Chapter 2 Map Use and Map Reading

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Maps can have many functions: they are used for instance for orientation and navigation, they can be used for storing information (inventories) for management purposes (such as road maintenance), for education, terrain analysis (is a site suitable for specific purposes?) and decision support (is it wise to build a town extension in a south-westerly direction? Or to build a new supermarket in that low-income area?). This chapter will give some examples of what maps can contribute.

A. The map as a predictive tool (for navigation and orientation)

With a topographic map (which describes the nature of the land and the man-made objects on it, see figure 2.7 and chapter 5)) of an area you are about to visit, you can deduce in advance the nature of the terrain you are going to visit. Most important will be what the route/road will be like: will it be straight or have many bends, will it be steep, uphill or downhill? What kind of human settlements will you be passing on your trip? You can find out their number of inhabitants from the size of their names on the map!). What will the countryside be like? What kind of vegetation, parcellation, crops, will there be? Will you have to cross rivers or pass through forests? What man-made objects will you sees on the way – factories, canals, railways (infrastructure), and what kind of cultural environment or cultural heritage objects (castles, monuments, religious sites) will you find on your way? And will you be able to pass everywhere, or would there be restrictions, such as boundaries, or roads that are open only part of the year? And where will you have to go if you are in trouble (police stations, municipality offices, fire brigade, hospitals, etc.).

The kind of map you would have to bring with you, on paper or on a display, would depend on your mode of transportation, whether you would be walking, cycling, or going by car. For walking, a map on the scale 1:25,000 would be deemed suitable (if available), for cycling the optimal scale would be 1:50 000, for motoring 1:200,000 (and for planning a long trip a map 1:1,000,000).

From the topographic map one may for instance derive information on distances, directions and slopes. The contour lines on these maps (formed by the intersections between parallel planes and the earth surface, (see figure 2.2), would allow you to find out the height of any point on a map. The slope then can be deduced from the difference in height and distance between two points on the map. First, from the orientation of the height figures with which the contour lines are labelled, one can see whether in a specific direction the slope goes up or down (figure 2.3).

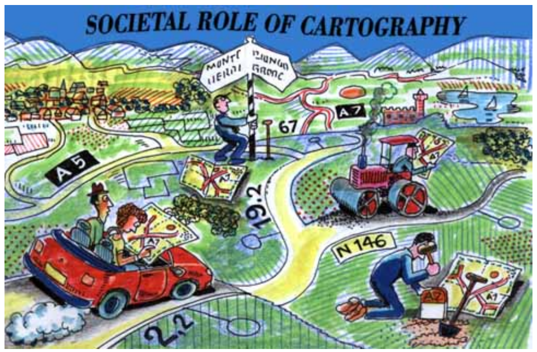


Figure 2.1 Map functions. (Drawing A.Lurvink).

Figure 2.2. The principle of contour lines. (©HLBG).

The procedure to assess the height of a specific point is done by interpolation: In this case point A is located on the 490m contour line, so its height is 490m; point B lies halfway two contour lines with the values 510 and 500 respectively (see figure 2.4). If the scale of the map is 1:6.000 and the distance AB is measured by a ruler to be 5 cm, the actual distance in the terrain between the two points would be 6.000x5cm= 30.000cm=300m. If the two points A and B are 300m apart and their heights are 490 and 505 m, their height difference is 15m.

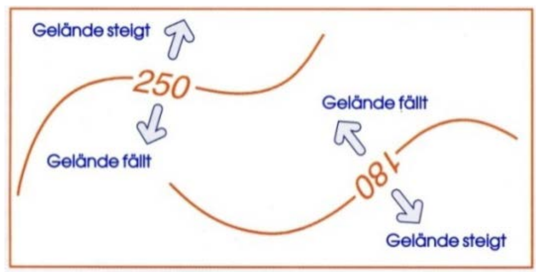


Figure 2.3. The meaning of contour labels. (©HLBG).

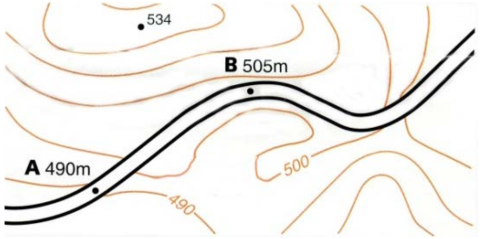


Figure 2.4. Assessing a point's height through interpolation. (©HLBG).

The slope between these two points can be expressed as a fraction (or ratio) between the horizontal distance (rise) and the vertical distance (run), here 15/300 or 1:20. Slopes can also be given in percentages, for which one must assess the number of vertical units for every 100 horizontal units. For 300/3=100m run the rise would be 15m/3=5%. Finally, the slope can be expressed in angles, which are given in degrees. In the triangle in figure 2-5 formed by the horizontal and vertical distances, the angle is expressed as the trigonometric tangent of the slope angle. In a goniometric table, this value can be retrieved and is found to be 3° (degrees). A slope of 100% corresponds to a 45°slope (see also figure 2.5).

Why are slope values relevant? Because they will decide whether you will be able to pass that specific road or track, walking, cycling or motoring. Slopes of 1:40 (or 2,5%) are already almost too steep for trains; slopes of 1:10 (or 10%) are too steep for cycling and one would have to get off one's bike; slopes of 1:3 (or 33%) would be almost too steep for a 4-wheel drive car (see figure 2.6). From the relative location of the contour lines we

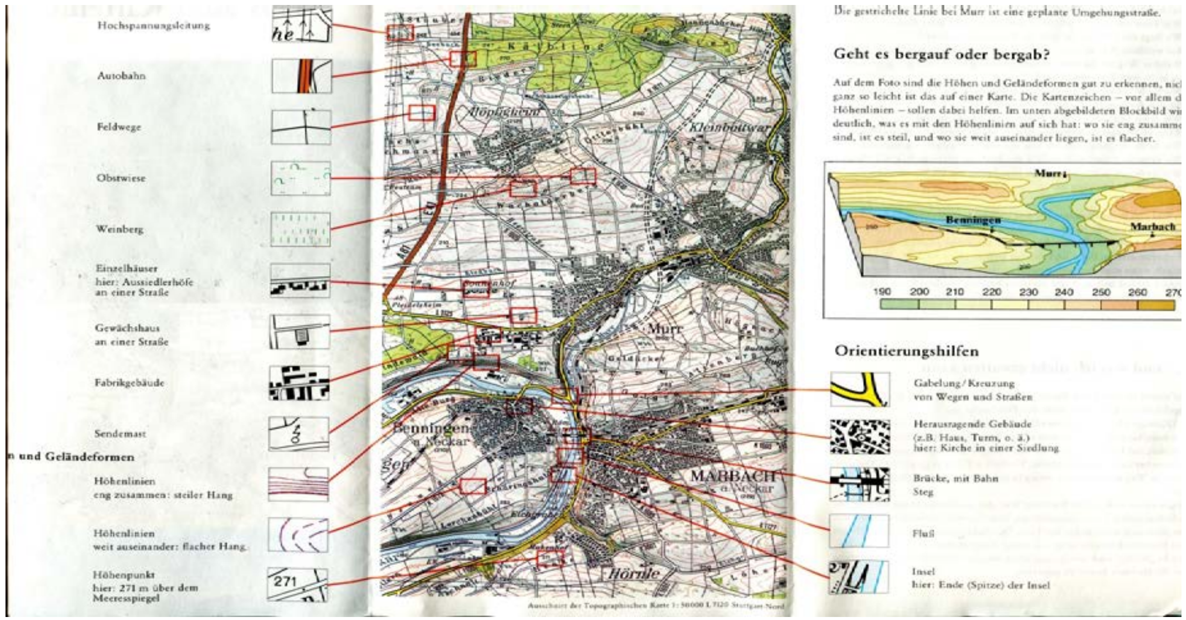
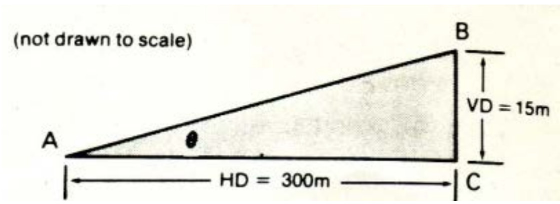


Figure 2.7. Topographic map, with information categories highlighted. (©www.lgl-bw.de).

can deduce the slopes of the terrain: if they are close together it will be steep, if they are further apart the slopes will be more gently.



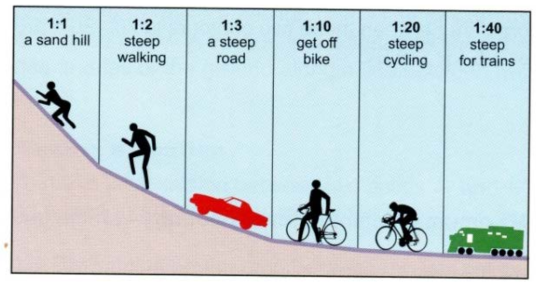


Figure 2.6. Slope effects. (©NSW Dept. of Lands).

Now that we have found the road to be passable, we can assess what we will encounter or see from the road: the natural and man-made environment, the infrastructure, cultural objects and restrictions like boundaries, off-limits roads or areas, railway crossings, ferries or tunnels. In figure 2.7 we can see what kind of individual objects can be seen from the road, like power lines, motorways, agricultural roads, orchards, vineyards, separate houses, greenhouses, factories or TV towers.

We will be further helped in our navigation by conspicuous buildings or terrain characteristics on the

map that are easy to recognise in the field, such as a fork or crossroads, conspicuous buildings like churches, mansions or towers, rivers or the bridges over them.

The very names on the map provide information as well: different object categories have different letter styles. River names may be blue and tilting backwards, names of small villages black and leaning fore wards, names of cities rendered in capitals, the size of the fonts indicative of the number of inhabitants of the named place.

Some countries denote the land use on their topographic maps by colours, other by repetitive symbols. Forests usually are rendered green on the map, with symbols added to indicate whether they are coniferous, deciduous or mixed. In Eastern European topographic map extra information is added by showing the average height, circumference and inter distance between the trees for every forest patch.

B. Maps as links in information systems

Maps in atlases (see chapter 7) also can be regarded as geographic information systems (see chapter 3 for digital GIS´s). Just compare the kind of information that can be read off different school atlas maps: in order to learn

more about a specific area, like the Algarve in Portugal, on an general overview map in a school atlas (figure 2-8), which shows it as a coastal plain with a hilly hinterland up to 900m with the town of Faro as the main centre, we

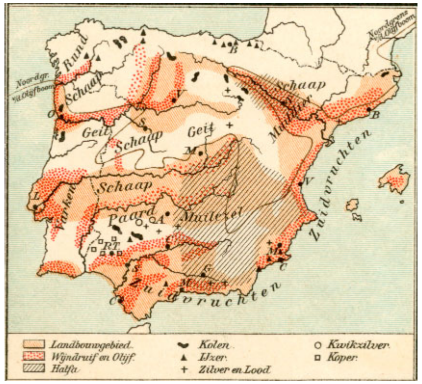


Figure 2.9.Inset map of the Bos atlas showing agriculture. (Bosatlas 31sr ed., 1927).

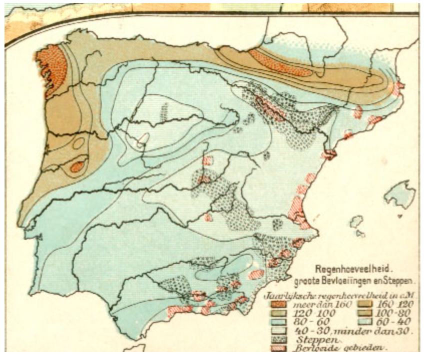


Figure 2.10. Inset map shopping climate.(Bosatlas 31st ed.,1927).

Figures 2.8. The Algarve, in the south-western Iberian Peninsula according to the Bos atlas. (47th ed., 1971).

should link it on the basis of its location to other maps that show this area. If we link it to an agricultural map (figure 2.9) that also shows the Algarve, for instance, we would see that its coastal areas have Mediterranean agriculture (cereal growing and vineyards) and the inland hills would have animal husbandry (esp. goats). A map on the occupational structure would show that the Algarve has an exceptionally high percentage of people working in the services sector, which means, considering its seaside location, in Tourism. From a climate map (figure 2-10) we would see that the area is reasonably humid; likewise that the population density is till rather low (110), when compared to the European Union (150) average. From a soil map of the region it can be deduced that there are terra rossa soils. It can all be deduced from various atlas maps, although the process to do so is rather laborious and roundabout.

Figure 2.11. The Algarve according to the Alexander Atlas. (©Ernst.Klett Verlag GmbH).

It is conceivable to include more information in the overview map. The Alexander Atlas from Klett publishers would be an example (see figure 2.11). As the map has more detail, it has the advantage that specific terrain forms can directly be associated with specific land use or land cover forms. The map shows that the Algarve coastal plain has citrus growing and fruit trees, that land irrigated from the Guadiana reservoirs. The forests show a blue tree symbol denoting oak trees. Their bark is a resource from which corks are produced. There is a clear difference between the Portuguese Algarve coast and the neighbouring Spanish coast, which cannot be deduced from figure 2.7, with its height layer zone colouring. The scheme in figure 2.12 shows additional differences in expression and related information density.

The advantage of the Alexander atlas is that it shows local links or connections. It doesn't teach you, however, to establish links between the various data sets or maps that is to establish the locations or addresses as links. But the maps themselves are little wonders of well-integrated and perfectly legible mapped information.

Paper atlas information system

	Bosatlas	*Alexander Atlas*
Algarve	Coastal plain	Coastal plain with citrus fruit irrigated
	Hilly hinterland	Hills with macchia and sheep/ goats
Andalusia		
Delta Guadalquivir	Lowland	Lowland, marshes, vineyards
	Industry around Cadiz	Shipyards, machine-industry
Guadalquivir valley	South bank low	Extensive agriculture, olives
	North bank steep	Mediterranean forest, irrigated river lands
Sierra Nevada		
mountains	Up to 3700m	Mediterranean forests, citrus and fruit trees on slopes; irrigated agric. in river valleys
along the coast	Hilly	Extensive agriculture
Sierra Morena		
slopes	Reservoirs; 200-1000m	Mediterranean forests, macchia
plateau	200-500m	Extensive agriculture, cork oaks

Figure 2.12. The kind of information different paper atlas information systems might provide on a region.

So we can oppose the analytical approach in the Bosatlas, which shows on each map 'where is that phenomenon?', enabled by the fact that phenomena are shown in isolation (either height layer zones or agriculture or climate, etc) and the synthesis-approach by the Alexander atlas ('what is there?'). The graphical approach by the latter invites one to make a journey of discovery through the area (describe for instance what you will see on a biking trip from Faro northwards). But one should realise the drawbacks of this method as well: in industrialised areas the overlapping symbols used mask land use, and nothing is communicated about the tertiary (services) sector, which in this tourist area is so important. For getting to deal with information systems, the prior approach might be more effective.

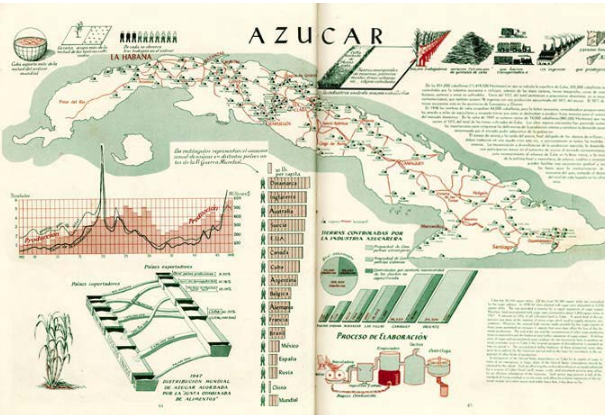


Figure 2.13. Sugar production atlas spread from Canet's Atlas de Cuba (1949).

A third approach is to combine all information that is relevant to a specific topic, like sugar in Cuba (figure 2.13). Here on this atlas spread (a double page related to one specific theme) both the actual sugar factories, the transportation network to get the sugar to the ports, and the counrties where it is exported to are shown, with diagrams illustrating which part of the arable land and of the workforce is used for sugar production.

Climate data

If you would like to know what is the best month to visit a country, based on the likelihood of rain occurring during your trip, try the following FAO website: http://www.fao.org/WAICENT/FAOINFO/sustdev/EIdirect/climate/EIsp0022.htm. It is an animated map which shows for every month the amount of rainfall expected, based on thirty years averages. In order to answer the question one would have to identify the country first, and then look at the rainfall patterns changing over time. Should the animation run too quickly, then it is also possible to look at the individual maps produced for each month, like the one in figure 2.14.

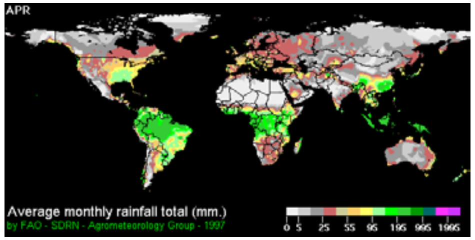


Figure 2.14. FAO world rainfall map for the month of April.

C. Maps as inventories or switch boards

In order to speed up urban renewal, many cities have information services for their citizens on which these can indicate where something is amiss. After entering the website of Rotterdam municipality I asked for the Utrechtsestraat, which then came up, large scale, allowing me to pinpoint the location of a malfunctioning lamp post. For easier reference the house numbers are also given. In figure 2.15 this is shown. On the basis of such reports the municipal maintenance services can better plan their operations.

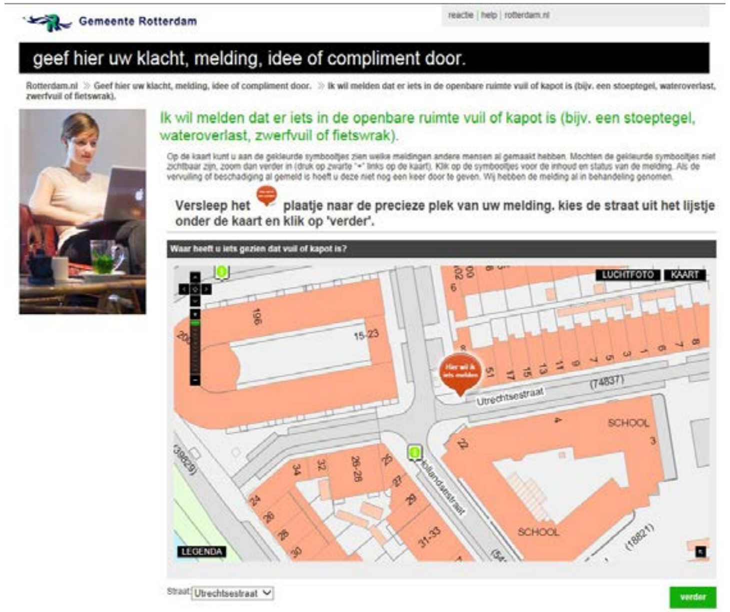


Figure 2.15. Map for reporting damaged 'street furniture'. (©Rotterdam municipality).

Another example would be the cadastral map: if I would like to know the current value considered appropriate for my house, I would consult the municipal website where I can log in and find out for what amount my house is assessed by the municipality. It would also show the assessments of similar houses in my neighbourhood. Figure 2.16 is an example of such a cadastral map. The black numbers in the parcels refer to a list, the ledger or land register in which are indicated the names of my wife and me as the owners of the house, any outstanding mortgages and the amount for which we bought it, and the date of the purchase.

Figure 2.16. Extract of a cadastral map. Black numbers are cadastral numbers of parcels; red numbers refer to street addresses.(©Kadaster Nederland).

Soil maps2- are another form of inventories in which geospatial knowledge has been stored. Soil maps display soil units, that is areas that have the same soil characteristics, such as depth of the various soil layers, percentage of humus in the soil, chemical composition, permeability, ground water level, etc. The suitability for specific crops such as barley or sunflowers of a given area would depend on these soil characrteristics, combined with climate data such as the amount of rainfall and the length of the growing season (number of consecutive days with a temperature above 5° C). The soil map (see figure 2.17a) won't give an immediate answer regarding this suitability, but when you address the characteristics of each soil unit (these would be stored in the codes applied to the soil units on the map or in the dataset on which the map is based) and tick off the requirements for the crop you want to raise, then the system will highlight those areas that would be suitable (figure 2.17b).

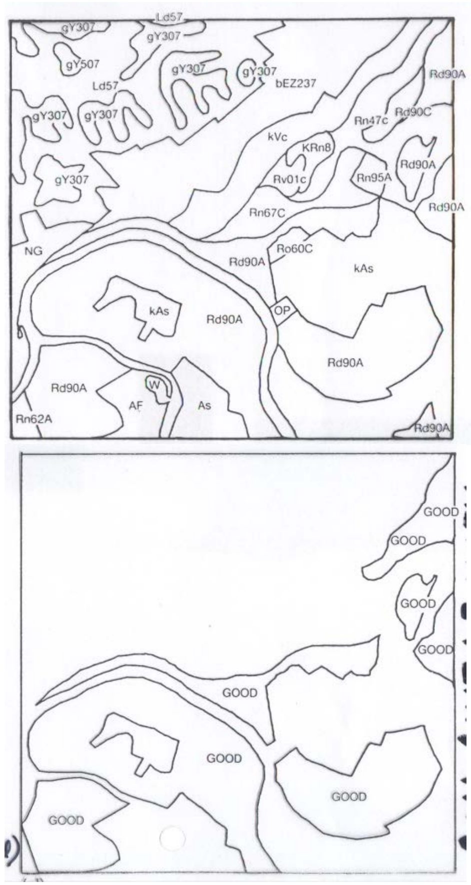


Figure 17a - Soil map; all soil units have codes that show its characteristics for a number of parameters. In 17b, those soil units are suitable for the crop we want to raise, that are from the R soil family (so their code starts with a R) and have drainage characteristic d (see second position of the codes).

D. Map use steps

In all these map use cases, the first step was to find the proper map for the assignment: a topographic map (see chapter 5) or thematic map (see chapter 6), a large-or small scale one, etc. The next step would be to find out how the information was visualised (what symbols are used for which information categories or objects), and only then would one be able to find out relationships between relevant objects, to recognise locations and see what their characteristics are. All these steps are a part of map reading.

A step further would be map analysis. That would entail doing measurements (of slopes, distances, directions, surface areas, etc.) or counting objects. Finally, when I would try to explain the situation (why are these objects concentrated there? or Why are the southern slopes of that mountain range forested and the northern slopes not?) my actions would be part of map interpretation, trying to find the reasons for a specific geographical distribution of objects or phenomena. In the case of the southern forested slopes, this might be because of prevailing southern winds that would bring rains to the southern slopes, a higher temperature, or measures against tree-eating animals, etc.

In all these cases the map tells you something about the mapped area without the necessity of actually going there yourself.

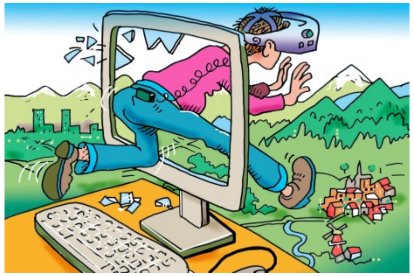


Figure 18 Maps as a window opening up reality (drawing A.Lurvink).