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# Satellite and Ground Data to Slash Risk Uncertainty



# OUTLINE

- Who we are
- The problem - or the market opportunity ...
- Our solution - and our marketable service ...
- ESA Kick-Start Activity CountFloors
- The Groningen service case
- Conclusions and future outlook



# WHO WE ARE

Ticinum Aerospace (TA) is a spin-off company of the University of Pavia

Based on three main pillars:

- Big Earth-Observation Data
- Large-Scale Machine and Deep Learning
- Smart Geospatial Data Analysis





# RISK MODELLING

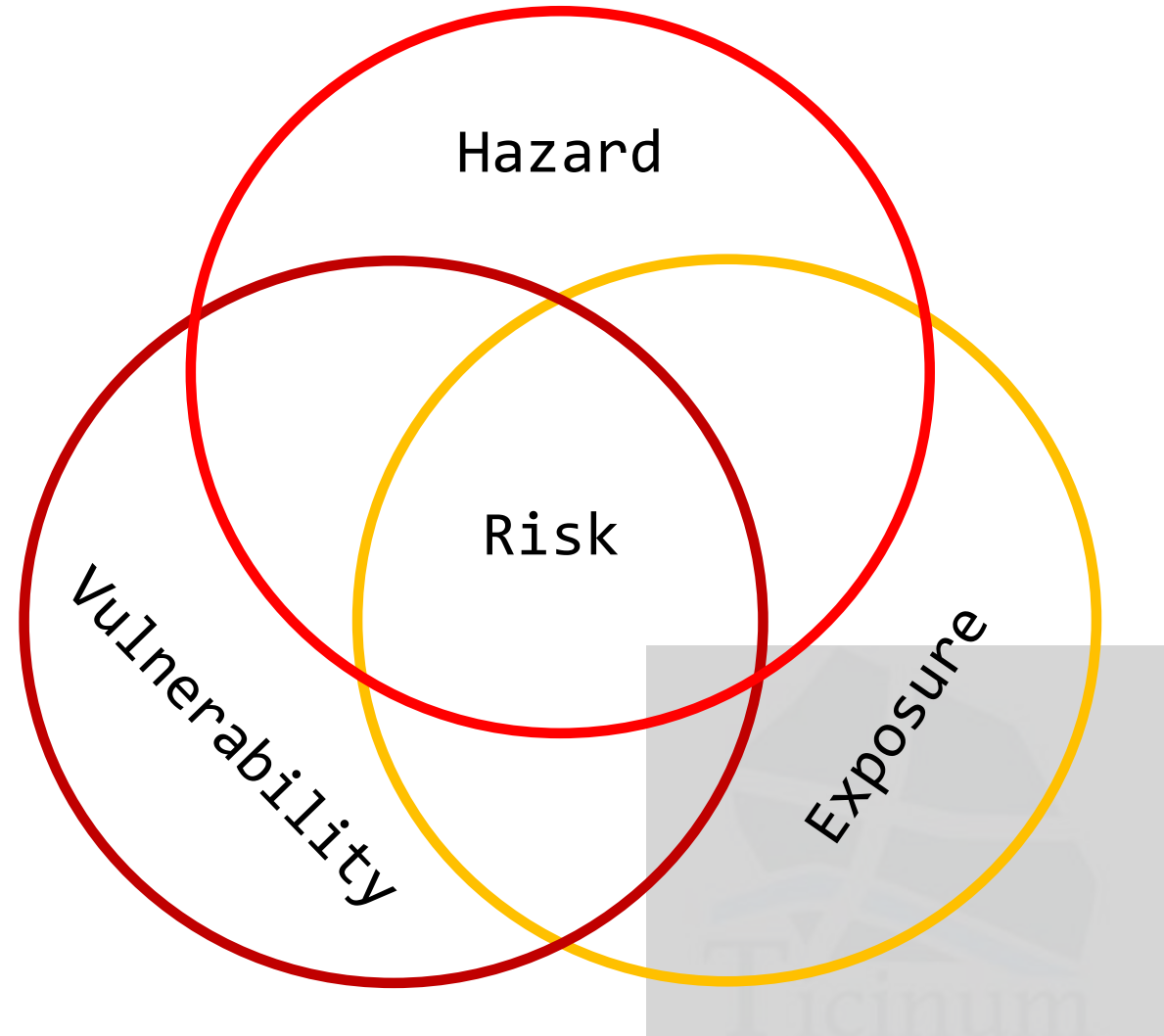


# RISK MODELS

Risk models are incredibly information-hungry!

For accurate risk assessment, all the three components of risk need to be known with sufficient confidence

Data is frequently difficult to access, or simply non-existing ...



# THE PROBLEM

Re/Insurance companies  
lack building-level data for  
risk/vulnerability/exposure assessment

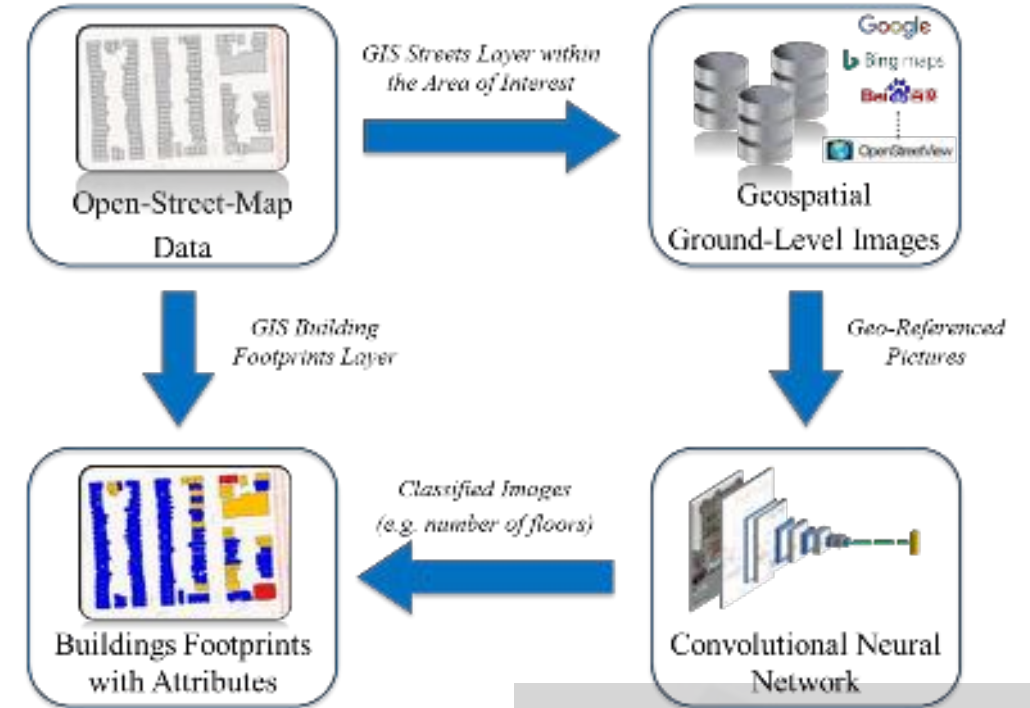
They use large-scale statistics as proxies

# AI-BASED FRAMEWORK

Opportunity created by wide availability of satellite data and georeferenced ground-level images of urban areas.

A framework could be designed to tackle the information need

We called the framework **CountFloors**



Picture from:

Iannelli, G.C.; Dell'Acqua, F. Extensive Exposure Mapping in Urban Areas through Deep Analysis of Street-Level Pictures for Floor Count Determination. *Urban Sci.* **2017**, *1*, 16.

# STREET-LEVEL DATA

The **CountFloors service** can automatically extract building features by analyzing street-level pictures.



Feature	Value
N° Floors	3
Occupancy	Commercial
Type	Masonry
N° Windows	16
Basement	No
Fence	No
...	...



# FEATURES

All visible exposure and vulnerability proxies can be automatically identified

Examples are:

- Number of floors
- Occupancy
- Trees
- Roof shape
- Maintenance status
- Basements
- Materials
- Fences
- Stairs
- ...

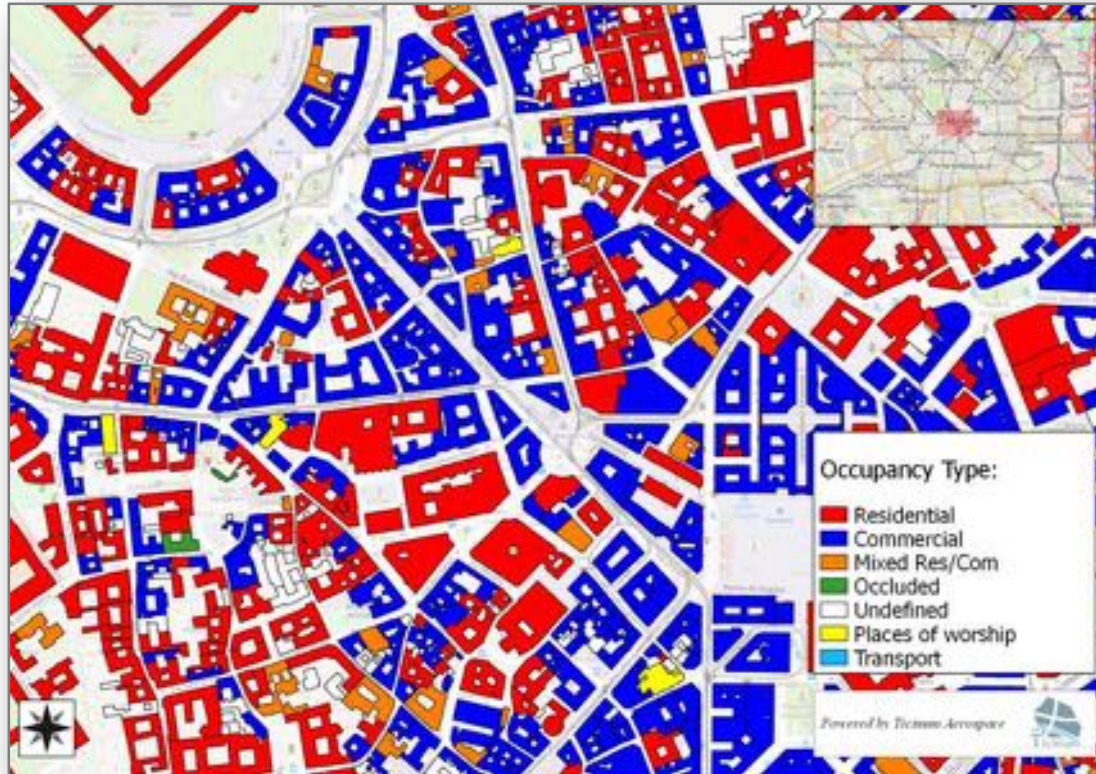


# THE PRODUCT

A city-wide / region-wide GIS layer with building footprints and all the required attributes



# PRODUCT EXAMPLE



Milan (Italy)



Manila (The Philippines)

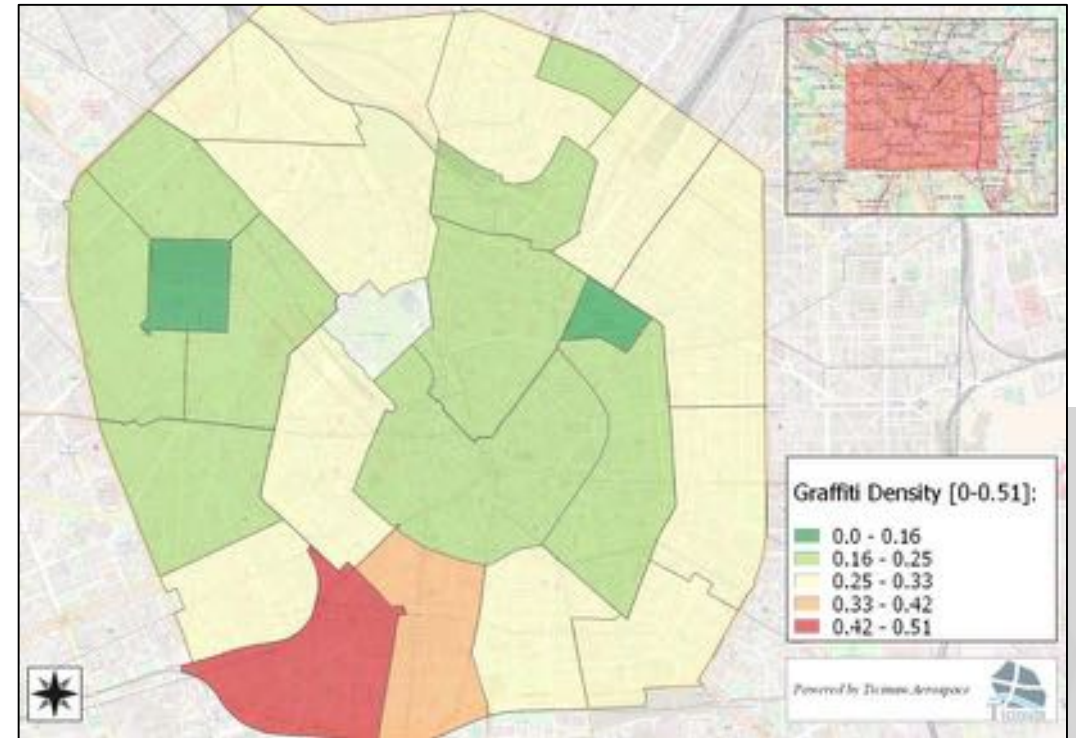
# PRODUCT EXAMPLE

Thematic Map representing the buildings with/without basements in Milan, Italy



# PRODUCT EXAMPLE

Thematic Map representing the density of 'graffiti/murals' within the city of Milan, Italy  
(Administrative boundaries)



# ESA KICK-START ACTIVITY



<https://business.esa.int/projects/countfloors>

- «Space for Municipalities» call
- Cooperation with the Municipality of Pavia, Italy
- A formal agreement has been reached and made official at the beginning of November 2018
- Funds allocated by the Italian Space Agency, whose support is gratefully acknowledged here

A screenshot of the ESA Business Applications website. The page title is 'COUNTFLOORS'. It features a blue wireframe house icon above the text 'COUNTFLOORS'. To the right, there is a table with project details:

ACTIVITY	Kick-start Activity
STATUS	Completed
THEMATIC AREA	Infrastructure & Smart Cities, Safety & Security, Finance, Investment & Insurance

Below the table, there is a paragraph of text: 'Vulnerability and exposure data currently used by insurance and re-insurance companies lack in terms of resolution and accuracy when risk models are used to determine fair premium levels. The ideal "exposure information on urban areas" would include characterizing each building in terms risk-related features, such as number of stories, occupancy, year built, area, construction type, number and size of windows, and countless other features. Insurance companies are hungry for such data, that would allow them increase their competitiveness, in a framework where large-scale statistics are still the go-to solution, while at the same time retaining a balanced level of financial risk. CountFloors will provide better exposure data to the (re)insurance companies, and -at the same time- to the covered municipalities, which get the generated data for free. Insurers are available to pay for such exposure data because it narrows significantly the uncertainty on risk estimates, thus allowing to offer more competitive insurance rates. Other markets such as real estate are being considered.'

# FIRST CUSTOMER

TA has been contracted to extract, and measure, risk-related features in urban area in the Dutch province of Groningen

The requested features are:

- Number of floors and its variants (e.g. ground-floors, attics, etc..)
- Presence of masonry chimneys
- Building openings (attribution of an empty-to-total area)

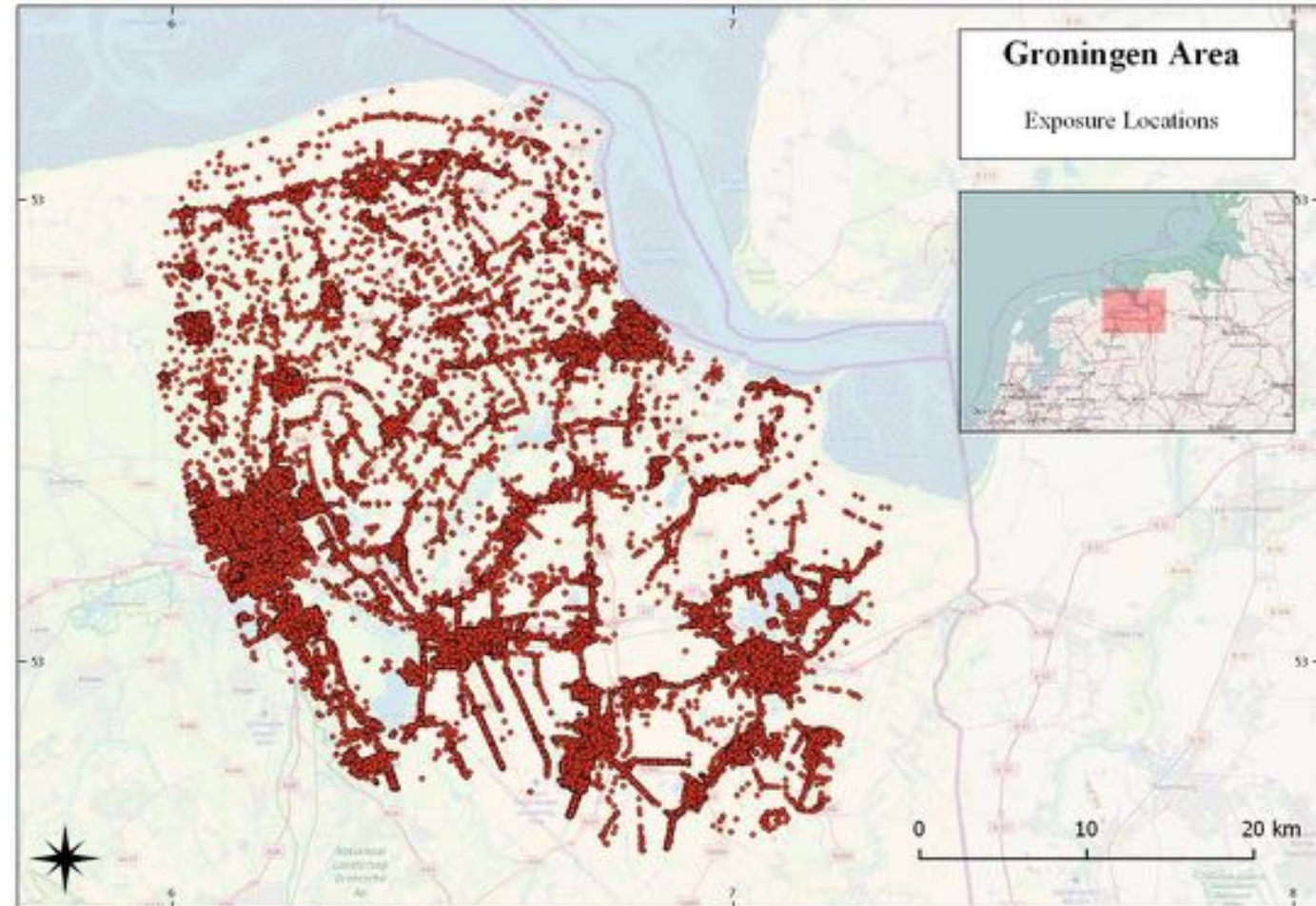
# EXPOSURE DATA

Almost 150 k buildings to be analysed and labelled

**No data** on number of floors

**No data** on chimneys

**Few data** (5%) on building openings, dating back 10 years





# IMAGE PROVIDER

**Google Street View** was discarded due to licensing policy issues.

We searched for an alternate provider and found the Dutch company **Cyclomedia** in Zaltbommel (NL) offering a large and deep archive of multitemporal acquisitions on the Netherlands and in other locations



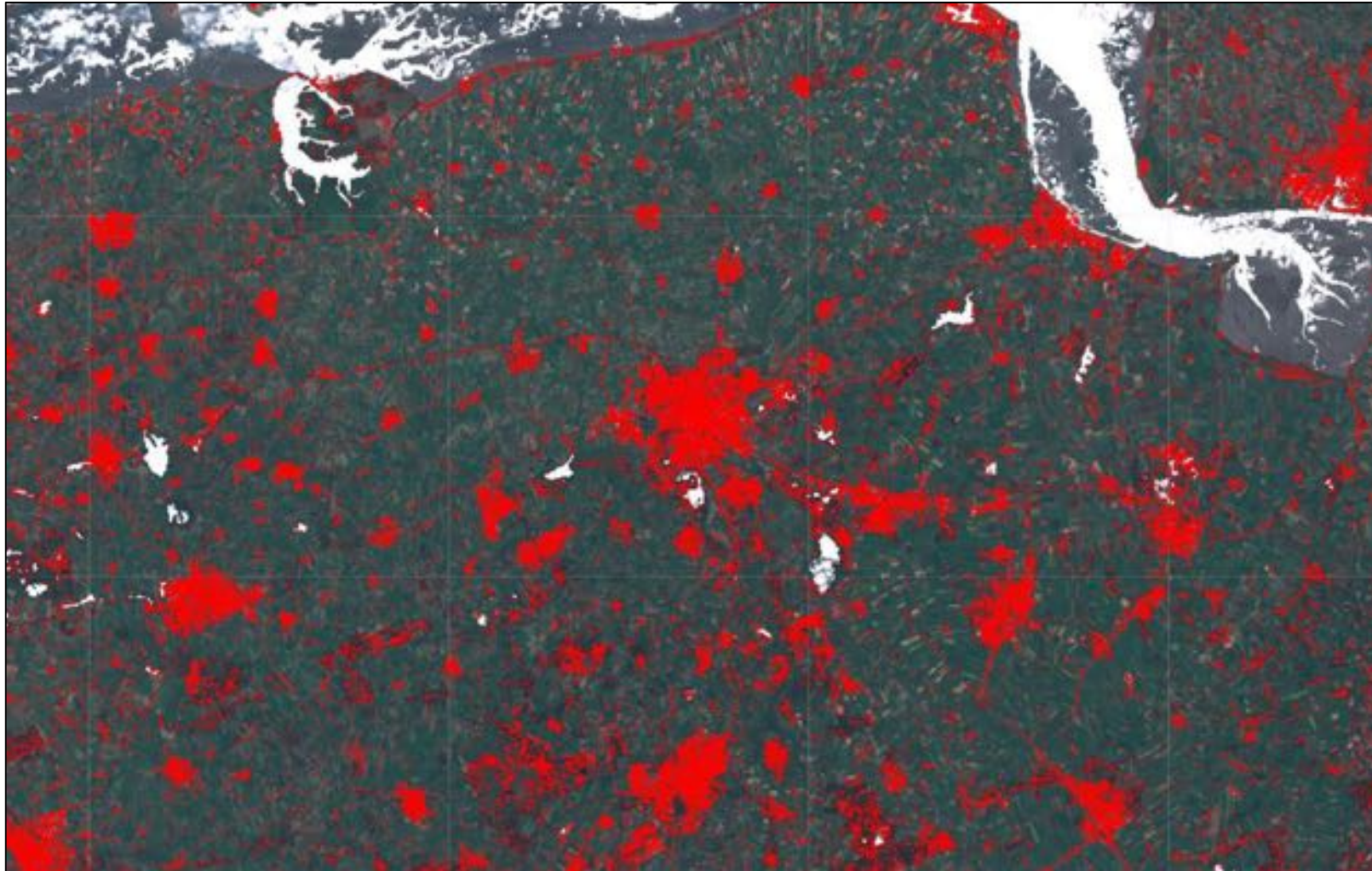
<https://www.cyclomedia.com/>



## SENTINEL-2 DATA ON GRONINGEN



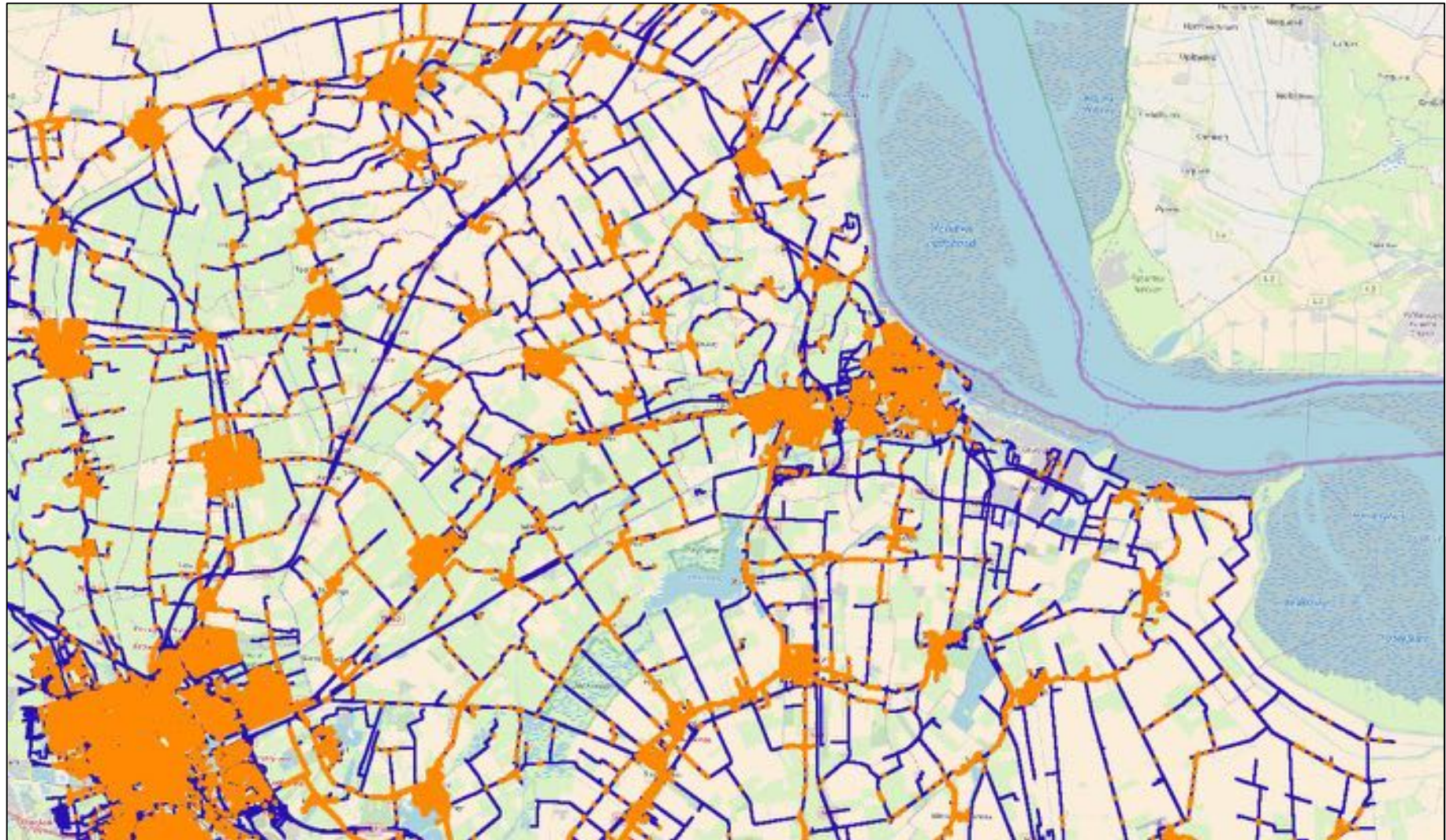
## URBAN MASK



## STREET-LEVEL IMAGE ACQUISITION POINTS



## SATELLITE-FILTERED ACQUISITION POINTS



# STREET-LEVEL IMAGES

The list of acquisition points has been provided by Cyclomedia

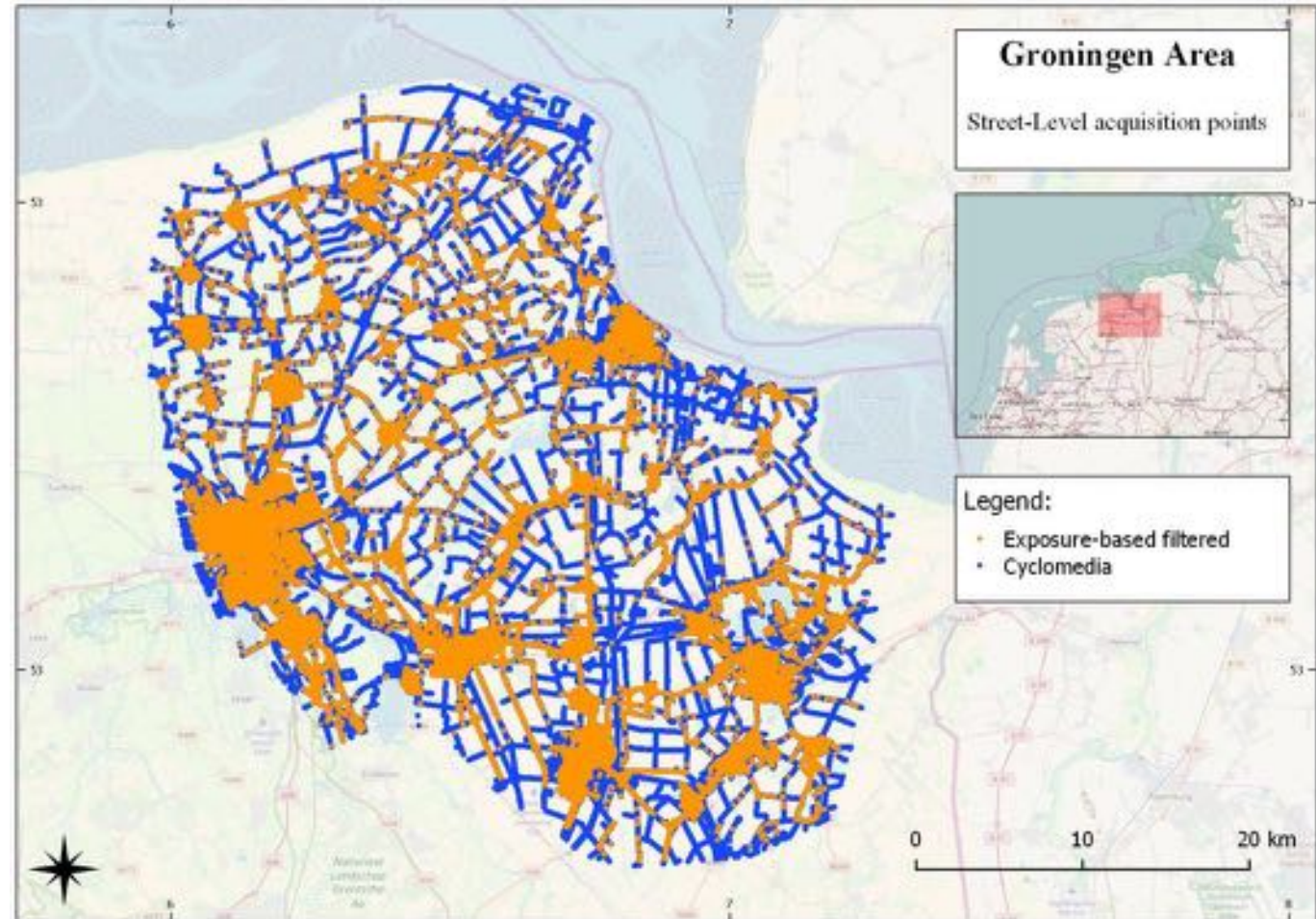
These have been automatically filtered based on targeted building locations



# STREET-LEVEL IMAGES

Raw images acquired by Cyclomedia are colored in blue

Filtered images are colored in orange

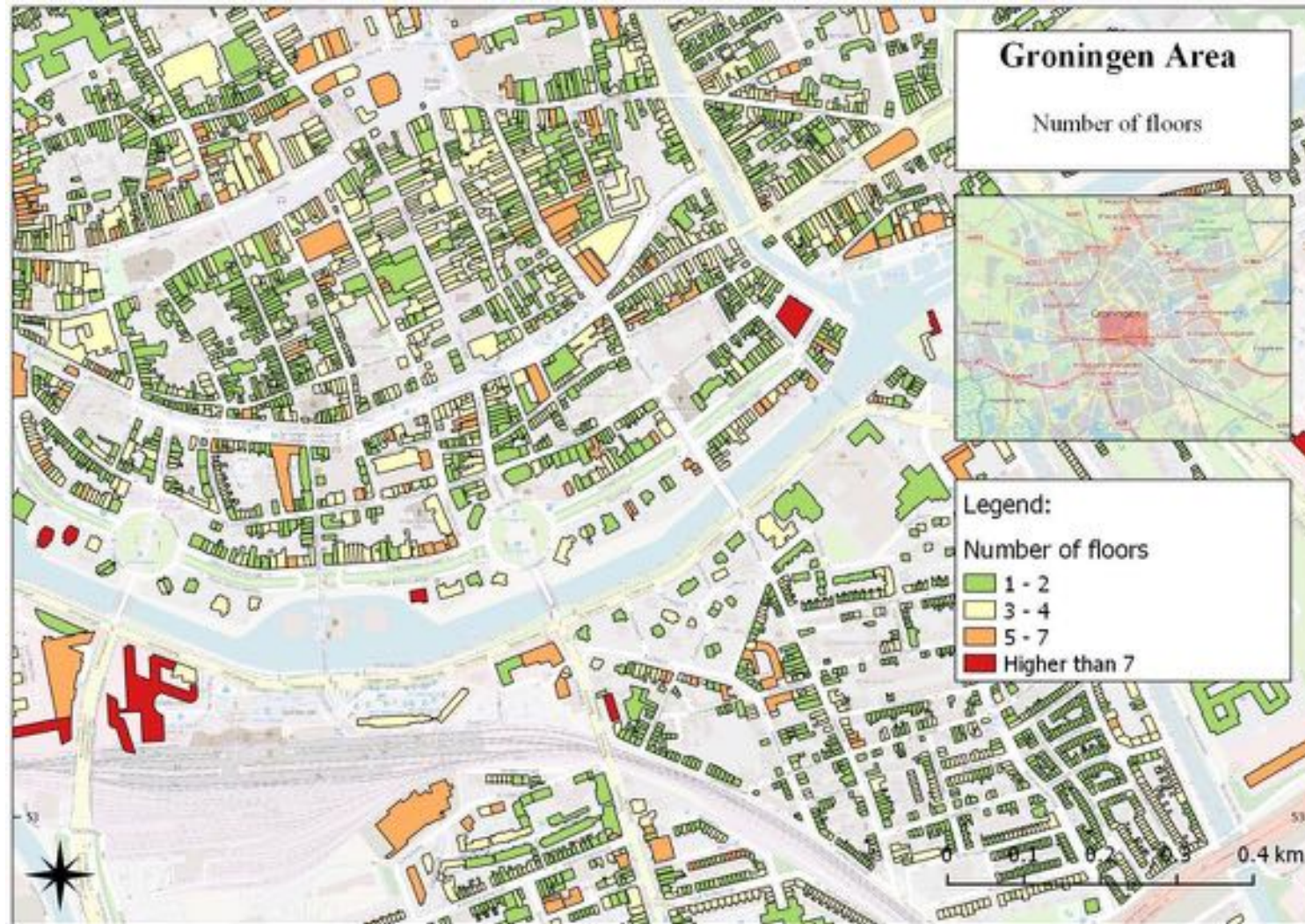


# SAMPLE IMAGES

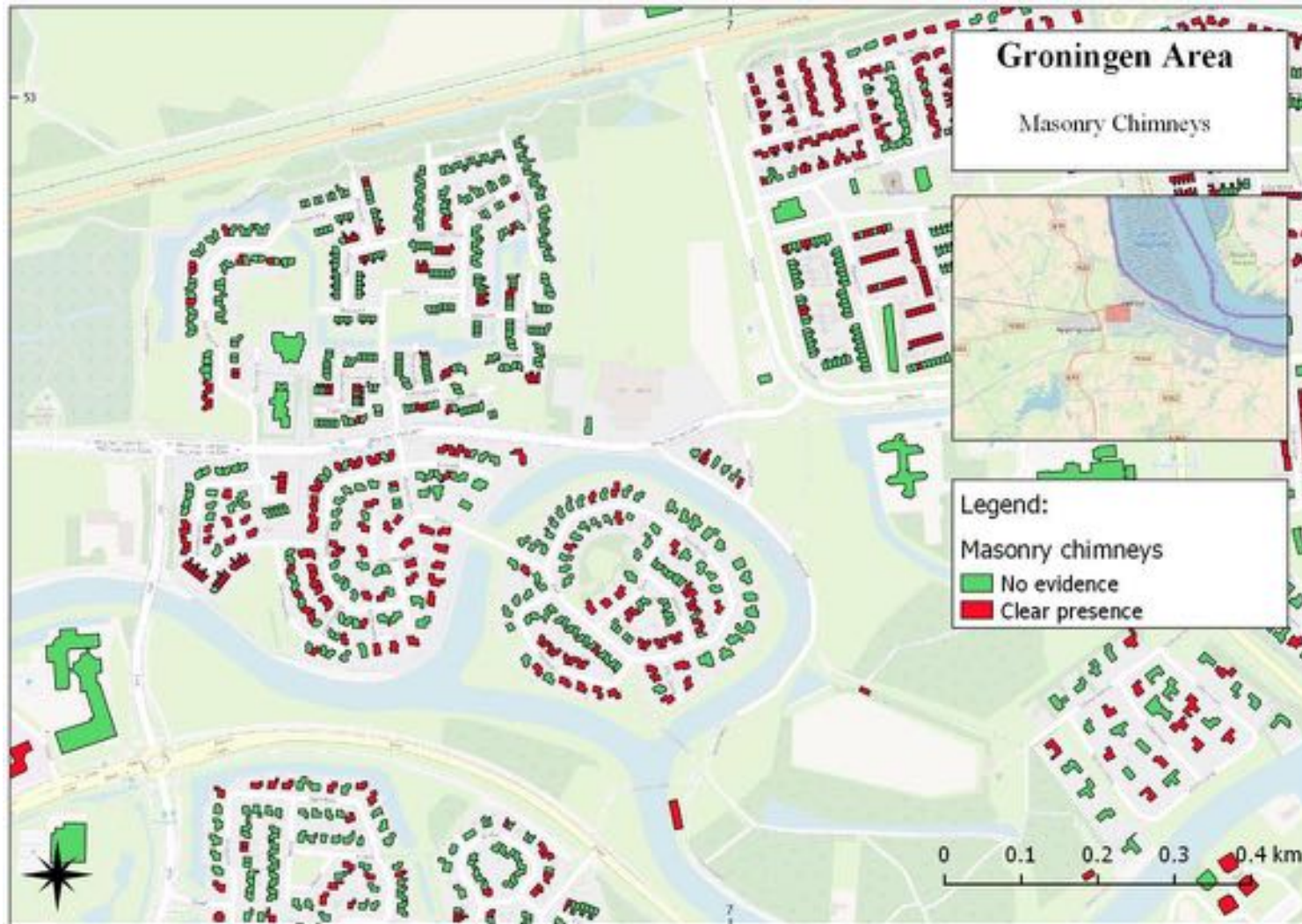




# NUMBER OF FLOORS



# MASONRY CHIMNEYS



# BUILDING OPENINGS



# FINAL RESULTS



92.5%  
Accuracy



96%  
of targeted  
buildings enriched



Positive  
customer  
feedback

# FUTURE DIRECTIONS

- **Go global** - regional data providers needed
- **Expand to other markets** – real estate, urban maintenance
- **Explore NRT applications** (e.g. pot holes mapping)
- Looking forward to future hyperspectral missions to incorporate **material information** into building labellings
- Last but not least – scientific use: **creating annotated data** for training of ML algorithms in classification of satellite data



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THANK YOU!

