

The background image shows a Dutch town with a prominent church tower, likely the Grote of Sint-Jacobskerk in Deventer, reflected in a body of water. The scene is captured during sunset or sunrise, with warm lighting and a cloudy sky.

Visualizing the difference between the geometric and administrative parcel surface area of the Cadastral Map of the Netherlands.

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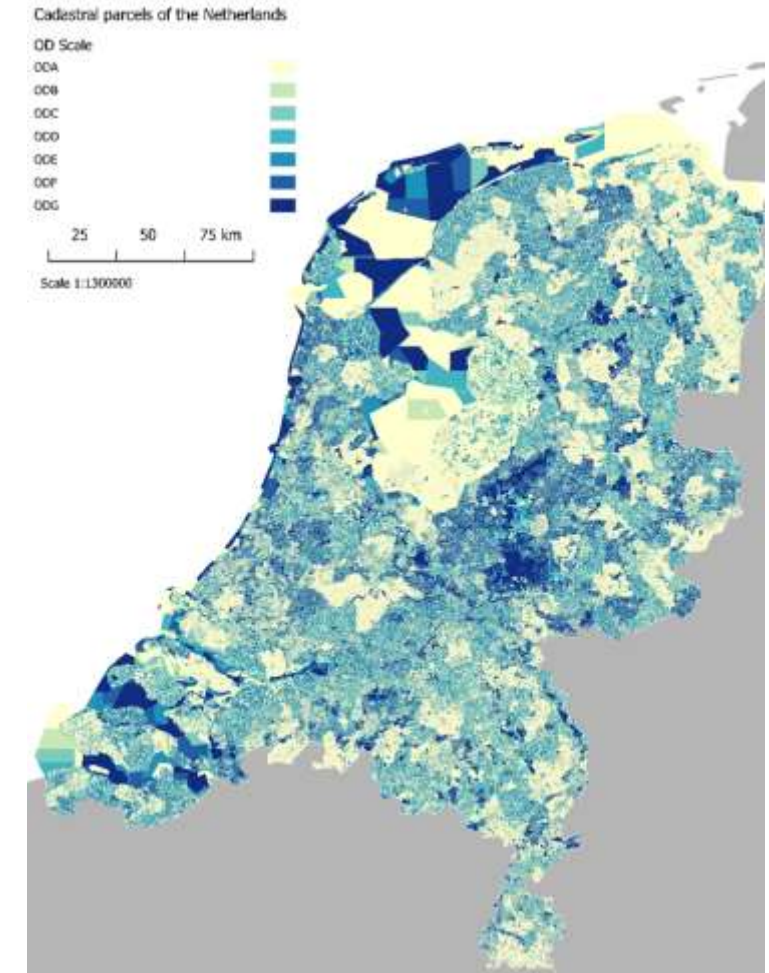
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## The research

- Parcel surface area
  - Geometric
    - Derived from cadastral parcel
  - Administrative
    - Deeds
      - WOZ value
    - Attribute data
- Difference in surface area
  - Relative/absolute
- Potential of misinterpretation by user
  - 5 m<sup>2</sup> for a parcel of 100 sqm in 95%



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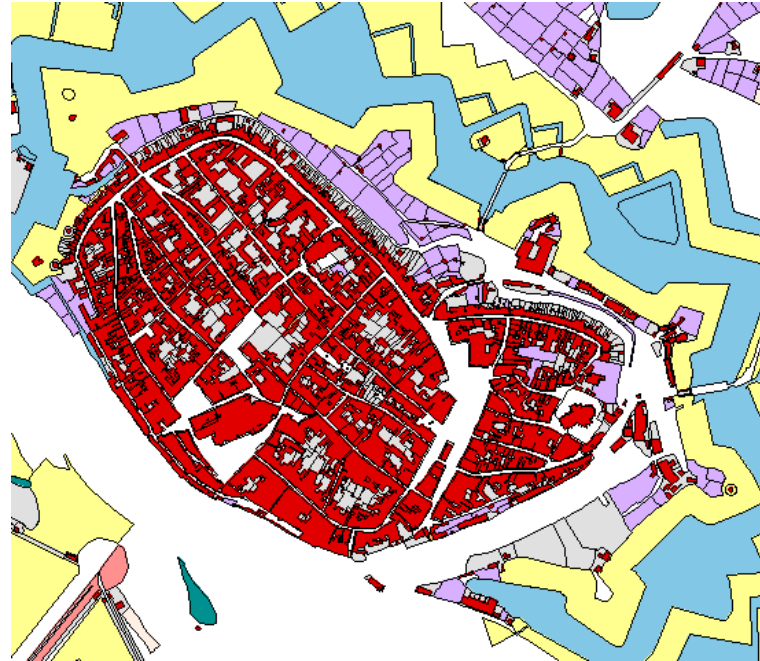
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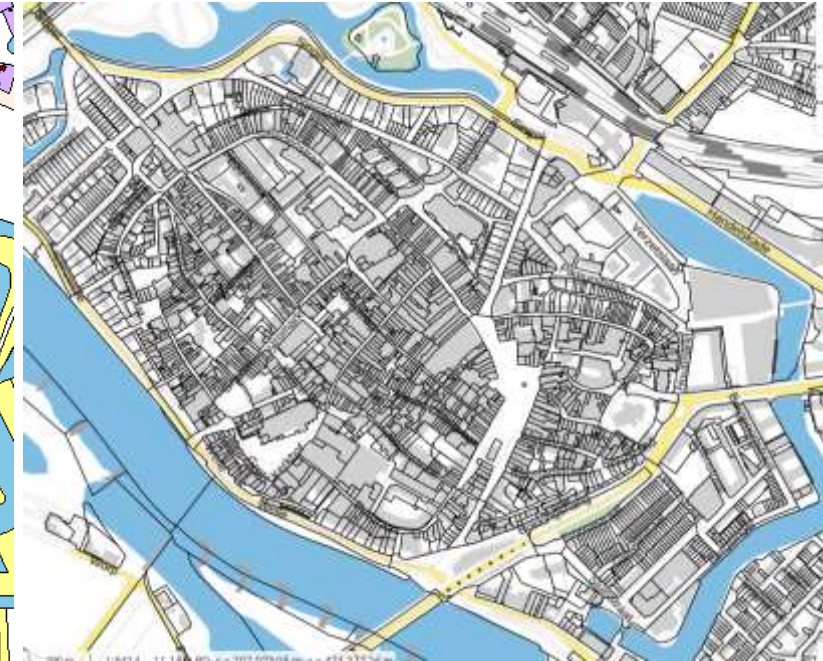
## The Dutch Cadastral map

- Dutch cadastral map
  - History
    - Emperor Napoleon
    - Dutch cadastre 1811
    - First cadastral map 1832
  - Status
    - 8 million parcels
    - Full coverage
    - BRK
    - Harmonisation of BGT
    - Continues development



Deventer 1832

Source: Hisgis.fa.knaw.nl



Deventer 2023

Source: pdok.nl

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## Classification

- Range of A – G
  - No point quality data
  - M-value
    - Length-width ratio
    - Geometric and administrative surface area
  - OD value ('oppervlakte delta' or area delta)

### BEKs norm (Hagemans et al., 2020)

- Based on Handleiding voor technische werkzaamheden (HTW96)

$$\sigma_{grootte.verschil} = \frac{1}{10} \sqrt{(\sigma_{grens,grootte}^2 + \sigma_{grens,oppervlakte}^2)} \left( v + \frac{1}{v} \right) opp$$

$$M = \frac{Opp_{krt} - Grt_{BRK}}{\sqrt{\left(v + \frac{1}{v}\right) \cdot Opp_{krt}}}$$

$$N_{Beks} = 2 \cdot \sqrt{(\sigma_{grens,grootte}^2 + \sigma_{grens,oppervlakte}^2)}$$

Perc. label	C <sub>0</sub> , size (cm2)	C <sub>0</sub> , surface (cm2)	Assumed situation parcel /indication standard	Alternative situation parcel
<b>ODA</b>			Both values are of high quality, with size determined from measurement figures, the map local 1-to-1 quality.	Both values are highly correlated (e.g., size determined from the sa map)
	A (4)	A (4)	<b>N1: Standard terrestrial local: 1-to-1 quality</b>	<b>Beks norm / M-value: 0,0566</b>
<b>ODB</b>			Both values are of high quality, with size determined from measurement figures, the map 1-to-1 quality.	Both values are highly correlated (e.g., size determined from the sa map)
	A (4)	B (25)	<b>N2: Standard terrestrial absolute: 1-to-1 quality</b>	<b>Beks norm / M-value: 0,1077</b>
<b>ODC</b>			Size determined from measurement figures (B); map improved graphical quality (C)	The reverse of the assumed situation
	B (25)	C (100)	<b>N3: Norm graphically improved</b>	<b>Beks norm / M-value: 0,2236</b>
<b>ODD</b>			Meets the urban area standard: size determined from measurement figures (BD) or a correct map (DB)	The reverse of the assumed situation
	B (25)	D (400)	<b>N4: Norm graphically urban: ~ 5√v norm urban area</b>	<b>Beks norm / M-value: 0,4213</b>
<b>ODE</b>			Meets the rural standard: size determined from measurement figures (CE) or a correct map (EC)	The reverse of the assumed situation
	C (100)	E (1600)	<b>N5: Norm graphic rural / redress urban: ~ 10√v norm rural area</b>	<b>Beks norm / M-value: 0,8246</b>
<b>ODF</b>			Does not meet standard norm: either size, map area or both do not meet. norm	The reverse (CF or FC) or both have large errors.
	C (100)	F (6400)	<b>N6: Norm relief rural: ~ 20√v norm rural area</b>	<b>Beks norm / M-value: 1,612</b>
<b>ODG</b>			Gross errors in one or both numbers	No alternative

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## Data and tools

- Used Data
  - Pilot data
  - Opensource data
  - Parcel ownership data

Name	Format	Source	Comment
KKN pilot data	.gkpg	Kadaster	
Basisregistratie Kadaster (BRK)	.gkpg	Kadaster	Contains Parcels and registered area
TOP10NL	.gpkg	cbs.nl	For selecting rural or build-up
Parcel Ownership	.shp	Kadaster	Data specifying public or private ownership and municipality
BAG	.gkpg	PDOK	Basic registry for selecting Verblijfsobjecten
Natura 2000	.gkpg	PDOK	Nature areas with a 2000 classification

- Tools / Programs

- Postgis
- GeoDA
- Qgis



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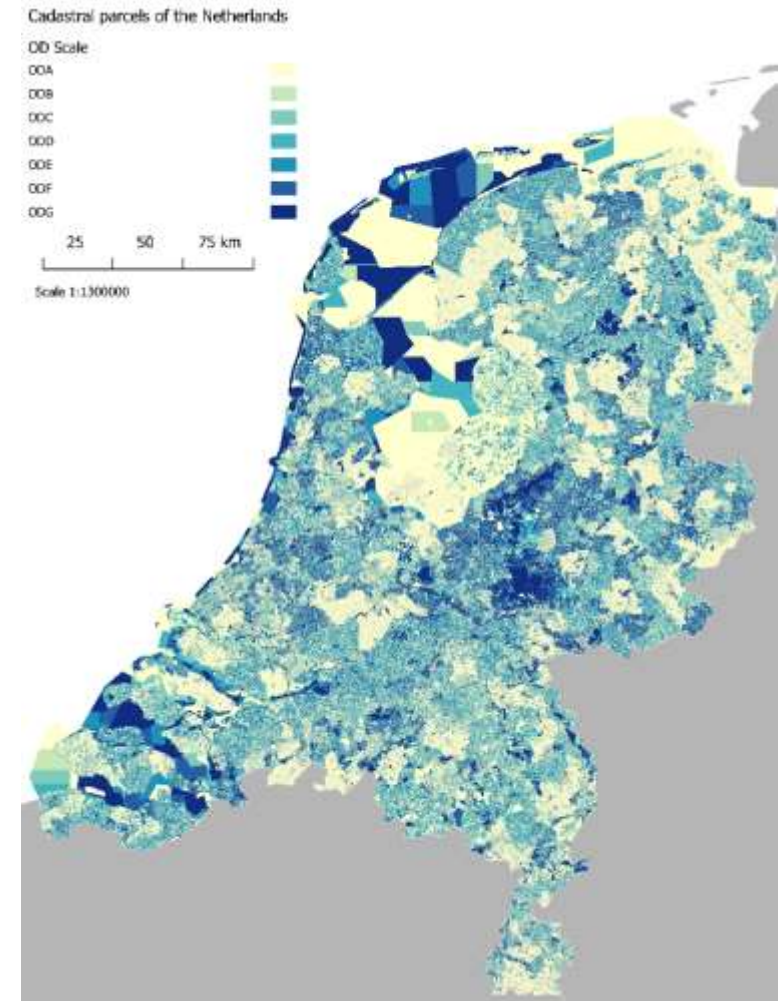
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## Analysis results: National map

- Absolute difference
  - 0,078%
  - 32209515 m<sup>2</sup>
- Negative outliers
  - North sea parcels
  - Nature areas
  - Factor 10, 100
- Positive outliers
  - New Neighbourhoods
  - Province of Flevoland



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## Results: Parcels type

- Area quality difference for parcels types
  - Measuring methods
  - Age of revision/measurement
- Rural and built-up
  - TOP10NL
  - Built-up ( $m = 0.10$ ,  $SD = 0.22$ )
  - Rural ( $m = 0.35$ ,  $SD = 0.85$ )
  - Similar to residential properties
- Nature areas
  - Nature ( $m = 0,77$ ,  $SD = 1.75$ )
  - Governmental ( $m = 0.25$ ,  $SD = 0,89$ )

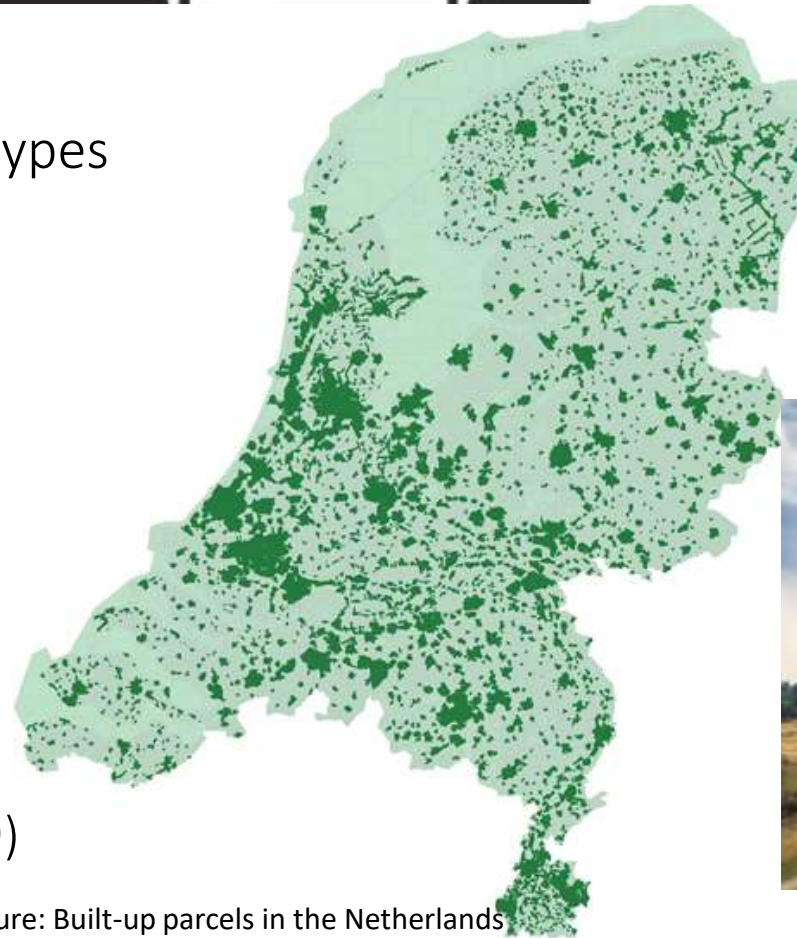


Figure: Built-up parcels in the Netherlands

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## Results: Area size difference of parcels

- Difference in surface area
  - Cadastral sections
    - Hagestein
    - Wassenaar
  - Old city centres
  - Rivers

Percentage area difference

-3 - -2  
-2 - -1  
-1 - 0  
0 - 1  
1 - 2  
2 - 3

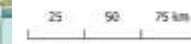


ODA  
ODB  
ODC  
ODD  
ODE  
ODF  
ODG

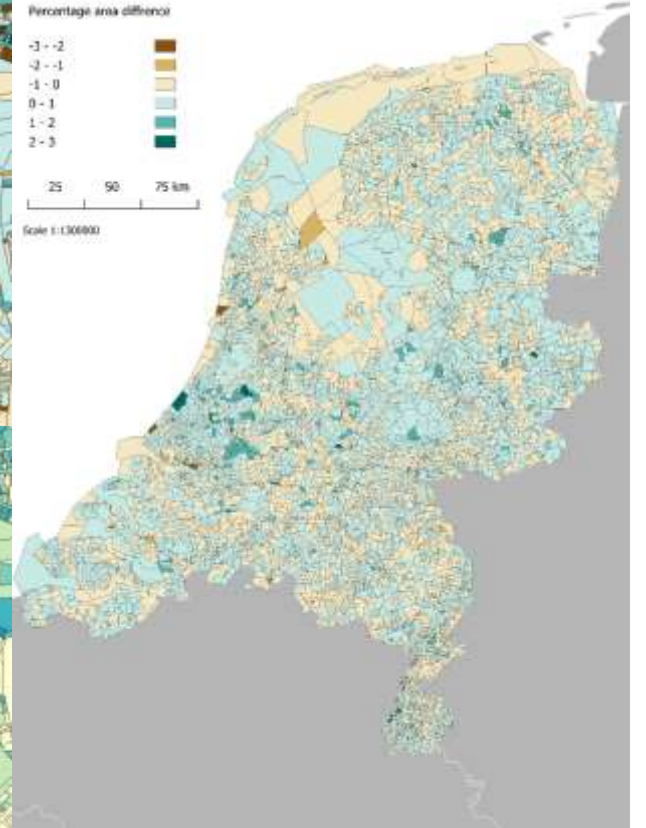
Cadastral sections

Percentage area difference

-3 - -2  
-2 - -1  
-1 - 0  
0 - 1  
1 - 2  
2 - 3



Scale 1:100000



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## Results: Examples in the province of Utrecht

- ODA
- ODB
- ODC
- ODD
- ODE
- ODF
- ODG



Land consolidation in south of the province Utrecht

- ODA
- ODB
- ODC
- ODD
- ODE
- ODF
- ODG



Utrecht old city center

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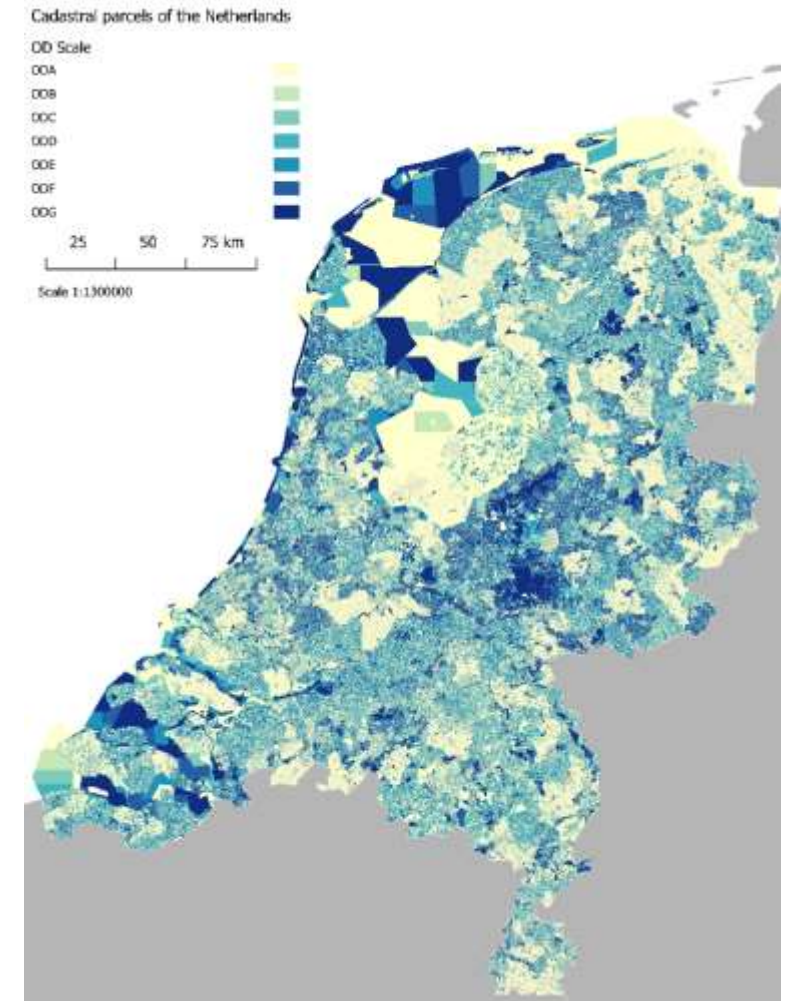
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## Conclusion and potential future research

- Conclusion
  - Difference between parcels
    - Type
    - Location
  - Small amount of clustering
  - Difference in total area size
- Future research
  - Incorporating quality of measurement
  - Effect on the WOZ-value
  - Including more categories of parcels



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DIGITAL TRANSFORMATION FOR RESPONSIBLE LAND ADMINISTRATION

FIG Commission 7 & 2 Annual Meeting 2023

2-4 October 2023, Deventer

Thanks for listening!

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