Farming in Prehistoric Europe

Modelling the impact of the first agriculturists on the landscape

L.P.H. (Rens) van Beek[1], H. (Rik) Feiken[2]

EGU 2013: SSS 9.5-GM 4.8: Interactions between soils, organisms and hydrogeomorphological processes

- Department of Physical Geography, Utrecht University, The Netherlands, r.vanbeek@uu.nl
- Groningen Institute of Archaeology, University of Groningen, The Netherlands. h.feiken@rug.nl

university of groningen

Universiteit Utrecht

Man and the Mediterranean landscape

Man is a major governing factor in Mediterranean landscapes:

- Exploitation of fragmented resources;
- Often expansion onto marginal lands under increased population pressure.

Human activities are threatened by continuous degradation.

Objective

To explore the options open to the first Neolithic farmers in Mediterranean environments. Starting from a static model, we evaluate farming strategies along a landscape gradient and compare this to the outcome of Gregg's study (1988) for temperate Europe. This serves to:

- Highlight local and inter-regional differences;
- Reveal the sensitivity of the underlying assumptions;
- Corroborate the validity of the land use model in CALEROS.

Ultimately this allows to assess the stability of the first agricultural systems and the carrying capacity of the Neolithic landscape.

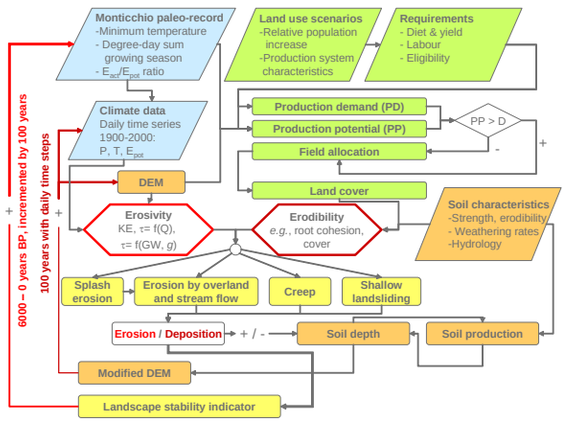
Simulating land use

In CALEROS energy requirements are fixed over time. Technological advances are prescribed by fixed scenarios detailing per period (e.g., Neolithic):

- Crop rotation and bench terrace construction;
- Crop calendar;
- Plough, sowing and harvesting techniques and associated labour costs.

This leads to a carrying capacity that changes with climate and, consequently variations in population.

Gregg (1988) imposed varying field sizes (0.35, 0.40 and 0.45 ha p.p.) for a village of 34 persons. Climate variability was included stochastically. Contrary to CALEROS, she deducted additional losses (*e.g.*, predation) for cereal production and imposed fixed herd sizes; CALEROS supplements cereal production with stock-breeding dynamically.



Flow diagram of the different components of CALEROS and their interactions. The model is largely free to respond to the climatic forcing, earthquakes, land use scenarios and initial landscape that are imposed.

Model experiment

In CALEROS, we imposed:

- Single settlement of 34 persons and the household sizes of Gregg;
- Static environment including:
  - Uniform soil conditions;
  - 100-year climate series for three areas:
  - Contrada Maddalena at 500 m.a.s.l.;
  - Contrada Maddalena at 1000 m.a.s.l.;
  - SW Germany (Swabian Alb).

In all cases, 90% of the energy intake had to come from agriculture and preferentially from cereal production. For the Mediterranean, winter wheat was planted, in SW Germany a spring crop was sown in a two-year rotation.

Outlook

Results highlight the sensitivity to the environmental setting and underlying assumption.

Gregg's model is more detailed but does not consider landscape development and feedbacks. CALEROS does so, but at present, agricultural options are constrained.

In the next step, an optimization of land use in CALEROS will be considered and the stability of the Neolitic landscape under the first farmers explored.

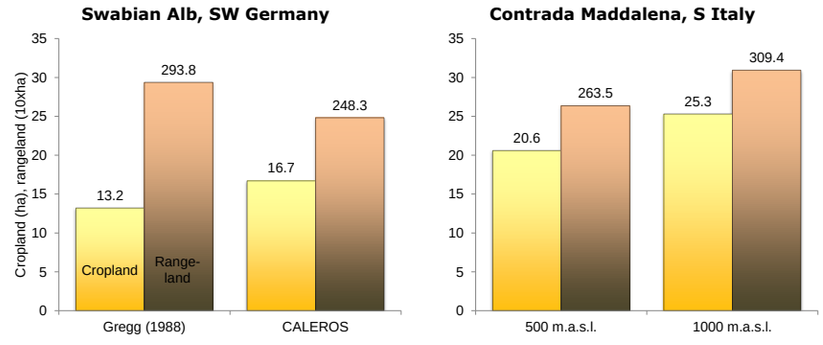
CALEROS: a meso-scale landscape dynamics model

CALEROS is a process-based model and is currently implemented for the 14 km^2 large catchment of the Contrada Maddalena. It includes:

- Soil production and development;
- Soil hydrology;
- Sediment transport due to water induced erosion and diffuse transport (creep, tillage, landslides);
- Dynamic vegetation growth for plant-functional types (incl. cereal);
- Regional population growth;
- Field and resource allocation to meet demands of produce (crops and livestock) and wood.

Results

For the allotment of 0.40 ha per capita and herds of 40 goats and 40 cattle, Gregg obtained area estimates for cultivation and rangeland for SW Germany. Under different assumptions, we repeated these estimates with CALEROS.



CALEROS gives precedence to wheat cultivation and dynamically obtains any surplus energy requirements from livestock. As such the average cropland is larger in CALEROS and the rangeland smaller than in Gregg's estimates for SW Germany. Also, CALEROS imposes closed woodland and preference is given to more productive and tolerant goats than cattle.

In CALEROS cereal growth is more sensitive to climate variability. Cropland estimates increase on average and yields in the Mediterranean climates are more erratic and dependence on livestock increases relatively.

References

Feiken, H. , van Beek, R., van Asch, T., van Leusen, M., (2011). CALEROS: an erosion-deposition model for landscape archaeology. In Pre- And Protohistoric Landscape Studies, Siena, Italy, May 25-27, 2007, in BAR International Series 2320 2011, Oxford, pp. 13-16.

Gregg, S. A. (1988). Foragers and farmers: population interaction and agricultural expansion in prehistoric Europe. University of Chicago Press.