New method for locating sources of light pollution and dark areas in the Project Oudlandpolder (Belgium)

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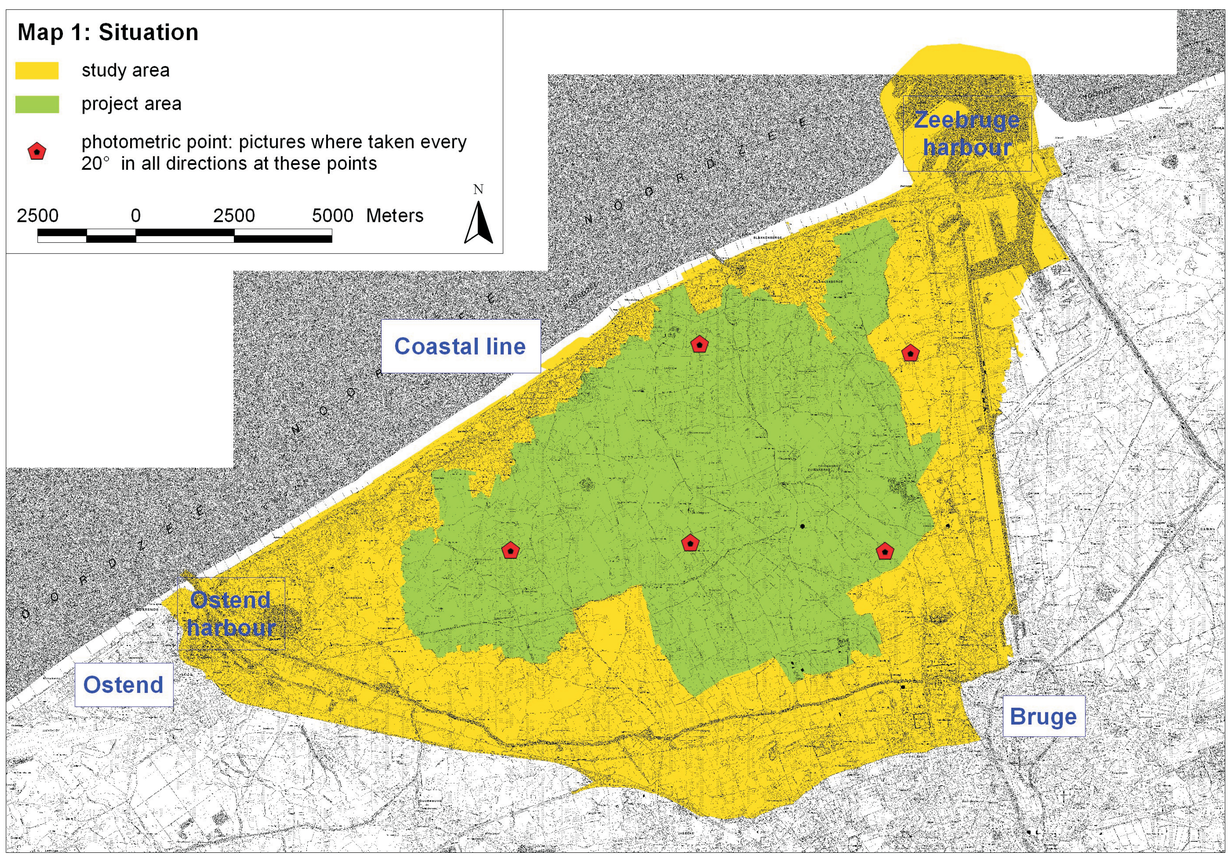
Introduction

The province of West-Vlaanderen asked us to make an inventary of light pollution in the "Oudlandpolder". This area, situated near the Belgian coast in the triangel Ostend-Bruge-Zeebruge, is an agricultural landscape with few small villages, few roads (mostly not luminated), between areas with lots of light polution such as the harbours of Ostend and Zeebruge, the coast line itself and the cities of Ostend and Bruge. The project area is about 15 km by 10 km, the study area 25 km by 20 km. The province of West-Vlaanderen wants to make the first dark area in the Oudlandpolder and wants to know where the major sources of light polution are located.

Material and methods

1. Digital imaging form selected locations in the area

Within the area we located 5 photometric points near the center of the 5 x 5 km UTM grid. These points had to have a clear view in all directions (so no large buildings and no direct lighting in the surrounding). The exact position of each point was determinated using a GPS. On each photometric point we took horizontal pictures every 20° using a Canon EOS 300D camera with an EF-S 18-55 mm f / 3.5 - 5.6 zoom lens in tele mode (55 mm). Pictures are taken both before 0.30 am and after 0.30 am. Each picture has a horizontal view of 23° 20' and a vertical view of 15° 40'. Map 1 shows the project and study area and the 5 photometric points.



2. Digital processing RW-pictures

All pictures are processed by the RAW2LUM software by Jan Hollan. This software calculates the luminance for each pixel. It divides the image in to a grate of 48 x 36 cells and calculates the mean luminance for each cell in the grate. Each cell has a horizontal and vertical view of 29'. We made an 360° picture composed of the 18 individual processed pictures on each point. This give a grate of 741 x 36 cells. Whe only use the data from two rows in the grate. These rows are situated above all buildings so we have a clear view of the sky in each cell. The average luminance for overlapping cells 8 cells (4 width and 2 high) is calculated, so the final cell has a width of 1° 56' and a hight of 0° 58', giving 186 cells per photometric point.

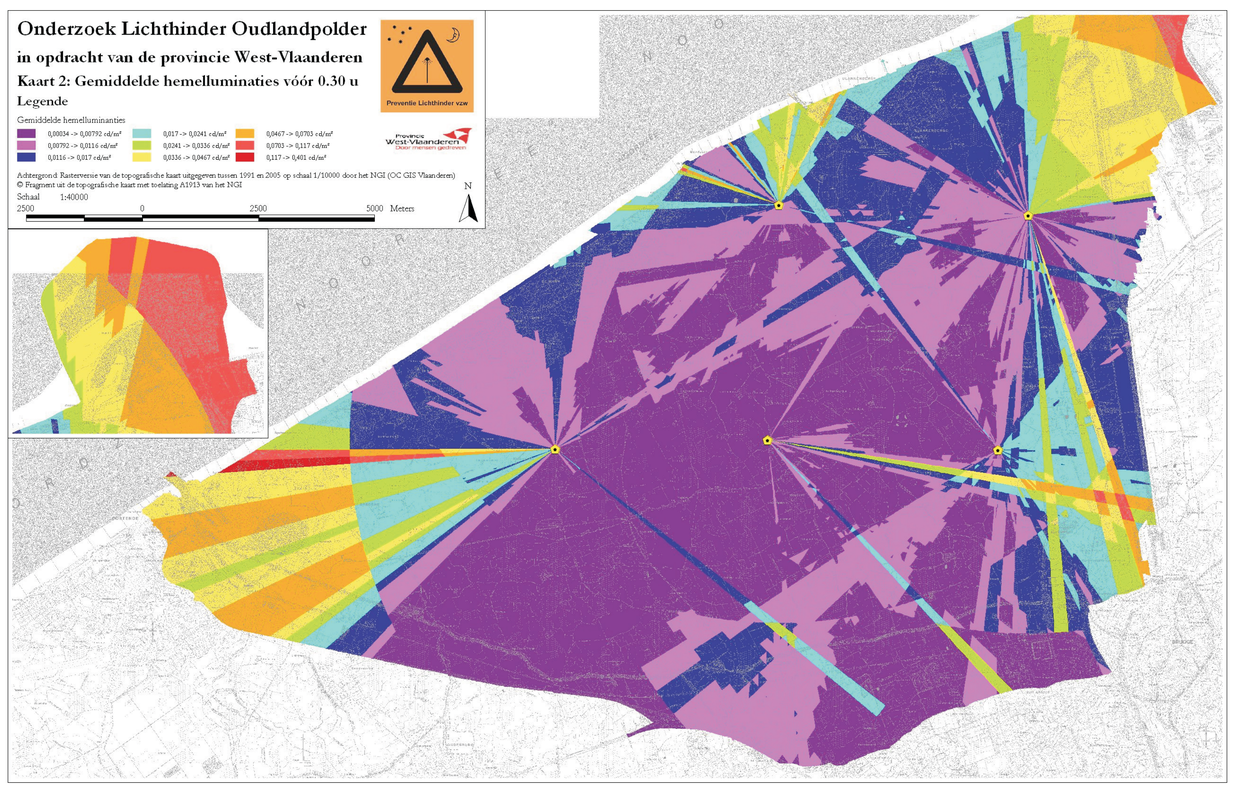
3. Using GIS

The average luminance per cell of the composed picture of every photometric point is transferred to a Geographical Information System (Arcview 3.2). The data from the 5 photometric points are combined within the GIS-environment to create a map of observed sky luminance. This results in two maps. The first map gives the average sky luminance before 0.30 am, the second one the average sky luminance after 0.30 am. To make the map readable, lumincances where categorised:

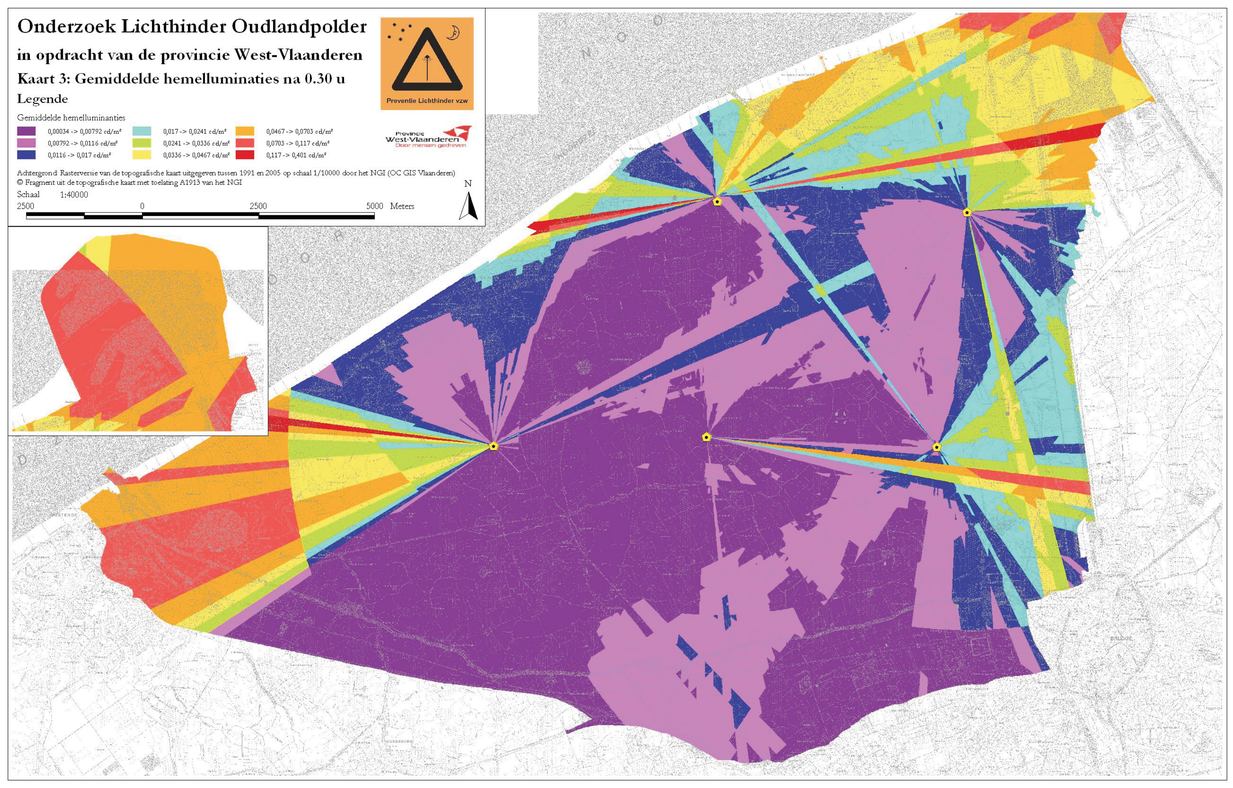
Average luminance	map colour	meaning
1. 0,00034 - 0,00792 cd/m²	dark purple	almost no light polution
2. 0,00792 - 0,0116 cd/m²	light purple	very few light polution
3. 0,0116 - 0,0170 cd/m²	dark blue	few light polution
4. 0,0170 - 0,0241 cd/m²	light blue	limited light polution
5. 0,0241 - 0,0336 cd/m²	green	average light polution
6. 0,0336 - 0,0467 cd/m²	light yellow	medium light polution
7. 0,0467 - 0,0703 cd/m²	orange	severe light polution
8. 0,0703 - 0,1170 cd/m²	pink	very severe light polution
9. 0,117 - 0,401 cd/m²	dark red	excessive light polution

Results

The map of the average sky luminance before 0.30 am is shown below.



The map of the average sky luminance after 0.30 am is shown below.



Discussion

The maps are very accurate in the center where the average luminance of 3, 4 or 5 photometric points could be calculated. Near the egde of the map, the accurancy drops signifianctly because only 1 or 2 photometric points could be used. This can be solved be taking more photometric points, preferably outside the study area. This would increase the time needed for computing the maps.

The major sources or group of sources of light pollution, even outside the study area, can be detected. The darkest locations are best suited for amateur astronomy in the entire region.

This new method can only be used under following conditions:
- flat areas such as the lowlands of the Flemish Region or the Netherlands;
- open areas with few and low buildings (not in cities or industrial areas);
- medium scale (not for smal areas).