Land, rain and sweat: Building a database of what we need for building a temporally dynamic and a spatially-explicit agent-based model of Neolithic occupation in Languedoc-Roussillon, France

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To cite this version:
Mehdi Saqalli, Marie-Alexandrine Sicre, Odile Peyron, Pierre Sabatier, Nathalie Combourieu-Nebout, et al.. Land, rain and sweat: Building a database of what we need for building a temporally dynamic and a spatially-explicit agent-based model of Neolithic occupation in Languedoc-Roussillon, France. Atelier MISTRALS "Impacts des changements climatiques en Méditerranée", Oct 2017, Montpellier, France. 2017. hal-01688180

HAL Id: hal-01688180
https://hal-univ-tlse2.archives-ouvertes.fr/hal-01688180
Submitted on 19 Jan 2018

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Land, rain and sweat: Building a database of what we need for building a temporally dynamic and a spatially-explicit agent-based model of Neolithic occupation in Languedoc-Roussillon, France.

Mohdi Saghal², Marie-Alexandrine Sire³, Odile Peyron², Pierre Sabatier², Nathalie Comboutre-Nebout², Laurent Dezileau², Matthieu Giliardi², Catherine Kuzucuoğlu², Maria-Angela Bassetti², Boris Vannière³, Laurent Carozza¹, Jean-Michel Carozza¹, Laurent Lespez² and Paleodem team

1. GEDOS UMR 5602, CNRS, Université de Toulouse 3 Jean-Jaurès, 2. LOCAM, Sorbonne université, 3. ISEM, Montpellier, 4. Laboratoire DEFI, UMR CNRS 5216, Université de Languedoc-Roussillon, 5. Géosciences Montpellier, UMR CNRS 5216, CEGRE UMR CNRS 7320 – Université d’Auvergne, 6. UFR UMR CNRS 5110, Université de Paris Est, Créteil et Université de Paris 1, 7. ETENUM UMR CNRS 5110, 8. Centre de Géosciences Montpellier UMR CNRS 5216, Université de la Méditerranée, 9. LIENSS, UMR 7266, CNRS – Université de Littoral Côte d’Opale, 10. Université de Lorraine, 11. Le Cnt me-CNRS, UMR 6253, Université de Coimbra.

Objectives and challenges

Building a dynamic and spatially-explicit model is an interesting way for combining altogether:
- At the operational scale, meaning the Neolithic family level, i.e. one hectare and one season
- All the biophysical and socio-economic constraints and assets this family face
- Along the period and the site we considered, meaning the Languedoc Roussillon during the Neolithic era

⇒ for such a model, we need to collect accurate data, meaning:
⇒ Precise enough, exhaustive both temporally and spatially
⇒ relevant, meaning having a defined impact on simulated dynamics

Reconstitute the season-level climate along the Neolithic era

- 3-months Seasonal Neolithic Temperature variability
  (Worldclim.org)
- 1 km² Neolithic Europe Temperature map (Worldclim.org)

Simulate the season-level climate

- 3-months Seasonal Neolithic rainfall variability
  (PALEOMEX data)
- 1 km² Neolithic Europe rainfall map (PALEOMEX data)

Hunting & Gathering

- Seasonally-defined activities
- Declining over time with human long-term presence
- Fishing
- Focus on large game: Boars & wild ruminants/ deer, aurochs
- Gathering
- Collect mushrooms & fruits, dry (hazel nuts) or not (apple, wood fruits etc.)
- Rasmussen (1990); Hachem (1999, 2001); Arboagst et al. (2001); Elbersbach & Schade (2004); Bedard & Hachem (2008); Breithard (2008); Tresset & Vigne (2011); Goizet (2007)

Formalize the Neolithic livestock-keeping system

- Cattle, sheep, goats, pigs
- Livestock-keeping practices
- Collection management of herds, family use of by-products
- Ruminants pastures: meadows, forest foddering by pruning, fields refuse
- Ruminants feeding house wastes & refuses, oak acorns
- Ozturk & Hoyt (1976); Gregor (1988); Hachem (1995, 2011); Arboagst et al. (2001); Elbersbach & Schade (2004); Bedard & Hachem (2008); Breithard (2008); Tresset & Vigne (2011); Goizet (2007)

Simulating the social systems and dynamics

- Pushing factors
- Climatic demography
- Ancestor family rules: ultimogeniture vs. primogeniture
- Attracting factors
- Local dissemination according to amenities (soil, water, resources)
- Presence of a long distance colonization?

Colonization & segmentation rules

- Multiple processes: regional response, occupation in a territory,
  population turnover, site abandonment, local development

Formalize the Neolithic manpower conditioned cropping system

- Cereals, legumes & flax
  1. Farming practices
  - Permanent vs. itinerant farming
  - Both autumn & spring sowings
  - A systematized associated crops: legumes + cereals
  - A systematized livestock-manure fertilized fields
  - A field expansion based on the Chayanov ratio MODPap.

Bakker (1978); Gregory (1988); Fecher et al. (1999); Knörzer (1997); Kreuz et al. (2005); Riess et al. (2002); Bogaard (2004); Salsaver (2010, 2011)

A system of activities consistent with the family rationality and constrained by the manpower availability

- Technical capital:
  - No evidence of cart, plough or ard
- Land: High land availability
- Land fertility: important issue
- Manpower: important issue

Simulating the farming system

- A farming system based on a crop-livestock association

Data and metadata

- PALEOMEX data
- Worldclim.org

Reconstitute the 1-ha territory during the Neolithic era

- 1 present-time Elevation at the 1-ha scale
- 2 present-time Hydrogeology at the 1-ha scale
- 3 present-time Pedology at the 1-ha scale

Formalize an erosion map

- “Erosion reverse engineering”
- Neolithic watershed reconstitution
- Neolithic soil map modelisation

A cellular automata

Each cell is characterized by its reactivity and sensitivity regarding the climate but also the human uses (agriculture, livestock)

References

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A long-term project to build within the PALEOMEX research group

Among all data and groups of data needed for building a socially-defined multi-agent model, few are available or not so-hard to prepare:
- The white numbers (from 1 to 13) are the data or metadata available in the PALEOMEX team or that can be constructed by one PALEOMEX member;
- The black numbers (from 1 to 8) are the ones not available for now. Their construction need the building of a consensual agreement of several working hypotheses on their values and organizations

- Vannière, Lespez, Carozza, Berger, Saqqalli, Salavert, Breihard, Vigne, Tresset. 2014
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