The answer is blowin' in the wind. Research desires and data possibilities.

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Abstract: This paper was supposed to be called "Buried by the wind. Regional analysis in Palaeolithic and Mesolithic Archaeology in the Southern Netherlands". It was supposed to examines the influence of loess deposits on the distribution of Palaeolithic and Mesolithic find spots in Limburg, the most southern region of the Netherlands, using a Geographic Information System (GIS). It was supposed to demonstrate that the archaeological visibility of Palaeolithic find spots in that part of the Netherlands is greatly hindered by the Upper Pleistocene loess cover of this part of the country. It was supposed to demonstrate also that the visibility of Mesolithic find spots is not influenced by that geological phenomenon. And it was supposed to investigate if these differences in the distribution of find spots, and the concluded differences in land use, are a result of geological processes.
But the quality of the data set did not make any of this possible.

Key words: GIS, Palaeolithic Archaeology, land use.

Introduction

The following research is part of an ongoing project about the Palaeolithic of Limburg, the southern part of the Netherlands (Kamermans & Rensink 1999). This research tries to analyse and interpret Palaeolithic and Mesolithic find spots from the Dutch loess area from a landscape perspective. One of the problems is how to evaluate correctly areas without find spots. Does this point to a selective use of specific zones by hunter-gatherers, or are these 'empty' areas a result of geological or recovery processes? In more general terms: to what degree is the observed distribution of stone artefacts across the area representative for the use of the landscape by prehistoric hunter-gatherers?

This particular part of the research started with the following question:

"We assume a different economy and a different land use between the Palaeolithic and the Mesolithic period, or at least between the Middle Palaeolithic and the Mesolithic. Can one see this in the distribution of sites in the landscape in South Limburg or is this pattern influenced by the geology? The Middle Palaeolithic sites were covered by loess during the Pleniglacial and the later Mesolithic sites were not. Are we looking at a difference in distribution or are we simply looking at moreorless the same pattern obscured by the deposition of loess. What if we use GIS and throw a loess cover over the Mesolithic sites. Would the same pattern as for the Palaeolithic emerge?"

For good research you need a good theoretical background, a good research question, a good dataset, and good tools to research your question. It looked as if all this was available for our Limburg case study.

There is no problem with the theoretical background, but what about the research question?

Research question

There is an ongoing debate about differences in subsistence strategies during the Middle and Upper Palaeolithic. What is the difference in subsistence strategy between the Neanderthals, or the Ancients as Stringer and Gamble (1993) call all pre-modern humans, and the Moderns? For instance, did Neanderthals hunt? If yes, were they general or specialised hunters? Most researchers see the change in subsistence happening between Ancients and Moderns, and considered it as part of the so-called Middle to Upper Palaeolithic "transition". Others see changes during the Middle Palaeolithic (c.f. Stiner 1994, Kuhn 1995). Differences in subsistence, means differences in human behaviour and should leave a difference in spatial patterning of the material culture in the landscape. The problem is there. Can we solve it in Limburg?

The data set

Limburg is archaeologically speaking a very well researched area. Not only for archaeology in general but especially for the Palaeolithic period. Roebroeks excavated the Bélvèdere quarry with the oldest site from the Netherlands, 250.000 years old (Roebroeks 1988). Rensink studied the Magdalenian sites in Limburg and surroundings (Rensink 1993). Amateur archaeologists are very active in that part of our country and for GIS applications Limburg is perfect; it is one of the few places in the Netherlands with some form of relief and has a

great variety in landscape.

But for a GIS application you need both maps and archaeological data. For this research we used two geological maps, one soil map, one geomorphological map, two maps with the distribution of the loess, and a slope map and a slope aspect map from parts of the area. For the archaeology we used a slightly updated dataset from ARCHIS, the national Dutch sites and monuments record.

Figure 1 shows the distribution of loess and the location of the Middle Palaeolithic and Mesolithic sites. The loess map indicates areas with a loess cover of more than 1 meter thick, loam on slopes, stream sediments and areas with no loess. The loess cover was deposited during the Pleniglacial, lets say from 55.000 until 13.000 year ago. Some of the Upper Palaeolithic sites (from 35.000 until 10.000) date from during this period of deposition and some do not. Including these Upper Palaeolithic sites will complicate matters so we leave that period out of our analysis. With a visual inspection we do not see a difference in distribution.

Table 1 gives the relation between Middle Palaeolithic sites and the various deposits and shows us as many sites on the loess as expected and twice as many on the slopes as expected.

Table 2, the relation between Mesolithic sites and the various deposits, gives more or less the same picture. On the loess are as many sites as expected, on the slopes twice as many.

The Middle Palaeolithic sites on the loess are of course a problem. They date from before the loess and, for that reason, cannot be on top of the loess. The map (figure 2) confirms this.

This shows us the first problem with our data set. The maps are apparently not accurate enough although the resolution is 25 meters. The scale of the original maps is 1 : 100.000.

Another option is to use the slope map. There is a relation between loess and slope. The loess cover is still present on relatively flat surfaces. We have a slope map from part of the area, the Central Plateau. Maybe the slope map will show that the Middle Palaeolithic sites on loess are in reality lying on steep, eroded slopes (figure 3). The table (3) gives more information. One fourth of the number of sites that could be expected on the basis of chance lie on the flat area and more sites than expected lie on the slopes.

For the Mesolithic the number of sites on the flat surface is as expected and on the slopes more than expected (table 4). It looks as if the loess does influence the pattern. But there are still Middle Palaeolithic sites lying on the flat surface. So also the slope map is not accurate enough.

We know that most maps are not accurate (soil maps for instance have an average accuracy of 70% (Kamermans & Rensink 1999).

So much for GIS as a tool to solve all your problems. But is it possible to do the analysis without maps? Is there enough information in the database? If the database tells us if the site is a surface find or an excavation that will help. It does, but as I said we used a slightly updated ARCHIS dataset and we only included surface sites, so the problem remains.

A similar analysis on data collected by the Agro Pontino Project (Voorrips *et al.* 1991) utilized the field database and used maps only for illustrations (Kamermans 2000). The data that was registered in the field included not only the parent material, but also the soil type, the slope angle and the slope aspect, the geomorphology, and dozen's of other things (Voorrips *et al.* 1989). We could perform the same kind of analysis for our Limburg research but is this kind of information available in the Dutch national database ARCHIS?

There is a lot of information in the database. Administrative information about the locality, information about the landscape and information about the site and the archaeological material. There is information about the geomorphology, the geology, the texture of the soil and the situation in the landscape. But there are two problems. It is not always clear if this information is collected on site or taken from a map and the information is not always there. On the form people have to fill in when they report a new find, a suggestion is printed next to the geomorphology field, which is to take this information from the geomorphological map. In the case of the current research therefore, ARCHIS did not help very much. This is the second problem with the data set.

Conclusions

With a very straightforward application, like the one sketched above, we encountered two major problems: the digital maps and the archaeological data set. Will these problems be solved in the near future?

A new development with digital maps in the Netherlands is the AHN (Actueel Hoogtebestand Nederland), a new digital elevation database from the whole of the country made with laser altimetry (http://www.minvenw.nl/rws/mdi/geoloket/index1.html). It has a density from 1 point per 16 m². This 3D dataset is accurate enough to solve in the near future the problem of the relation between slope and loess coverage.

But the digital geological map, soil map and loess map will not become more accurate than the original maps. So these maps are not accurate enough to rely on the information. To do the analysis on the basis of a database we will need an awful lot of data in ARCHIS. We need information gathered on site about the geology, geomorphology, soils (like parent material, texture, soil type), drainage, slope angle, slope aspect, etc, etc. Only then we can do our analysis independent of our maps.

The ROB is planning a new version of ARCHIS. It will have three layers of information. One for experts, one for scientists and one for lay people. Every layer would have their own kind of information. From the documentation (Van Capelleveen *et* al. 2000) it becomes clear that the expert layer will contain mainly administrative information to manage the site. The form to register a site into ARCHIS will stay more or less the same, so it looks as if not all of the information required for a good

regional analysis will be there.

The problem is highly relevant. One of the most important products of the State Service at the moment is the IKAW, the indicative map of archaeological values (Deeben *et al.* 1997). These maps are a result of predictive modelling on the basis of ARCHIS and digital maps of the physical environment. There has been a lot of criticism directed towards the first two generations of these maps (c.f. Verhagen *et al.* 2000). The new ARCHIS will play an important role in the production of future predictive maps. In my opinion it is impossible to predict site location for CRM purposes without a very detailed archaeological database. The only other solution is to rely on the unreliable digital maps.

With the general available data it was impossible to answer the simple question formulated above. The problem remains, so in the end *the answer, my friend, is blowin' in the wind.*

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Tables

unit	area	perc	O sites	E sites
löss cover	346.47125	50.03	35	39.03
loam on slopes	163.47375	23.61	37	18.41
stream sediments	53.19625	7.68	0	5.99
no löss	129.334375	18.68	6	14.57
	692.475625	100.00	78	78.00

Table 1. The relation between Middle Palaeolithic sites and the various deposits. Area is in km², O sites is observed sites and E sites is expected sites

unit	area	perc	O sites	E sites
löss cover	346.47125	50.03	19	22.52
loam on slopes	163.47375	23.61	24	10.62
stream sediments	53.19625	7.68	1	3.46
no löss	129.334375	18.68	1	8.40
	692.475625	100.00	45	45.00

Table 2 the relation between Mesolithic sites and the various deposits

unit	area	perc	O sites	E sites
low	61.82	78.83	2	7.88
medium	8.60	10.97	6	1.10
high	8.00	10.20	2	1.02
	78.42	100.00	10	10.00

Table 3. the relation between Middle Palaeolithic sites and slope class.

unit	area	perc	O sites	E sites
low	61.82	78.83	5	6.31
medium	8.60	10.97	3	0.88
high	8.00	10.20	0	0.82
	78.42	100.00	8	8.00

Table 4. the relation between Mesolithic sites and slope class.

Figures

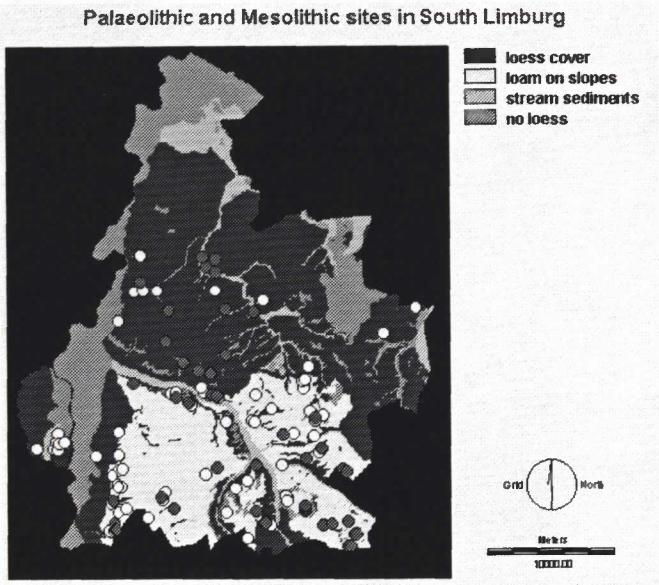

Figure 1. The distribution of loess and the location of the Middle Palaeolithic (white dots) and Mesolithic (red dots) sites.

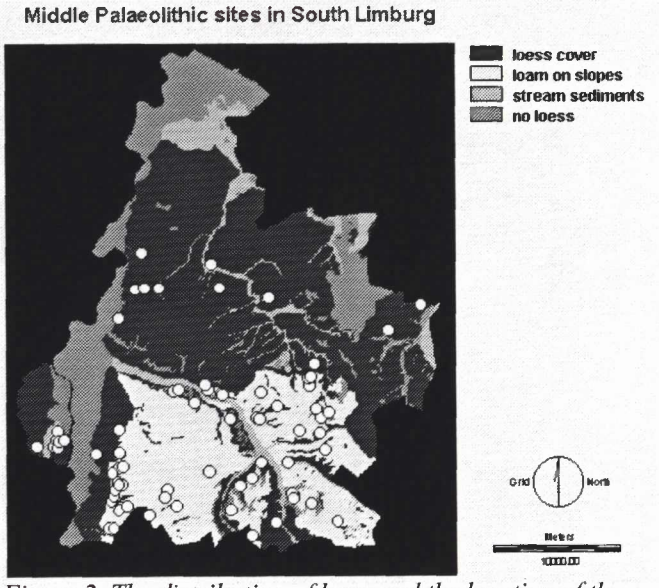

Figure 2. The distribution of loess and the location of the Middle Palaeolithic sites.

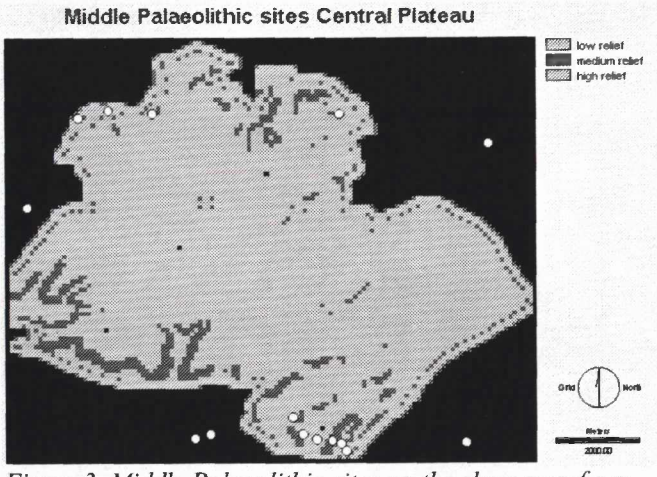

Figure 3. Middle Palaeolithic sites on the slope map from the Central Plateau.