Parking spaces 2019

Spatial scale / resolution:	PC6 Address locations
Spatial coverage:	Netherlands
Temporal range:	2019
Data format input data:	csv tables / ESRI File Geodatabase (FileGDB)
Data format output data:	Polygons/Points /ESRI File Geodatabase (FileGDB)
Data source input data:	BGT2019: BGT.gdb (Kadaster / ESRI - AG online) TOP10 2019: TOP10NL.gdb (Kadaster / ESRI - AG online) Parkeerlocatie GPS-coordinaten RDW 2019 (https://opendata.rdw.nl/Parkeren): Open_Data_Parkeren__GPS-CO_RDINATEN_PARKEERLOCATIE.csv Parkeergarages RDW 2019: GEO_Parkeer_Garages.csv BAG 2015: BAG.gdb (Kadaster / ESRI - AG online)

Data storage outputdata:

..\Source_data\Traffic\Parking\Park_data.gdb

Data description:

There is no geodata available for the Netherlands that completely covers all possible parking places. However, by combining different datasets we can get a reasonable complete coverage of parking spaces.

The combined dataset combines parking areas or parking locations from the following input sources:

1. Parkeervlakken from polygon feature class 'wegdeel' in the 'Basisregistratie *Grootschalige* Topografie' (BGT) 2019, see for details http://imgeo.geostandaarden.nl/def/imgeo-object/wegdeel/parkeervlak
2. Parkeerplaatsen from polygon feature class 'wegdeel_vlak' in TOP10 (Basisregistratie Topografie - BRT) 2019
3. Parkeerlocatie GPS-coordinaten, v. November 2019 (table). A geographic location of an entrance or exit of a parking area or parking garage with associated parking capacity in number of parking places. https://opendata.rdw.nl/Parkeren/Open-Data-Parkeren-GPS-CO-RDINATEN-PARKEERLOCATIE/k3dr-ge3w
4. Parkeer Garages Open Parkeerdata RDW, v. November 2019 (table). 'Parkeergarages' are already covered by dataset nr. 3, but this dataset (which seems less well updated) gives more details on the naming of the garages and can therefore be helpful. https://opendata.rdw.nl/Parkeren/GEO-Parkeer-Garages/t5pc-eb34

5. Polygons from the BAG dataset (2015) that are interpreted as parking areas when meeting specific area and attribute criteria with an area between 15 and 40 m2 and within 25 meters distance of existing dwellings.

In total we find a combined number of circa 11.800.000 parking places, of which approximately 8.820.000 shared parking places on the street, about 403.000 spaces in public or semi-public parking garages and 2.577.000 private places linked to inhabited dwellings.

Data processing:

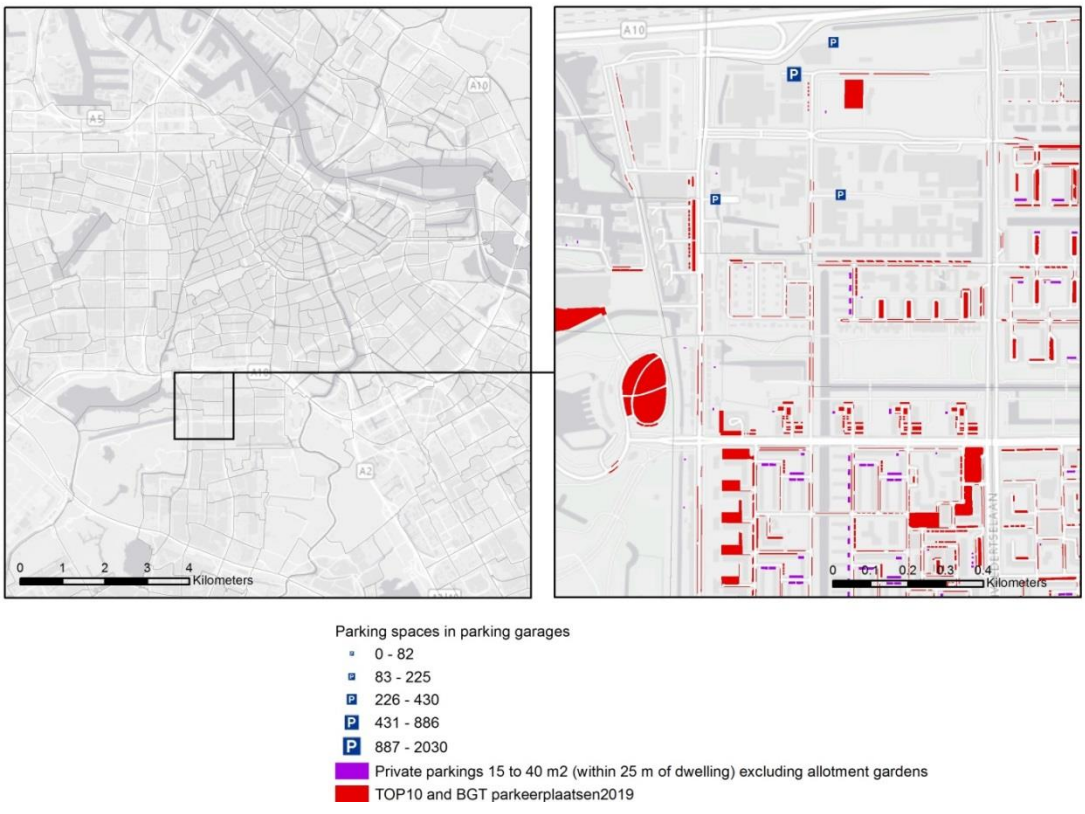
Because the development of this dataset consists of many different data processing steps, the applied methodology is added separately in appendix 1.

Discussion

A separate discussion concerning completeness aspects of this dataset and some reflection on the number of parking spaces versus the availability of parking spaces at residential locations and destinations, is provided in appendix 2.

Map example polygon map BGT – TOP 10 2019 / BAG 2015

..\Geodata\Source_data\Traffic\Parking\ Metadatasheet map overview parking spaces_ArcMap10_6.mxd



Map example point map BGT – TOP 10 – RDW 2019 / BAG 2015

..\Geodata\Source_data\Traffic\Parking\ Metadatasheet map overview parking spaces_ArcMap10_6.mxd

Variables

Table 1 provides an overview of variables that are available in the dataset 'Total_Parkspaces_2019'

Table 1: Overview of attribute data in TOP10 and BGT parkeerplaatsen2019 (polygon) and Total_Parkspaces_2019 (point)

Variable name	Description	Original dataset
Functie	Road function	
FIRST_TYPE	Road type	
FIRST_stat	Status	
Parkspaces	Original area based (calculated) number of parking spaces	
LocationRe	I-O if RDW parking space, otherwise <NULL>	
Location_1	I-O location ID	
Capacity	I-O location capacity	
COUNT_Capa	Number of I-O entrances / exits	
Cap_x_IO	Capacity divided by the number of I-O's	
Overlap_RDW	Overlap with RDW parkings: <NULL> or YES for polys > 500 m2 within 10 m distance	
Overlap_PP	Overlap with private built-up parkings: NO or YES within	

	10 meters distance
CapxIO_rdw	Number of park spaces for each I-O entrance/exit
Cntcap_rdw	Number of I-O entrances/exits
Parkspace_total	Parkspaces based on BGT/TOP10 2019 or RDW spaces if Overlap_RDW is yes (multiplied with number of I-O entrances/exits)
Park_type	1 = RDW parkspace 2 = parkspace BGT/TOP10 2019

Data provider

Several

Data quality

See description processing

Additional information

n.a.

Contact information

GECCO - Geoscience and health cohort consortium
Department of Epidemiology and Biostatistics
Location VUmc, De Boelelaan 1089a, 1081 HV Amsterdam
E: j.lakerveld@amsterdamumc.nl, a.wagtendonk@amsterdamumc.nl
T: 0031 (0)6 24858837

Terms and conditions

None, all public data

Suggested or required way of data referencing

GECCO reference

List of references

n.a.

Appendix 1: data processing

In the following description of the data processing steps carried out, the numbers refer to the data set numbers in the dataset description above.

1. Parkeervlakken BGT 2019

   From the BGT 2019 in BGT.gdb the feature class wegdeel_v was selected and visualized in the GIS project. Next, all records within the field 'function' with the value 'parkeervlak' were selected and exported to a new dataset named 'BGT_parkeerplaatsen2019.shp'. This concerns 1.306.194 polygons with a total surface of 111.6 km2 and an average of 85.4 m2.
2. Parkeerplaatsen TOP10 2019

   From the TOP10 2019 in TOP10NL.gdb the feature class WEGDEEL_VLAK was selected and visualized in the GIS project. Next, all records within the field 'TYPEWEG_1' with the value 'parkeerplaats' were selected and exported to a new dataset named 'TOP10_parkeerplaatsen_2019.shp. This concerns 24.108 polygons.
3. Parkeerlocaties RDW 2019

   This dataset comes as a table in csv format with XY coordinates in WGS84 (EPSG: 4326). After importing the table as an XY event layer into ArcMap, it is exported as an ESRI shape file and projected to the Dutch coordinate system (Rijksdriehoekstelsel – RD New). Because the dataset contains not only the coordinates of entrances and exits of parking places but also of the points of sale, the latter is filtered out the dataset. Next, manual checks are made for the largest known parking areas, especially those locations were a parking capacity of zero is recorded. Where possible the correct parking capacity from available online information is added to the dataset. For example, the largest public parking areas of Schiphol airport were listed in the dataset with a capacity of 0 parking spaces. The corrected dataset named 'Parkeerlocaties-met-specificaties-RDW-opendata-versie-nov2019_GEO-Parkeergarages_capacity_per_entrance_RD_2.shp' contains 1737 records with a total capacity of 286.180 parking spaces.

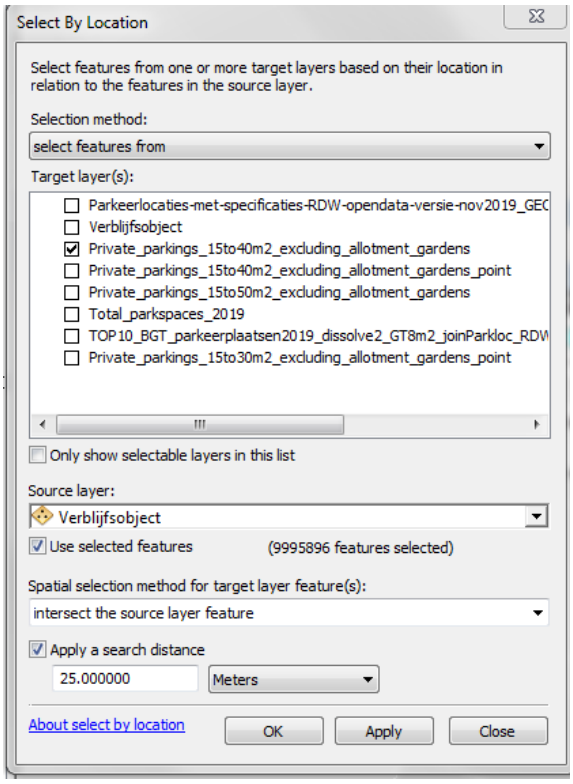
   Please take notice that the field 'Capacity' can contain duplicate records because one parking space can have multiple entrances and or exits. Therefore I have searched for identical parking locations using the function 'Find Identical' with the field 'AreaId' and flagged the parking spaces with multiple exits/entrance and assigned the number of entrances/exits in the newly added field 'Cntcap_rdw'. Next, I divided the number of parking spaces in the field 'Capacity' by the number of exits/entrances for one individual parking space in the field 'Cntcap_rdw' and

assigned the divided number of spaces to each of the entrances/exits in the field 'CapxIO_rdw'. The number of parking spaces in this field can be summed up to get the total number of 286.180 parking spaces.

5. BAG dataset (2015)

The private covered / built-up parkings (garages, car ports etc.) that belong to inhabited dwellings cannot be mapped separately. However, a rough indication of their whereabouts can be acquired from the BAG dataset. To select potential built-up private car parkings I carried out the following selection:

- select buildings from the BAG (2015) between 15 and 40 m2
- add an attribute field named 'parkspaces' and calculate the number of parking spaces by dividing the field 'SHAPE_Area' by 15
- make a subselection of buildings that intersect with the point dataset verblijfsobjecten that have a user function classified as 'other' (overig) and are within 25 meters of an inhabited building
- -add subselection of buildings that do NOT intersect with any point of the dataset verblijfsobjecten) and are within 25 meters of an inhabited building
- remove all buildings that intersect with the land use class allotment gardens (volkstuinen) in the landuse dataset from CBS for the year 2015.



The resulting dataset is named 'Park_data2.gdb\ Private_parkings_15to40m2_excluding_allotment_gardens_within25m_dwelling_point'.

Spatial union between BGT2019 and TOP10 2019

The 'parkeervlak' polygons of BGT2019 (BGT_parkeerplaatsen2019.shp) and the TOP10 2019 (TOP10_parkeerplaatsen_2019.shp) were combined in a spatial union operation between the two datasets leading to a dataset named 'TOP10_BGT_parkeerplaatsen2019_merge.shp' (note that the naming 'merge' is mistaken and should have been 'union').

- Next, all records from the TOP10 2019 dataset were selected and an attribute value 'parkeervlak' was given to the selected records in the field 'function'.
- Next, a dissolve operation was carried out with the field 'function' as the dissolve field resulting in the layer 'TOP10_BGT_parkeerplaatsen2019_dissolve2.shp'.
- Next, all polygons < 8 m2 were removed from the dataset (which concerns polygons too small to be a parking space) resulting in the layer 'TOP10_BGT_parkeerplaatsen2019_dissolve2_GT8m2.shp'.
- Next, a new field 'parkspaces' was added to estimate the number of parking spaces based on the size of the parking area. The assumption here was that larger parking areas use relative more space per parking space because considerable parts of the parking area need to be used for driving and maneuvering space. To test these assumptions a couple of parking spaces were selected with a known (or countable) area and number of parking spaces. Therefore the following selections and field calculations were made:
    - polygons with an area < 100 m2: `Parkspaces = [Shape_Area]/11.5`
    - polygons with an area 100 - 250 m2: `Parkspaces = [Shape_Area]/12.5`
    - polygons with an area 250 - 500 m2: `Parkspaces = [Shape_Area]/15`
    - polygons with an area 500 - 1000 m2: `Parkspaces = [Shape_Area]/20`
    - polygons with an area > 1000 m2: `Parkspaces = [Shape_Area]/32.5`

Spatial join TOP10-BGT2019 dataset and RDW parking locations 2019 dataset

To avoid double counting of parking spaces between polygons from BGT/TOP10 ('TOP10_BGT_parkeerplaatsen2019_dissolve2_GT8m2.shp') and the RDW parking locations ('Parkeerlocaties-met-specificaties-RDW-opendata-versie-nov2019_GEO-Parkeergarages_capacity_-per_entrance_RD_2.shp') a spatial join was made between the two datasets of intersecting locations, with a spatial tolerance (search radius) of 10 meters. The resulting join is named 'Park_data.gdb\TOP10_BGT_parkeerplaatsen2019_dissolve2_GT8m2_joinParkloc_RDW'.

Combination of data in point and polygon maps of park space data Netherlands

To calculate the total number of shared parking spaces (these are public free and paid parking spaces on the street, fenced-off parking areas, public and private parking garages) I merged the datasets 'TOP10_BGT_parkeerplaatsen2019_dissolve2_GT8m2_joinParkloc_RDW_point' and 'Parkeerlocaties-met-specificaties-RDW-opendata-versie-nov2019_GEO-Parkeergarages_capacity_per_entrance_RD-_2' to a new dataset named 'Total_parkspaces_2019'. Next, I added a new attribute field 'Parkspace_total' to 'Total_parkspaces_2019' and I selected the records where the parking terrains and garages of RDW intersect within 10 meters distance with parkspace polygons larger than 500 m2 while the RDW parking capacity is larger than zero (for some of the RDW parking garages no parking spaces are recorded, thus Cap_x_IO = 0). These are the records where Overlap_RDW = "YES for polys > 500 m2 within 10 m distance". To create this selection the following query was carried out:

- Select from Total_parkspaces_2019 where Overlap_RDW IS NOT NULL AND Capacity >0

For the resulting selected records I assigned the number of parking spaces according to RDW in the field 'capacity' to the new field 'Parkspace_total'. I do this because I give preference to parkspace counts from RDW terrains / garages over parkspace polygons from BGT, TOP10 and BAG.

Next, I switch the selection in the attribute table and assign the value in the field 'Parkspaces' to the field 'Parkspace_total' for all selected records (so including the RDW parking areas with a capacity of zero).

In the final selection step I select the RDW parking spaces that do NOT intersect within 10 meters distance with parkspace polygons larger than 500 m2 and have a capacity greater than zero:

- Capacity > 0 AND Overlap_RDW IS NULL

Also for these selected records I assign the number of parking spaces according to RDW in the field 'capacity' to the new field 'Parkspace_total'. This means only when RDW parking spaces intersect with larger parking polygons (> 500 m2) and no capacity is recorded, the record will get the parkspace from the polygon.

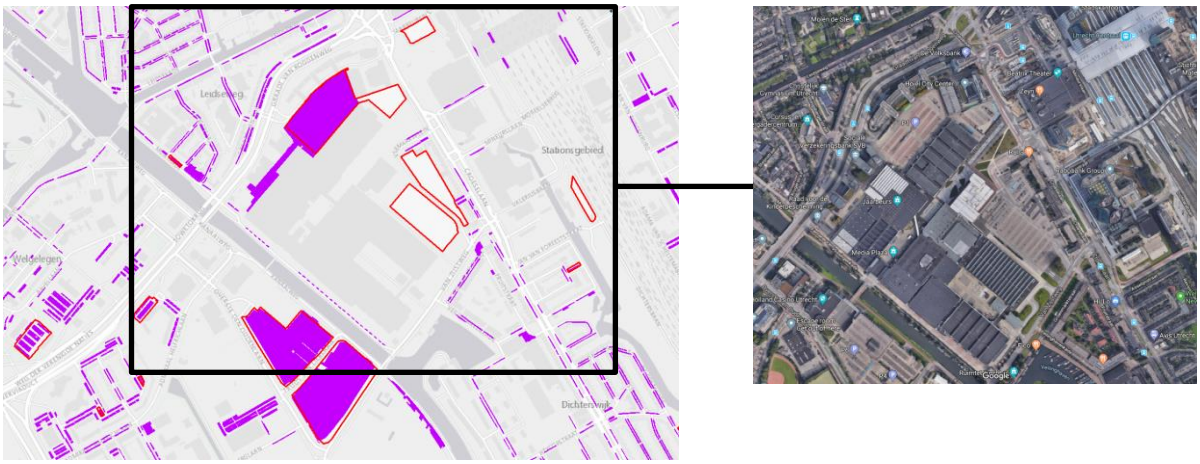
A rest category is formed by records from RDW that do not intersect with any polygons and have a capacity of zero. Although present in the dataset, these parking areas will not show in the map.

In a final step I transformed the parkspace polygons from BGT, TOP10 and BAG to a point dataset with a feature to point operation and join this point dataset to the RDW park locations that to not intersect within 10 meters distance with the BGT-TOP locations. This joined point dataset is named 'Park_data2.gdb\TOP10_BGT_parkeerplaatsen2019_-dissolve2_GT8m2_joinParkloc_RDW_point' (see 2nd map example in the main text).

Appendix 2: Discussion

Completeness

The BGT and BRT TOP10 maps complement each other well. The BRT TOP10 only contains large parking areas, while the large parking areas in the BGT are not always completely covered, see for example the Jaarbeurs area Utrecht here below. The dataset with parking areas/garages from RDW subsequently completes the image together with all private built-up parking spaces derived from BAG 2015.



Purple areas: BGT parkeerplaatsen 2019

Red lines: BRT - TOP 10 parkeerplaatsen 2019

Example: parking garage Vaartsche Rijn (Parkeer_locaties_RDW_2014_V21mei2019_RD)

The number of spaces in public or semi-public parking garages is certainly an underestimated number because the list with parking garages from RDW is far from complete, many commercial garages, e.g. the ones from Parkbee, are missing as well as the many company based –for employees only- garages. Furthermore, the number of 2.577.00 private parking places is uncertain as this is based on a specific selection of buildings in BAG based on the area of the building, it's distance to

existing dwellings and the 'verblijfsobject' type of the building. The criteria can both include too much and too little buildings that are or can be used as a private car parking.

Park space availability

Available parking spaces is not the same as free parking spaces. In other words, the presence of many parking spaces does not mean enough unoccupied parking spaces are available for residents and/or visitors. This is especially relevant in areas that attract non-resident motorized visitors to work destinations and/or utilitarian and leisure destinations, which need many more parking spaces than the number of households with a car in an area.

Another distinction that needs to be made is between parking availability at destination and parking availability at home. With the objectives of the obesigenity study in mind the drivability of a neighborhood might be defined differently than previously thought. Research shows (Christiansen et al., 2016), that car ownership and car use depend on many factors among which parking availability at destination and at home. Parking availability at destination is problematic factor if we do not have individual information about visited destinations. However, what we can calculate is the availability of parking spaces (compared to the number of households) at home. Moreover, Christiansen et al. (2017), show that the walk distance between home and home parking location significantly reduces the probability of choosing the car. It makes therefore sense to incorporate the distance between a location and the most nearby parking spot in the analysis. Next, it makes sense to include in a statistical summary per neighborhood only the parkspace availability of residential locations and maybe make a separate map of parkspace availability around utilitarian and leisure locations.

References

Christiansen, P., Engebretsen, Ø., Fearnley, N., & Hanssen, J. U. (2017). Parking facilities and the built environment: Impacts on travel behaviour. *Transportation Research Part A: Policy and Practice*, *95*, 198-206.