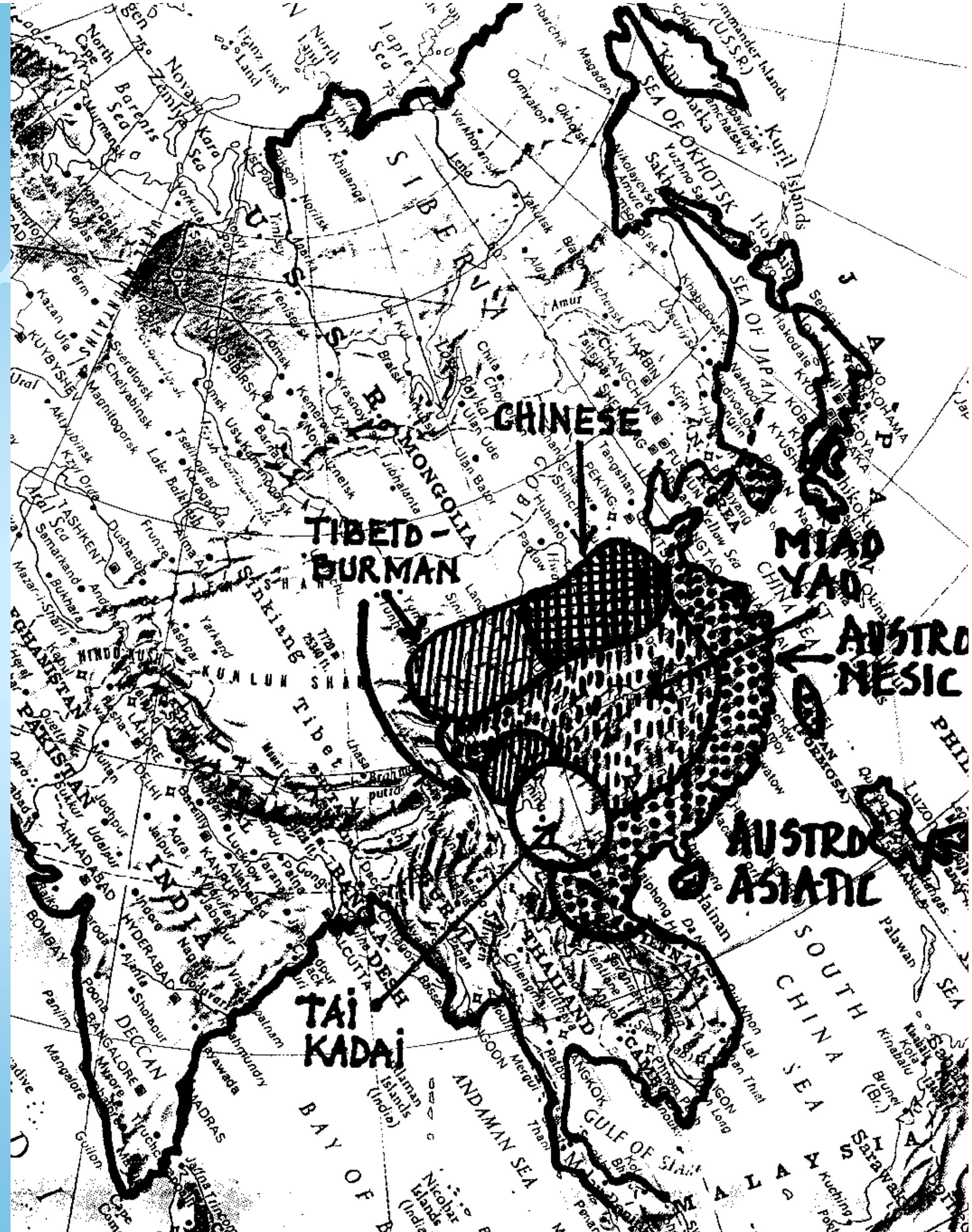
Enter agriculture; Simulation from 10,000 BC to 1,500 BC



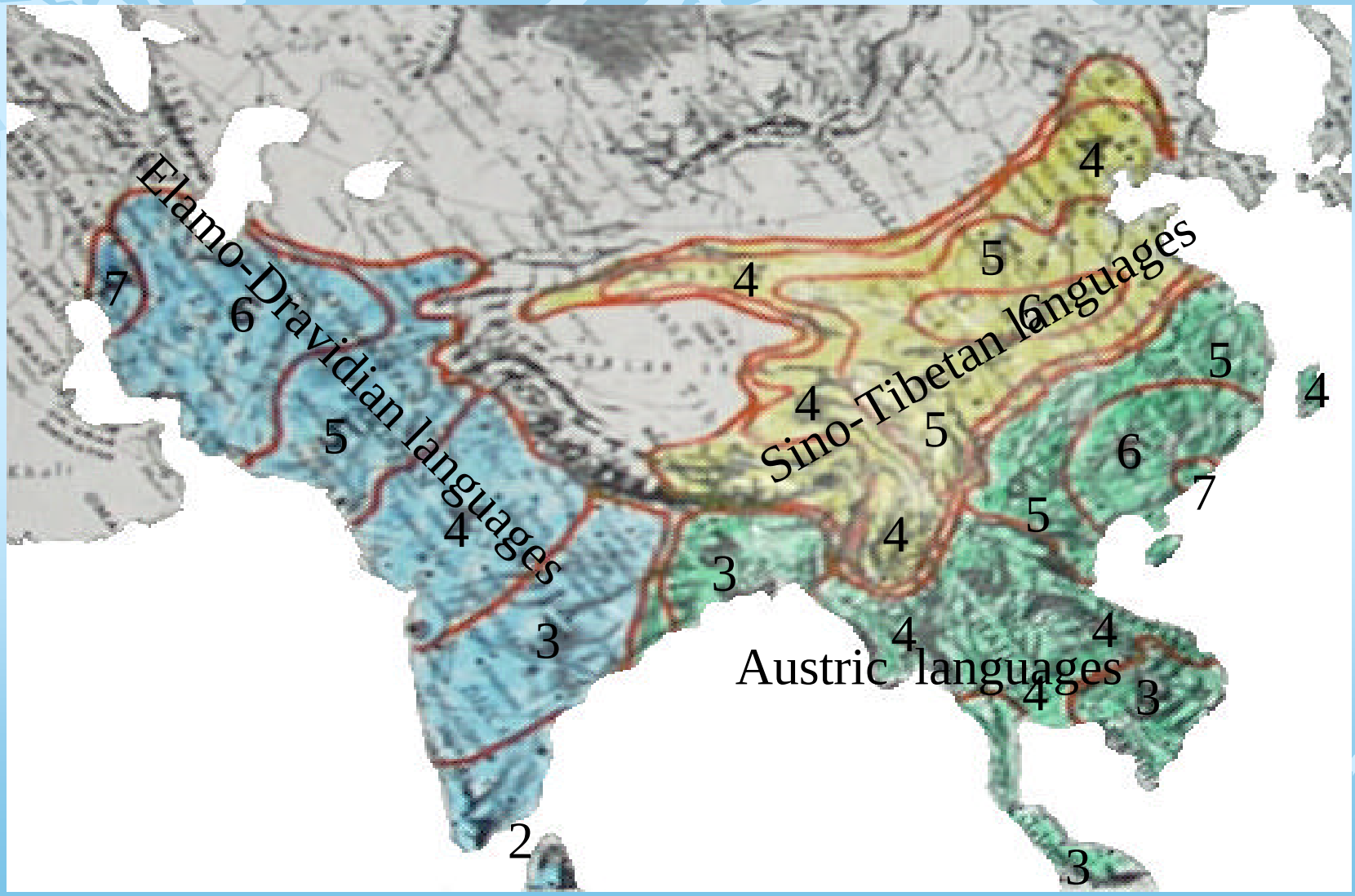
The spread of agriculture in the west color



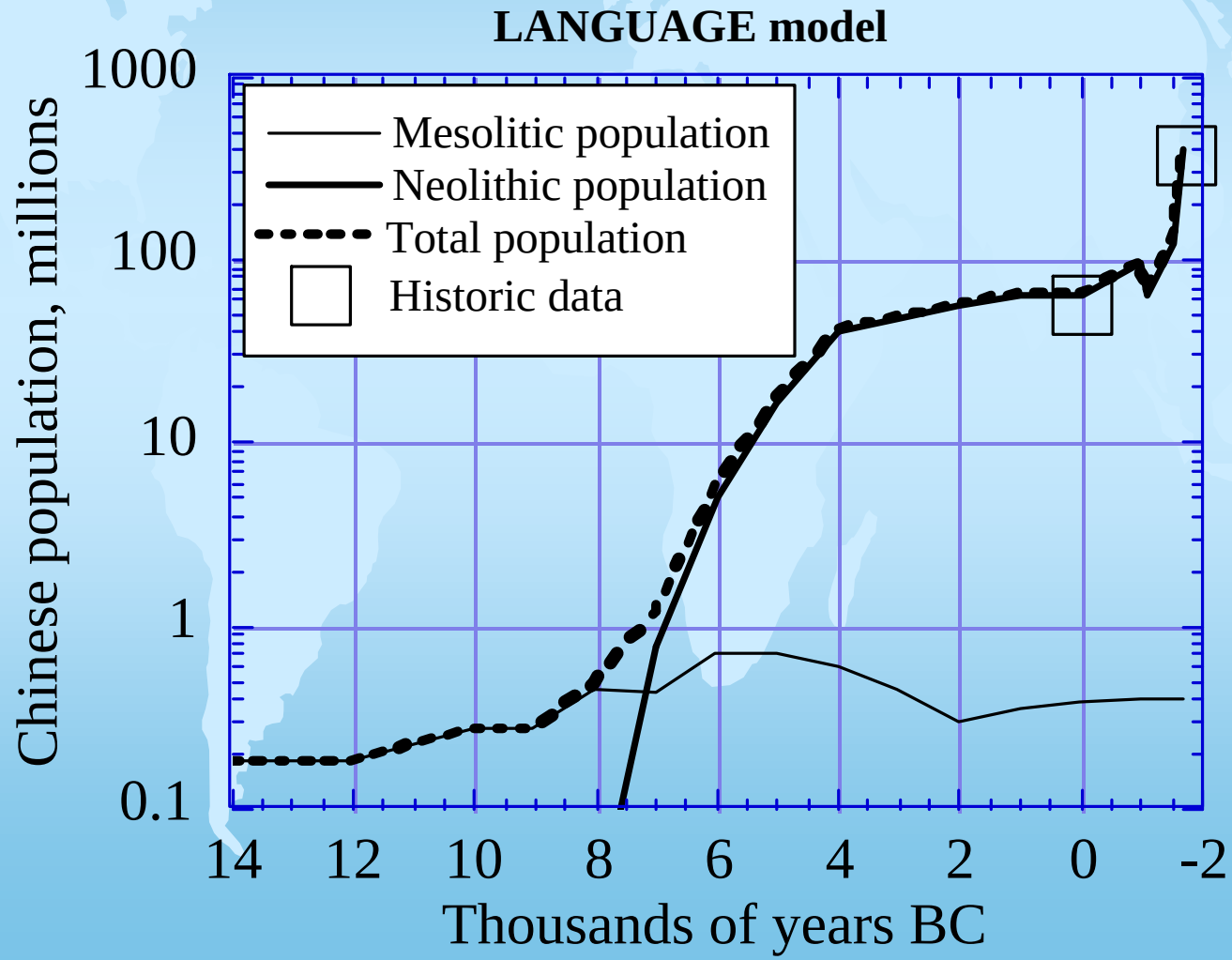
Initial positions in Far East Asia at onset of agriculture



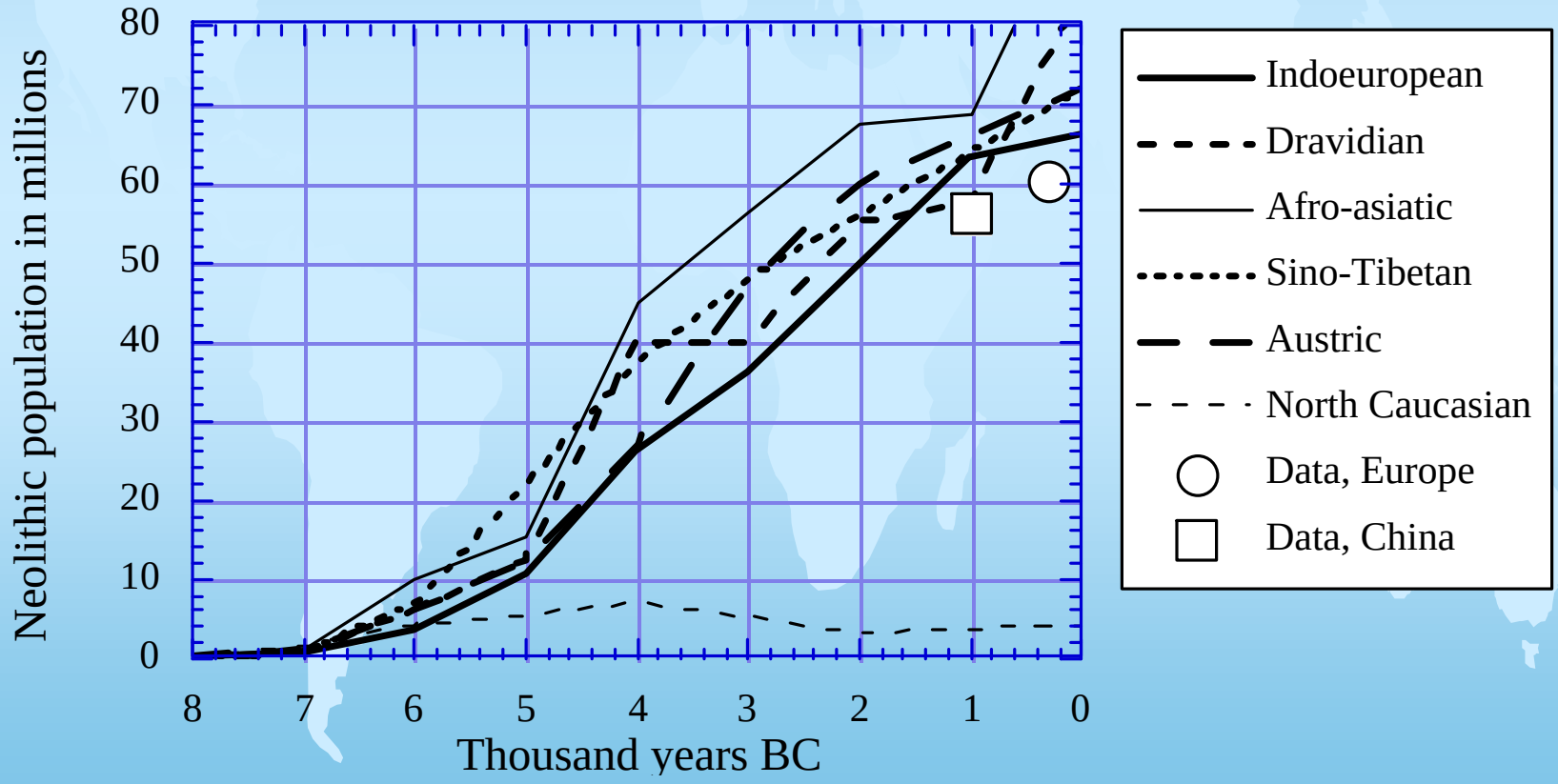
The spread of agriculture in Asia



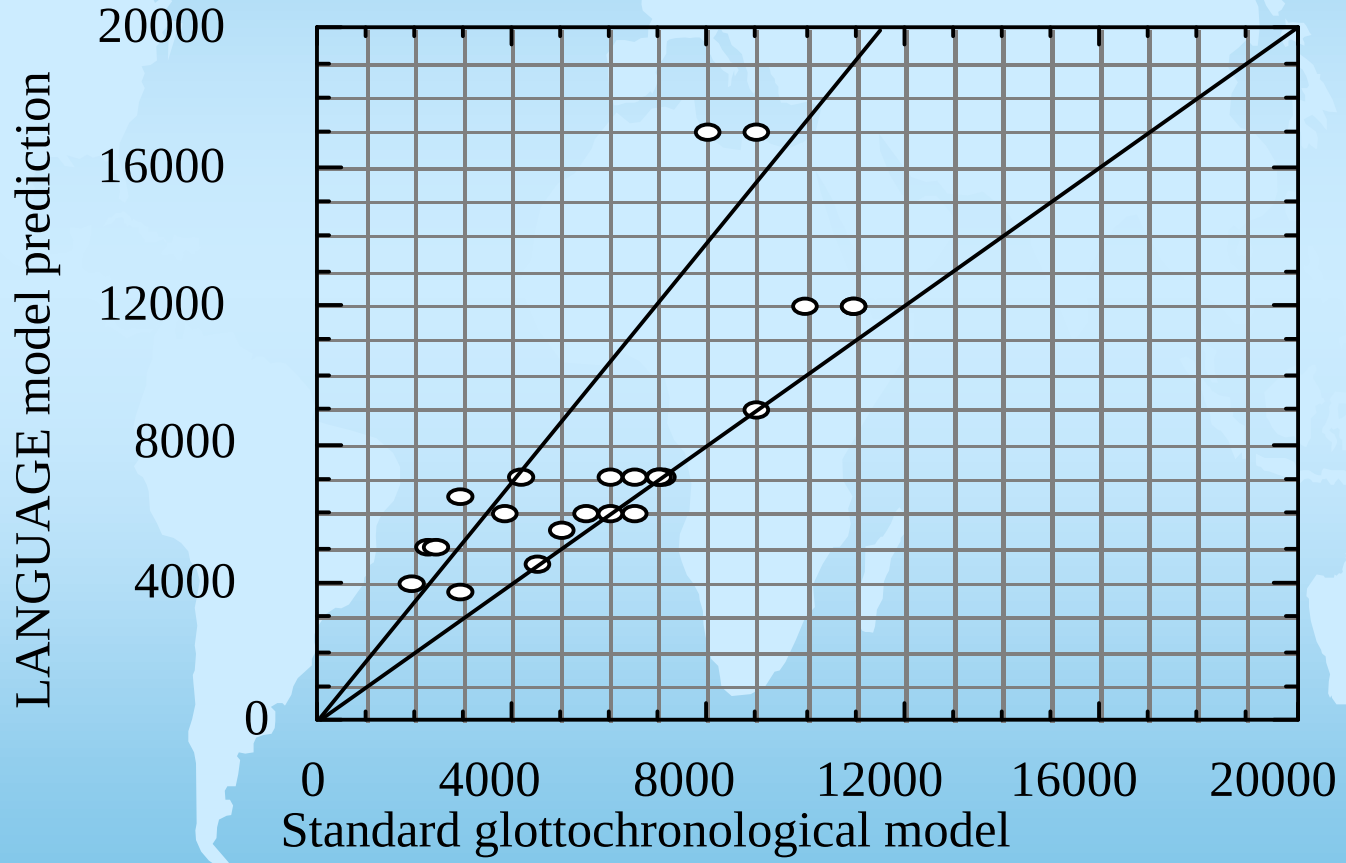
Population in China according to model



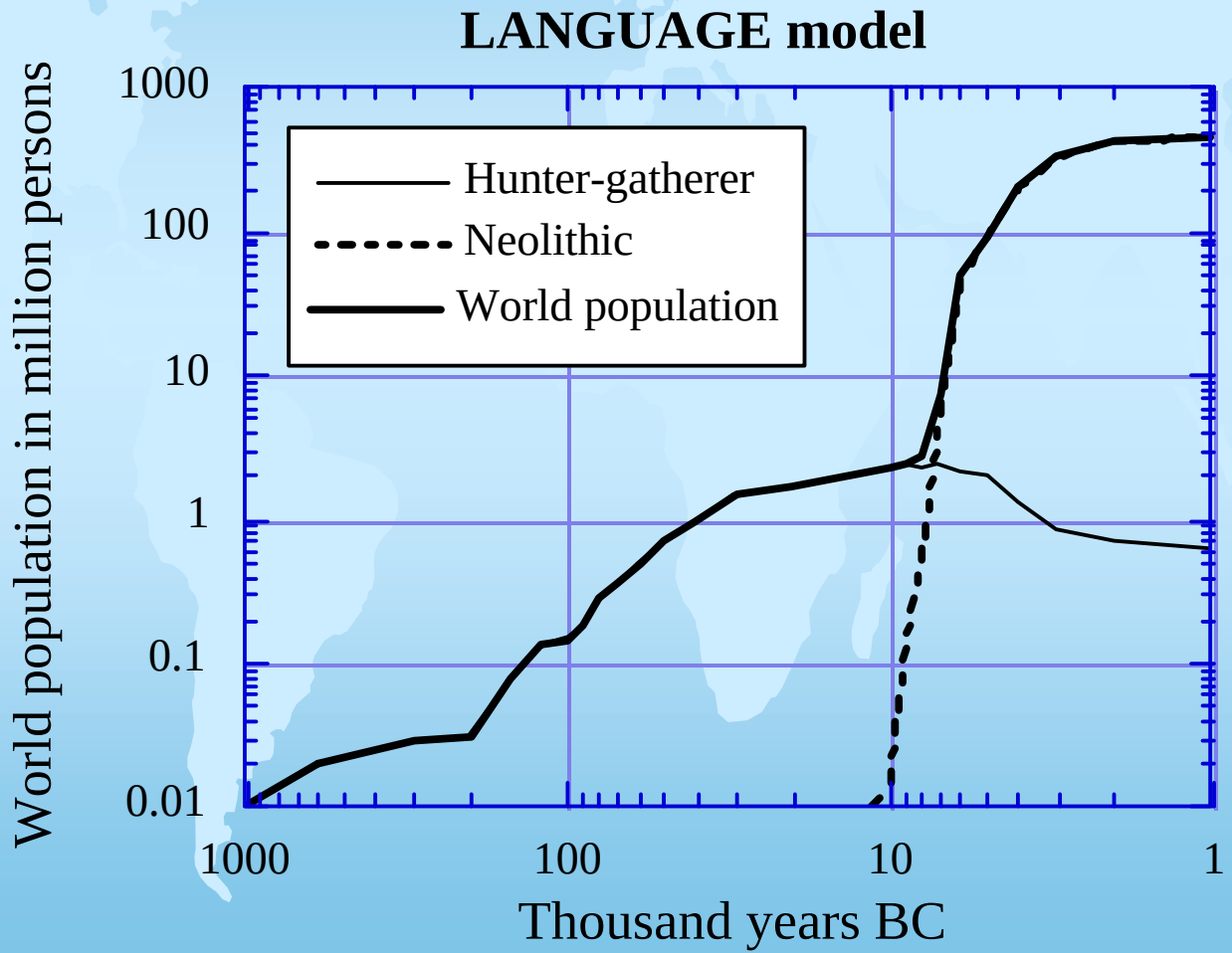
Calculated population numbers



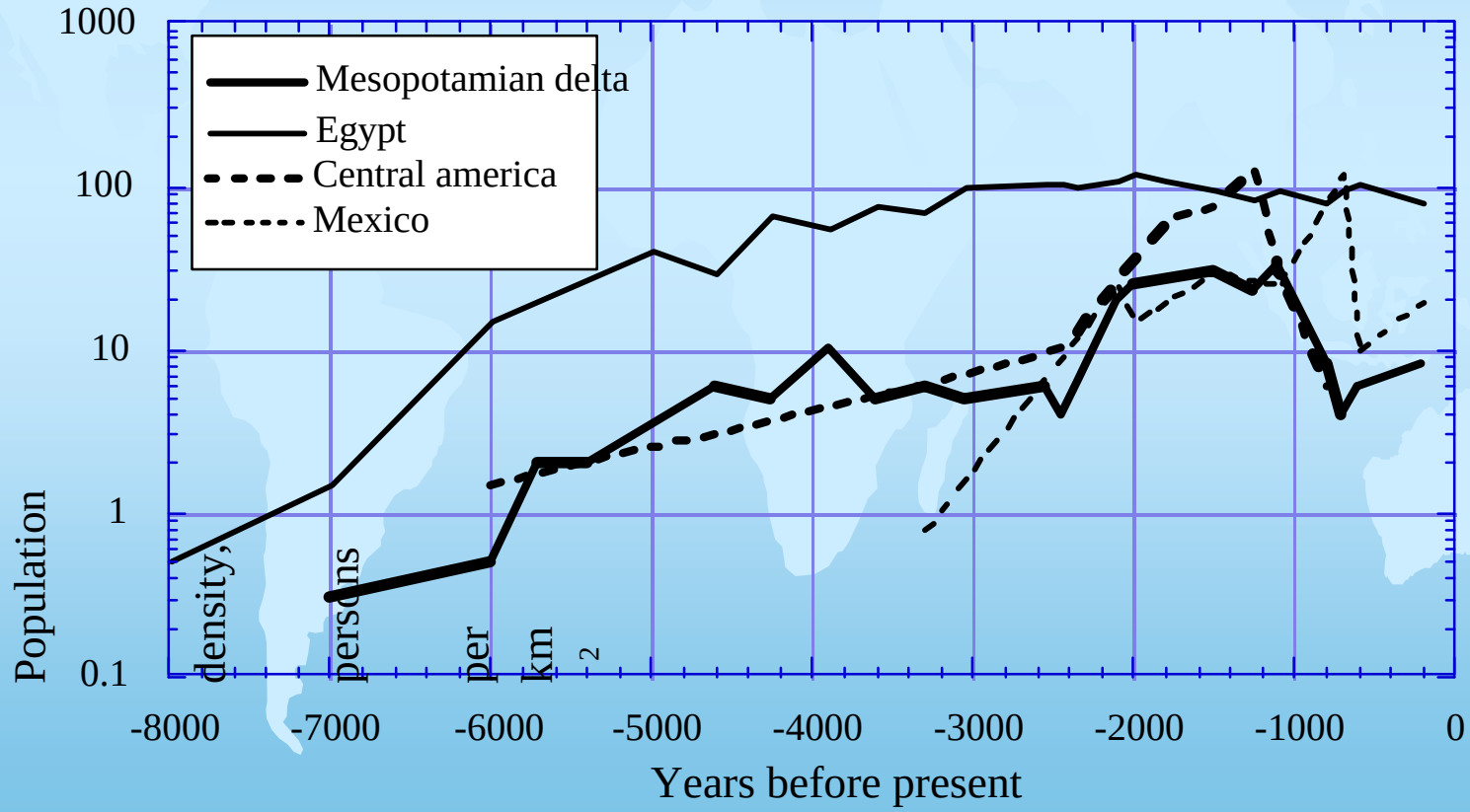
Test against glottochronology



The farmers outnumbered hunter-gatherers by 1:500

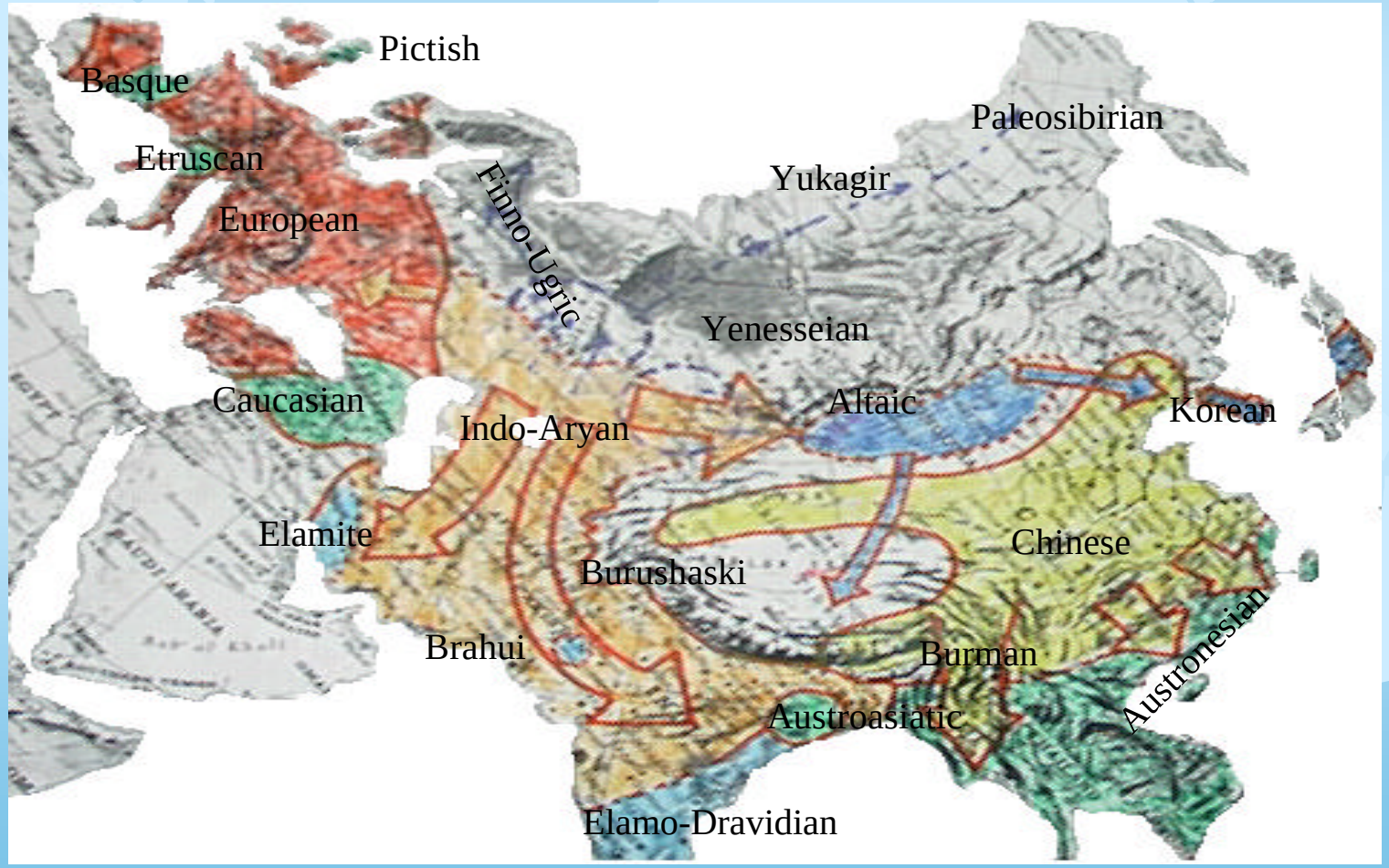


Observed population densisties in agricultural societies

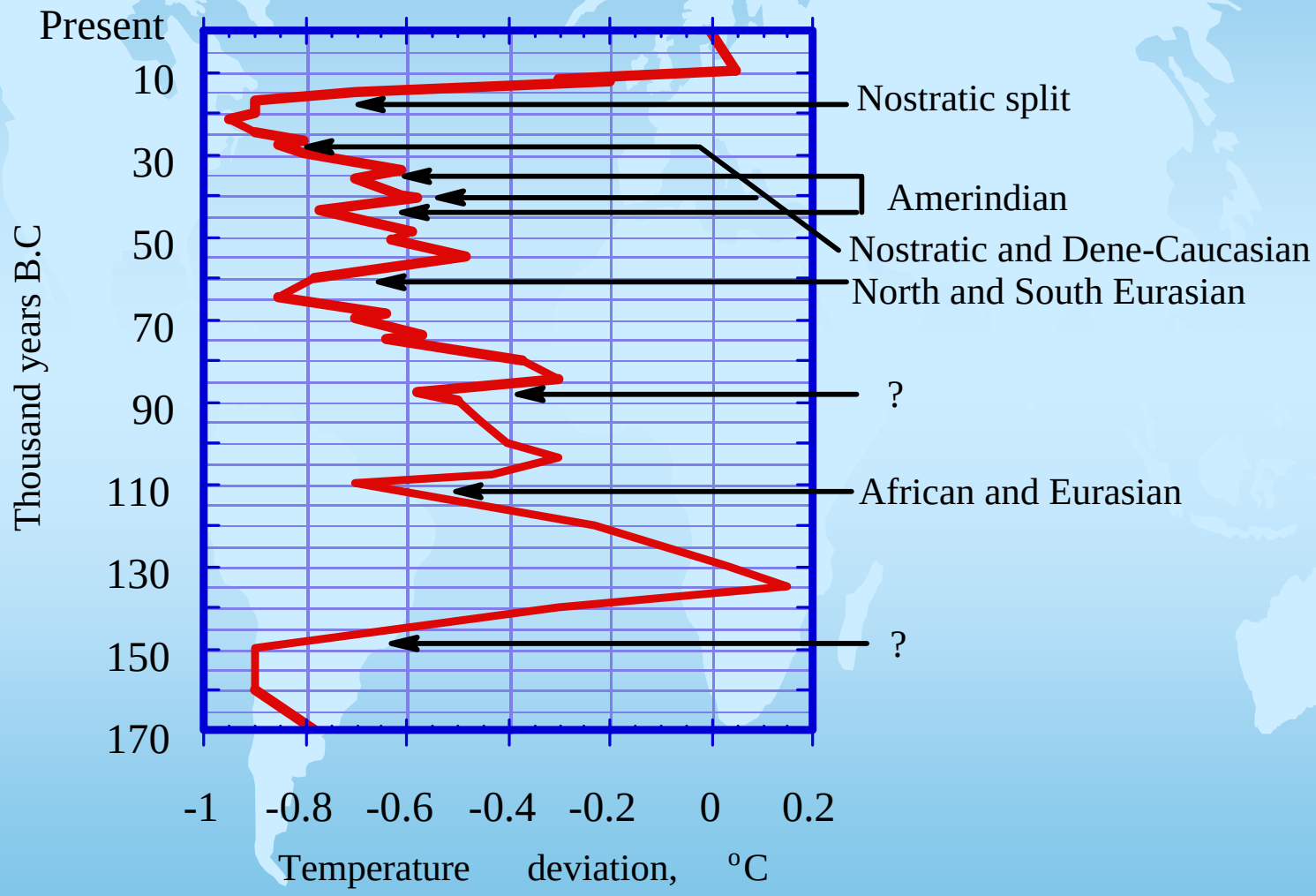


Indoeuropean homeland

Elite dominance, the rise of nomadism and horse warfare



Events correlate with climate



Conclusions

- The model is capable of reconstructing first time of arrival within +/- 5,500 years in the period from 140,000 BC to 9,000 BC
- The model is capable of reconstructing the observed genetic patter in Europe and Asia
- The model is giving populations estimates consistent with estimates based or archaeological data

Conclusions 2

- The model reconstructs the Nostratic language family as determined by linguists down to small detail
- The model reconstructs a Sino-Caucaso-Iberian language family, consistent with findings of long-range linguistist. The group diverged 25,000 BC and fractionated through isolation with the advent of agriculture

Conclusions 3

- The model reconstructs Austric as a language family with depths of 25,000 BC for diversification and 7,000 years for rearrangement by agriculture

Conclusion 4

- The LANGUAGE model is at present in awkward form and need reprogramming to FORTRAN90 in order to become generally useful for extensive scenarios
- A fat, nice research grant is needed