# Research Method

* 1. *Research Area*

***AFBEELDING LOCATIE NEDERLAND ERBIJ ZETTEN***

The area that is going to be studied is the Netherlands (https://www.pdok.nl/geo-services/-/article/administratieve-eenheden-inspire-geharmoniseerd-, last accessed: 04-05-2020). The Netherlands has very fragmented and diverse landscapes, which is caused by the urbanisation in the 20th century and the remodelling of waterworks to protect cities and villages against the great waterbodies (De Mulder, 2019).

This landscape was caused by developments that were going on in second half of the 20th century. A national policy document was introduced about the on spatial planning. First was the spatial planning in the 1960s focused on spreading of regional grow poles, building housing for the growing population post-war and introducing the mobility caused by the generalization of the car. However, the changing social dynamic and the limit the urban sprawl toward peripheral area. In the 1970’s, the focus was on regional grow poles and zoning of land use was introduced. There were also buffer zones introduced to lower the urbanisation rate. In the late 1980’s, the subsidization of regional grow poles became financial unhealthy and therefore stopped. This subsidization was refocused on the cities and therefore focused on grow poles on a national level.

The final period of the national document of spatial policy reorganized spatial planning on local and regional governmental instruments such as municipalities. This caused that spatial planning became project driven instead of plan driven. However, this governmental instrument was overoptimistic and caused over zoning of areas, which lead to a more fragmented landscape. In 2010, the spatial planning became fully regional and local, which ended the national policy of spatial planning (Janssen-Jansen, 2016).

Furthermore, the Netherlands has implemented Bird and Habitats directive into its spatial policy as part of the European Union policy. Therefore, the national government is responsible for the management of these sites. It created several special designated chosen natural areas (Beunen, Van Assche and Duineveld, 2013). This policy is in line with the development with fragmented landscape.

The country has the high population density of 513 people / km2 (CBS, 2019) and the high dense road network, which that people are highly mobile (CBS, 2016). This can greatly influence the fire regime in the Netherlands, because around 97.1% of forest fires are caused indirectly by human agents (Ganteaume *et al.*, 2013) and that road density and distance has been related to fire (Oliveira *et al.*, 2012).

The globally averaged surface temperature has increased with 0.9 °C, whereby the Netherlands is following this trend since 1880. There is an increase of precipitation over all the seasons and the temperature will increase over all the seasons (KNMI, 2014). This is also predicted in the Köppen-Geiger classification map of Beck *et al.* (2018),whereby the new classifications of climate of the Netherlands is a temperate climate without a dry season, but with a warm summer in the late 21st century. There are also some predictions that these variables will increase the risk of wildfires in Western-Europe (Lung *et al.*, 2013).

The spatial policy history, geographic location and the fragmented landscape of the Netherlands is ideal to research. This information can be used to get information how these fire are caused and spread.

*VIIRS dataset*

The VIIRS instrument is on the Suomi National Polar-orbiting Partnership (S-NPP). The satellite orbits the earth at an altitude of 829 km and crosses the equator ascending around 13:30 (Greenwich time) and descends around (01:30). The swath width of the instrument is 3060 kilometres. The sensor can measure different wavelengths at day and night (Cao *et al.*, 2017). An algorithm has been developed by Schroeder et al.(2014) to identify active fires on the earth surface at a resolution of 375 meter or 750 meter (depending on the horizontal location of the pixel) and increased the detection of fires by day and night. The 375- and 750-meter resolution is the unique aggregating scheme of the satellite. The algorithm itself uses the brightness temperature of several sensor and can differentiate between water and land. This dataset is as ASCII text file and is taken from the VNP14ML monthly dataset (<ftp://fuoco.geog.umd.edu/VIIRS/VNP14ML>, last accessed on May 2020).

*Corine Land Cover*

The dataset that is used to extract the landcover is the Corine Land Cover (CLC) Dataset from 2012 and 2018. This dataset is setup with the satellite date of the SENTINEL 2, whereby the satellite instrument Landsat-8 is used for gap filling. The CLC 2018 dataset has been developed between 2017 to 2018 and the CLC 2012 dataset between 2011-2012. The datasets have both an equal or greater 85% thematic accuracy with a minimum mapping unit of the polygon is 25 ha and it has a minimum pixel size of 100 meter. Furthermore, all changes that are greater than 5 ha must be mapped into the dataset (Büttner *et al.*, 2017).

The datasets are taken from <https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=download> (last accessed on May 2020) and <https://land.copernicus.eu/pan-european/corine-land-cover/clc-2012?tab=download> (last accessed on September 2020).

*Overview of the methods*

Two different methods, which are visualized in flowcharts (see figure 1 **and X)** have been developed for this research. The first method is for acquiring the data from the VNL14ML, CLC rasters and administrative borders of the Netherlands. For each method, there will be given an overview what the reasoning is behind the different choices are **DIT MISSCHIEN IN THE LEIDING VAN DIT HOOFDSTUK ZETTEN**.

*Acquiring the data for the Research*

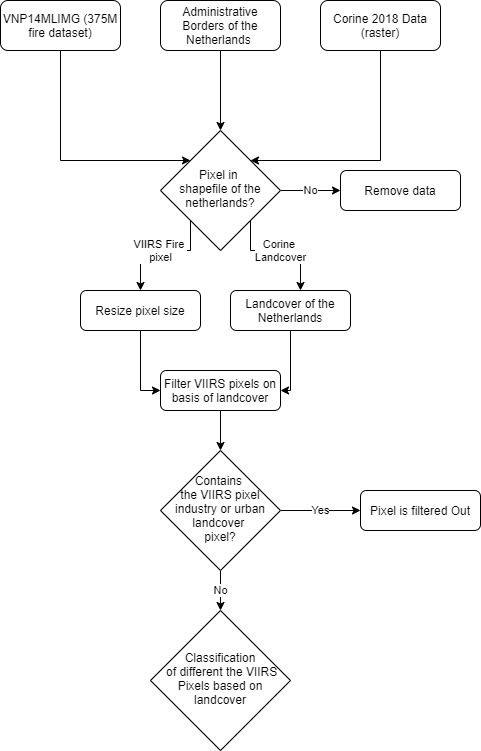


Figure 1 Flowchart on how the data from the data sources are used and are selected. The outcome if this flowchart are a shapefile and a rasterfile containing information about the land cover and the size of the fires.

The general overview of the method for acquiring the data can be seen in figure 1. The VIIRS dataset contains information about the size of the pixel, the classification with the help of the Corine landcover, the year and the month of observation.

*VIIRS Fire pixels*

The size of the fire pixel is determined on which horizontal the pixel has been observed. The further away from the nadir how greater the bow-tie effect is, which means that the pixels toward the edge a more surface area cover. The change in angle, observation distance and curvature of the earth causes this effect. VIIRS use multiple bands to compensate this effect and keep the pixel size 375 meter, however after the 960th pixel, the instrument cannot compensate the pixels which cause that the pixel size is 750 meter instead of 375 meter (Cao *et al.*, 2017). This effect is compensated when parsing the fire pixels. The horizontal location is used to determine if the pixel to determine the pixel size. If the horizontal pixel location is smaller than 960then the pixel

*Classification of the fire pixels*

After resizing of the fire pixels, the VIIRS fire pixels are going to be classified based on the CLC dataset. The classification of the fire pixels is following the formula

The classification of the pixels in the Corine Landcover dataset (Kosztra *et al.*, 2017) the head classes 3 (Forest and semi-natural areas) and 4 (Wetlands) are used to filter the urban, agricultural and water bodies identified fire pixels. Hereby are the bare rock class

This will be more convenient for the analysis of the data and the flexibility of the data. For the landcover datasets means that the datasets are cropped to the range of the administrative borders of the Netherlands and for the burned dataset means that the points which are in range of the borders are filtered out of the dataset.

Beck, H. E. *et al.* (2018) ‘Present and future Köppen-Geiger climate classification maps at 1-km resolution’, *Scientific Data*. MACMILLAN BUILDING, 4 CRINAN ST, LONDON N1 9XW, ENGLAND: NATURE PUBLISHING GROUP, 5(1), p. 180214. doi: 10.1038/sdata.2018.214.

Beunen, R., Van Assche, K. and Duineveld, M. (2013) ‘Performing failure in conservation policy: The implementation of European Union directives in the Netherlands’, *LAND USE POLICY*. THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, OXON, ENGLAND: ELSEVIER SCI LTD, 31(SI), pp. 280–288. doi: 10.1016/j.landusepol.2012.07.009.

Büttner, G. *et al.* (2017) ‘CLC2018 Technical Guidelines’, (3436), p. 60. Available at: https://land.copernicus.eu/user-corner/technical-library/clc2018technicalguidelines\_final.pdf.

Cao, C. *et al.* (2017) ‘NOAA Technical Report NESDIS 142 Visible Infrared Imaging Radiometer Suite (VIIRS) Sensor Data Record (SDR) User’s Guide Version 1.3’, *NOAA Technical Report NESDIS 142*, (March). Available at: https://ncc.nesdis.noaa.gov/documents/documentation/viirs-users-guide-tech-report-142a-v1.3.pdf.

CBS (2016) *Transport and mobility 2016*, *Statistics Netherlands*. Available at: https://www.cbs.nl/-/media/\_pdf/2016/38/2016-transport-and-mobility.pdf.

CBS (2019) *Statline*. Available at: https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37296ned/table?ts=1600865782793 (Accessed: 23 September 2020).

Ganteaume, A. *et al.* (2013) ‘A Review of the Main Driving Factors of Forest Fire Ignition Over Europe’, *Environmental Management*. ONE NEW YORK PLAZA, SUITE 4600, NEW YORK, NY, UNITED STATES: SPRINGER, 51(3), pp. 651–662. doi: 10.1007/s00267-012-9961-z.

Janssen-Jansen, L. (2016) ‘Taking national planning seriously: A challenged planning agenda in the Netherlands’, *Administration*, 64(3–4), pp. 23–43. doi: 10.1515/admin-2016-0023.

KNMI (2014) ‘KNMI’14: Climate Change scenarios for the 21st Century – A Netherlands perspective; by Bart van den Hurk, Peter Siegmund, Albert Klein Tank (Eds), Jisk Attema, Alexander Bakker, Jules Beersma, Janette Bessembinder, Reinout Boers, Theo Brandsma, Henk van d’, *Scientific Report WR2014-01, KNMI, De Bilt, The Netherlands*. Available at: http://www.climatescenarios.nl/.

Kosztra, B. *et al.* (2017) ‘Updated CLC illustrated nomenclature guidelines’, *European Environment Agency*, (3436), pp. 1–124. Available at: https://land.copernicus.eu/user-corner/technical-library/corine-land-cover-nomenclature-guidelines/docs/pdf/CLC2018\_Nomenclature\_illustrated\_guide\_20190510.pdf.

Lung, T. *et al.* (2013) ‘A multi-hazard regional level impact assessment for Europe combining indicators of climatic and non-climatic change’, *Global Environmental Change*, 23(2), pp. 522–536. doi: https://doi.org/10.1016/j.gloenvcha.2012.11.009.

De Mulder, E. F. J. (2019) ‘Landscapes’, in *The Netherlands and the Dutch: A Physical and Human Geography*. Cham: Springer International Publishing, pp. 35–58. doi: 10.1007/978-3-319-75073-6\_3.

Oliveira, S. *et al.* (2012) ‘Modeling spatial patterns of fire occurrence in Mediterranean Europe using Multiple Regression and Random Forest’, *Forest Ecology and Management*, 275, pp. 117–129. doi: https://doi.org/10.1016/j.foreco.2012.03.003.

PDOK Beheer (2020) *Dataset: Administratieve Eenheden (INSPIRE geharmoniseerd)*. Available at: https://www.pdok.nl/geo-services/-/article/administratieve-eenheden-inspire-geharmoniseerd- (Accessed: 1 May 2020).

Schroeder, W. *et al.* (2014) ‘The New VIIRS 375m active fire detection data product: Algorithm description and initial assessment’, *Remote Sensing of Environment*. 360 PARK AVE SOUTH, NEW YORK, NY 10010-1710 USA: ELSEVIER SCIENCE INC, 143, pp. 85–96. doi: 10.1016/j.rse.2013.12.008.