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Asset Value Prediction Hue Vietnam

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AK – Fernerkundung Bochum 29.- 30.09.2025

IZES Institut für ZukunftsEnergie- und Stoffstromsysteme

geomer GEOINTELLIGENCE AND BEYOND

MCII

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FONA Research for sustainability

Sustainable Development of Urban Regions

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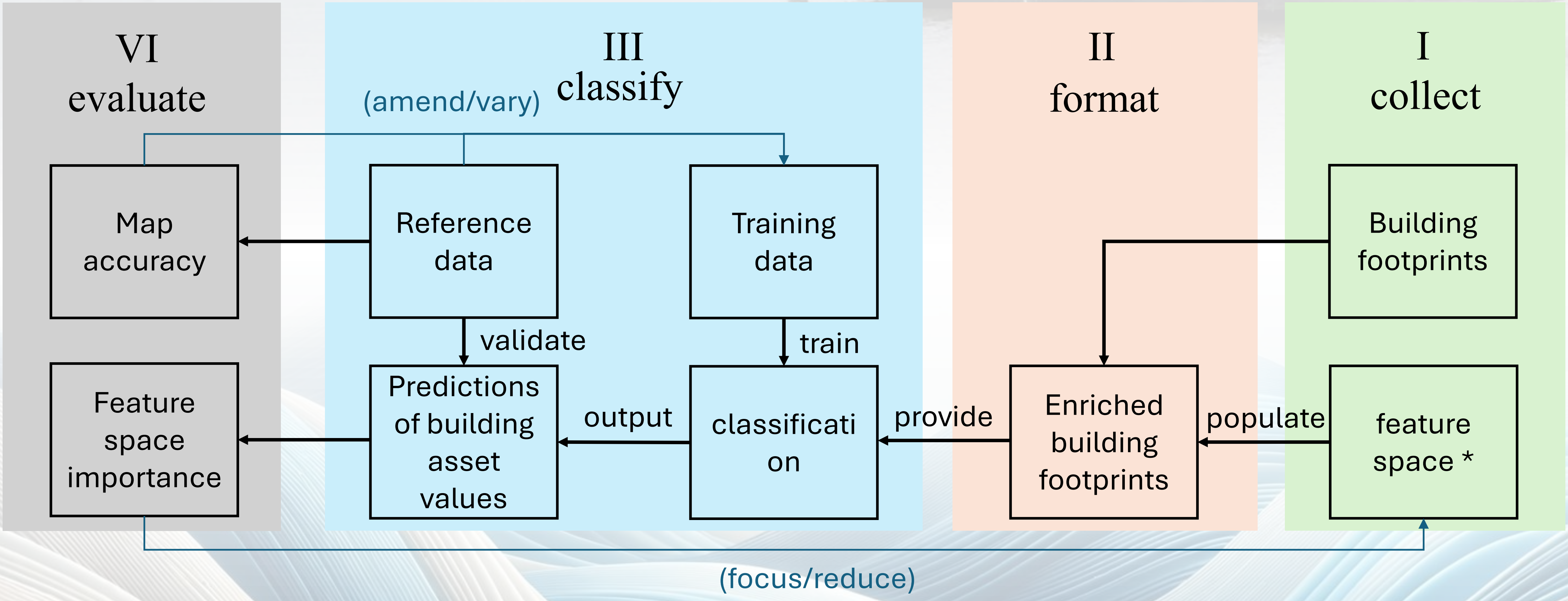
Justification/Intro

Support for decision making by alocating ressources

Remote Sensing and OSM as global/generic source of information

Benefits of AI for creation of large area products of human function

Prediction/classification of building asset values



*remote sensing data of different devices, auxiliary data

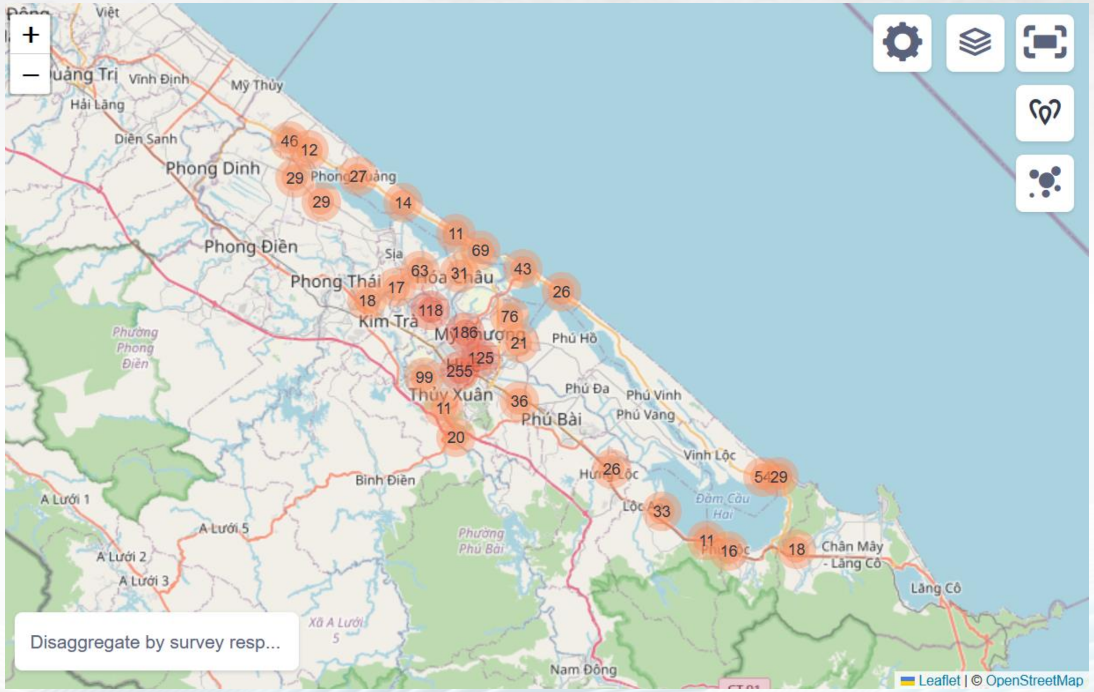
Method for Prediction of Building Asset Values

I. Field Campaign (Mar 2023 & Mar 2024)

II. Reference Data (n=1572)

III. Categorize 49 Building Types

IV. Map to 5 Govt. Cost Classes



Apartment Buildings

Social Housing - Low rise

Social Housing Apartments

Individual Houses (villa style)

Individual Houses

Method for Prediction of Building Asset Values

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V. Train ML Model using generic feature space
(Auxiliary layers, OSM + Remote sensing)

Input feature space
OSM/Remote sensing/Demographics

Dataset	What it measures	Resolution	Coverage (time)	Why we use it
Sentinel-1/2 via SEPAL & GEE	SAR backscatter; multispectral reflectance	10–60 m	2014/2015–present	Robust time-series and cloud-scale processing for land-surface dynamics.
OSM/OSRM accessibility	Network travel time/distance	n/a (network)	As of OSM snapshot	Reproducible isochrones and OD matrices for access analyses.
WSF Evolution & 3D	Settlement emergence; building fraction/height/volume	30 m / ~90 m	1985–2015; reference epoch for 3D	Urbanization timing and 3D urban form metrics.
JAXA LULC Vietnam	Annual land-use/land-cover classes	30 m	1990–2020	Consistent national LULC trajectories.
WorldPop	Gridded population counts (UN-adjusted)	~1 km or 100 m	Year-specific	Population exposure and normalization.
VIIRS Black Marble	Nighttime light radiance	500 m	2012–present	Human activity proxy and temporal dynamics.

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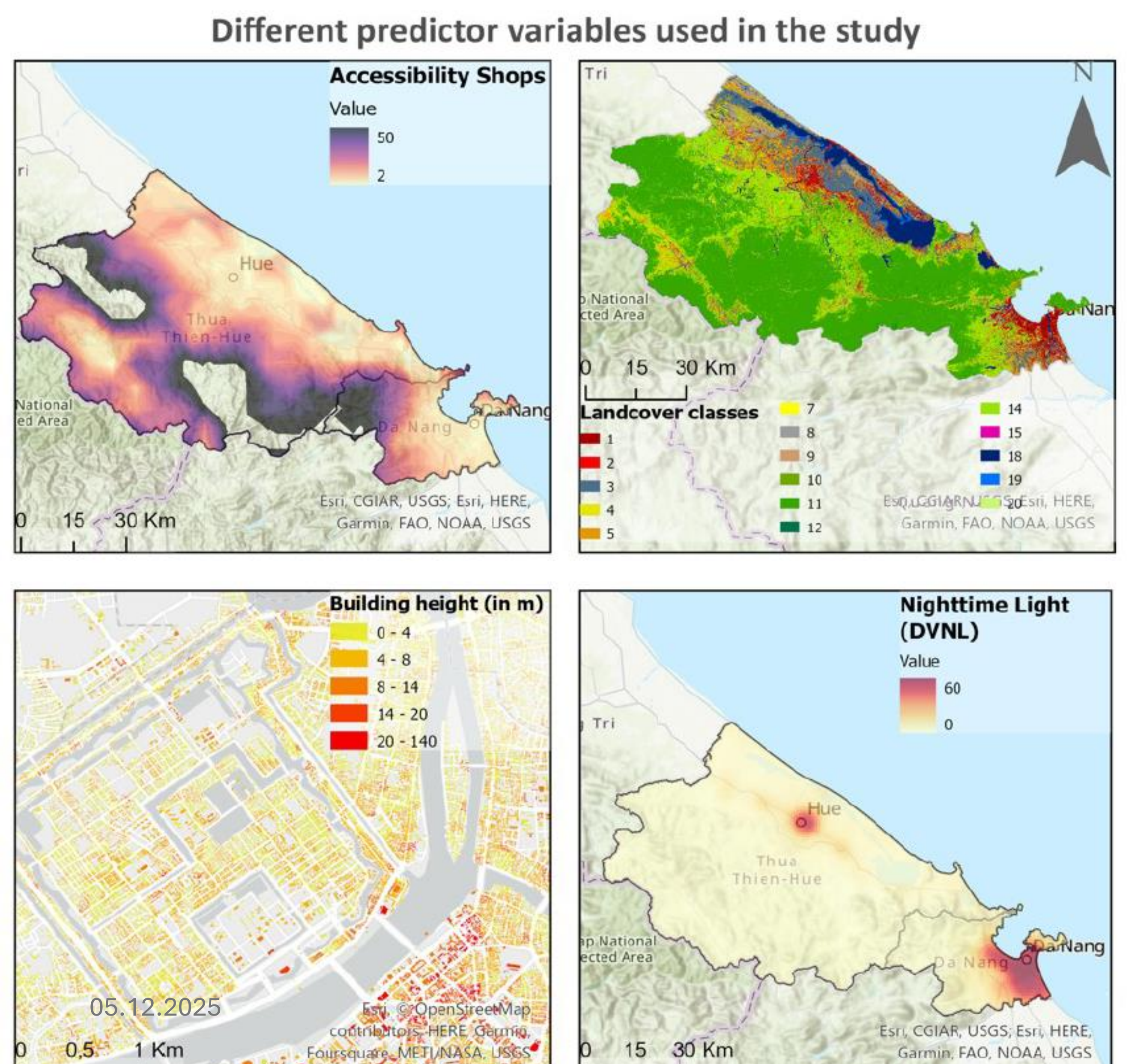
Generic feature space



Remote Sensing Data:
- Satellite imagery and derived products
- Captures biophysical properties of surfaces

External Datasets:
- Accessibility metrics (e.g., access to shops, healthcare, education)
- Derived from sources like OpenStreetMap

Synergistic Effect:
- Combination enhances model performance
- Provides both physical and anthropogenic insights

Versatility:
- Applicable to various predictive tasks across different domains

Feature Space Representation:
- Graphical depiction of combined data layers
- Highlights areas with varying accessibility

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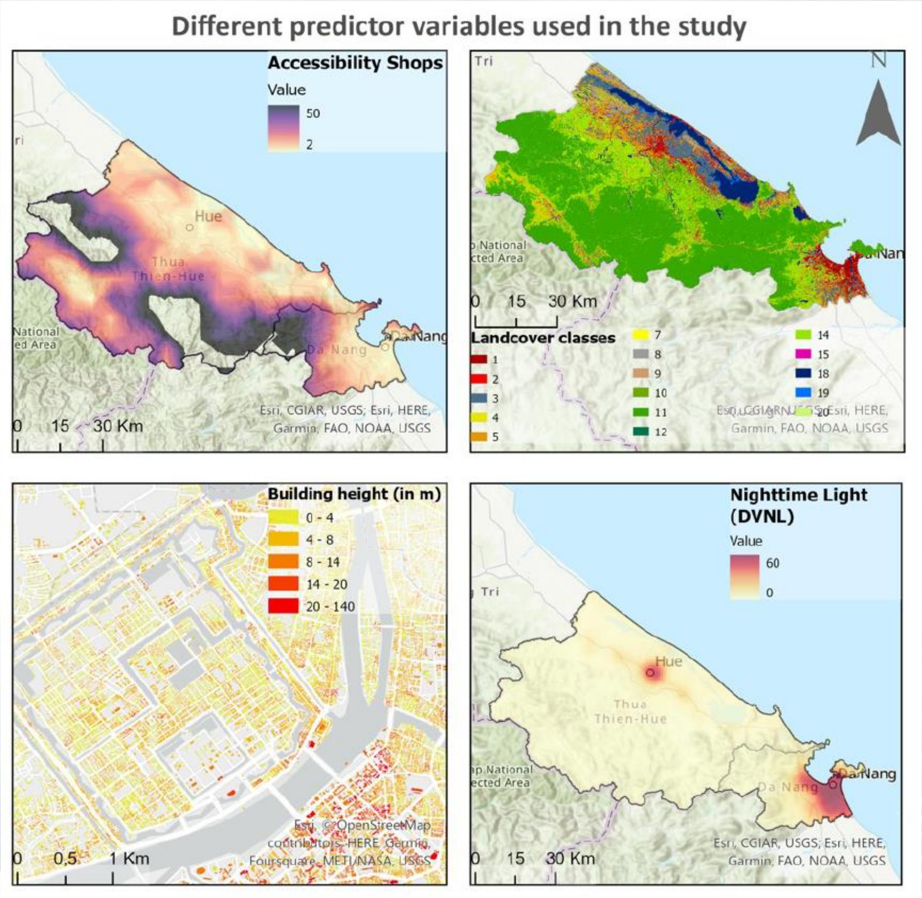
VI. Classify 600k Buildings

VII. Estimate Floors from Building Height

VIII. Compute Asset Value (sq.m. cost × floor area)



Asset Value Prediction (RS+OSM as feature space)

Data Collection:

- Collected ~1,500 reference points on building types
- Building values obtained from investment plans

Training Classification Models:

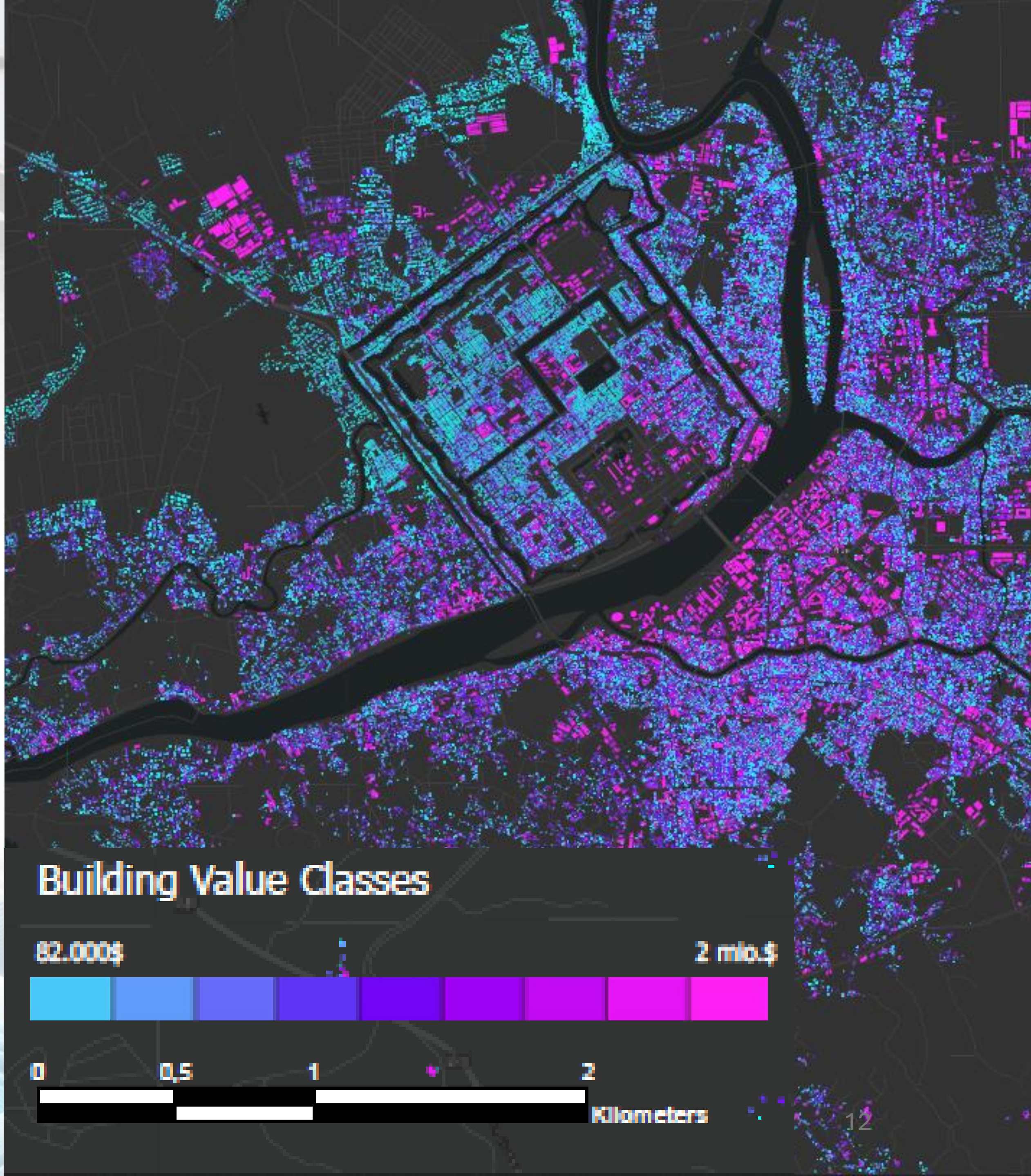
- Used collected data as training input

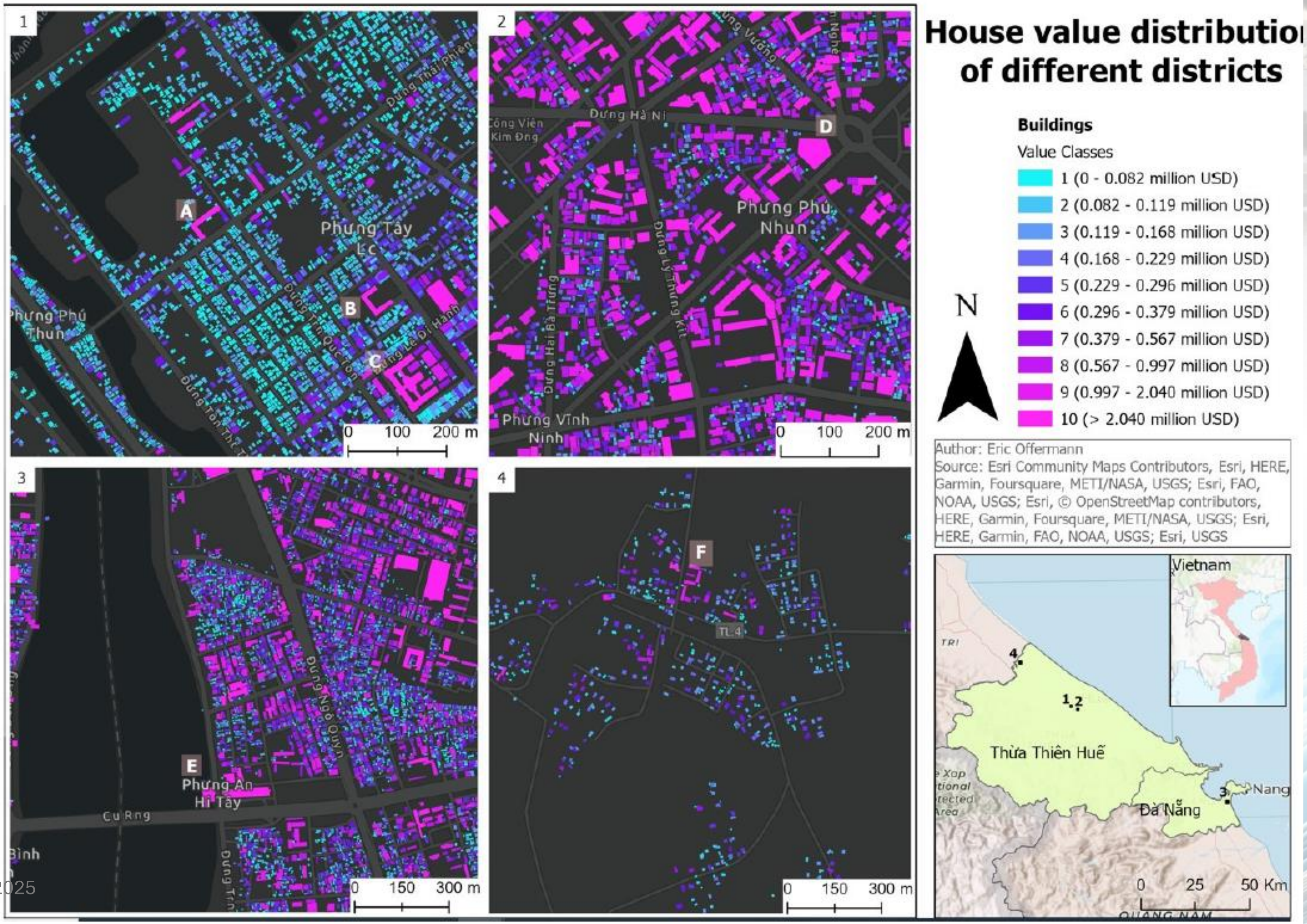
Remote Sensing Data Feature Space

- Biophysical properties of surfaces

OpenStreetMap (OSM) Feature Space

- Shop accessibility
- Access to healthcare
- Access to education



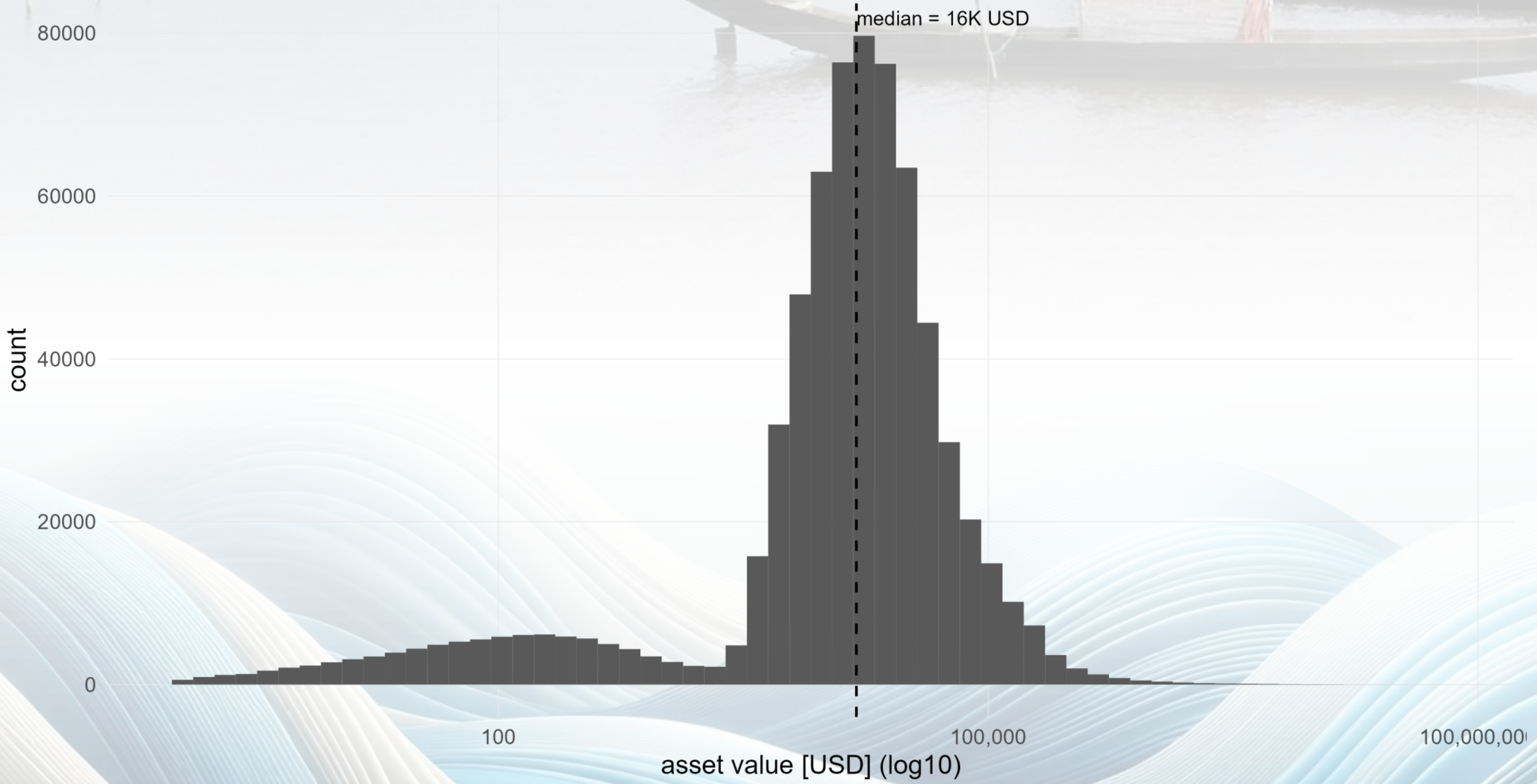


House value distribution of different districts
Buildings
Value Classes
1 (0 - 0.082 million USD)
2 (0.082 - 0.119 million USD)
3 (0.119 - 0.168 million USD)
4 (0.168 - 0.229 million USD)
5 (0.229 - 0.296 million USD)
6 (0.296 - 0.379 million USD)
7 (0.379 - 0.567 million USD)
8 (0.567 - 0.997 million USD)
9 (0.997 - 2.040 million USD)
10 (> 2.040 million USD)
N
Author: Eric Offermann
Source: Esri Community Maps Contributors, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS; Esri, FAO, NOAA, USGS; Esri, © OpenStreetMap contributors, HERE, Garmin, Foursquare, METI/NASA, USGS; Esri, HERE, Garmin, FAO, NOAA, USGS; Esri, USGS
1
2
3
4
A
B
C
D
E
F
Phường Tây Lộc
Phường Phú Thuận
Phường Phú Nhuận
Phường Vĩnh Ninh
Phường An Hải Tây
Đường Hà Nội
Đường Lý Thường Kiệt
Đường Hai Bà Trưng
Đường Ngô Quyền
Đường Trần Quốc Toản
Đường Lê Đại Hành
Đường Thái Phiên
TL 4
0 100 200 m
0 150 300 m
Vietnam
Thừa Thiên Huế
Đà Nẵng
0 25 50 Km


Total asset value by category
Bars labeled with totals; counts per cat: 5=676,204 2=8,846 4=1,968 1=176 6=1,415
total asset value [USD]
15.0B
10.0B
5.0B
0.0
18.1B
4.6B
973.7M
252.7M
101.2M
Individual Houses
Social Housing Apartments
Social Housing Low-Rise
Apartment Buildings
Individual Houses (villa style)

Per-building asset values (log scale)

Dashed line shows the sample median



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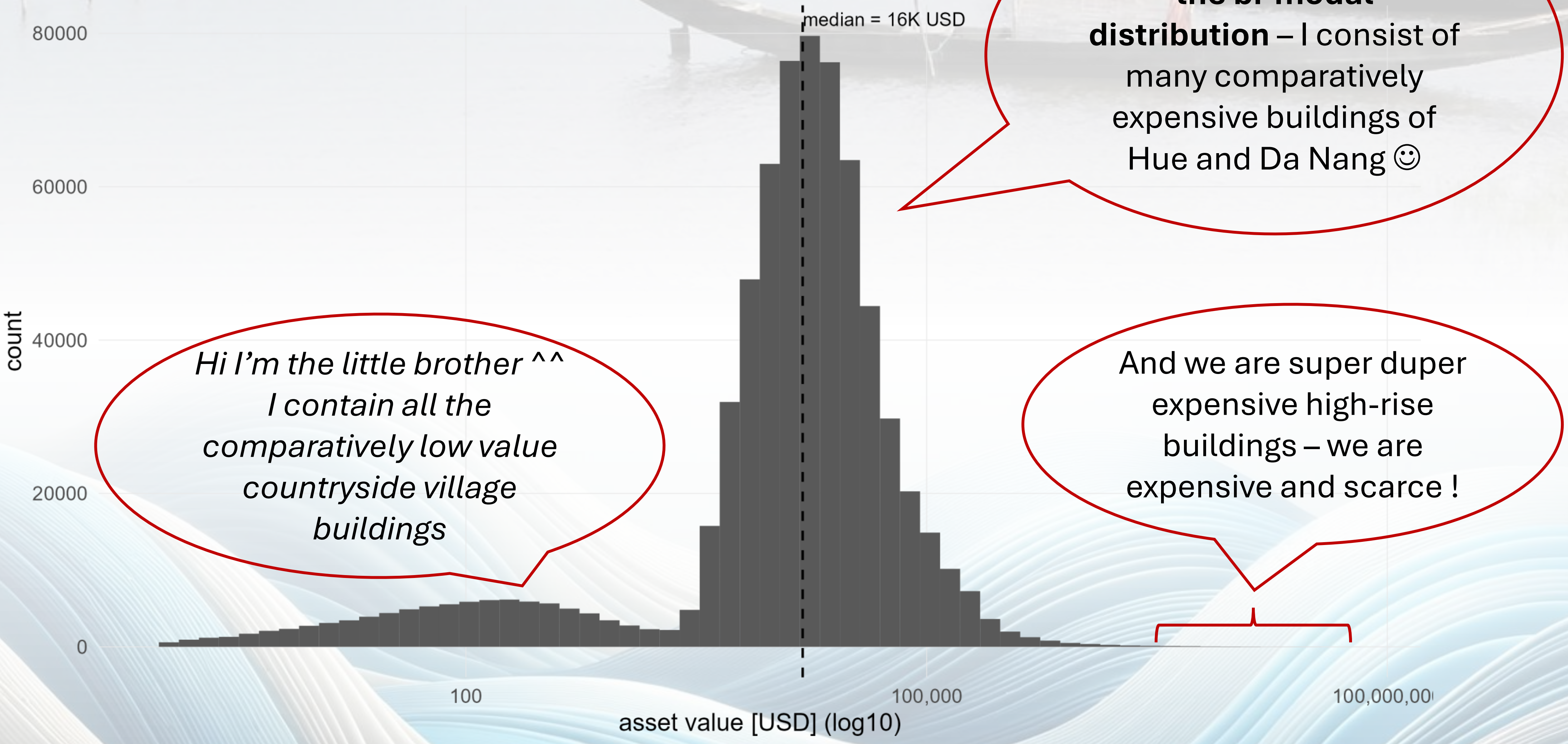
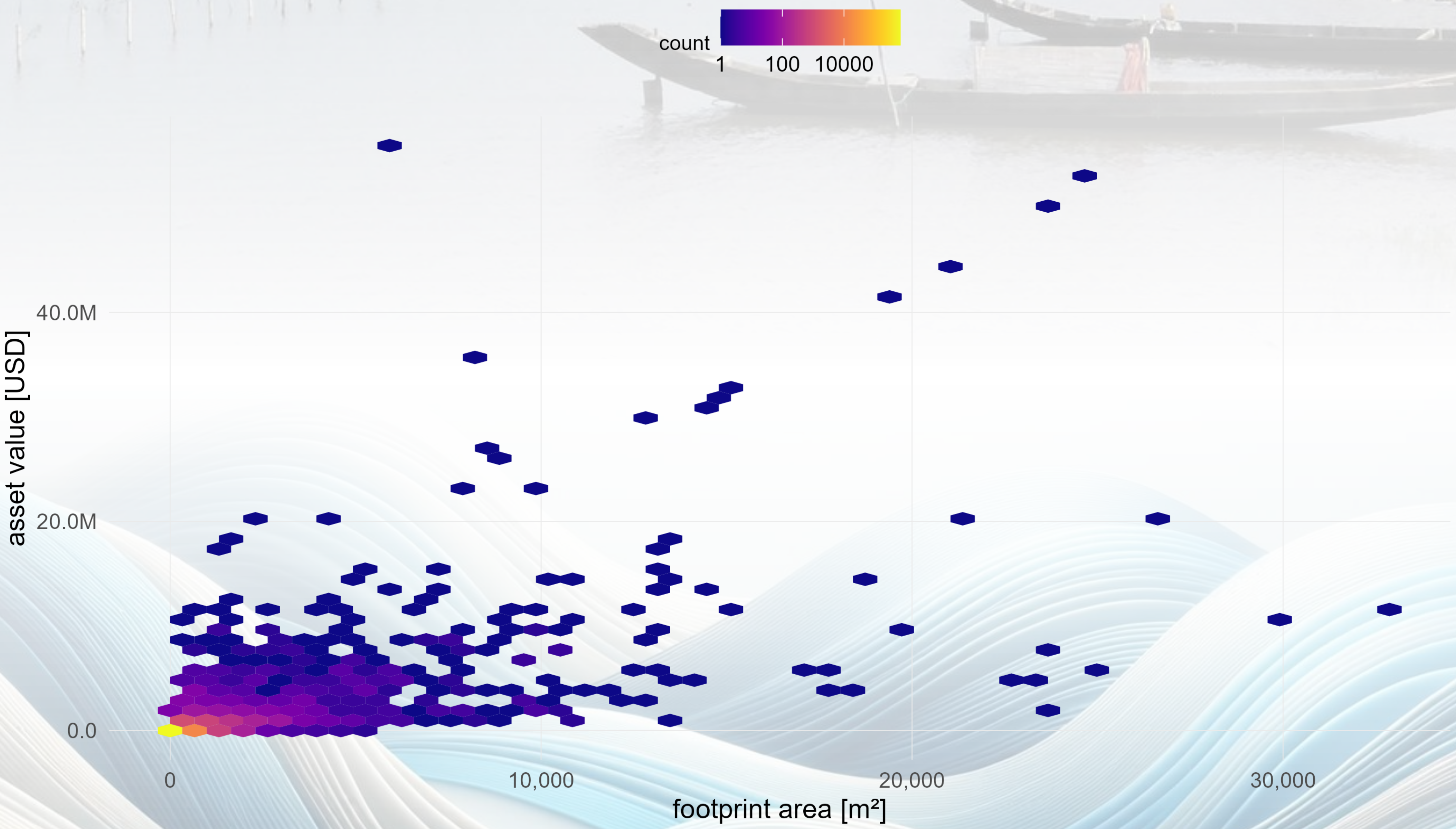
Per-building asset values (log scale)

Dashed line shows the sample median



Area vs value — hexbin density

Color scale shows log count per hexbin



Accuracy

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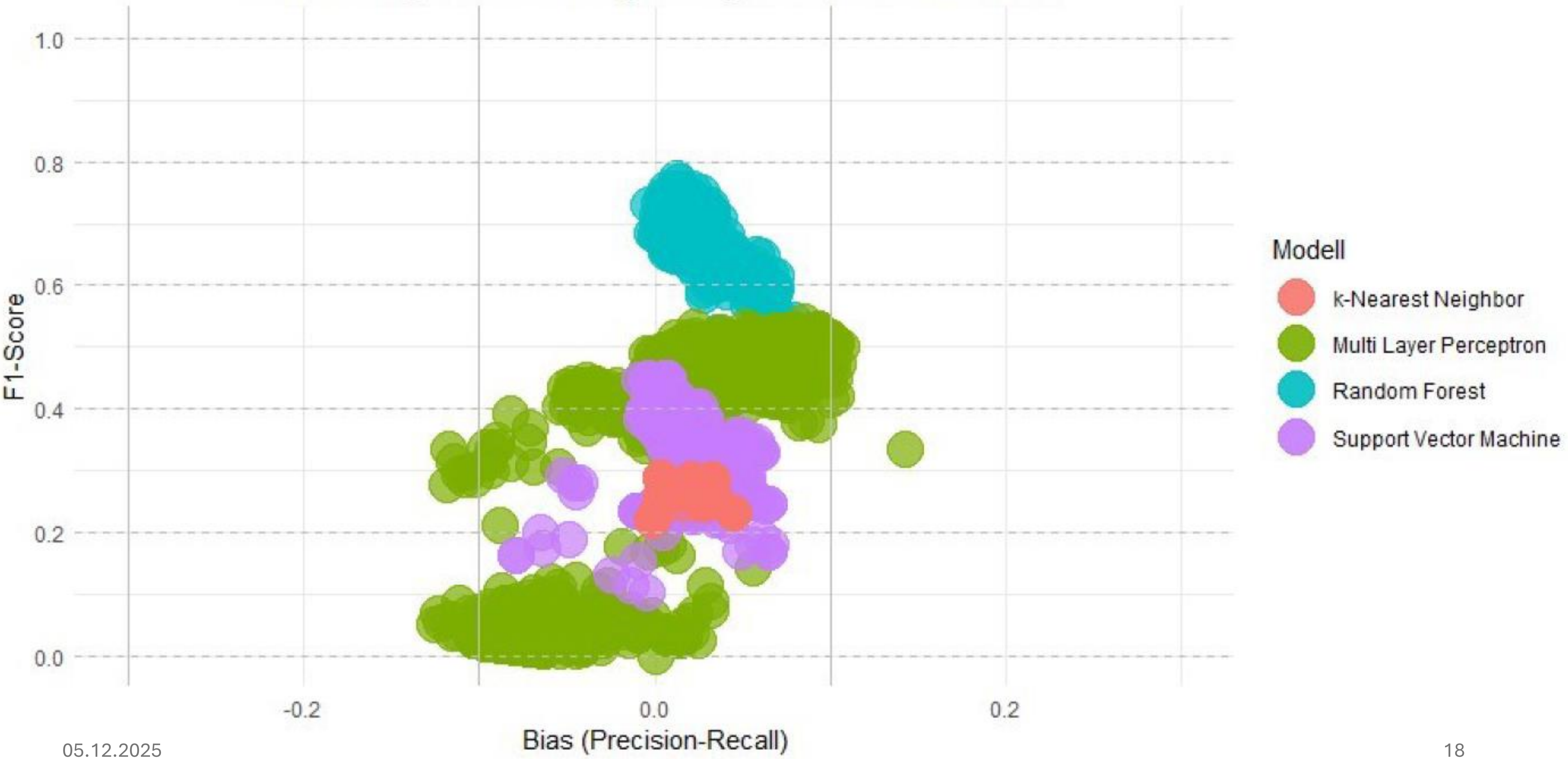

Conclusion and Outlook

- Scalable per-building replacement value mapping for Thua Thien Hue using **remote sensing, OpenStreetMap, and auxiliary layers.**
- Reference data: 1,572 labeled points from field campaigns in March 2023 and March 2024.
- Pipeline: 49 building types mapped to 5 government cost classes; heights → floor counts; area × unit cost → per-building value.
- Coverage: approximately 600,000 buildings classified and valued.
- Applications: prioritization, flood loss modeling, and on-the-fly aggregation in support of FloodAdaptVN decision making.
- Reproducibility: KoBo field forms and GitHub repository; generic feature space transferable to other provinces and cities.
- Limitations: class imbalance for high-rise types, OSM completeness, height estimation and unit-rate uncertainties.
- Next steps:
  - Update to current Ministry of Construction unit rates and add uncertainty bands.
  - Extend mapping to the wider central Viet Nam region; perform external validation.
  - Integrate with flood hazard layers to generate impact and adaptation scenarios.
  - Publish GeoNode layers and API endpoints; run stakeholder calibration workshops.

Bundesministerium
für Forschung, Technologie
und Raumfahrt

Vielen Dank

Thank You

धन्यवाद

谢谢

Merci à toi

Cảm ơn

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Contact: *michael.Schultz@uni-tuebingen.de*

Daniela.Heigenhauser@uni-tuebingen.de

Overall descriptive statistics

```
buildings (n): 688,609
total asset value (USD): 24,073,354,356  (24.07B)

USD distribution:
  min   : 1  (1)
  p25   : 7,246  (7.25K)
  median: 15,587  (15.59K)
  mean  : 34,959  (34.96K)
  sd    : 243,013  (243.01K)
  p95   : 103,596  (103.60K)
  max   : 55,689,716  (55.69M)

footprint area total (m²): 61,154,788  (61.15M)
GFA total (m²)           : 90,550,386  (90.55M)

floors (min / p25 / median / mean / p95 / max): 1 / 1 / 1 / 1.33 / 2 / 45
```

Source: desc_stats_overall.csv

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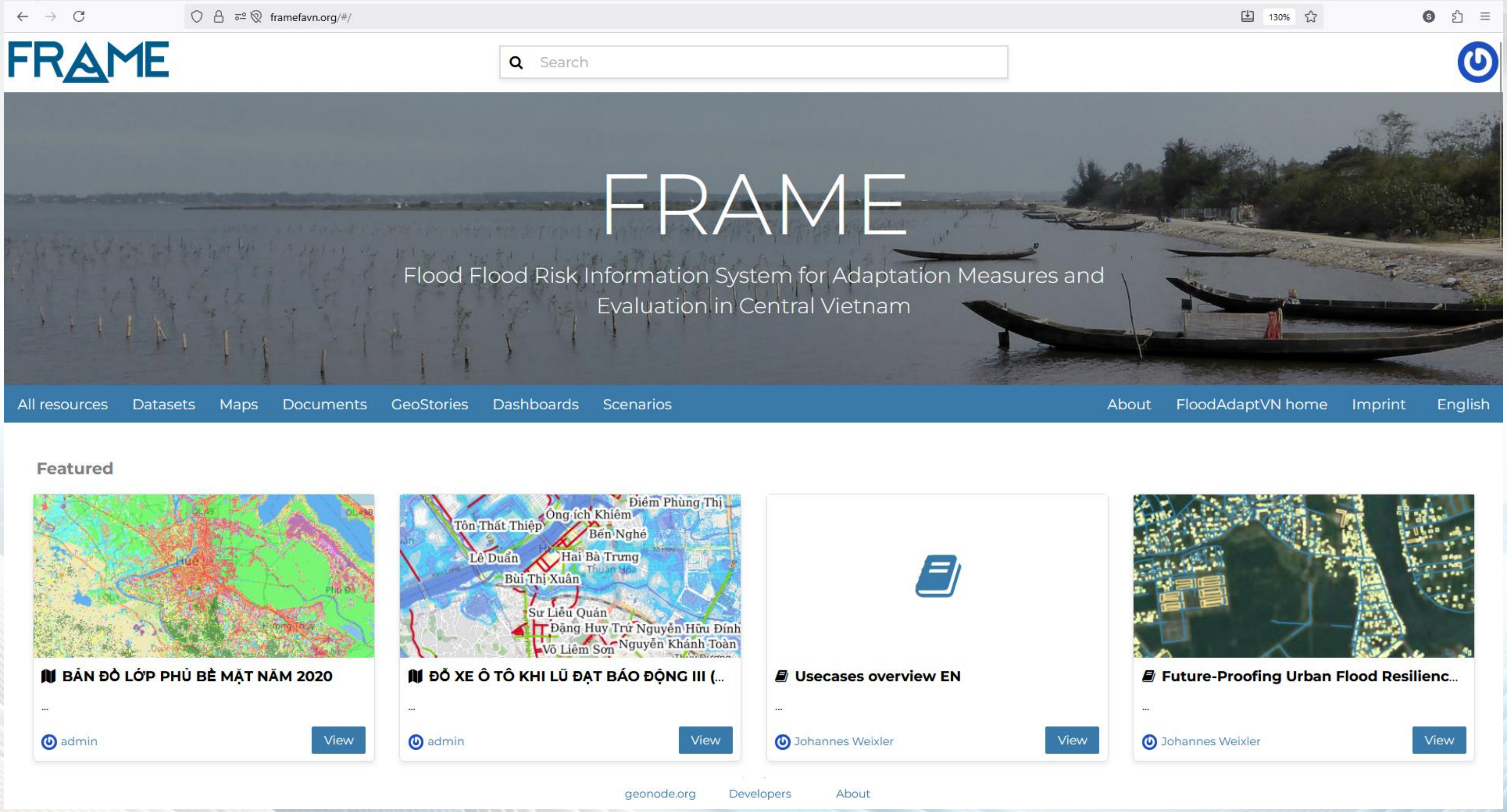
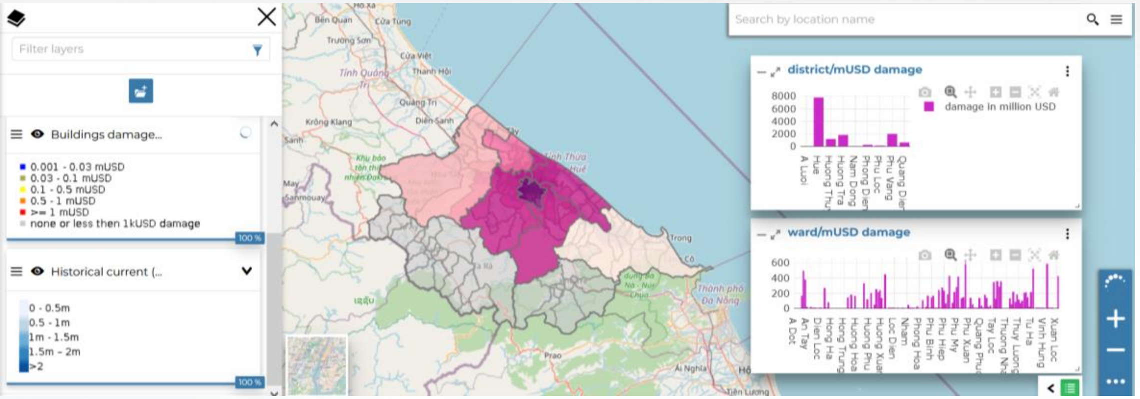
Facilitation FRAME

FLOOD ADAPT VN

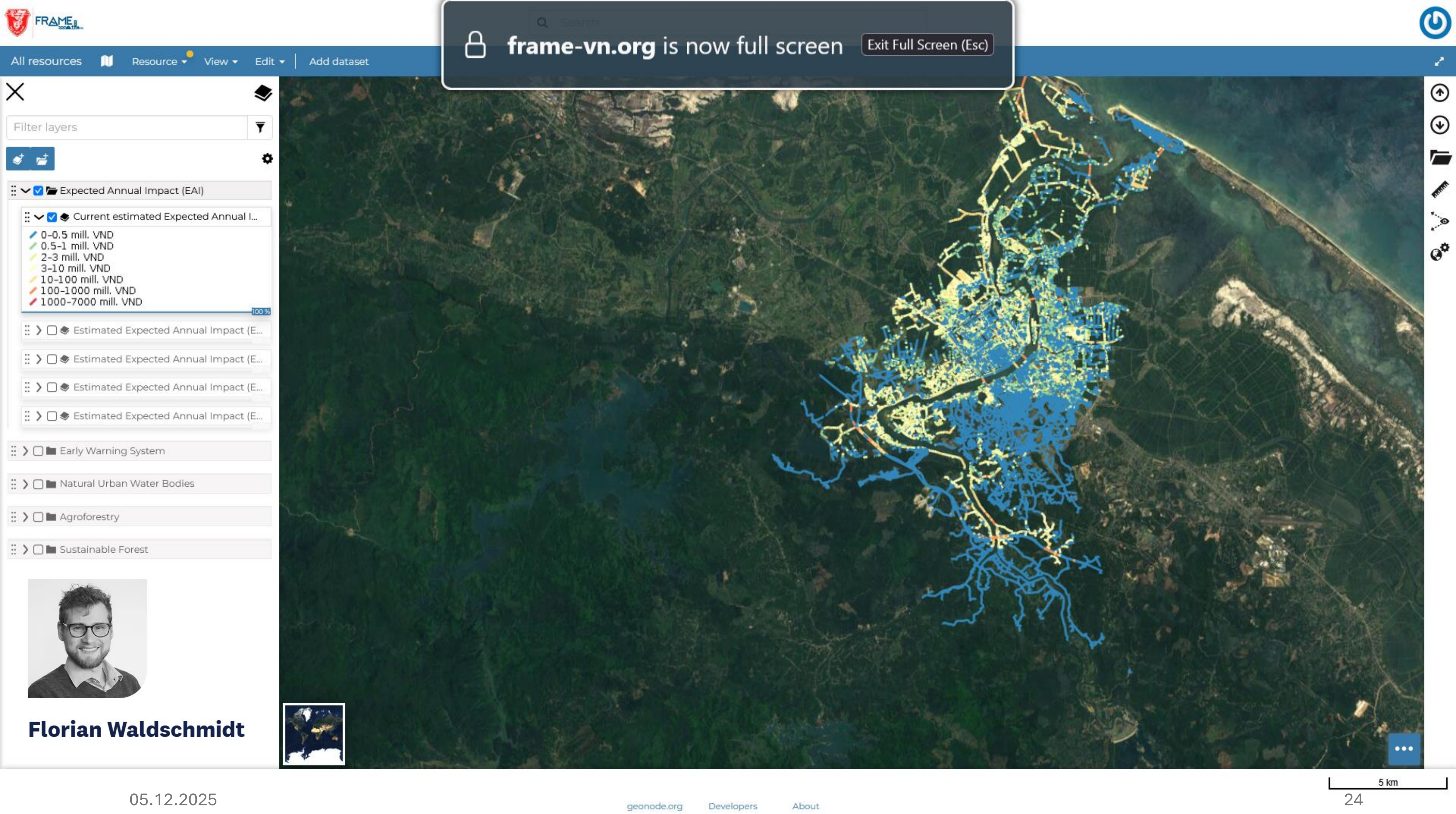


Facilitation FRAME

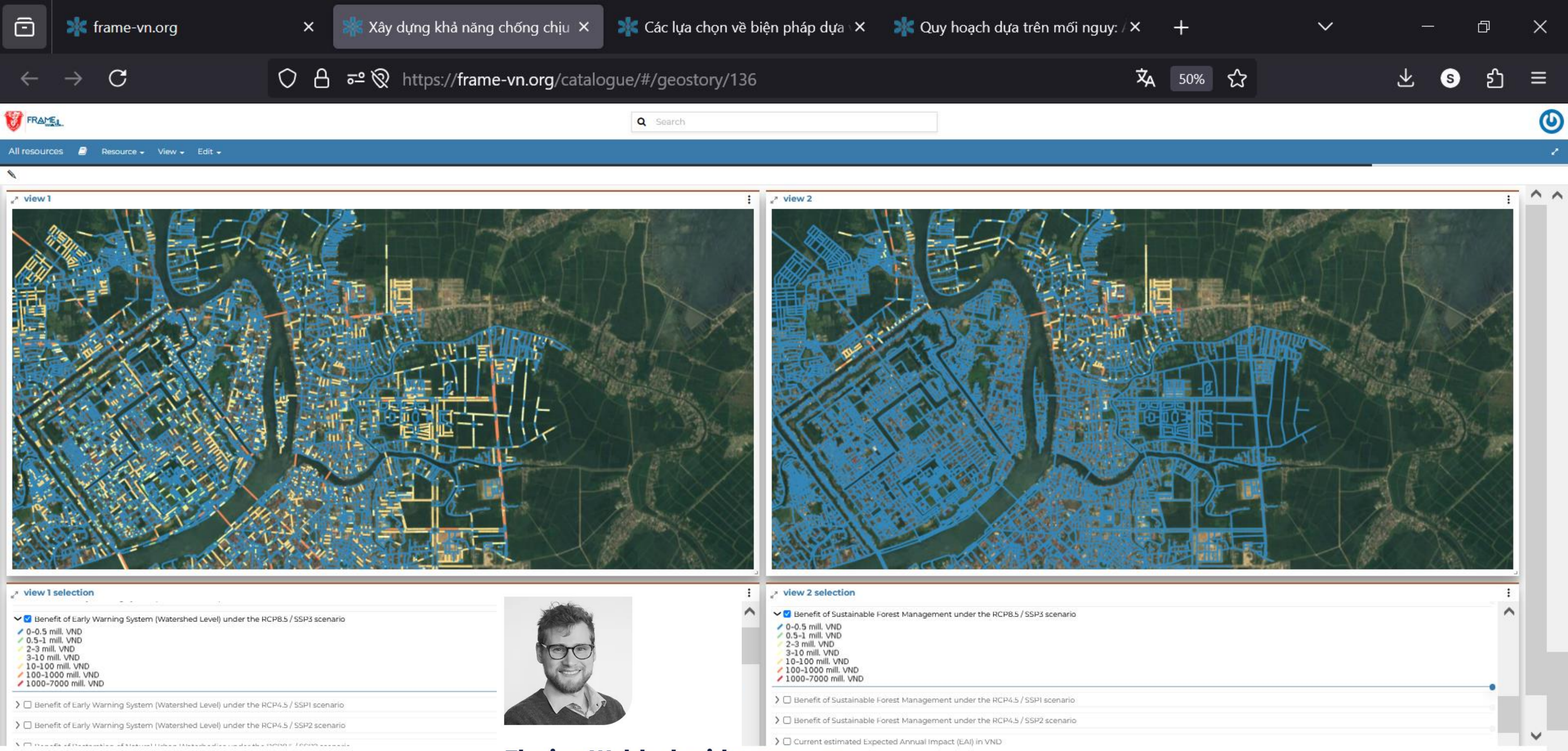
a) on the fly data aggregation feature via widgets



b) individual buildings and flood impact analysis

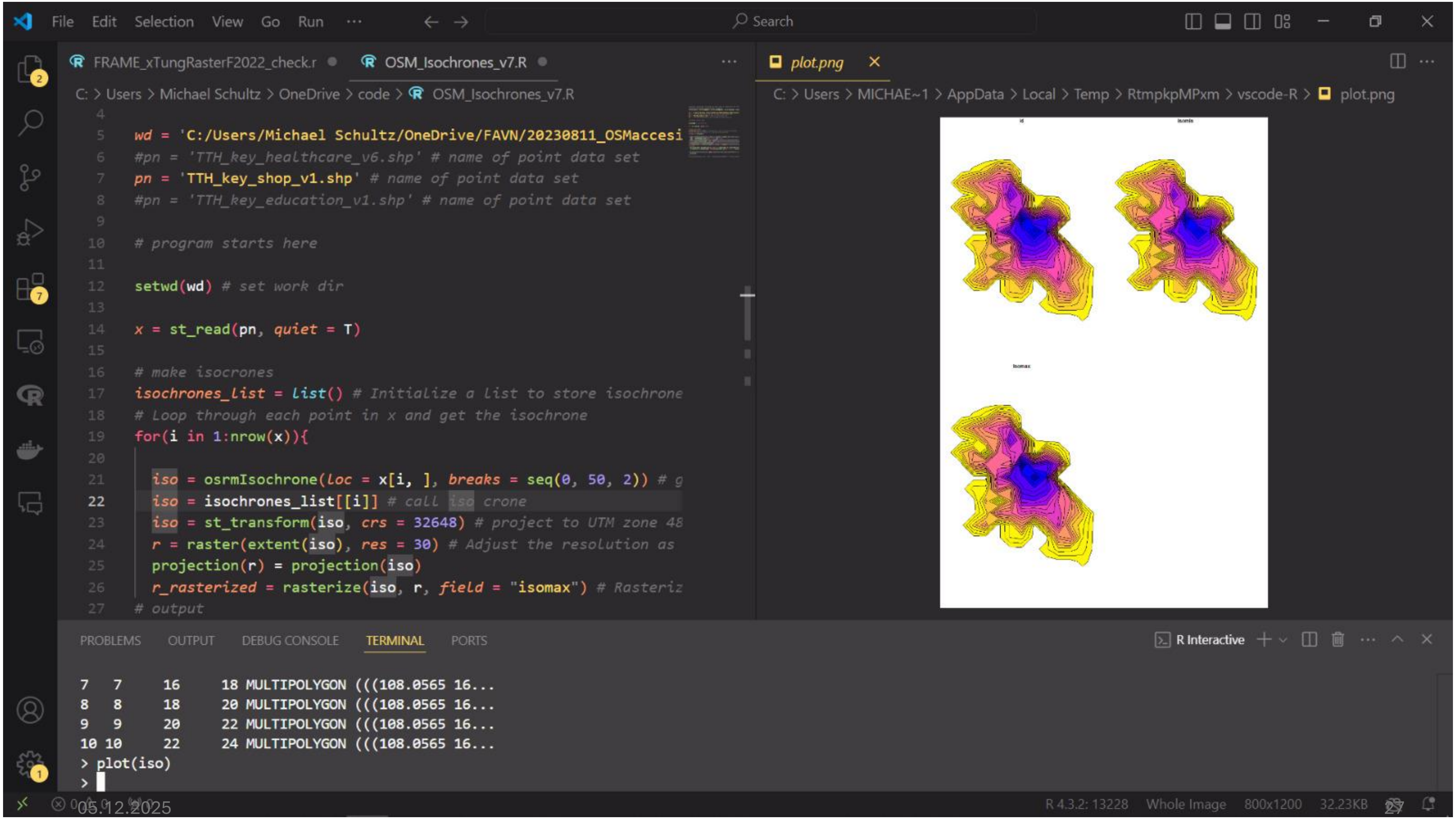


Florian Waldschmidt



Florian Waldschmidt

Method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OSM_Isochrones_v7.R
plot.png
C: > Users > Michael Schultz > OneDrive > code > OSM_Isochrones_v7.R
wd = 'C:/Users/Michael Schultz/OneDrive/FAVN/20230811_OSMaccesi
#pn = 'TTH_key_healthcare_v6.shp' # name of point data set
pn = 'TTH_key_shop_v1.shp' # name of point data set
#pn = 'TTH_key_education_v1.shp' # name of point data set
program starts here
setwd(wd) # set work dir
x = st_read(pn, quiet = T)
# make isocrones
isochrones_list = list() # Initialize a list to store isochrone
# Loop through each point in x and get the isochrone
for(i in 1:nrow(x)){
iso = osrmIsochrone(loc = x[i,], breaks = seq(0, 50, 2)) # g
iso = isochrones_list[[i]] # call iso crone
iso = st_transform(iso, crs = 32648) # project to UTM zone 48
r = raster(extent(iso), res = 30) # Adjust the resolution as
projection(r) = projection(iso)
r_rasterized = rasterize(iso, r, field = "isomax") # Rasteriz
# output
C: > Users > MICHAE~1 > AppData > Local > Temp > RtmpkpMPxm > vscode-R > plot.png
isomax
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
R Interactive
7 7 16 18 MULTIPOLYGON (((108.0565 16...
8 8 18 20 MULTIPOLYGON (((108.0565 16...
9 9 20 22 MULTIPOLYGON (((108.0565 16...
10 10 22 24 MULTIPOLYGON (((108.0565 16...
> plot(iso)
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R 4.3.2: 13228 Whole Image 800x1200 32.23KB

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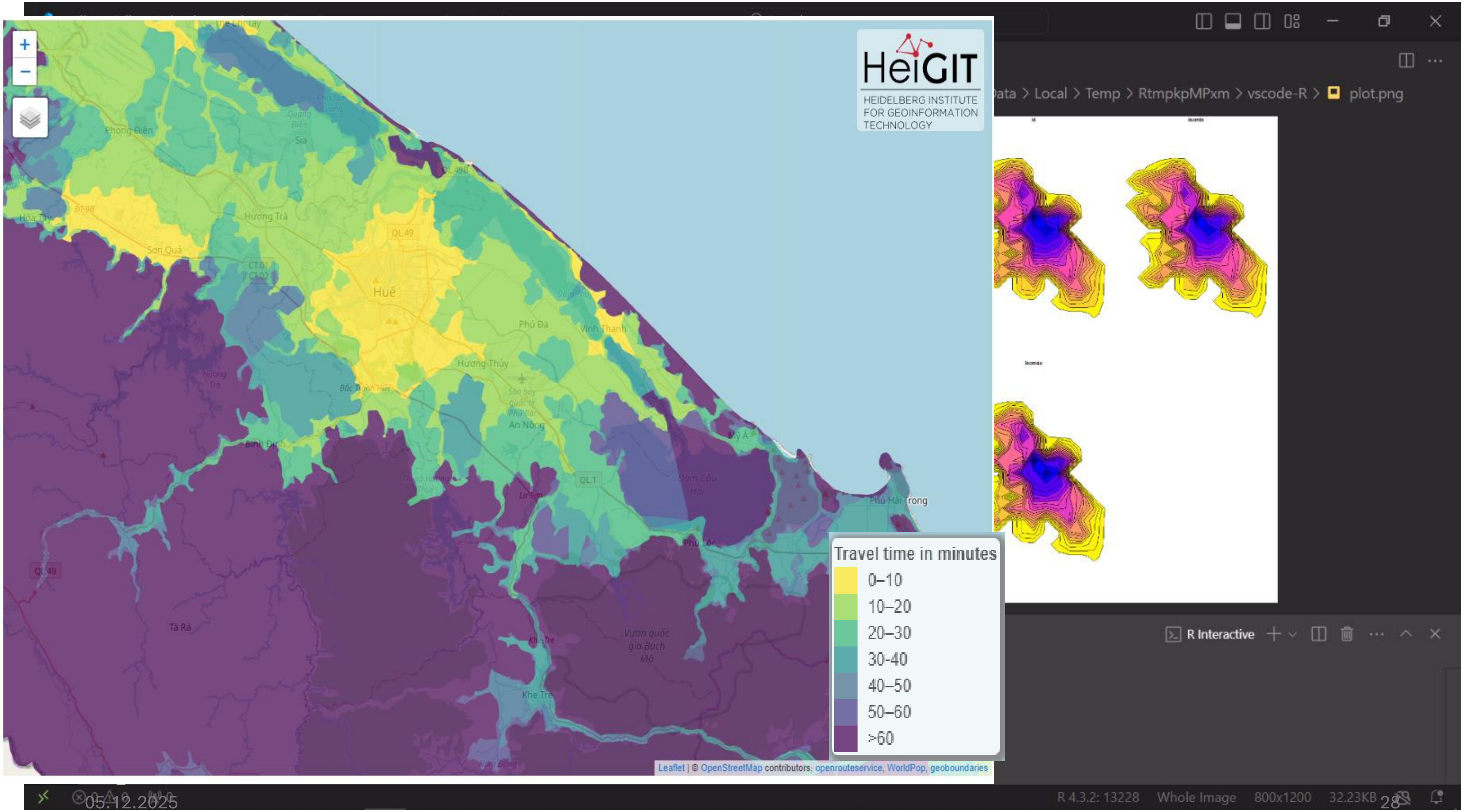
HeiGIT
HEIDELBERG INSTITUTE FOR GEOINFORMATION TECHNOLOGY
Travel time in minutes
0–10
10–20
20–30
30-40
40–50
50–60
>60
Huế
Phong Điền
Hương Trà
Sơn Quả
Phú Đa
Vinh Thanh
Hương Thủy
An Nông
Bình Điền
Tà Rá
Khe Tre
Phú Hải Trong
Leaflet | © OpenStreetMap contributors, openrouteservice, WorldPop, geoboundaries
Data > Local > Temp > RtmpkpMPxm > vscode-R > plot.png
R Interactive
R 4.3.2: 13228
Whole Image
800x1200
32.23KB

Input training data

- Ground truth campaign 2023/24 https://kf.kobotoolbox.org/#/forms/aAY7brXZq5urtpvsRTpd9r/data/map
- We estimate construction replacement value United States Dollar (USD) for every building polygon using nationally announced investment unit rates per square meter by housing class and floor count. Rates and rules follow Vietnam Ministry of Construction Decision 610/QĐ-BXD (announcement of 2021 construction investment unit costs) (Ministry of Construction, Socialist Republic of Viet Nam, 2022), applied at Q4/2022 price level with 1 USD = 22,890 VND

Input training data

- A total of 1572 reference points were collected during two field campaigns in March 2023 and March 2024.
- Each reference point contained information on building categories (for example, urban structure types and building types) sampled across Hue province.
- Trained personnel inspected individual buildings to assign the appropriate building category, yielding a detailed inventory of building types for all reference locations.

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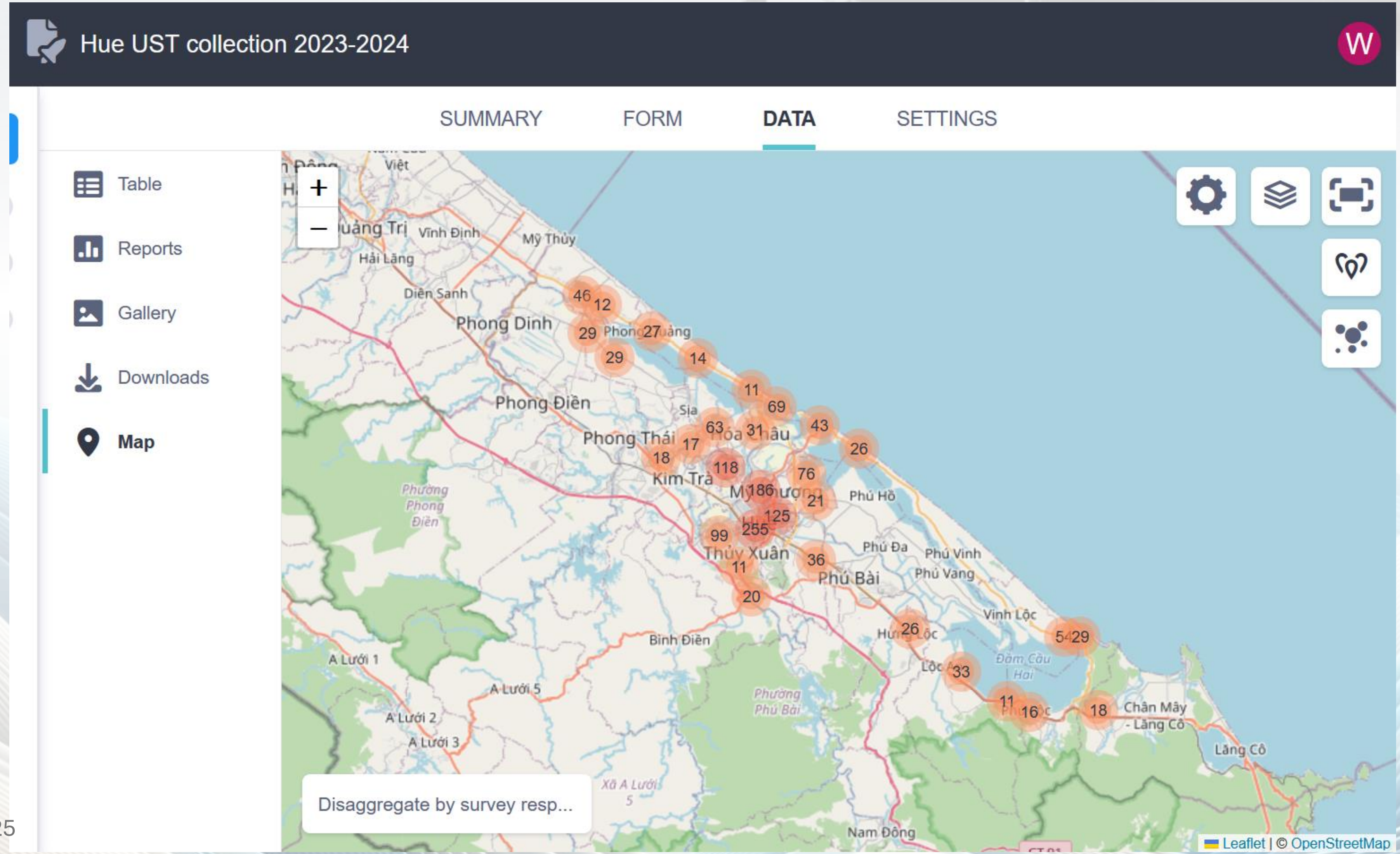
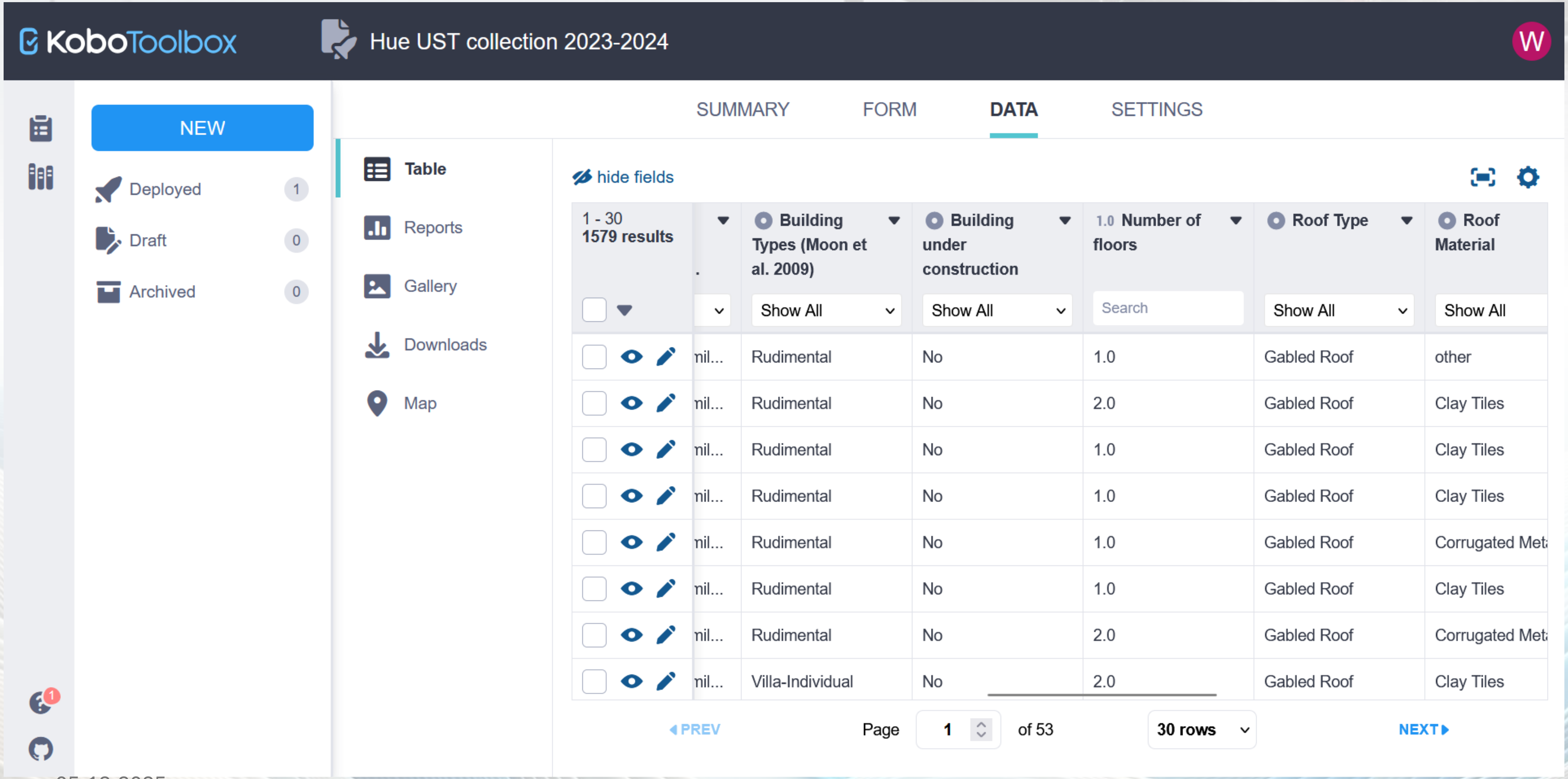
Ground truth campaign 2023/24



Ground truth campaign 2023/24



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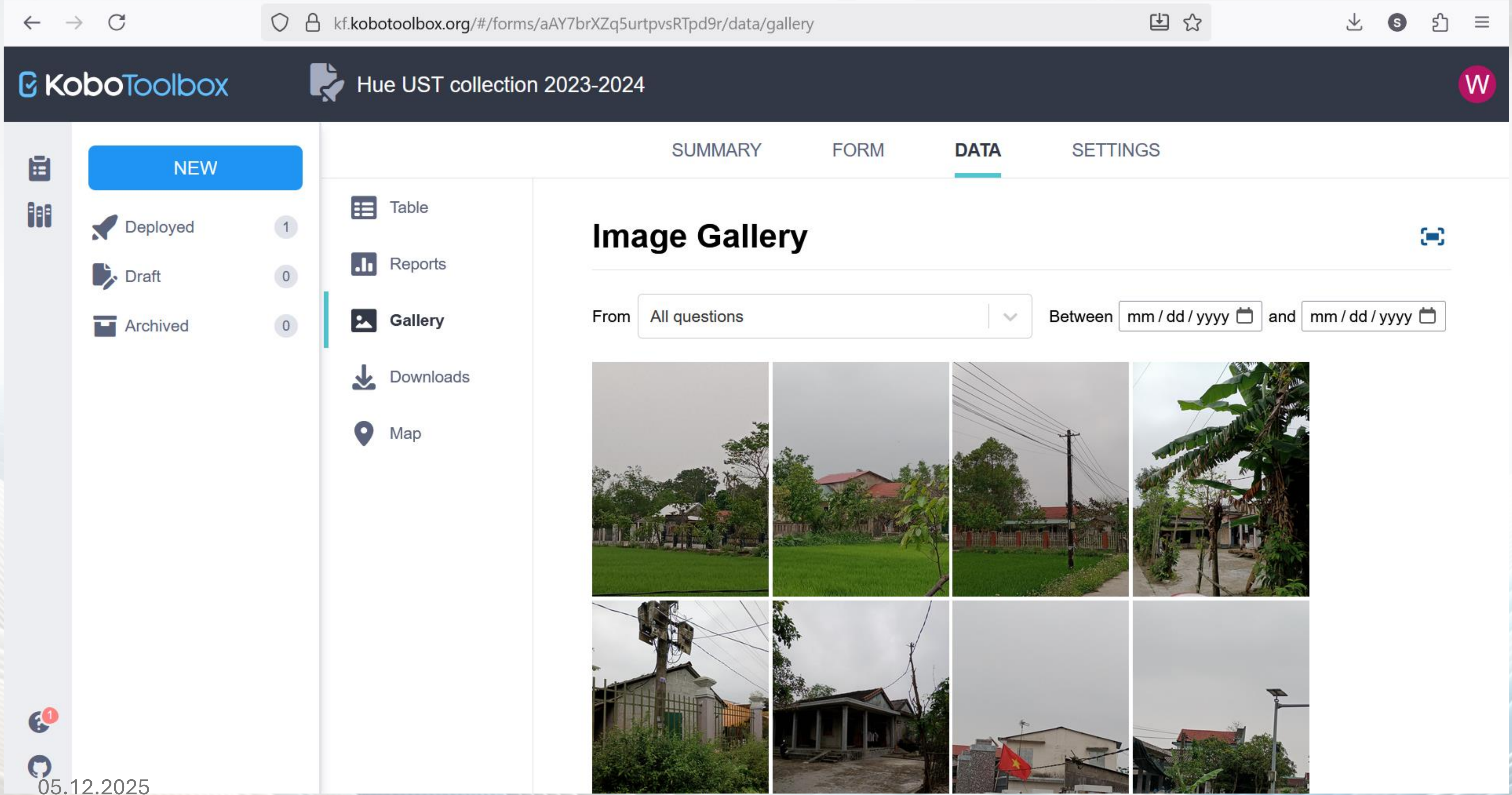
Ground truth campaign 2023/24



https://github.com/HeigenhauserD/hue_buildings

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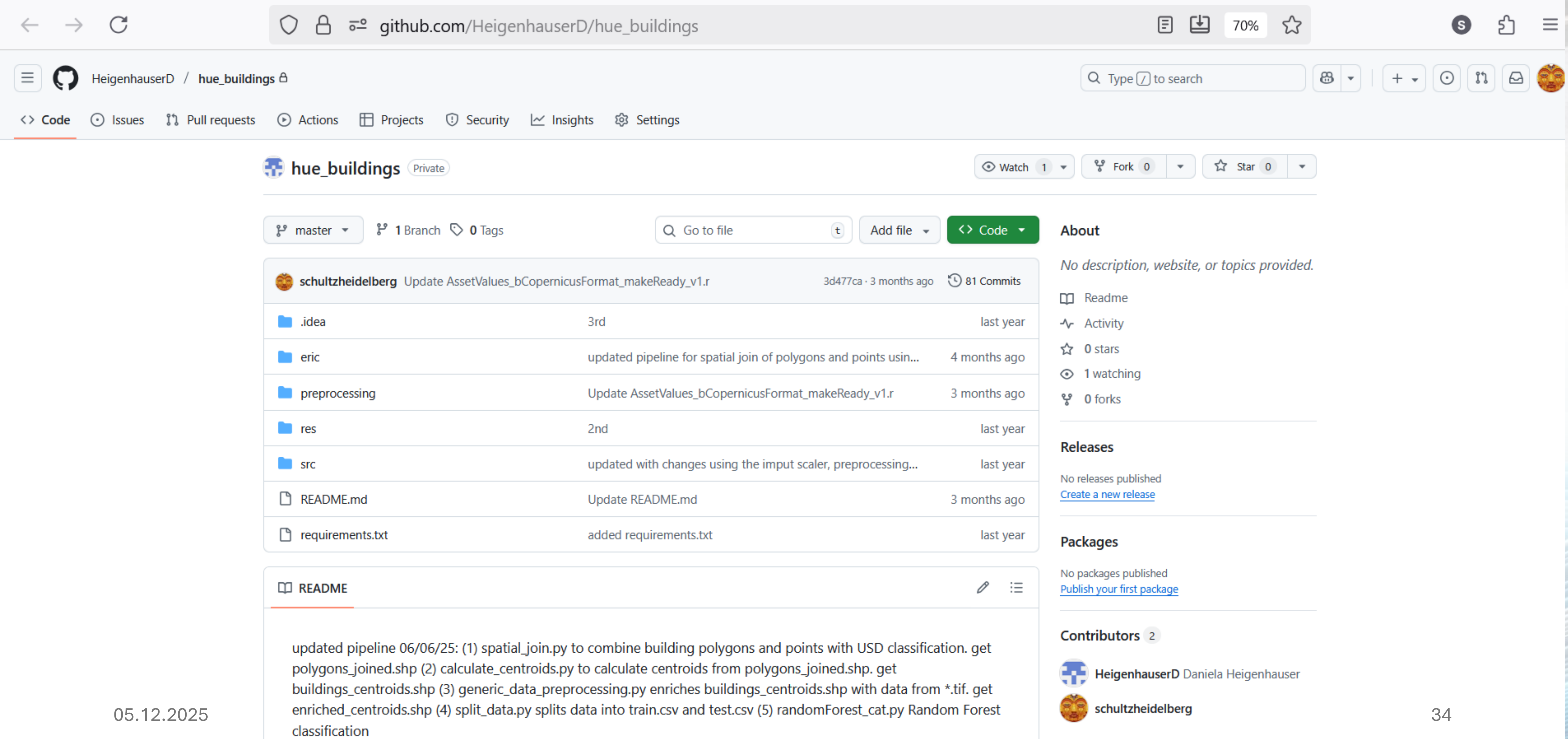

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