Aurélie Jouvenel
Université Lyon II - Archéorient
UMR 5133
IFPO Amman
acjouvenel@gmail.com

**Aurélie Jouvenel**

# Ancient Roads of Iron Age Edom: A New Spatial Analysis

Anyone interested in analysis of settlement patterns and spatial dynamics eventually ends up thinking about trade routes, roads and paths. The Kings' Highway is always cited as a main transport route despite never having been verified on the ground. However, thanks to methods developed over the past three decades, such as GIS, and the efforts of field-workers who make geo-referential data accessible, we can now test a number of different hypotheses.

Archaeologically speaking southern Jordan, i.e. the land of Edom, is still largely unknown to us. Very few sites have been excavated and explored. The results of older excavations, such as those of Crystal Bennett at Buṣayra, Ṭuwaylān and Umm al-Biyāra, must be viewed with caution – in spite of the insights they offer – because of the many problems encountered by Piotr Bienkowski during their publication (Bienkowski 1990, 2002; Bennett and Bienkowski 1995). More recent work such as that of Tom Levy and his team at Khirbat an-Nuḥās (e.g. Levy *et al.* 2001, 2004, 2010) still needs to be linked with results from the plateau above. Finally, the results of many surveys in the region (e.g. MacDonald 1988, 1992, 2004; Hart and Falkner 1985) have not yet been integrated within a regional spatial analysis.

An approach based on recent advances in landscape archaeology and spatial analysis is proposed here. This does not intend to put forward a definitive answer to the debate; rather, the aim is to examine new hypotheses and hence stimulate new aspects of research. In so doing, different methods of spatial analysis will be presented, along with the results of their application to the case study; the limitations of these methods will also be discussed.

## 1. Review of the Main Archaeological Sites

It should be mentioned at the outset that the research under discussion here was carried out in the framework of a much larger project, namely doctoral research on settlement patterns in the Negev and Jordan during the Iron Age. It is a work in progress and, as such, is subject to revision and improvement.

The database used in this analysis is that published by Sarah Morgan Harvey in her 1999 doctoral dissertation entitled The Iron Age II Period in the Central Negev Highlands and Edom: A Comparison of Settlement Intensification and Land Exploitation. This database is somewhat out of date, but has the advantage of being straightforward and easy to use, even though it is probably simplistic. It is the starting point for this work, but in future it is hoped to ground-truth the database and update where necessary. Here it is used primarily to demonstrate the methodology.

Harvey divided sites into ten categories: large residential sites, small residential sites, fortified sites, towers, villages, farms, encampments, tombs, mining sites and sherd scatters. This is not entirely satisfactory as the categories are too simplistic and do not always take reality on the ground into account. Nevertheless, it is important that other databases continue to use the same recording system, so that data remain comparable. As the task of checking and reorganising Harvey's data has not yet been completed, it was deemed preferable to use the database as it stands. The analyses which follow relate to the 'large residential site' category, which has been the main focus of interest.

## 2. Simple Modelling

### *2.1. Cost-distance analysis*

The following analysis was done on ArcGIS© 9.2 software and is based on a digital elevation model (DEM) developed by Olivier Barge (Maison de

l'Orient et de la Méditerranée, attached to the Archéorient research laboratory at Lyon).

The first analysis looks at cost-distance. As the name suggests, it allows calculation of distances from a point of origin in terms of kilometres covered. Here, a topographical constraint has been retained, as this factor is pre-eminent in our study area. This analysis allows us to visualise the distance between two sites in terms of the time needed to walk between them (Schneider and Robbins 2007). The standard used is three hours' walking at an average speed of 5 kph. A journey on foot of three hours allows for the move from Point A to Point B, completion of activities at Point B and the return journey back to Point A in one day. When applied to the large residential sites (FIG. 1a), two distinct groups can be determined: one in the north around Buṣayra and a second in the south around Umm al-Biyāra and Ṭuwaylān. These had been previously identified by Piotr Bienkowski. The dividing line between these two groups seems to lie in the vicinity of ash-Shawbak, although it should be noted that survey and excavation by Charlotte Whiting in this area, around Khirbat ad-Dabba, has led to the discovery of new sites which may change this interpretation.

The second analysis concerns Tall al-Khalīfa. It enables comparison of the time needed to reach the Gulf of 'Aqaba from sites on the plateau on the one hand, and sites in Wādī 'Arabah on the other (FIG. 1b). The standard used is six hours' walking; this represents one day of medium-range travel, taking into account resting time, erection of an encampment and feeding of men and animals. It shows that ten days would be required to traverse the whole region from north to south, and that there is a difference of one day's walk between the journeys from the plateau and Wādī 'Arabah respectively.

The next two examples were selected for their archaeological interest as well as their geographic location. Khirbat an-Nuḥās, in Wādī 'Arabah, was a strategic site at this time owing to nearby sources of copper; Buṣayra, on the plateau, was the administrative centre of the region. Six and seven days would be needed to reach the furthest sites from Khirbat an-Nuḥās and Buṣayra respectively (FIGS. 1c and 1d). However, although this modelling sheds light on potential journey times, it does not tell us anything about the importance or otherwise of the Kings' Highway.

*2.2. Least-cost paths*

Least-cost paths are theoretical, optimal routes derived from cost-distance analysis. Here we have considered two constraints in our calculations: topography alone and topography combined with energy. The latter takes difficulty in walking owing to relief into account. Marble's formula also takes soil characteristics into account (van Leusen 1997: 217). This formula has not been used here, but it might be interesting to consider differences between walking on sand and hard soil. The analyses were carried out on the same three sites as above.

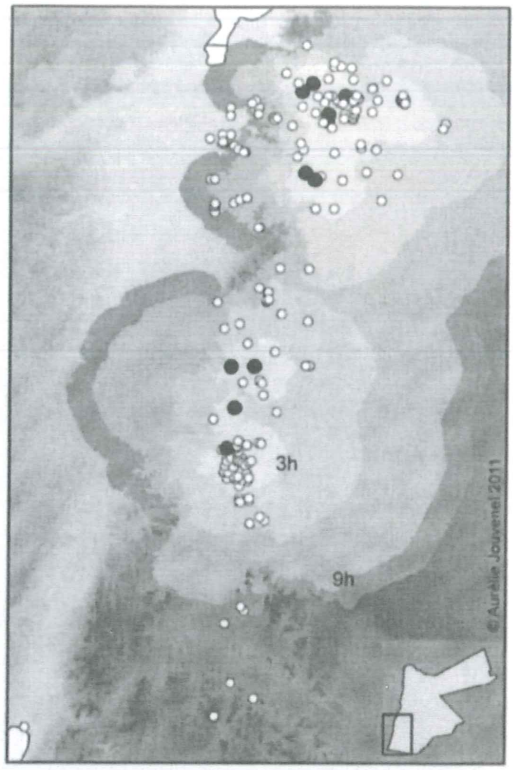
2.2.1. Tall al-Khalīfa: Two least-cost paths between Tall al-Khalīfa and other Iron Age sites can be identified, via the plateau and Wādī 'Arabah (FIG. 2a). There is little difference between the two constraints outlined above, except for sites in Wādī al-Ḥasā and around aṭ-Ṭafīla which are particularly easily accessible from the plateau.

2.2.2. Buṣayra: The paths traced from Buṣayra, which is situated on the plateau, naturally favour plateau routes. The two routes hardly differ (FIG. 2b); Wādī al-Ḥasā is crossed in the first model, but bypassed in the second. The paths pass through the desert zone, east of the plateau. The easier terrain of these paths may have favoured camels, which do not like steep slopes.

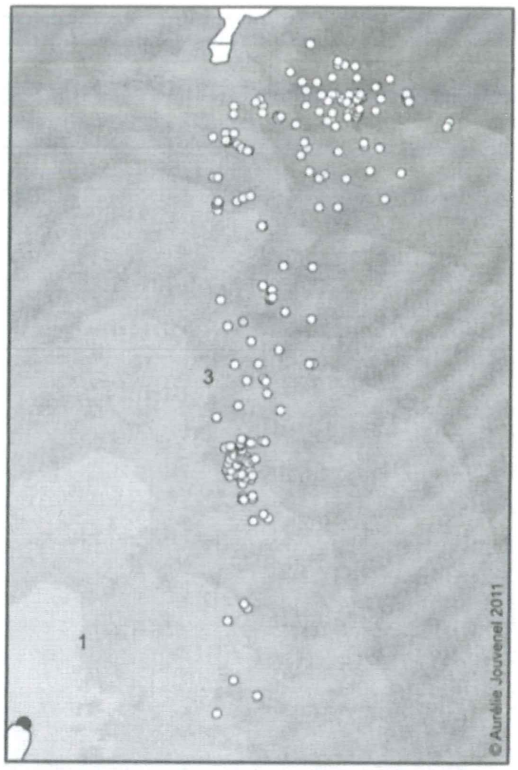
2.2.3. Khirbat an-Nuḥās: Unsurprisingly, the paths traced from Khirbat an-Nuḥās favour the Wādī 'Arabah route (FIG. 2c). At a local level, the use of certain sections of certain wadis is favoured over others when the amount of effort required is taken into account.

*2.3. Limitations of these analyses*

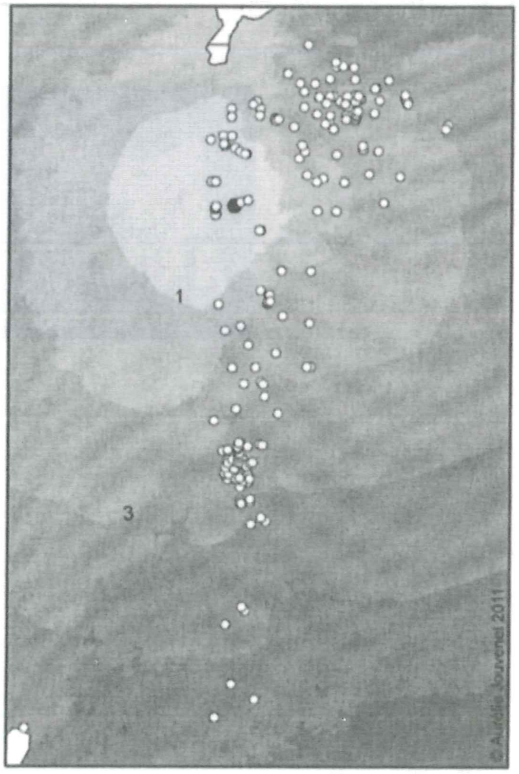
GIS is a useful tool that offers numerous possibilities, but one must be aware that it does not think for us. The least-cost paths identified above are theoretical constructions, i.e. which are the shortest routes taking into account topographical conditions, which routes are the most energy-efficient etc? They do not represent ancient routes, but point out the easiest ones. Minimum cost calculation is a contemporary concept that does not necessarily reflect ancient realities, as economy of effort may not always have been a priority. Pharaonic transport networks associated with exploitation of copper in the Red Sea hills and turquoise in the Sinai Peninsula are good examples of this (el-Raziq *et al.* 2002). Maurice Godelier explains opposing perceptions of the forest as hostile amongst Bantus and friendly amongst Pygmies thus:



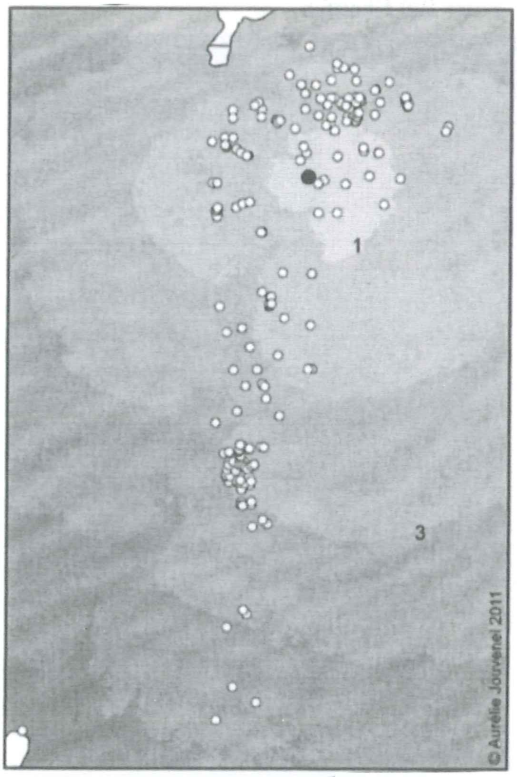

a. From the residential sites per 3h of walk



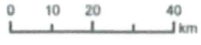

b. From Tall Khalīfah per day walk



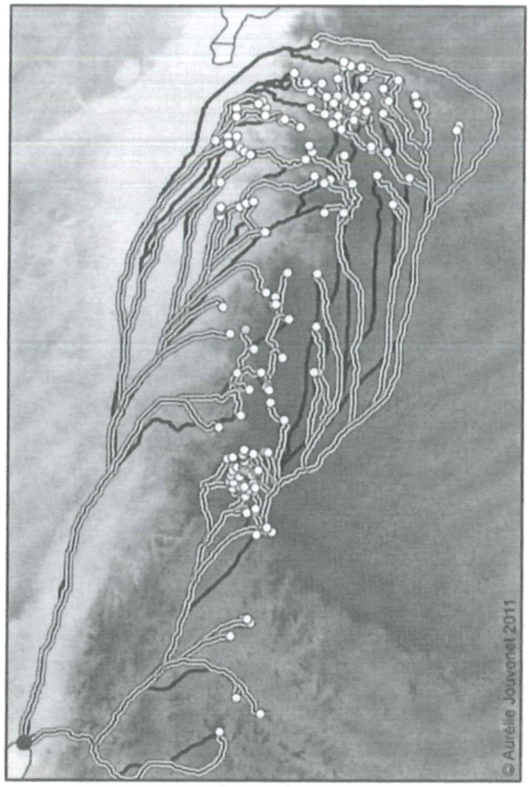

c. From Khirbat a an-Nuḥās per day walk



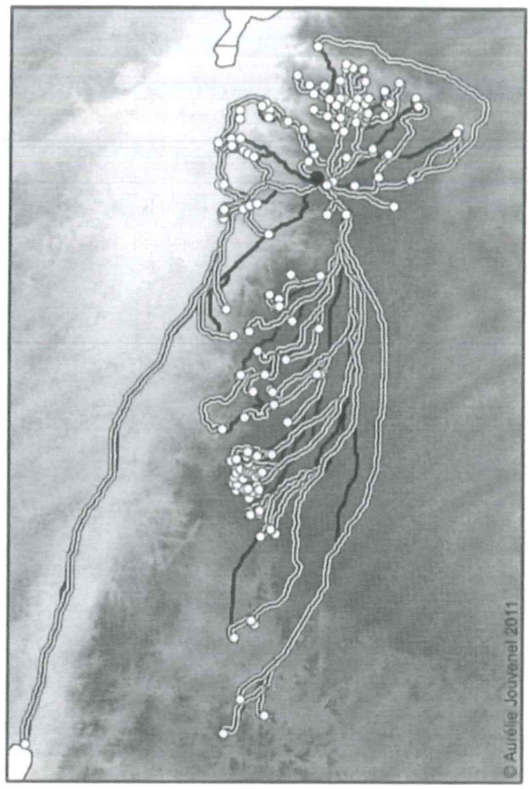

d. From Buṣayra per day walk



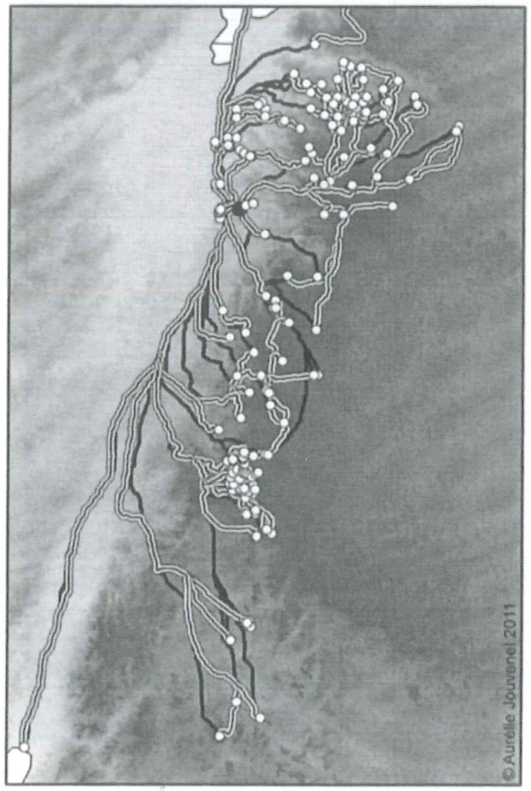

1. Cost-distance analysis with topographical constraint.



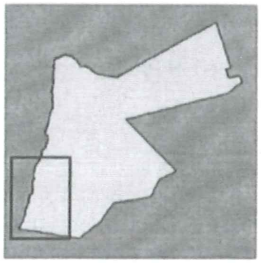

a. From Tall Khalīfah




b. From Buṣayra




c. From Khirbat an-Nuḥās



Paths with topographical constraint

Paths with topographical and energical constraint

0 10 20 40 km

2. Shortest paths calculated with the topographical constraint and energical constraints.

"the social perception of an environment is not only made up of almost exact representations of constraints of functioning of techno-economic systems, but equally by value judgments (positive, negative or neutral) and fantasmatic belief. An environment always has imaginary dimensions" (Godelier 1984: 54).

This type of modelling has the disadvantage of only taking physical geography into consideration, whilst the inhabited landscape is at the same time a social, cultural, political and symbolic space. How do we integrate these notions?

### 3. More Complex: Gravity Models

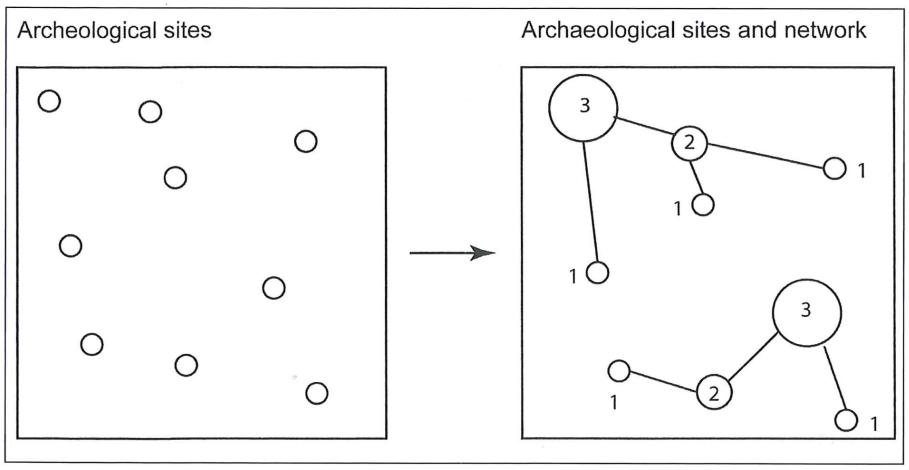
Other, more complex models of spatial analysis, i.e. gravity models, have been successfully applied to archaeological data. These models allow the identification of settlement networks characterised by dependent or exchange-based relations, and are based multivariate analyses of field data. A database can be constructed, detailing characteristics such as the presence of religious centres or prestige structures, size of site, type of material found etc. These categories are then weighted in such a manner as to create a hierarchy between sites (e.g. a religious centre might score 5 for an acropolis with several temples, 3 for an ordinary temple or just 1 for a *baetylus*). Different categories are weighted against each other on the basis of their contribution to the 'attractiveness' of the site (e.g. a domestic structure might be less 'attractive' than a religious centre). These different weightings enable the 'attractiveness' of a site to be calculated, with the most attractive sites exerting a gravitational pull on their neighbours (FIG. 3). Once such centres of influence are identified and mapped, it will be easier to define primary transport networks between them, and secondary networks between them and their satellites (Nunninger *et al.* 2006). Such models have not yet been utilised in our study, but it is hoped to do so in future.

As can been seen, application of gravity models tends to result in the classification of both data and sites, which may help with the evaluation of different interpretations of Edomite socio-political systems during the Iron Age.

The traditional interpretation views Edom as a centralised state with an administrative capital, Buseirah, and a territory with well-established borders. An alternative, proposed by Bienkowski and van der Steen (2001), sees Edom as a 'tribal kingdom' based on a heterarchical society with several centres of more or less equal importance (see also Bienkowski 2007).

### Conclusion

On the plateau, a transport route – not dissimilar to that traditionally known as the Kings' Highway – undoubtedly existed. However, the Wādī 'Arabah route would have competed with it. Numerous factors, e.g. access to water, have not been taken into account here, which will necessitate much finer grained analyses in future. The seasonal movements of the population also remain unknown to us. Modern *Bedouin* still practice limited transhumance, descending the plateau to pitch their tents in the 'Arabah wadis in winter. This, together with climatic factors such as seasonal fog and snow on the plateau, support arguments for the existence of transport routes in Wādī 'Arabah. However, this would have been a challenging route in summer, during which the plateau was probably the preferred option. Thus, there is little evidence for the existence of a coherent transport network.




3. Gravity models (based on fig 1, p. 3 in Nunninger, Sanders *et al.* 2006).

Even though the results presented here are limited and non-definitive, I hope they will encourage colleagues to think of space in different ways. The next step will be to integrate the data discussed here with data from the Negev. Then, through use of gravity models, we may hope for new results which place Wādī 'Arabah at the core of the discussion.

## Bibliography


Bennett, C. and Bienkowski, P. 1995. Excavations at Tawilan in Southern Jordan. *British Academy monograph in archaeology* no. 8. Published for the British Institute at Amman for Archaeology and History by Oxford University Press: Oxford.

Bienkowski, P. 1990. Umm el-Biyara, Tawilan and Buseirah in retrospect. *Levant* XXI: 91-109.

—— 2002. Busayra*:* excavations by Crystal M. Bennett 1971-1980. *British Academy monographs in archaeology,* 13. Oxford University Press: Oxford.

—— 2007. Tribes, Borders, Landscapes and Reciprocal Relations: The Wadi Arabah and its Meaning. *Journal of Mediterranean Archaeology* 20, 1: 33-60.

Bienkowski, P. and van der Steen, E. 2001. Tribes, Trade, and Towns: A New Framework for the Late Iron Age in Southern Jordan and the Negev. *Bulletin of the American Schools of Oriental Research* 323: 21-47.

El-Raziq, M.A., Castel, G., Tallet, P. and Ghica, V. 2002. Les inscriptions d'Ayn Soukhna. Institut français d'archéologie orientale du Caire - IFAO.

Godelier, M. 1984. L'idéel et le matériel : pensée, économies, sociétés. Fayard: Paris.

Hart, S. and Falkner, R.K. 1985. Preliminary report on a survey in Edom, 1984. *ADAJ* 29: 255-277.

Harvey, S.M. 1999. The Iron Age II Period in the Central Negev Highlands and Edom: A Comparison of Settlement Intensification and Land Exploitation A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Classical Art and Archaeology), Ann Arbor (ed.) University of Michigan.

van Leusen, M. 1997. Viewshed and cost surface analysis using GIS (Cartographic Modelling in a cell-based GIS II). Pp. 215-223 in *New techniques for Old Times.* CAA 98. Computer applications and quantitative methods in archaeology. Proceedings of the 26th Conference.

Levy, T.E., Adams, R.B., Witten, A.J., Anderson, J., Arbel, Y., Kuah, S., Moreno, J., Lo, A. and Wagonner, M. 2001. Early metallurgy, interaction, and social change : the Jabal Hamrat Fidan (Jordan) resarch design and 1998 archaeological survey : preliminary report. *ADAJ* 45: 159-187.

Levy, T., Adams, R., Najjar, M., Hauptmann, A., Anderson, J., Brandl, B., Robinson, M. and Higham, T. 2004. Reassessing the chronology of Biblical Edom: new excavations and 14C dates from Khirbat en-Nahas (Jordan). *Antiquity* 78, 302: 865-879.

Levy, T., Najjar, M. and Higham, T. 2010. Ancient texts and archaeology revisited – radiocarbon and Biblical dating in the southern Levant. *Antiquity* 84, 325: 834-847.

MacDonald, B. 1988. *The Wadi el Ḥasā Archaeological Survey : 1979-1983, west-central Jordan.* W. Laurier University Press, Waterloo, Ont.: Canada.

MacDonald, B. 1992. *The southern Ghors and northeast 'Arabah archaeological survey*, Sheffield Archaeological monographs, 5. J.R. Collis, Dept. of Archaeology and Prehistory, University of Sheffield: Sheffield.

MacDonald, B., Banning, E. and Neeley, M.P. 2004. *The Tafila-Buṣayra Archeological Survey 1999-2001, west-central Jordan.* American Schools of Oriental Research archaeological reports, ISSN 1933-6438 8. American schools of oriental research, Boston (Mass.).

Nuninger, L., Sanders, L., Favory, F., Garmy, P., Raymaud, C., Rozenblat, C., Kaddouri, L., Mathian, H. and Schneider, L. 2006. La modélisation des réseaux d'habitat en archéologie: trois expériences. M@ppemonde.

Schneider, K. and Robbins, P. 2007. Exercice 3: Modeling access to Health care: anisotropic cost distance. Pp. 51-70 in S. Kristin and R. Paul (eds.), *Mountain Environments and GIS.* Geneva.