OpenGeoEdu Exercise: Basic

Computation of transport related land use indicator

Level: Community

Introduction

Transport related land use indicators are important for the assessment of transport infrastructure (e.g. total road network density, transport area, etc.). For sustainable spatial planning, findings on the spatial variability of these indicators at different levels (municipality to federal state) are needed. Against this background, the question arises how to calculate the **total road network density at the municipal level** for a selected federal state? To this end, we discuss methods to generate and visualize the results and to compare their accuracy. The following contents are planned:

- Basics of data management using freely available, open data
- GIS technical calculation steps with geometric attributes
- Cartographic presentation of the results, comparisons and their evaluation

Problem

The IOER Monitor provides a total of 10 transport-related indicators at different levels. The total road network density is a particularly important indicator (unit of measurement [km/km²]). The indicator is calculated on the basis of the ATKIS Basis-DLM and defined as follows:

"The indicator describes the total length of the road transport network (classified and unclassified roads and main economic routes) per area. High indicator values occur above all in larger cities, densely populated regions that are well served by the road network (IOER Monitor: Transport)".

Here we show step-by-step how this indicator can be calculated and visualized using freely available open data (e.g. OSM) and open GIS software (e.g. QGIS). Alternatively, you can also work with open official data (ATKIS Basis-DLM data is openly available from the federal states: Berlin, NRW, Hamburg, Thuringia, Rhineland-Palatinate, Brandenburg, and Saxony) and other GIS software tools; but please note the terms of use of data products and software in relation to Open Data guidelines.

This task will be performed in five steps. The first step is data download, the second is data modeling, the third is data preparation, and the fourth is indicator calculation. Finally, the results will be presented as a map so that we can make an assessment using official data from the IOER Monitor.

Step 1: Data research

For this task we need the following basic data:

- Road network, and
- Administrative boundaries .

There are several ways - depending on factors such as computer capacity, Internet connection, GIS software platform, accuracy, raw or processed data, etc. - to download OSM data. Here we try two data types and processes:

- Road network: obtained from *GEOFABRIK* (processed OSM data) and
- Administrative boundaries: with the help of plug-ins (raw data)

Road network: GEOFABRIK offers up-to-date (every 8 hours) ESRI compatible Shape Files from OSM. Download the road network data for the Saarland (for practice purposes a relatively small federal state) at https://download.geofabrik.de/ These data are also accessible from other sources - e.g. mCloud shows road network data of the federal states also as WFS, WMS.

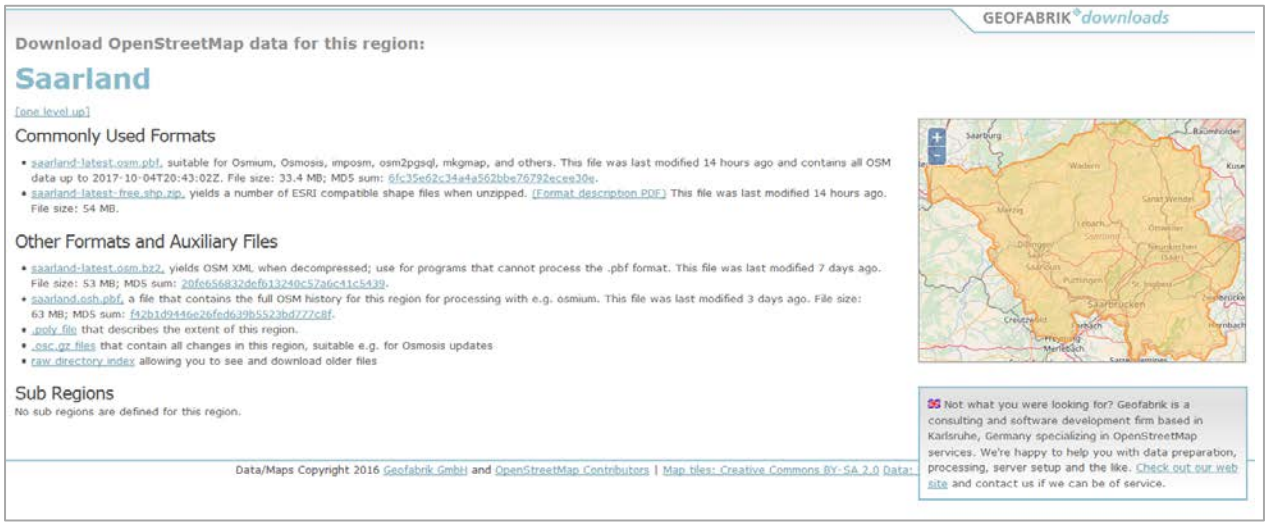

Figure 1 Screenshot GEOFABRIK (Example: Saarland)

Important: After downloading there are several shapefiles in the folder. However, this task should only be performed with road network data. Please read the "README" for further meta information as well as license questions and version.

Administrative boundaries: The total road network density can be calculated for different administrative levels, e.g. for federal states, spatial planning regions, districts and municipalities (see the lecture on Open Data https://learn.opengeoedu.de/en/opendata/vorlesung/open-government-data). Thus we can show the relation to indicators of transport infrastructure on different spatial levels. For this task we download the raw OSM

community boundaries for a federal state (e.g. Saarland) (Wiki for the administrative boundaries on OSM). For this we use for example the "QuickOSM plugin" directly in QGIS Desktop, from where the data can be exported in ESRI shape file format.

Step 2: Data preparation

Here we process our data further with regard to the task at hand. First we have to convert our data into the so-called "tidy" format. For geometrical reasons, both shapefiles must be available in the local coordinate reference system (LCS) in any case. Here we use WGS84/UTM zone 32 as local KBS.

Help: Projections, https://learn.opengeoedu.de/en/tutorials/OGE-Tutorial_KNE_Koordinaten-en.pdf

Preparation road network: The road network data must be semantically homogenized (German/English nomenclature). For this purpose, only certain "Road Types" must be selected (see table).

Table : Semantic homogenisation - road network types (Note: The types marked in red are deleted)

Geobasis/IÖR-Monitor	OSM
Autobahn/Bundes Straße	motorway
	motorway link
Schnell /Bundes Straße	Trunk
Schnell / Landesstraße	primary
	primary_link
Zufahrt/ Kreis Straße	secondary
	secondary link
Haupt/Gemeine Straße	tertiary
	tertiary_link
Wohnstraße	residential
Hauptwirtschaftswege	service
Hauptwirtschaftswege	track
Hauptwirtschaftswege	track_grade1
Hauptwirtschaftswege	track_grade2
Hauptwirtschaftswege	track_grade3
Hauptwirtschaftswege	track_grade4
Hauptwirtschaftswege	track_grade5
Hauptwirtschaftswege	trank_link
nicht klassifizierte	unclassified
nicht klassifizierte	unknown
	cycleway
	footway
	bridleway
	Living_street
	path
	pedestrian
	steps

Preparation of administrative borders: There are different administrative borders, but here we only need the municipal border for the federal state of Saarland. To prepare this data we ask ourselves the question whether the federal state border is correct? If not, then the additional borders must be deleted. There are several non-relevant attribute fields (these can be deleted if desired).

Step 3: Data modelling

We have already downloaded the basic data. Now the question arises how to calculate the total road traffic network density on the area? Which data preparations are necessary? What are, depending on the data basis and the GIS software platforms used, available geometric and statistical methods? For this purpose we create a data modelling diagram, a so-called UML/ERM flowchart. Here attribute fields, types, methods etc. should be selected. At this point the ERDPlus (Webtool - open, free to use) can be used, but other tools are also available.

Help: Data Modeling, https://learn.opengeoedu.de/en/tutorials/OGE-Tutorial_UML_Vorlesung-en.pdf

Step 4: Calculation

After data preparation, we now calculate the total road traffic network density on the area in three steps. First we calculate the geometric attributes:

i) Geometric attributes:

- Length of the road network (Geometric LENGTH: unit of measurement in km)
- Area of administrative boundaries (AREA: unit of measurement in km²)

(ii) attributes by position (i.e. spatial join)

(iii) total road network density in the area (TOTAL LENGTH/AREA: unit of measurement km/km²)

Step 5: Preparation of results

Now we compare our results with those of the IÖR-Monitor map. First we display the map and histogram in the same class width. The classification methods and graph can be selected in the IÖR Monitor.

(i) Automatic class division

(ii) Cartographic representation and graphic design (IÖR-Monitor vs. own calculation)

A.1	B.1
IÖR-Monitor map (indicator: total power grid thickness, analysis level: federal states, federal states: Saarland, spatial structure: municipality, class composition: same class width)	**Own map (with same cartographic representation as A.1 + histogram)**
A.2	**B.2**
IÖR-Monitor map (indicator: total power grid thickness, analysis level: federal states, federal states: Saarland, spatial division: municipality, class occupation: same class occupation)	**Own map (with same cartographic representation as A.2 + histogram)**

Figure 2 Comparing results

(iii) Visual comparison and assessment

This was an example of a GIS project on the topic "Fundamentals of data management". Please make a visual assessment of the results. Describe similarities and try to find answers for possible differences yourself.

The following points were worked on:

- ⇨ Use of open data, e.g. OSM data,
- ⇨ use and cleaning of data attributes,
- ⇨ introduction and use of geometric tools, and finally
- ⇨ the presentation and visual evaluation of the results.

Note: If you wish, use a different state for practice purposes. It may also be advisable to use a different GIS platform or other data, e.g. ArcGIS or the administrative boundaries of the BKG.

If you are interested, you can also see the advanced exercise.