# Research Method

* 1. *Research Area*

***AFBEELDING LOCATIE NEDERLAND ERBIJ ZETTEN***

As stated in the introduction, the Netherlands is the country where these fire regimes are researched. It is part of Western Europe and has a temperate climate with a warm summer (Beck *et al.*, 2018). The information about the governmental spatial data of the country is taken from the Public Services on the Map (Publieke Dienstverlening op de Kaart in Dutch; PDOK). The borders for the Netherlands are taken from https://www.pdok.nl/geo-services/-/article/administratieve-eenheden-inspire-geharmoniseerd (last accessed: 04-05-2020) and the information of the infrastructure is taken from the national road file (Nationaal Wegen bestand; NWP) and can been downloaded from https://www.pdok.nl/introductie/-/article/nationaal-wegen-bestand-nwb- (last accessed: 17-08-2020). PDOK is an open platform where people can find geodatasets that are related to the Dutch government instances.

*Active fire dataset of VIIRS*

The Visible Infrared Imaging Radiometer Suite (VIIRS) is an instrument, which can detect active fires daily with the help of an algorithm.This instrument is attached on the Suomi National Polar-orbiting Partnership (S-NPP).

The satellite orbits around the earth at an altitude of 829 km and crosses the equator ascending around 13:30 (Greenwich time) and descends around (01:30). VIIRS-instrument has a swath width of 3060 km. Hereby, measures VIIRS the earth surface with 22 different spectral bands (Cao et al., 2017).

**I en M sensoren uitleggen**

The active fire detection algorithm is developed by developed by Schroeder et al.(2014). The I4 sensor, which measures the Mediumwave infrared spectrum between 3.55 - 3.93 µm, is mainly used to distinguish the fires from the background area. To other sensors are used for quality control. This data is acquired for each month and saved in an ASCII file. Through this method, the resolution of the dataset is 375 m and has a low commission error (< 1.2%). Therefore, is this dataset used to get information wildfires in the Netherlands. These dataset are downloaded [*ftp://fuoco.geog.umd.edu/VIIRS/VNP14ML*](ftp://fuoco.geog.umd.edu/VIIRS/VNP14ML) *(last accessed on May 2020)*

*Land cover datasets*

Information about the land cover of the country are taken from the Corine Land Cover (CLC). The datasets from 2012 and 2018 are hereby used. This dataset is built up with the satellite date of the SENTINEL 2 and Landsat-8. The SENTINEL-2 is European earth observation program that is used for acquiring high resolution data of the land surface (**BRON ZOEKEN).** The Landsat-8 is part of the LANDSAT and has the same goal of the SENTINEL-2 satellite (**BRON ZOEKEN)**. The SENTINEL-2 provides the main dataset, while the data of the LANDSAT-8 is used for to fill in the gaps. 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 downloaded from [https://land.copernicus.eu/pan-euro pean/corine-land-cover/clc2018?tab=download](https://land.copernicus.eu/pan-euro%20pean/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) and is open access.

*Natura 2000*

Natura 2000 is a Europe Union biodiversity program. The goal of this program is to stop the decline of biodiversity in Europe. The European union want to achieve this with a European scale nature network or in short, the Natura 2000 network between country members. There are 162 areas in the Netherlands that are part of this network. The importance of the country is in the ecological diverse landscape, which are mostly import for breeding birds (LNV, 2006). This program could contribute to spatial distribution of fires in the Netherlands because it is zoning natural areas whereby natural areas are conserved. The shapefile with the locations of this areas is also taken from the same source as the administrative borders.

*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**.

The scripts that are developed for parsing and analysing the VIIRS, CLC, and PDOK files can be found on <https://github.com/CUniversityaccount/ForestFireNetherlands>.

*Acquiring the data for the Research*

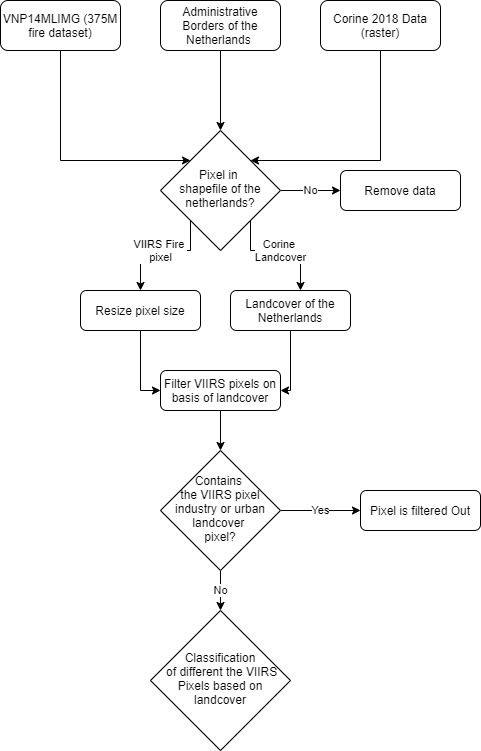


Figure 1 Flowchart on how the data from the data sources are used and are selected. The outcome if this flowchart are a shapefile and a rasterfile containing information about the land cover and the size of the fires.

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.

*Filtering of the VIIRS Fire pixels based on location*

The data from the VIIRS dataset is filtered based on the locations. The centre of the pixel is defined by the longitude and latitude attribute in the dataset. The shapefile of the administrative borders of the Netherlands by PDOK is used to check if the centre of the pixel is in these borders. If the pixel is not in the borders than the pixel is filtered out.

*Size of the pixel*

The size of the pixel is determined by the horizontal position of the pixel. The horizontal location has as starting point horizontal location of the nadir.

The change in angle, observation distance and curvature of the earth causes the increasing size of the from the centre of the measurements. VIIRS use multiple bands and aggregation scheme to compensate this effect and keeping most of the pixel sizes 375 meter, however after the 960th pixel, the instrument cannot compensate the pixels which cause that the pixel size increase to 750 meter instead of 375 meter (Cao *et al.*, 2017). The phenomenon is applied to the filtered pixels. The horizontal pixel number is defined in the dataset and is used to determine the pixel size.

*Filter and classification of the fire pixels*

Classification of the fire pixels has two purposes by this step. One is to filter out active fire pixels where humans are directly involved and to determine what the type of effected land cover is by the wildfire.

The CLC dataset has a three levels hierarchy the dataset (Kosztra *et al.*, 2017). The levels that are used to filter for this study are set out in table **X**.

|  |
| --- |
| 1. Artificial Area |
| 1. Agricultural area |
| 1. Forest and Semi natural areas    1. Forest    2. Shrub and/or herbaceous vegetation associations    3. Open spaces with little or vegetation       1. Dunes |
| 1. Wetlands    1. Inland marshes |
| 1. Waterbodies |

The classification is based on land cover. A pixel cannot contain an artificial area land cover pixel because it is not clear if a human-made object was at that moment on fire, e.g. a building or it was a wildfire. Next it is checked if the pixel all the land cover pixels in the fire pixel does not exists out of waterbodies, because fire above water cannot occur (**nakijken of wildfire boven water kan**).

The next constrain is that the fire pixel exists for at least 50% out of forest (CLC class 3.1), shrubbery (CLC class 3.2), dunes (CLC class 3.3.1) or/and inland marshes (CLC class 4.1).

*Measuring the distance between the fire pixel and road network*

The distance between the Dutch infrastructure NWB and the filtered pixels are calculated with the help of the program QGIS with the NNJOIN plugin. There will be no distinction between the roads in road activity, size of the road, and general use of the road. The type of the road is not mentioned in the NWB file.

The program that is used QGIS with a plugin named with NNJOIN. This program with this plugin will combine the closest datapoints and calculates the smallest distance between those two data points.

*Fires in Natura 2000 areas*

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