Global Gateway

EO Webinar

Spatial Data Use & Urban Development

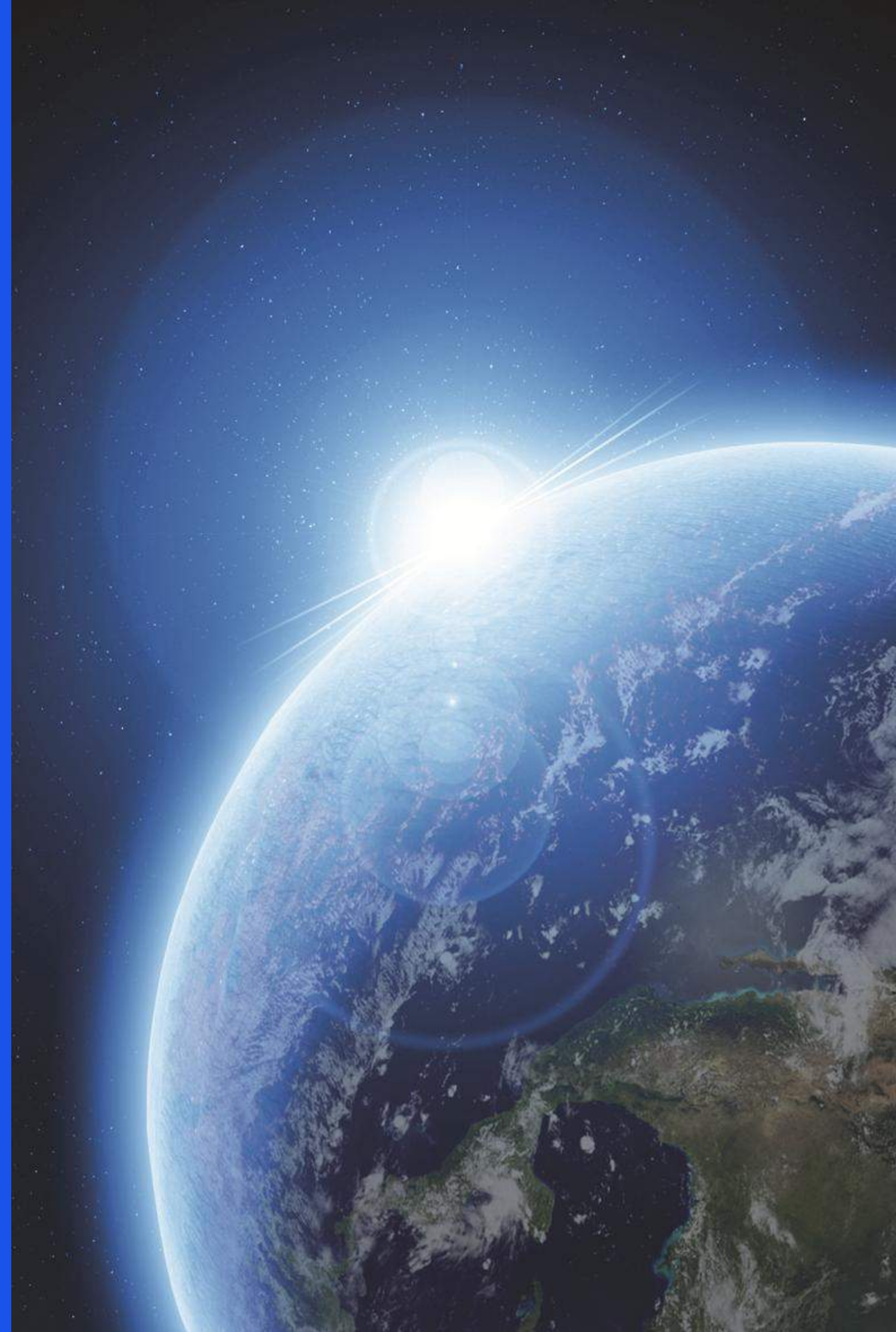
Role of Earth Observation & Spatial Analysis Modelling

vito

INTPA F4 - Urban Development Technical Facility (UDTF)

Webinar Overview

- The Copernicus Programme
- Applications of Earth Observation (EO) by VITO



Global Gateway

The Copernicus Programme

Focus on the LAC region

Manuel Múgica Barrera
Space and AI use cases team
DG INTPA F5: Digital Transformation Unit
European Commission

PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

Overview

1. The Copernicus Programme
2. The 6 Copernicus Services
3. The LAC Region

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Europe's eyes on Earth

The EU Space Programme

AN INVESTMENT IN A
FUTURE READY EUROPE

Competitive edge
Completing current satellite constellations, developing and launching the next-generation of satellites

Research **innovation**
Ambitious research and innovation programme benefiting from Horizon Europe

Fighting Climate Change
Monitoring biodiversity, environmental compliance and CO2 emissions (Paris Agreement)

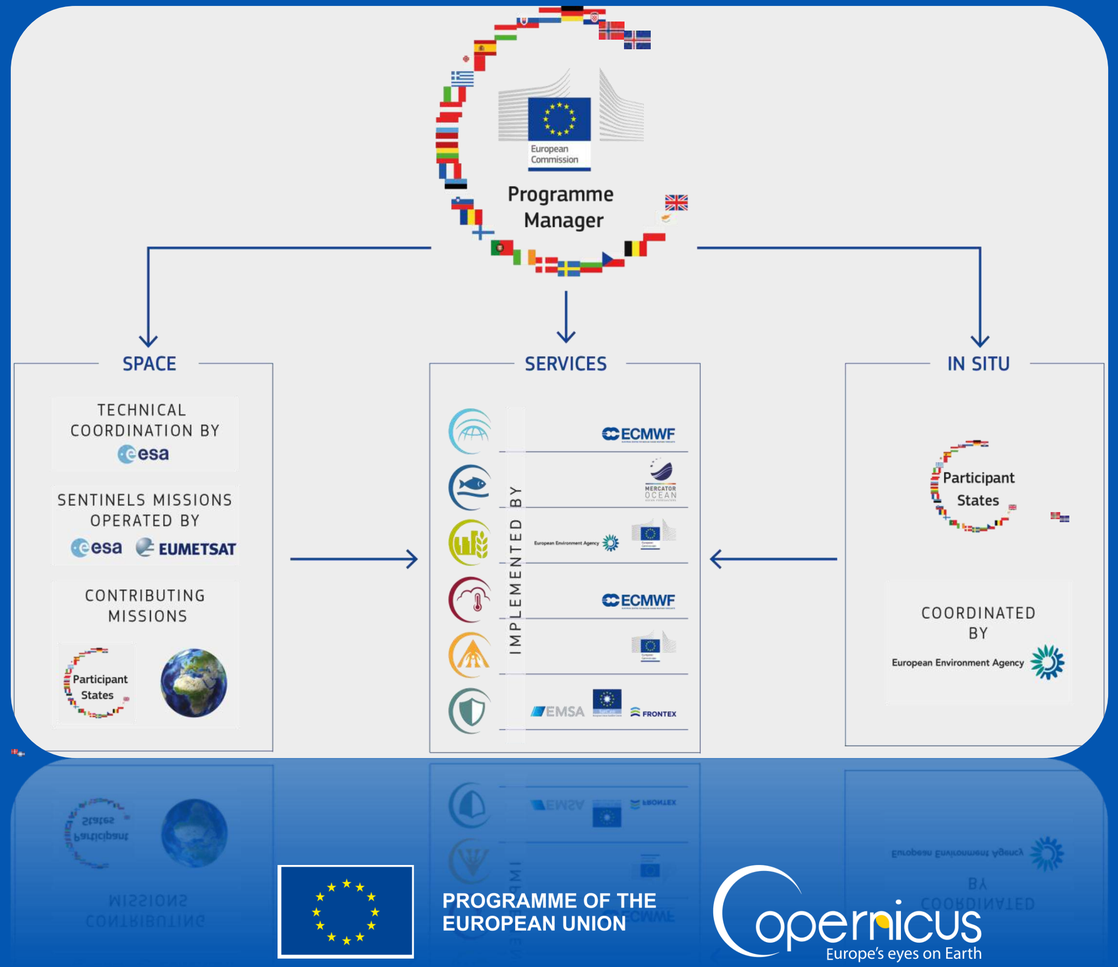
EU as a **global actor**
Supporting disaster relief, humanitarian assistance and security operations

PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

Copernicus Governance

- Copernicus is the **European Union programme** aimed at developing European information services based on satellite Earth Observation and in situ data
- Copernicus is coordinated and **managed** by the **European Commission**
- Copernicus is **implemented in partnership** with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan
- Copernicus **Multiannual Financial Framework** 2021-2027 > 5 billion €



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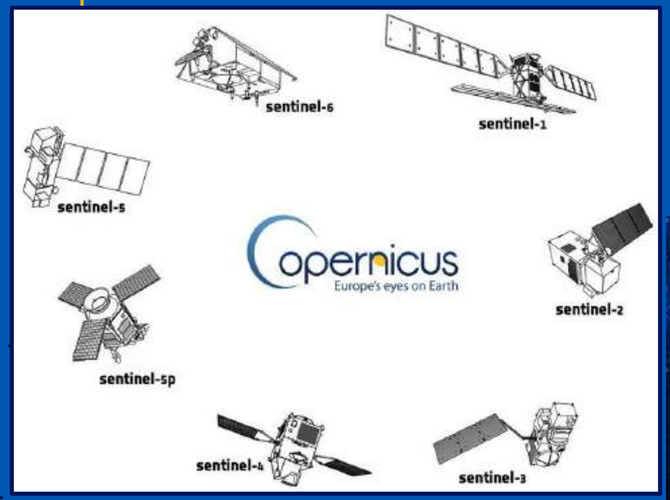
Copernicus
Europe's eyes on Earth

Copernicus Architecture



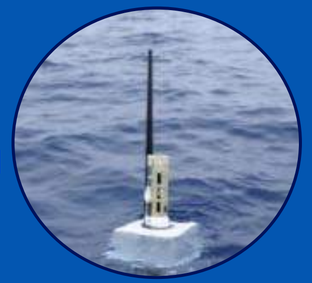
Sentinels

6 services use EO data to deliver…

…added-value products

Contributing missions

In situ data



FULL, FREE AND OPEN

PROGRAMME OF THE EUROPEAN UNION

opernicus
Europe's eyes on Earth

Sentinel Missions

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Copernicus Services

Full, free, and open data policy

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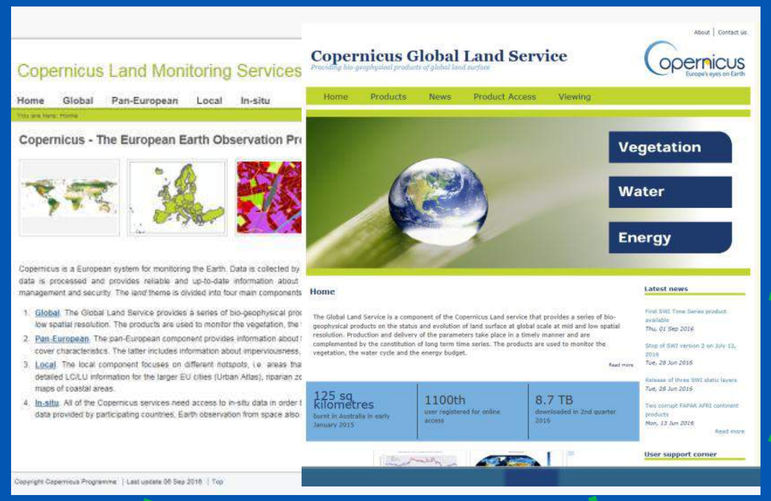
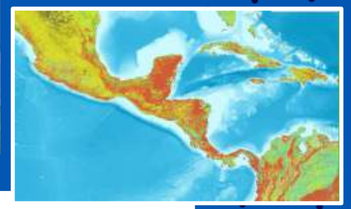
CLMS – Land Monitoring Service



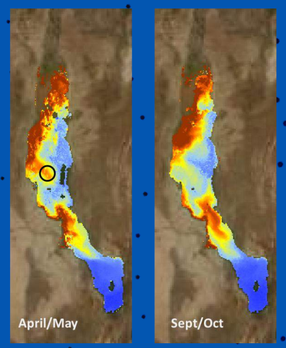
Land Cover & Change layers

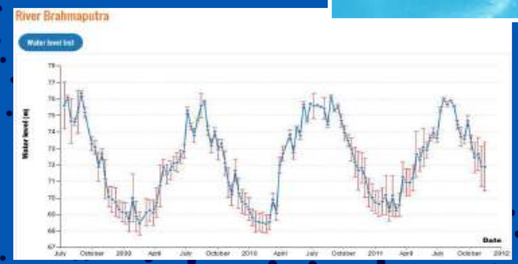
Biophysical variables



Ground Motion Service

Hot Spot land cover mapping





Sectoral information

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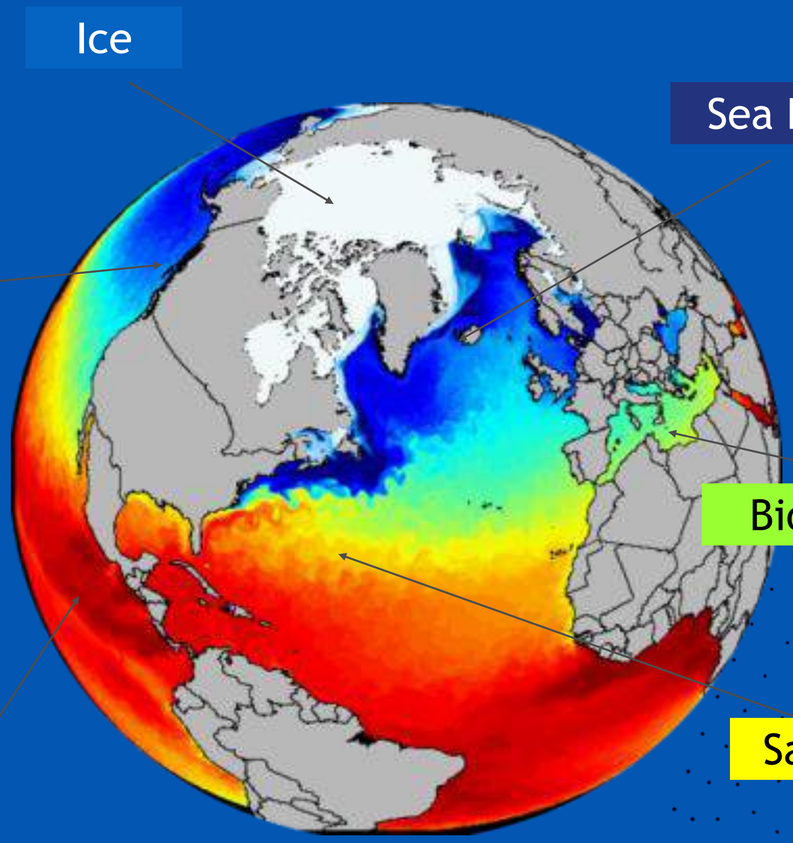
Copernicus Europe's eyes on Earth

CMEMS / Marine Environment Monitoring Service

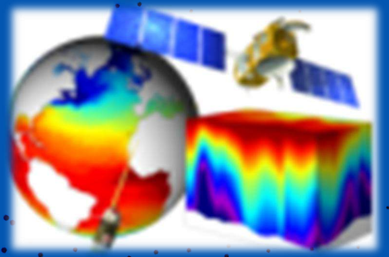
11 product groups & 140 products



- 1. Global
- 2. Arctic
- 3. Baltic
- 4. NWS
- 5. IBI
- 6. Med Sea
- 7. Black Sea

- **Global** and **Regional**
- **Re-analyses / Real Time / Forecast**
- **Satellite** & **In Situ** obs. and **Models**

A 3D and consistent estimation of the ocean state



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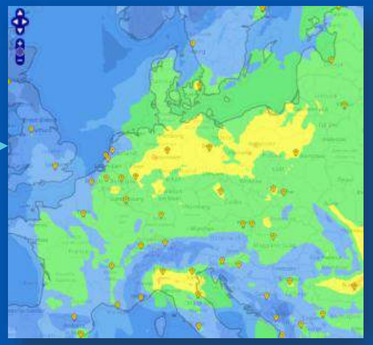
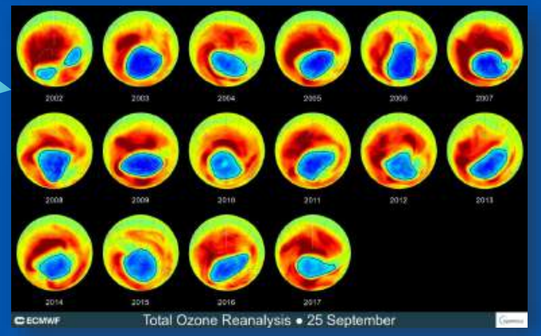
CAMS / Atmosphere Monitoring Service

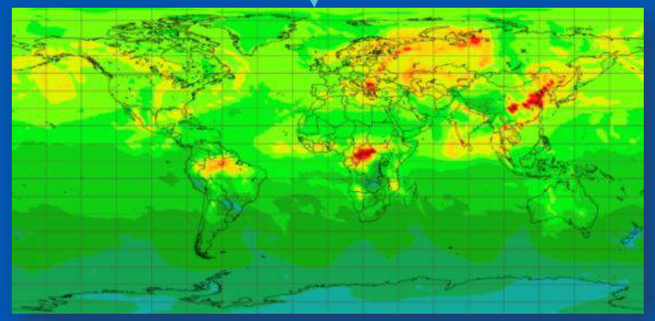


European Air Quality and products in support of policy users

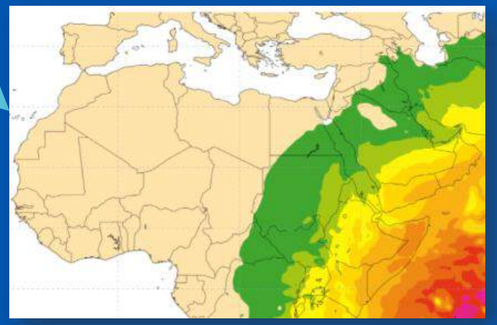


Ozone layer

Emissions and surface fluxes



Atmospheric composition : global analyses, forecasts and reanalyses



Solar radiation and UV index

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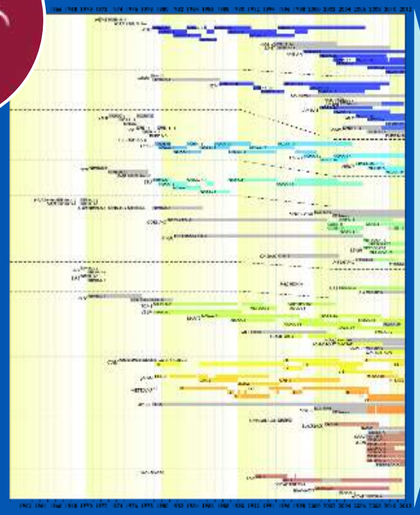
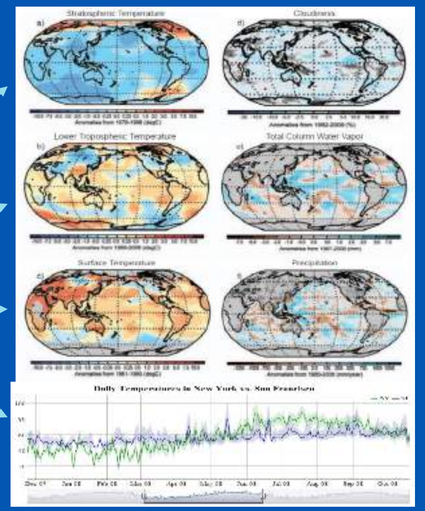
C3S / Climate Change Service

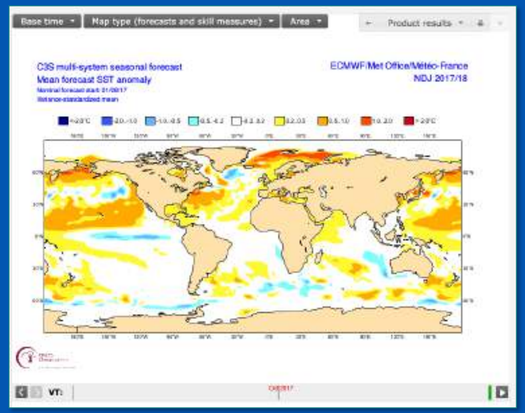


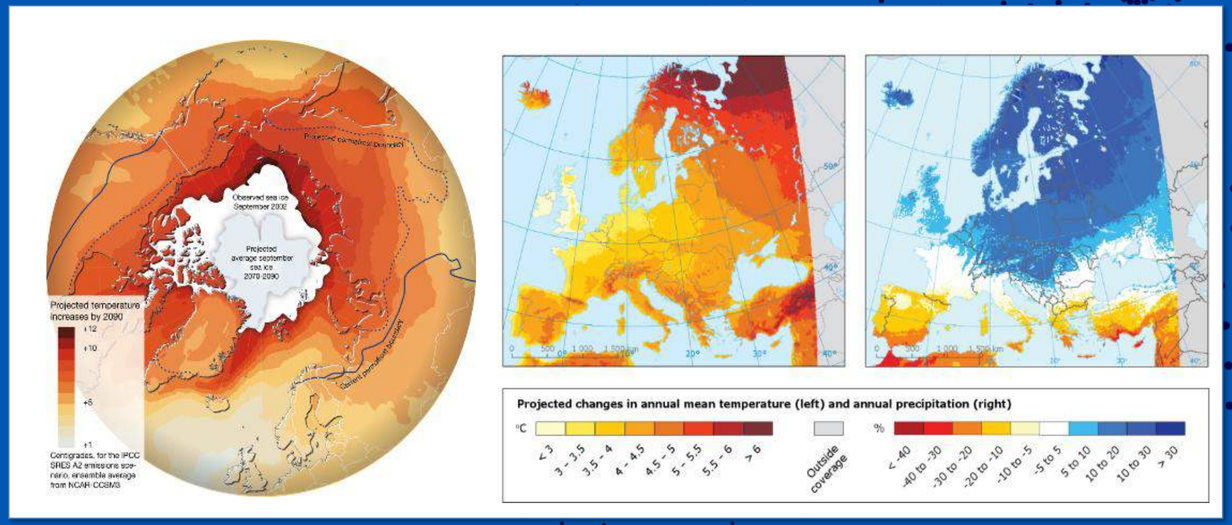
Earth system models



- Observations and climate re-analyses
- Seasonal forecast data and products
- Climate model simulations
- Sectoral Impact Assessment

Annual “European State of the Climate” **report** (C3S)





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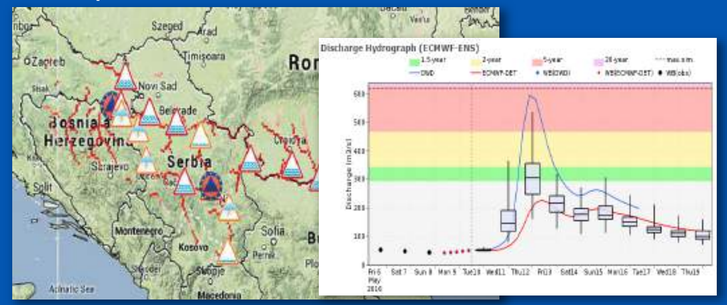
CEMS / Emergency Management Service

Scope

- Complementary to national efforts
- Supporting the EC's Emergency Response and Coordination Centre (ERCC)
- Focus on Europe but available globally

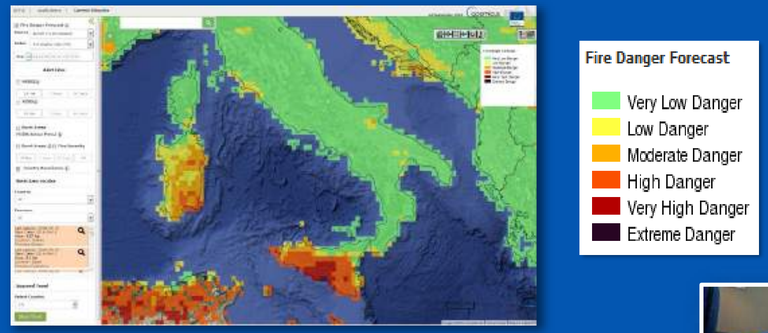
Flood Awareness System (EFAS - GLOFAS)

Flood monitoring and forecasting across Europe and Global



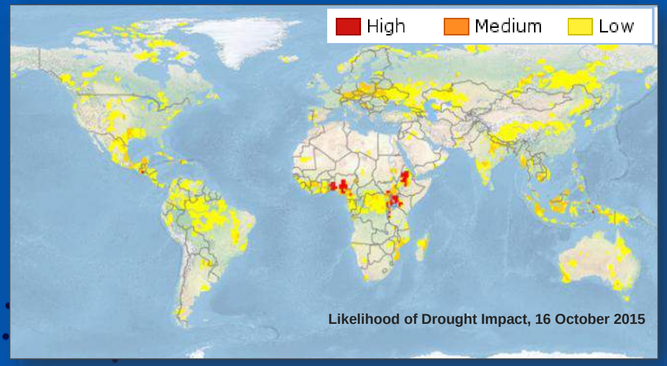
European Forest Fire Information System (EFFIS)

Near real-time & historical information on forest fires in the European, Middle Eastern & N-African regions



Drought Observatory (EDO – GDO)

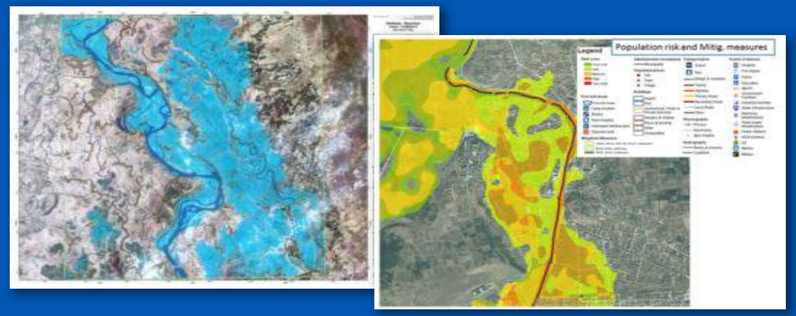
Early warning, monitoring & forecasting of droughts & their impacts



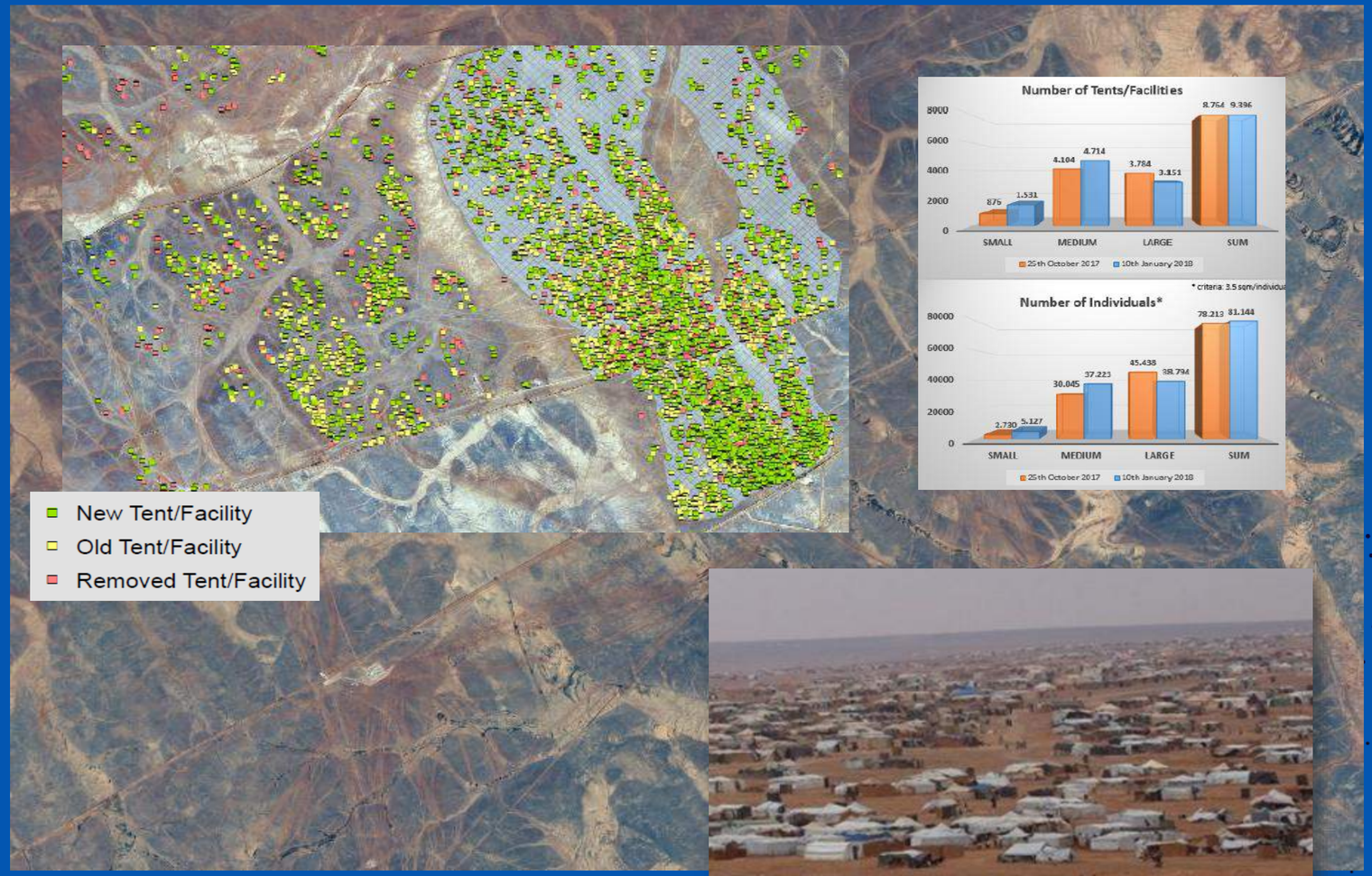
On-demand Mapping

Any disaster

On-demand provision of geospatial information in support of preparedness, emergency response, recovery for any type of disaster



CSS/ Copernicus Security Service



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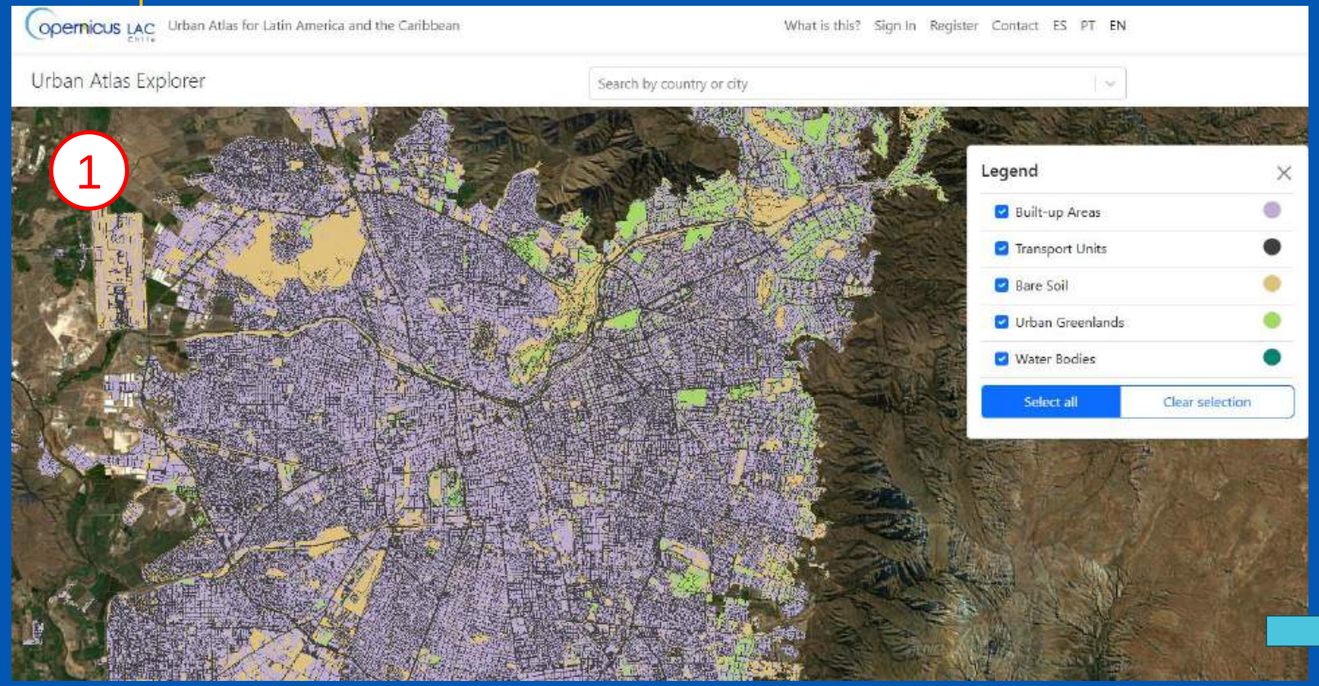
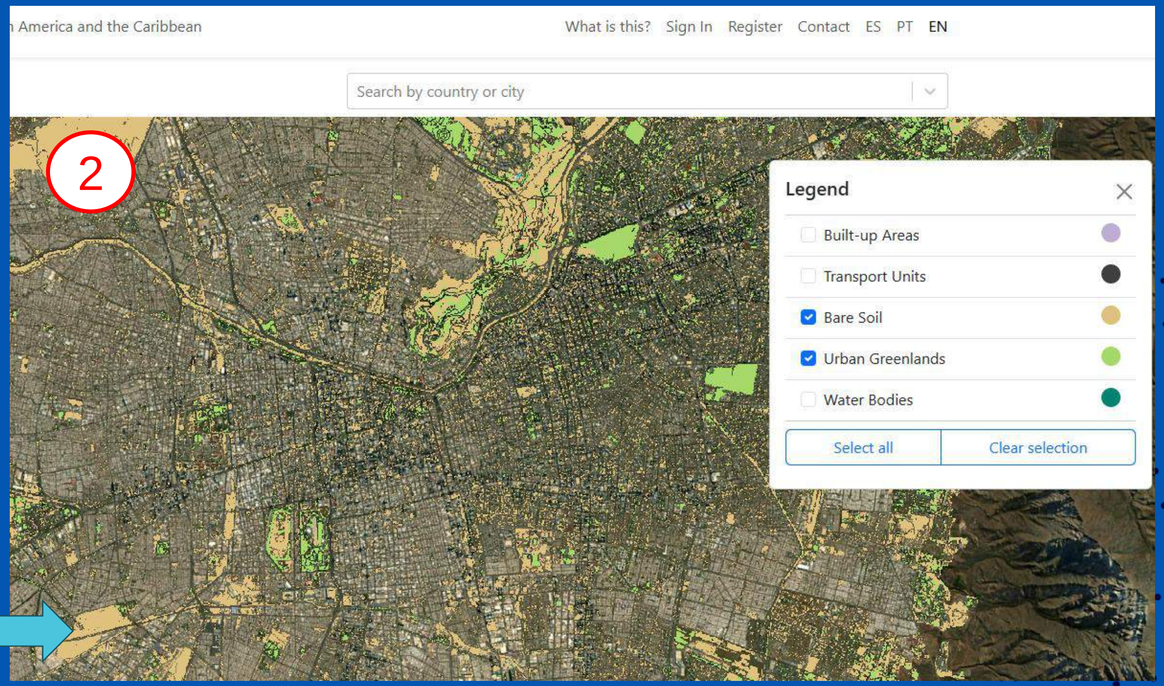
Copernicus LAC Centres – Urban Atlas

2 Copernicus Centres in the LAC region:

- CopernicusLAC Panama Centre: based on DRR geospatial products.
- CopernicusLAC Chile Centre: based on cc and urban products.





Santiago de Chile.

Possible uses:

🏙️ Urban and Regional Planning – e.g. identify areas for urban expansion, supports infrastructure planning

🌳 Environmental Monitoring and Sustainability – e.g. tracking of changes in green areas

🔍 Public Services and Social Infrastructure – e.g. Identifies underserved areas for targeted investments

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Copernicus Europe's eyes on Earth

Applications of EO by VITO

A. **Introduction VITO.**

B. **Deep Dive into Earth Observation (EO) & Spatial Analysis Tools for Urban Development.**

1. Urban Growth and Climate Impact (India)
2. Waste Management (Democratic Republic of Congo)
3. Flood Risk Management (Belgium, Vietnam, India, and China)

C. **Q&A Panel.**

Global Gateway

A. Introduction VITO

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We turn **scientific insights** into ground-breaking **technological innovations**, **AI solutions,** and **policy advice**

IMPACT DOMAINS

Regenerative Economy
Circular & Bio-economy
Energy & Water
Closed Loops

Healthy Environment
Environment - Health Impact
Space for All
Human Comfort

Resilient Ecosystems
Climate mitigation
Climate adaptation
Security

1393
employees

69
nationalities

297M€
revenues

27
patent applications

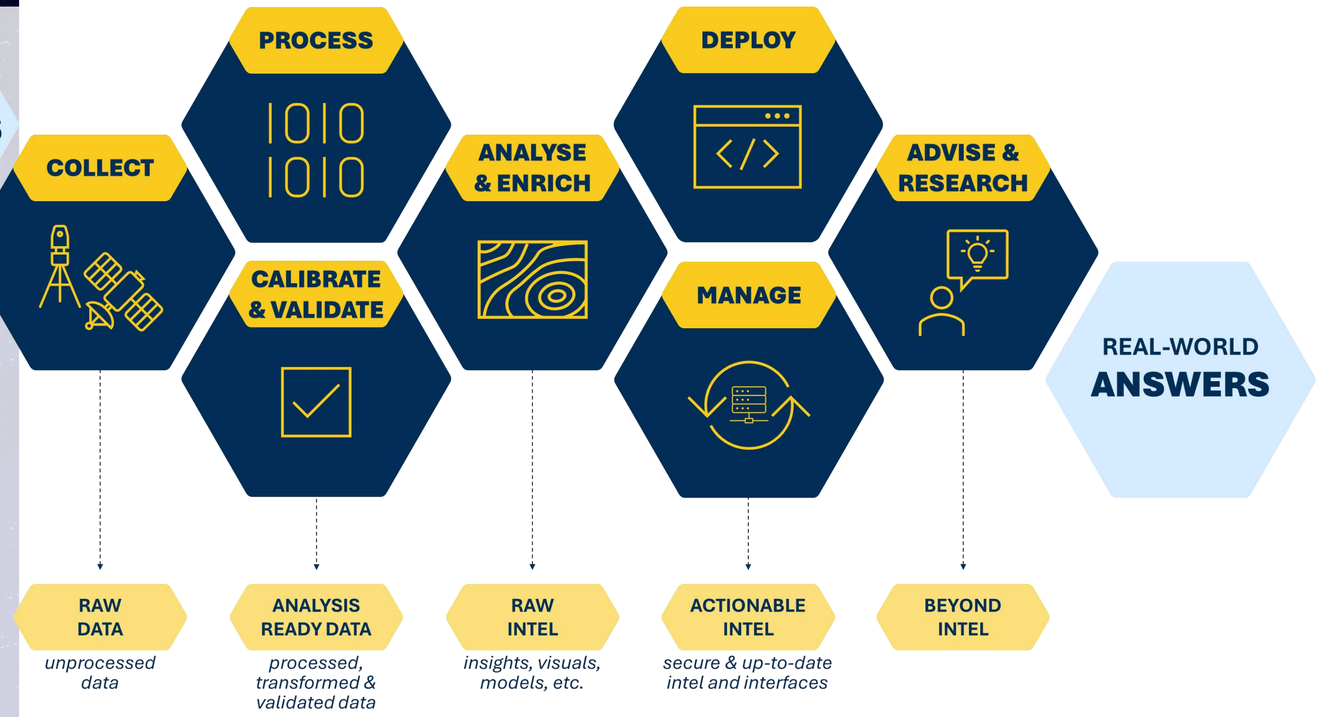
295
publications

40+
research domains

9
spin-offs

Year 2024

Earth Observation (EO) & Spatial Data @ VITO



Offering ***integrated solutions*** based on **expertise**
on environmental aspect (air, climate, land use, health), and
spatial data gathering, processing and modelling ***technologies***

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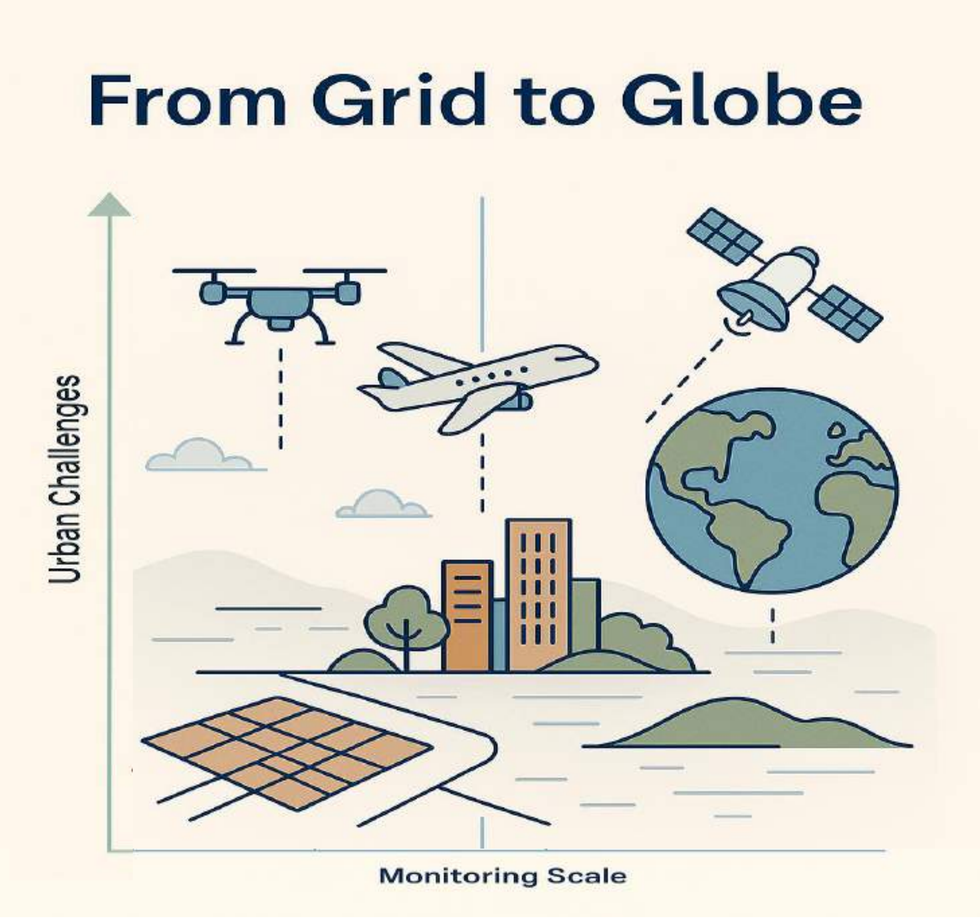
The Spatial & Temporal Extent of VITO's Environmental Intelligence



From Observing the Past to Shaping the Future

PAST	PRESENT	FUTURE
Remote Sensing Archives • Historical Satellite • Long-term Climate Datasets	Real-time EO & In-situ • Satellite / UAV Data • Sensor Networks • AI-driven Analytics	Predictive Environmental Models & Forecasts • Climate Scenarios • Policy Support Tools • Restoration Planning
Observe	Understand	Anticipate

Environmental Intelligence in Urban Challenges

Urban Growth: Land Use - Urbanisation - Spatial Planning

Climate Impact - Heat Stress

Air Quality

Waste Management

Awareness & Capacity

Underground Management

Flooding

Energy

Quick Question Before the Deep Dive

- Go to www.menti.com and use this code: **3912 2698**

Applications of EO by VITO

A. **Introduction VITO.**

B. **Deep Dive into Earth Observation (EO) & Spatial Analysis Tools for Urban Development.**

1. Urban Growth and Climate Impact (India)

2. Urban Services – Waste Management (Democratic Republic of Congo)

3. Urban Resilience and Risk Reduction – Flood Risk Management (Belgium, Vietnam, India, and China)

C. **Q&A Panel.**

Global Gateway

1. Urban Growth & Climate Impact (India)

- What is the urbanisation & climate challenge?
- What environmental modelling tools do we have available?
- Case study: Support tool for Indian cities
- Q&A

Karolien Vermeiren

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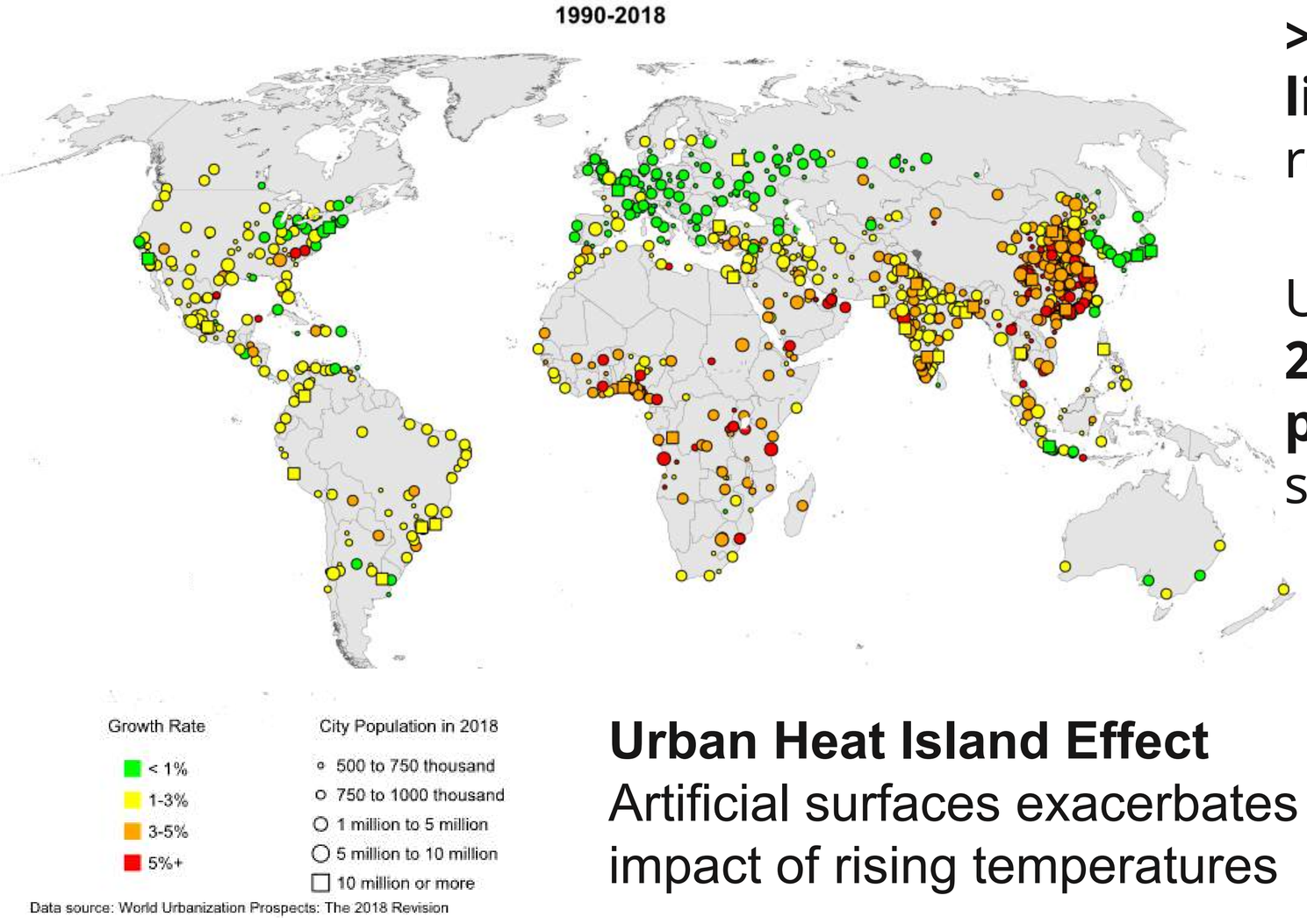
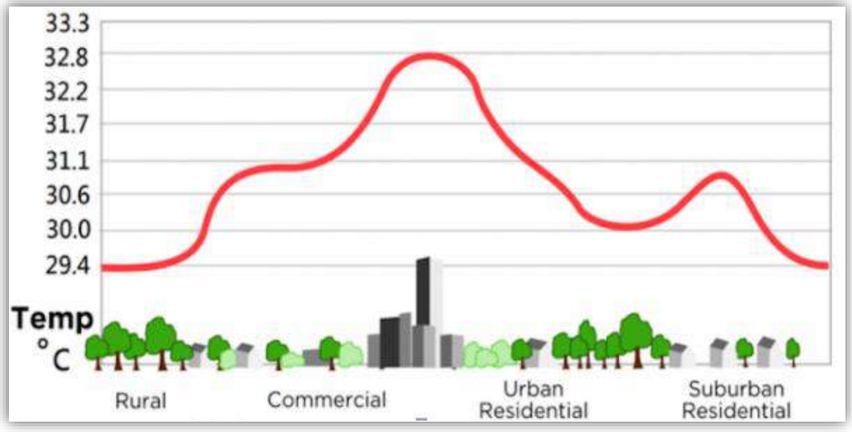
Urbanisation & Climate: a Dual Challenge



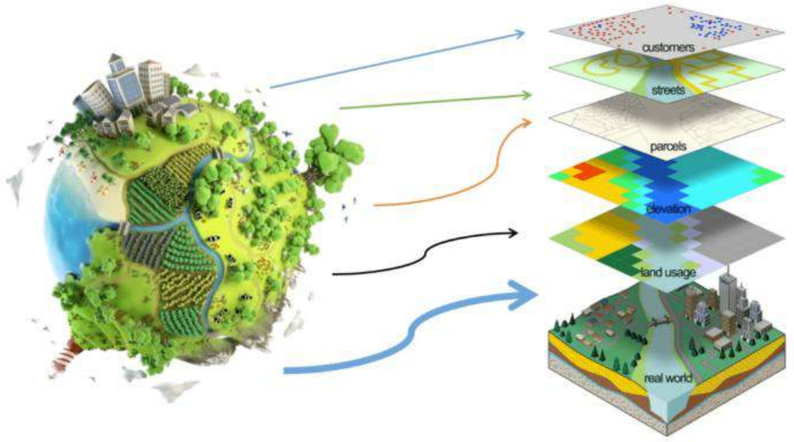
> 56% of the world's population lives in urban areas & is expected to reach **68% by 2050** (UN DESA, 2018).

Urban land expansion is **occurring at 2-3 times the rate of urban population growth**, mainly due to sprawl (Seto et al., 2012).

Urban Heat Island Effect
Artificial surfaces exacerbates the impact of rising temperatures



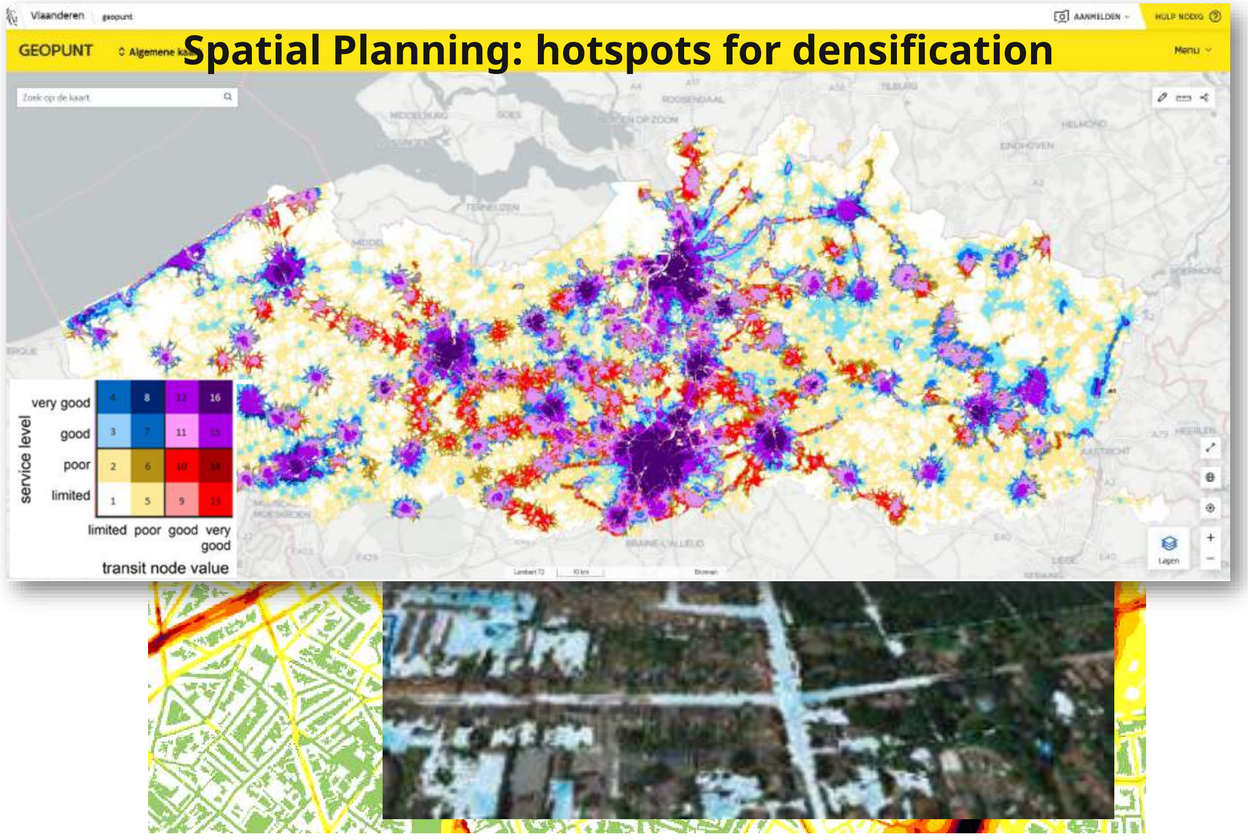
Environmental Modelling



Environmental Data - Geospatial Information

Land use, Water, Air, Climate & Geological Modelling
Ecosystem services and economic evaluation

Support Environment Policy



Reports (data/maps)
Viewers → visualize, search & analyse

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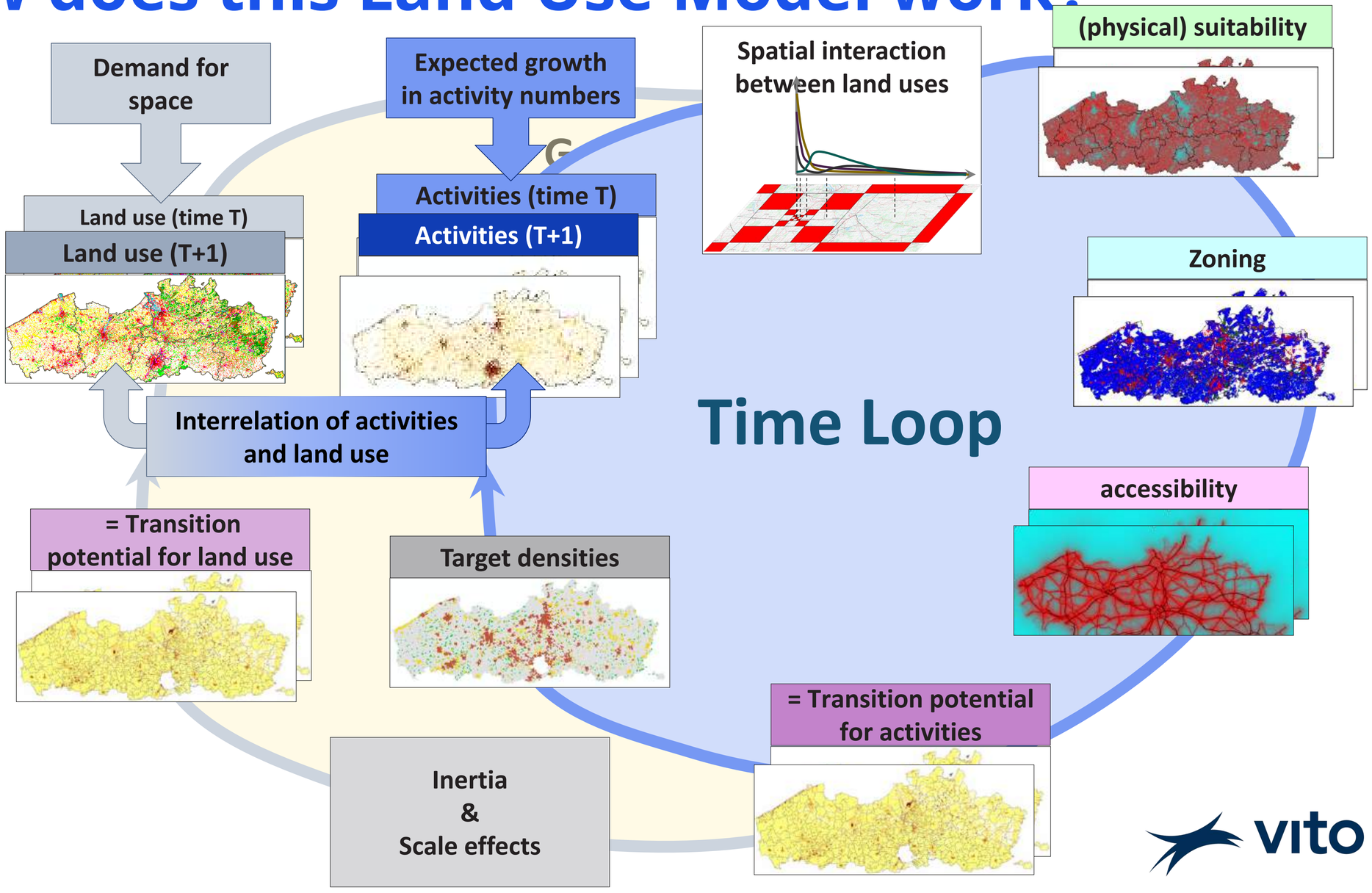
How does this Land Use Model work?

Required input:

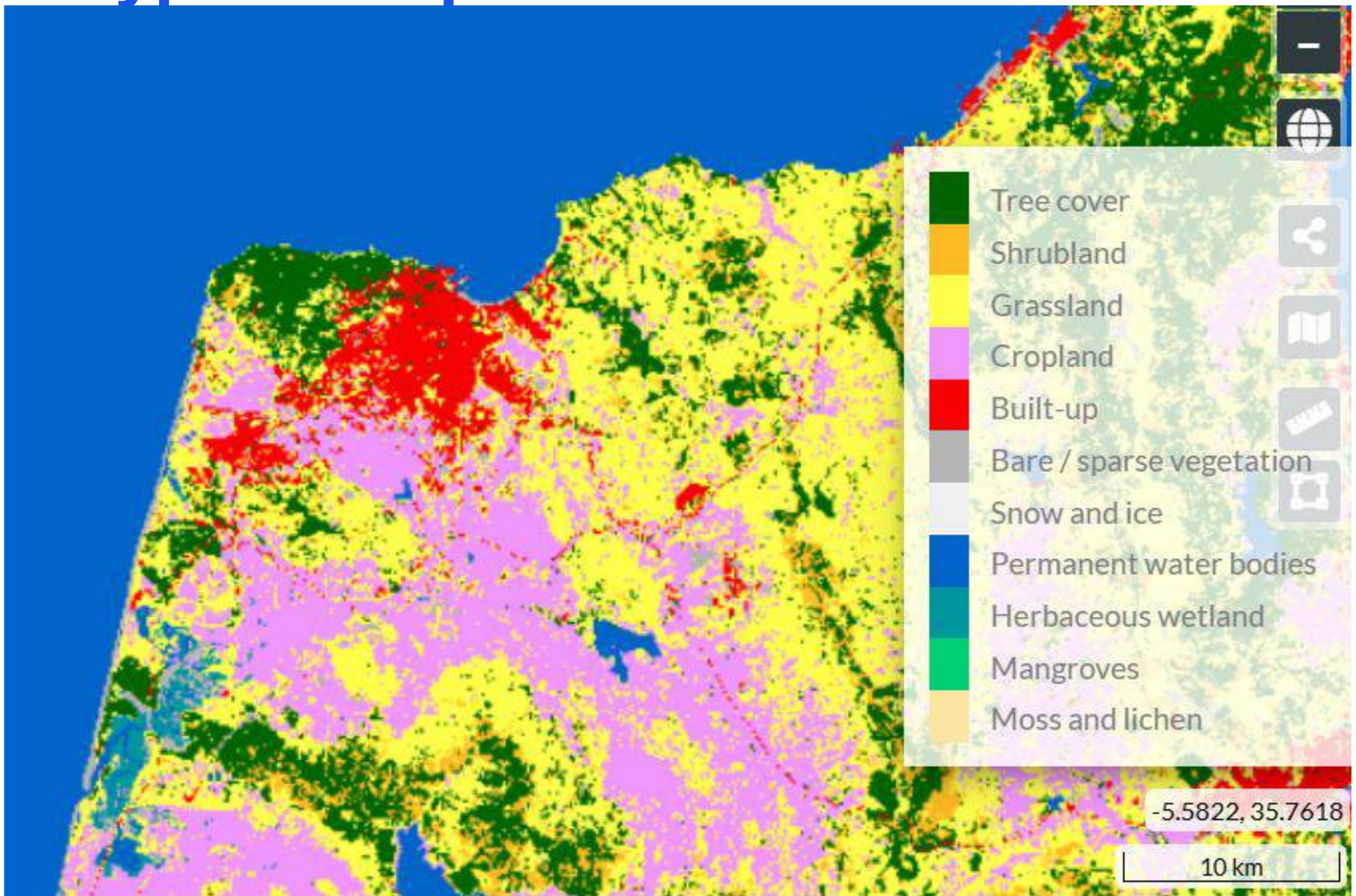
- Observed land use change trends derived from Copernicus historical data
- Expected demand for space & population
- Present land use (& population)



Types of Input: From Land Cover to Land Use

Type 1 land cover

Example: ESA World Cover



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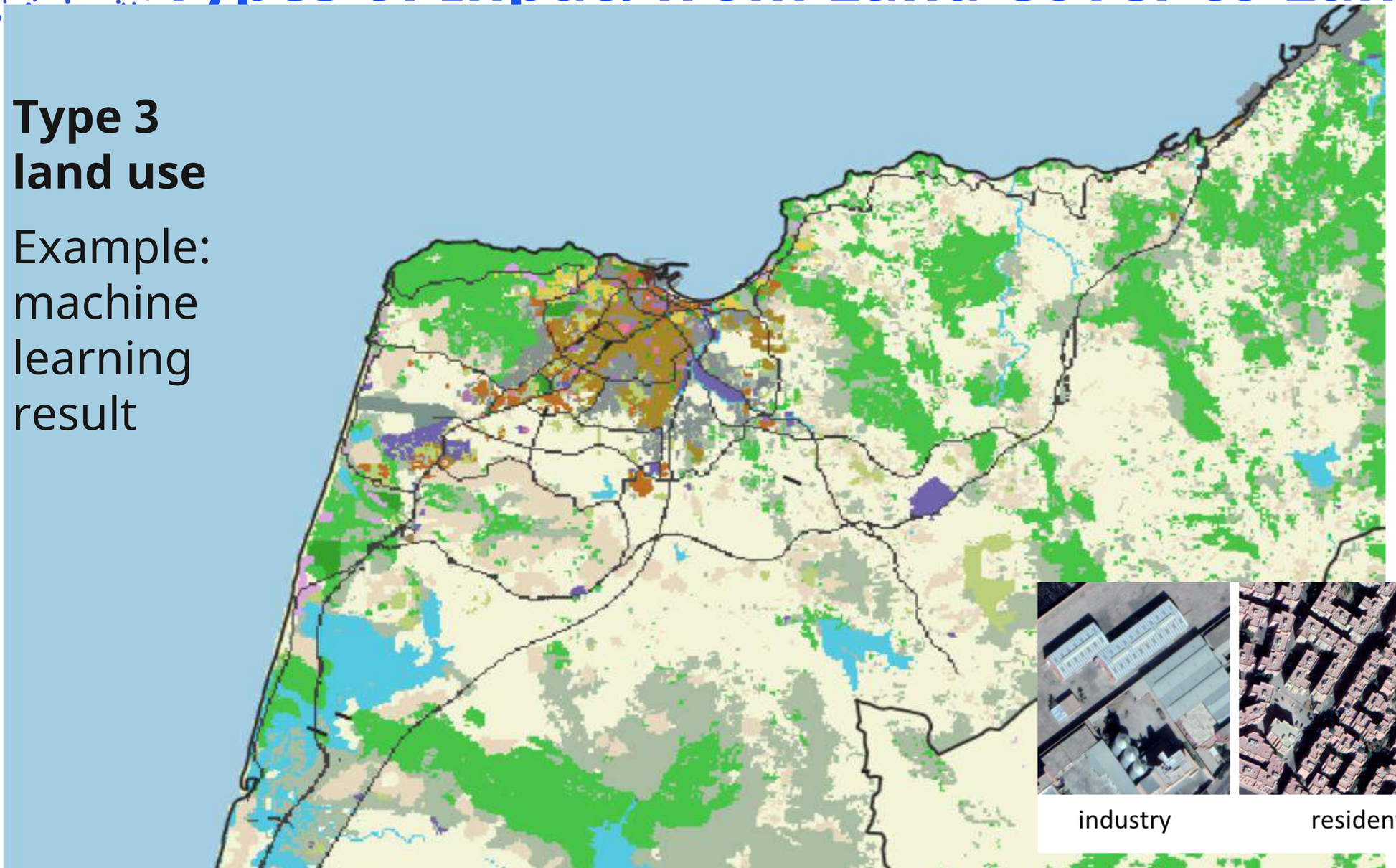
Types of Input: from Land Cover to Land Use

Type 3 land use

Example: machine learning result

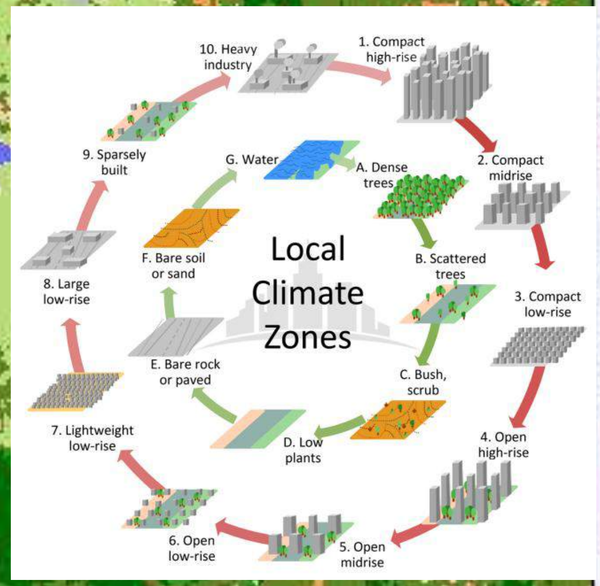


industry residential Villa's

Types of Input: from Land Cover to Land Use

Local Climate Zone
Wudapt Classification

35.9
35.8
35.7
35.6
35.5



Type 2
'in between' land cover – land use

Example: local climate zone map

- soil sand
- low plants
- bush scrub
- scattered trees
- dense trees
- water
- compact high-rise
- compact midrise
- compact low-rise
- open high-rise
- open midrise
- open low-rise
- lightweight low-rise
- large low-rise
- sparsely built
- heavy industry
- rock paved
- airport

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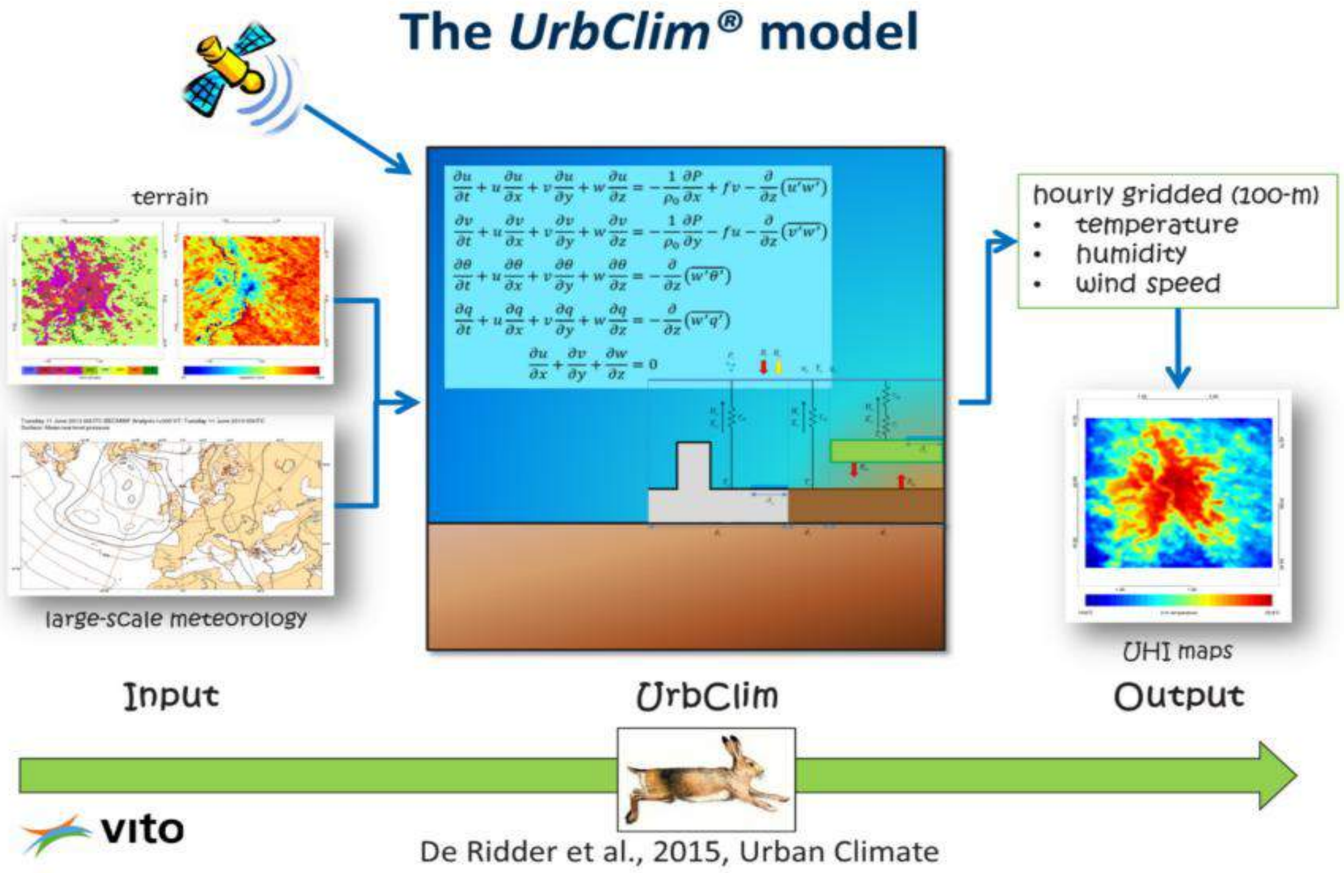
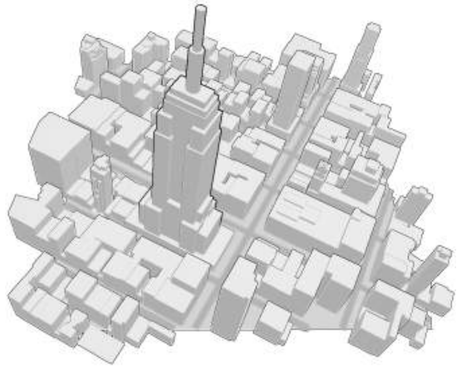
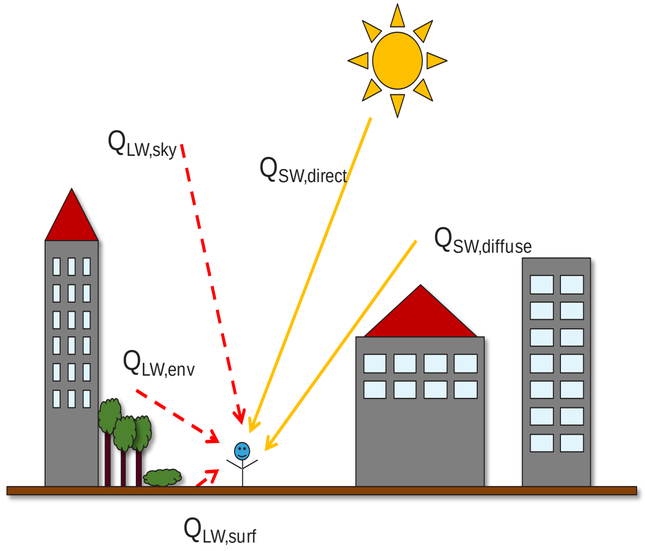
From Global to Local Information Using UrbCLIM® Model







URBAN CLIMATE SERVICE CENTRE

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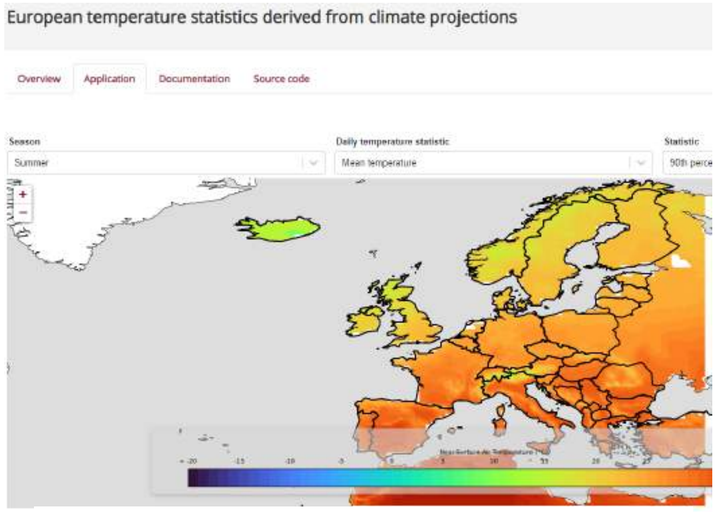
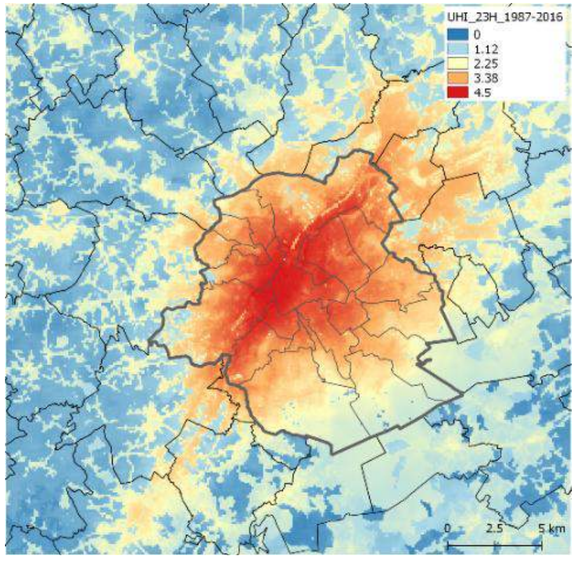
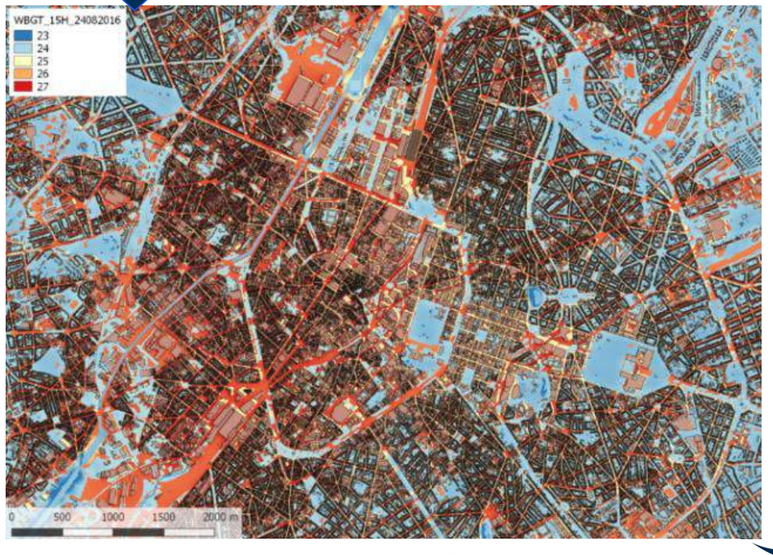
From Global to Local Information Using UrbCLIM® Model



10-30 km resolution



+-30 m resolution



1-2 m resolution

Climate services support the initiation, design, demonstration, and upscaling of urban solutions

URBAN CLIMATE SERVICE CENTRE

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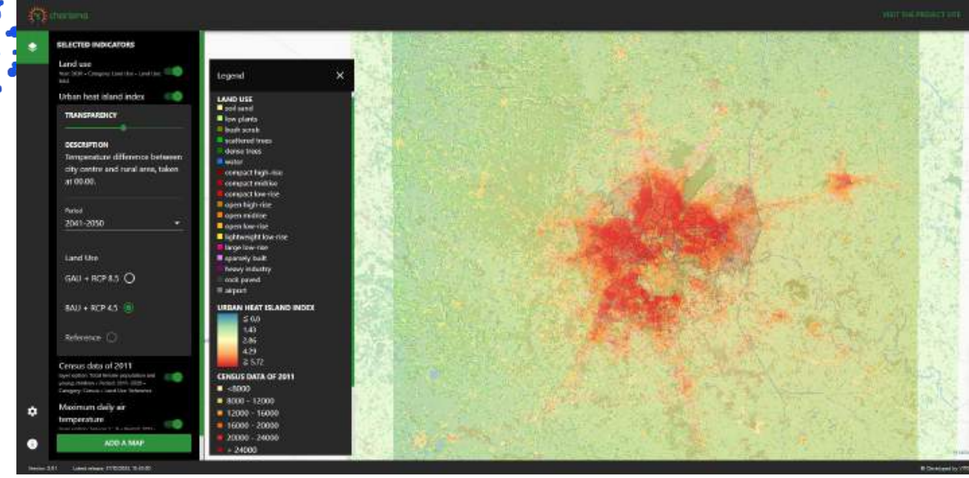
India Case Study

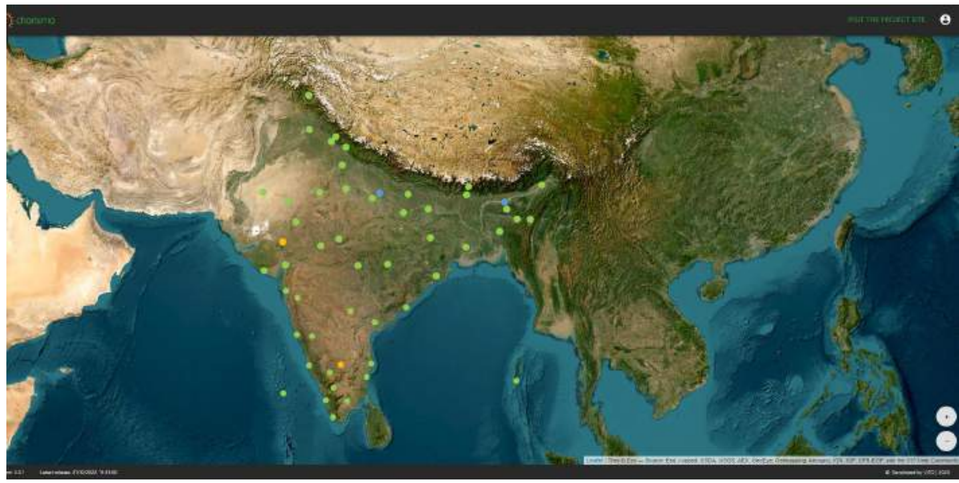
Facts & Challenges

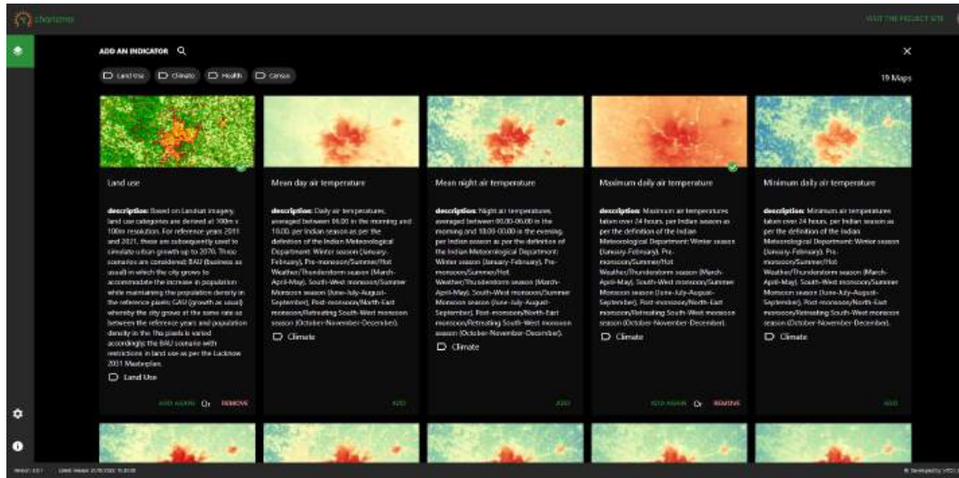
- Expected population growth by 2050 = **416 million urban dwellers** (UN World Urbanisation Prospects).
- Delhi, Mumbai, and Bangalore are among the world's most populous and fast-growing cities.
- Highly vulnerable to **climate-induced heatwaves**: urban areas reach life-threatening temperatures during pre-monsoon periods.
- Lack of reliable data.

Information Decision Support System

- Climate-health risk management in India with a focus on urban areas
  - Urbanisation
  - Heat stress
  - Health
- Funded by International Climate Financing through the Department of Environment (Flanders, Belgium)







Components & Timelines

Land Use

- Present at **100m resolution**
- Present at **30m resolution**
- Decadal **urban growth up to 2070**
- Present at 1m resolution (**3D**)
- Alternative urban growth scenarios

Land Use Statistics

Census

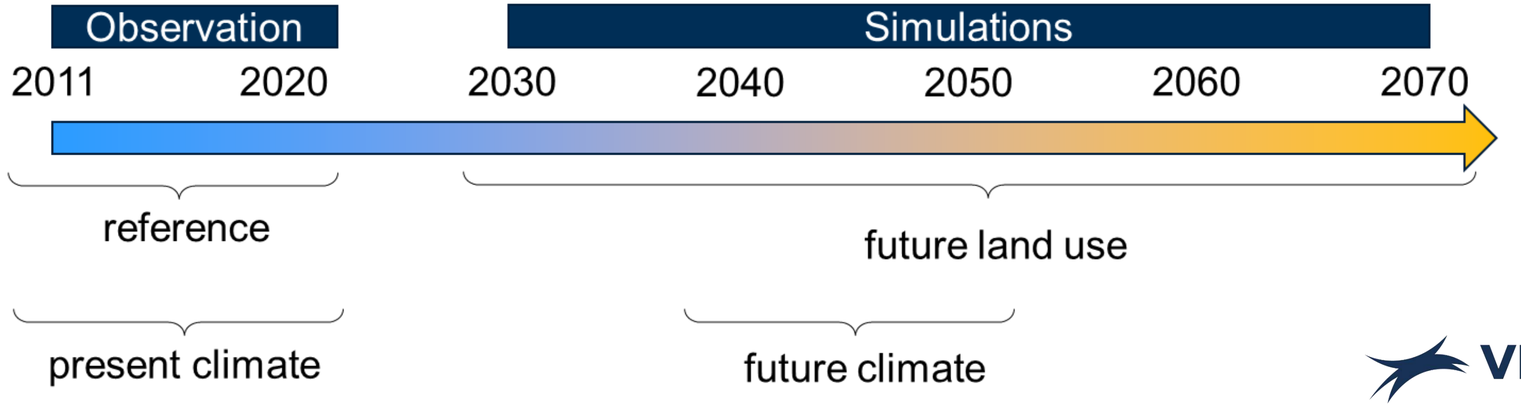
- 2011 Census data
- Ward limits

Climate

- **Derived** climate indicators, relevant for health impact at 100m resolution e.g. no. heatwaves, heatwave intensity, night temperatures
- Multiple **climate scenarios** (RCP4.5, RCP8.5)
- Multiple heatwave definitions
- Derived indicators relevant for heat stress
- **Thermal comfort** assessment at 30m resolution
- Illustrative thermal comfort assessment
  - at **1m resolution**,
  - for different times during the day,
  - with adaptive measures

Health

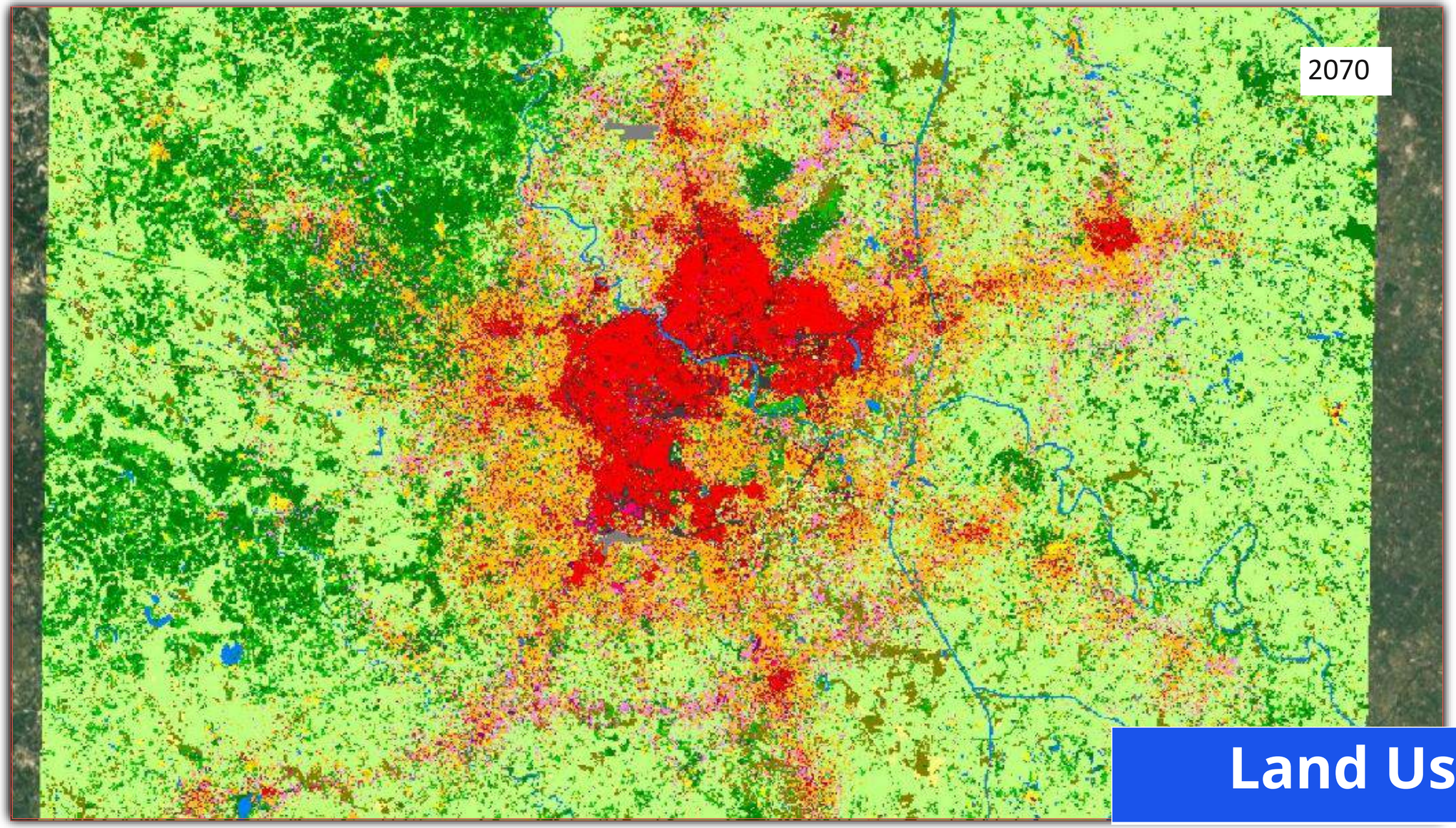
- **Heat vulnerability** index (cf. Azhar *et al.*, 2017, Int. J. Environ. Res. Public Health)
- **Relative Risk of Mortality** due to heatwaves (cf. Hales *et al.*, 2014, Word Health Organization report).
- **Loss of Labour** productivity due to heat stress
- **Thermal comfort** classification at 30m resolution
- **Dengue risk maps** present
- Assessment of influential parameters for dengue



vito

Results: Land Use Maps Past-Present-Future (2011-2070)

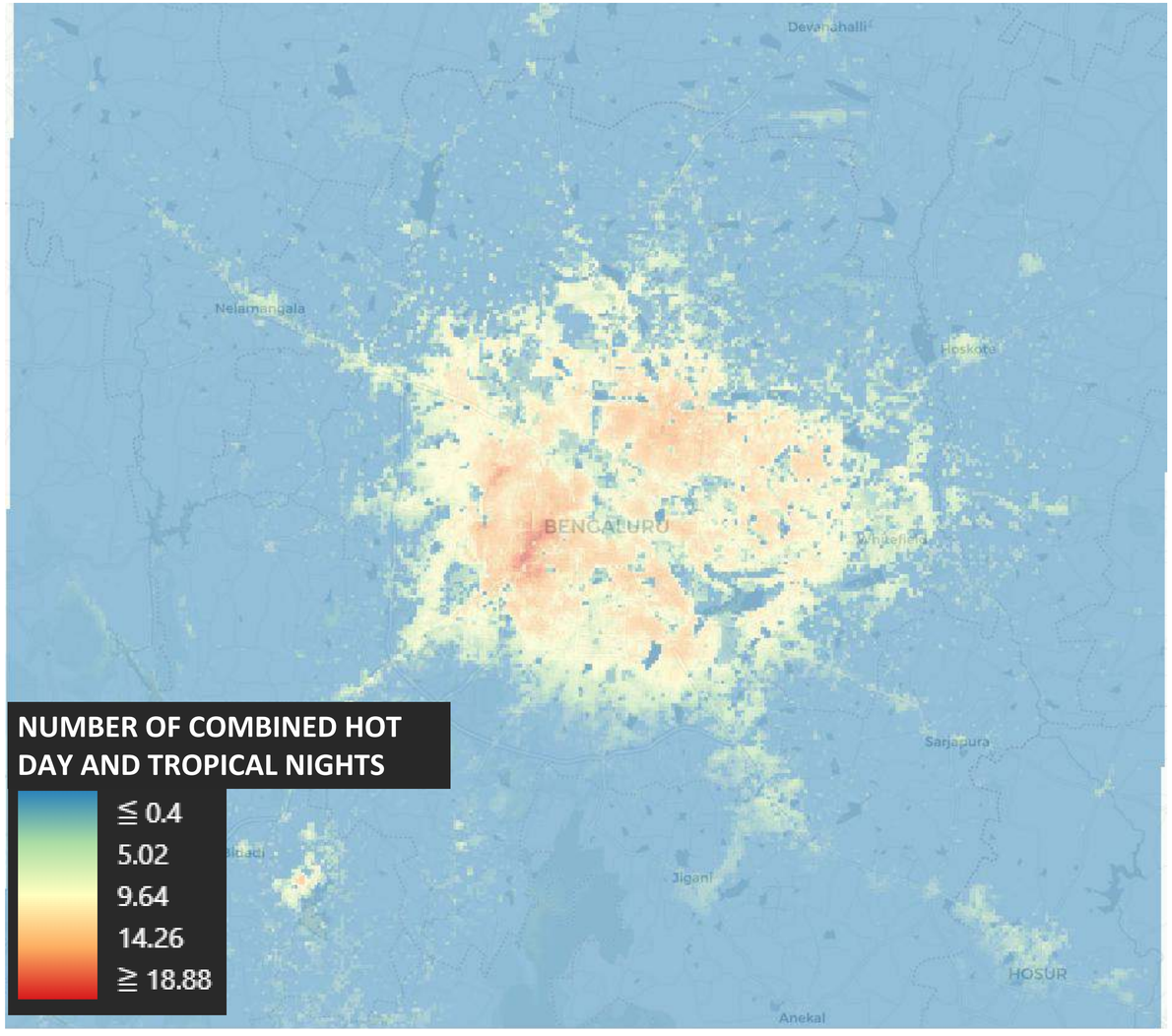
Lucknow



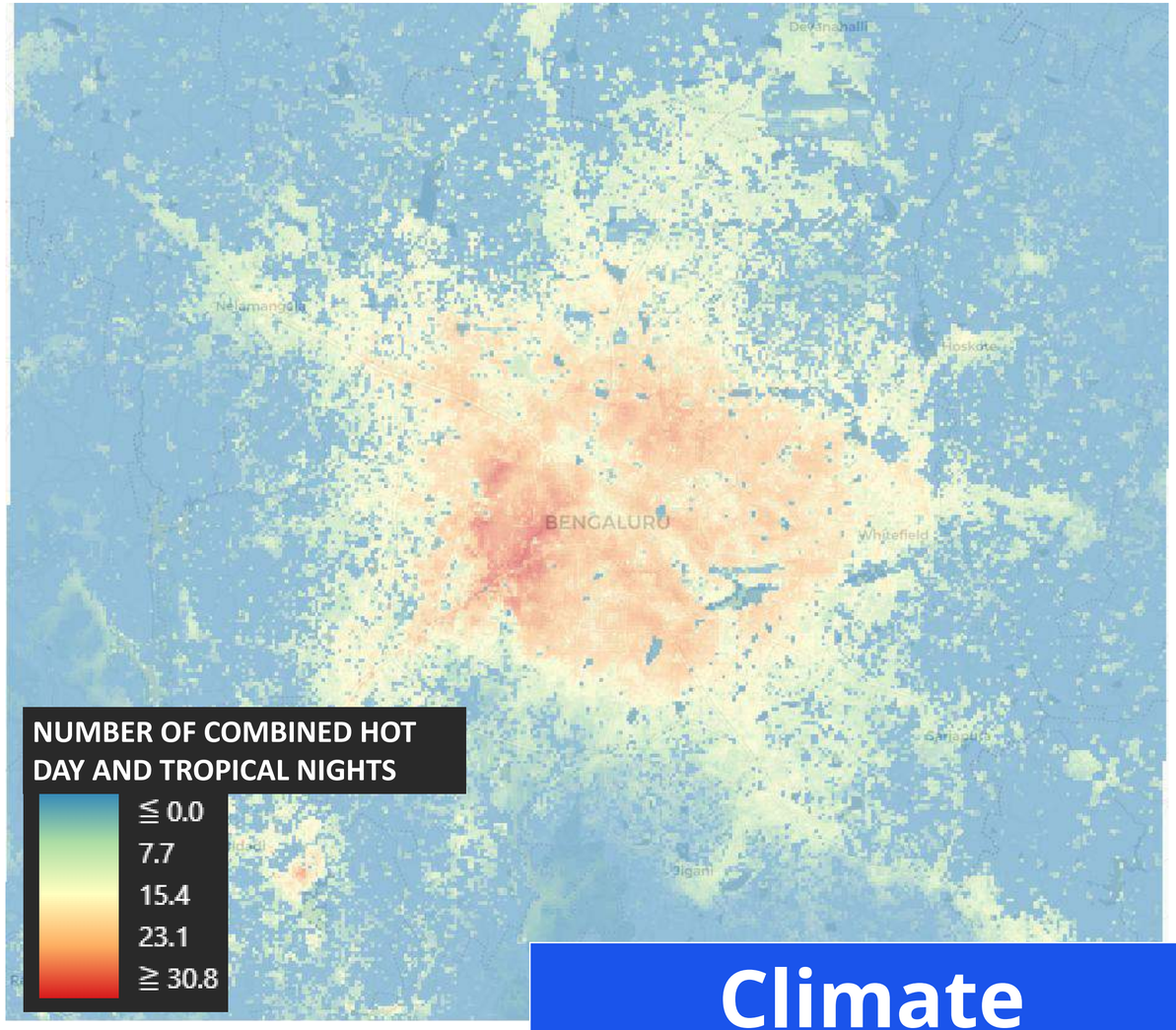
Land Use

Assess Urban Growth + Heat Stress Rise

2011



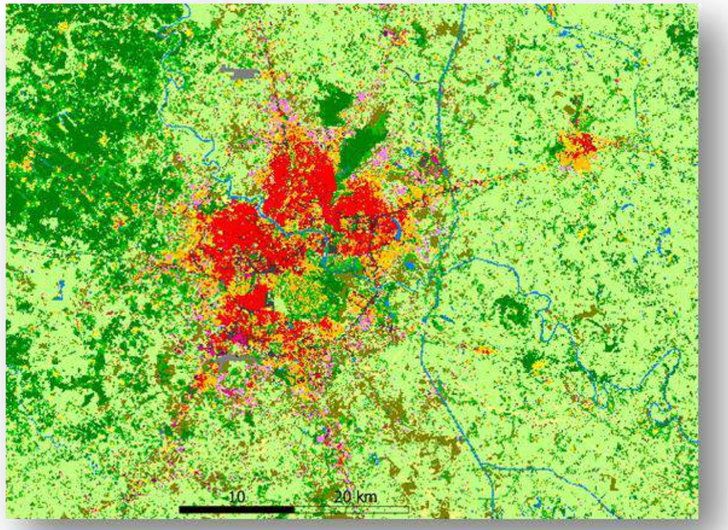
2050



Climate

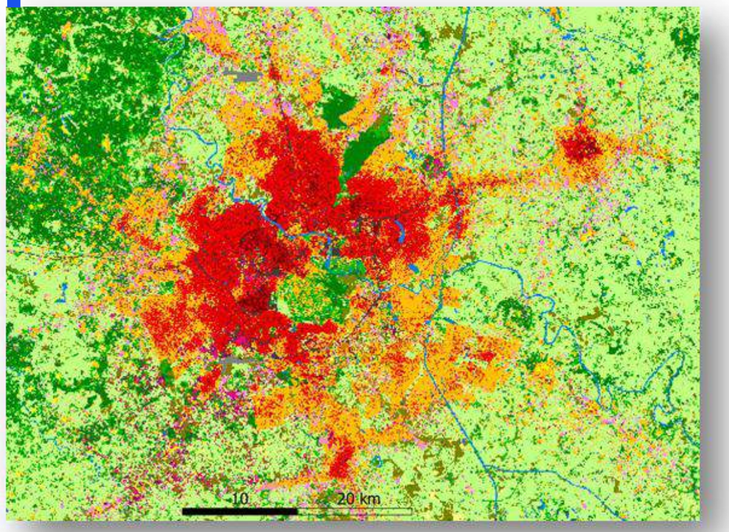
Using Models to Assess the Impact of Policy Measures

soil sand
low plants
bush scrub
scattered trees
dense trees
water
compact high-rise
compact midrise
compact low-rise
open high-rise
open midrise
open low-rise
lightweight low-rise
large low-rise
sparsely built
heavy industry
rock paved
airport



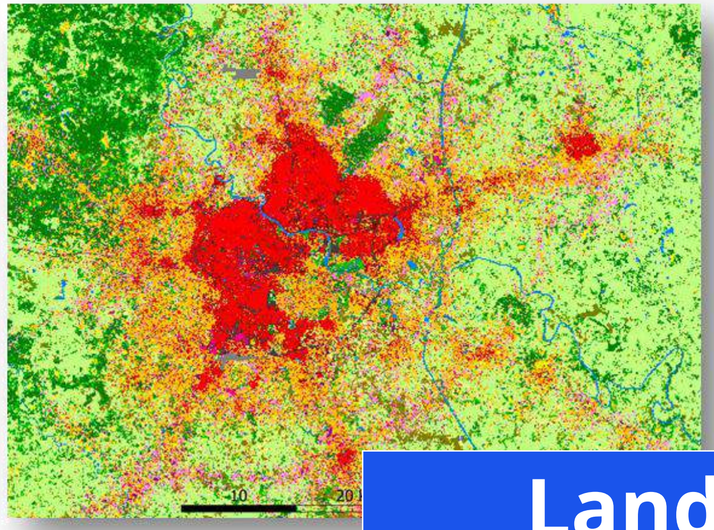
2021

Alternative Policy Scenario



2070

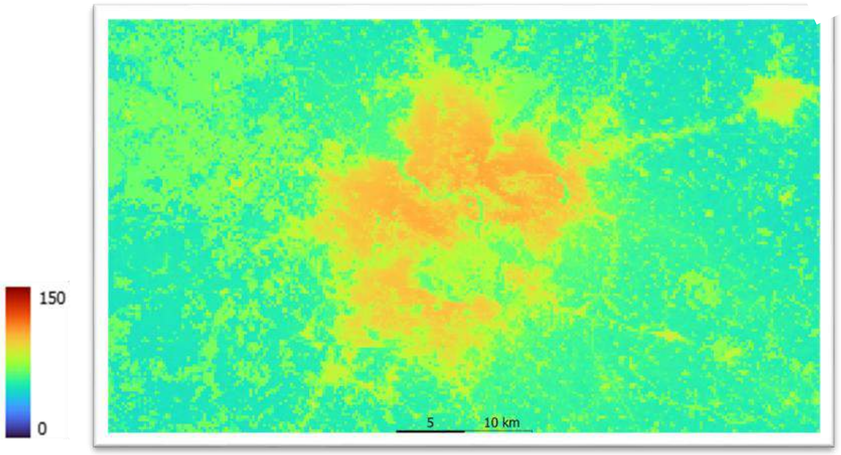
Business as Usual



Land Use

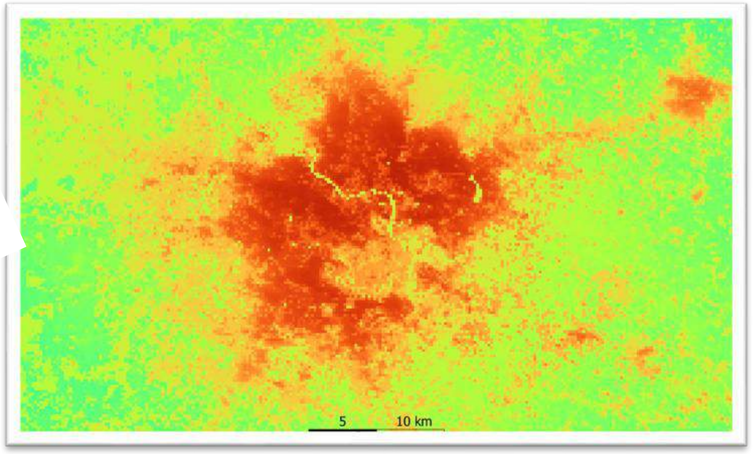
Land Use + Climate Modelling

Number of combined hot days (>35°C) and warm nights (>25°C)



2021

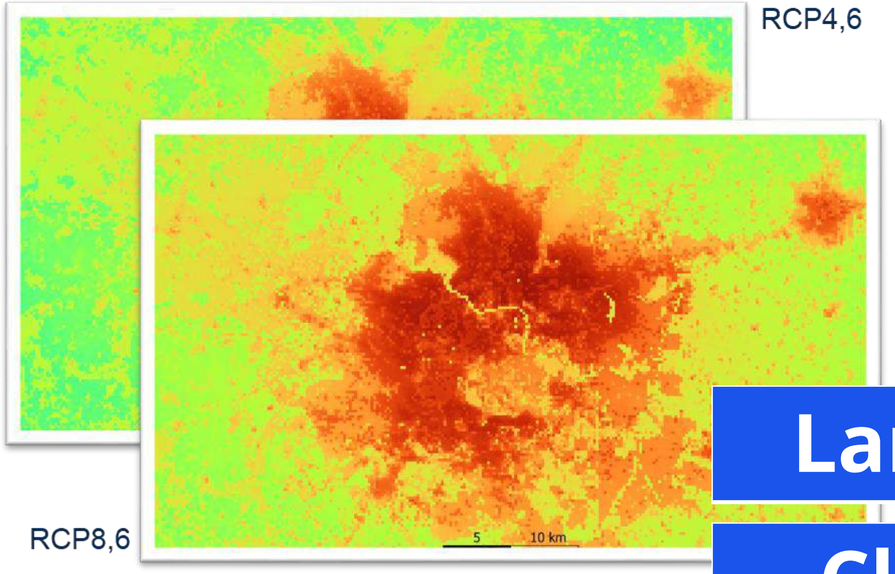
Alternative Policy Scenario



RCP4,6

Scenario

Business as Usual



RCP4,6

RCP8,6

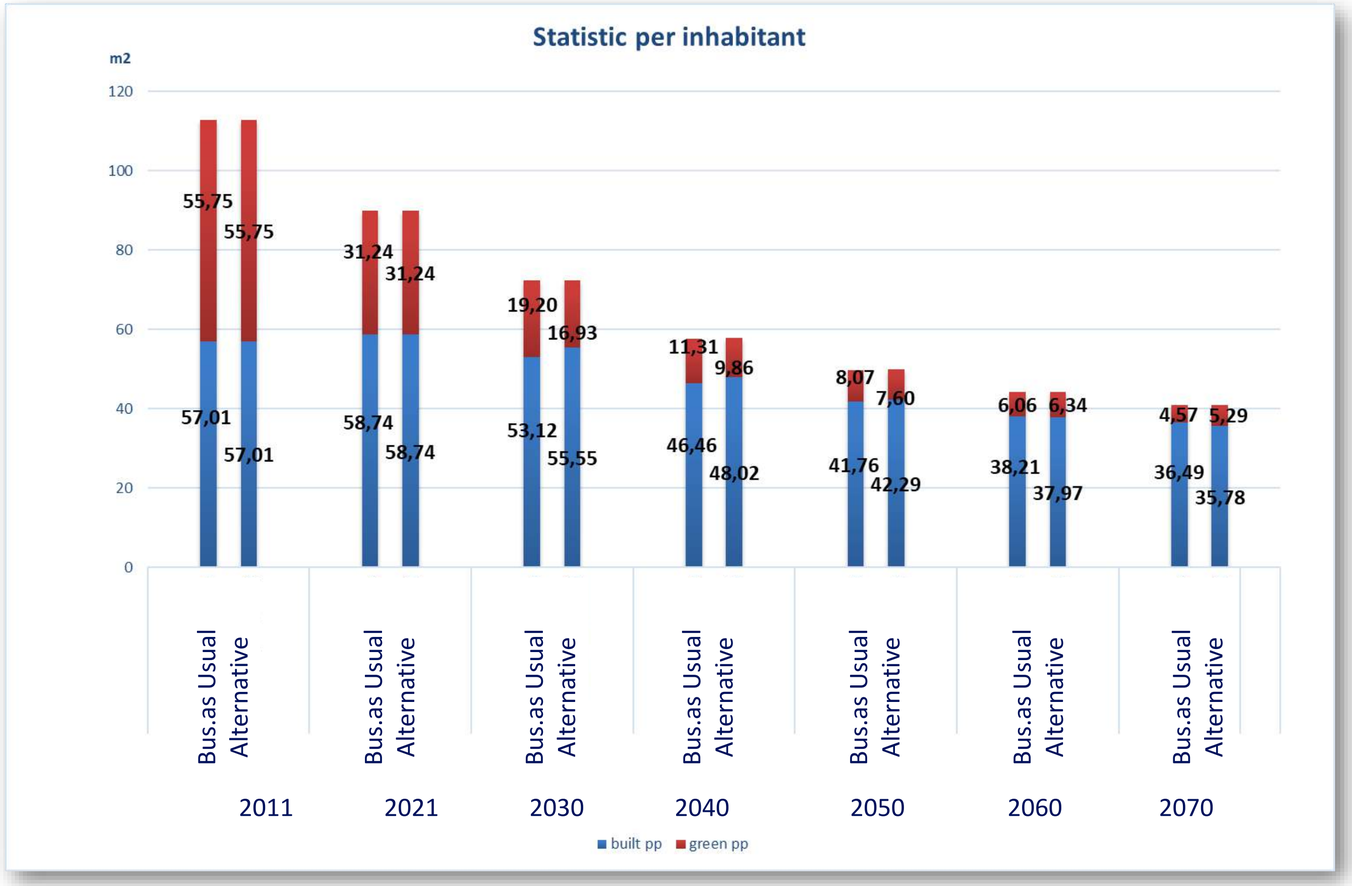
Present heat stress

Future heat stress

Land Use

Climate

Evaluate the Impact of Spatial Plans



Census | Land Use

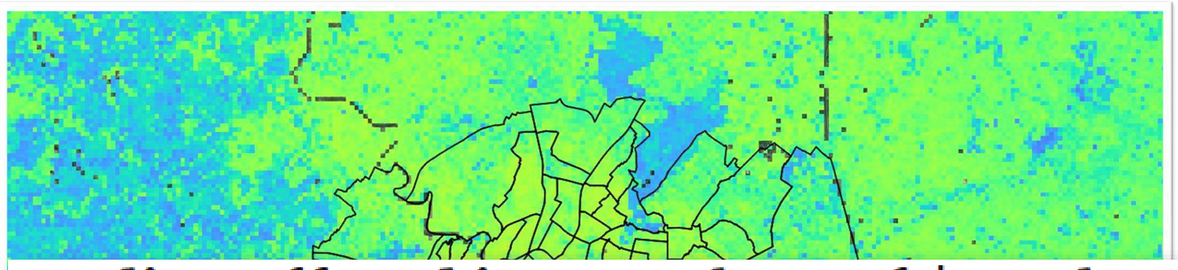
Census

Health

Where Data Becomes Powerful

Loss of working hours due to heat stress (moderate work)

2021



India suffered income loss of $159 bn due to extreme heat in 2021: Report

Heat exposure in the country led to the loss of 167 billion potential labour hours, a 39 per cent increase from 19901999, said the Climate Transparency Report 2022

Press Trust of India | New Delhi

2050

India facing highest labour work hour loss due to heat stress: Study

By Jayashree Nandi, Hindustan Times, New Delhi

Dec 15, 2021 04:54 AM IST

Heat exposure of labourers is linked to many health impacts, including early death; injures at the workplace; death from heat-related illness; and acute kidney damage

India To Report 34 Million Job Losses Due To Severe Heat Waves By 2030: World Bank

World Bank has given an ominous warning for India stating that it will soon be one of the first countries that will experience severe heatwaves to the intensity capable enough to break the human survivability limit.

Updated: December 7, 2022 5:38 PM IST

By Shrimansi Kaushik | Edited by Shrimansi Kaushik

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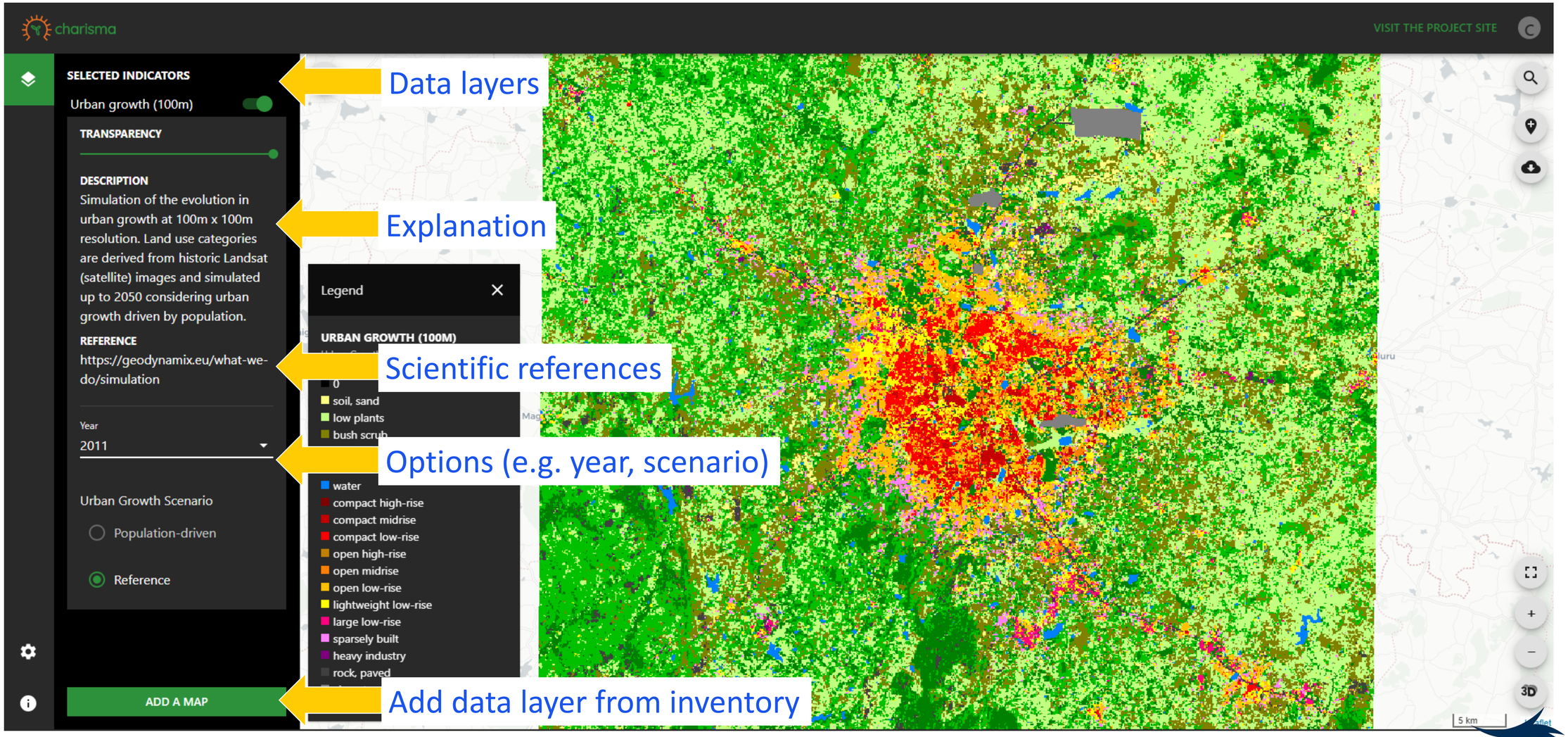
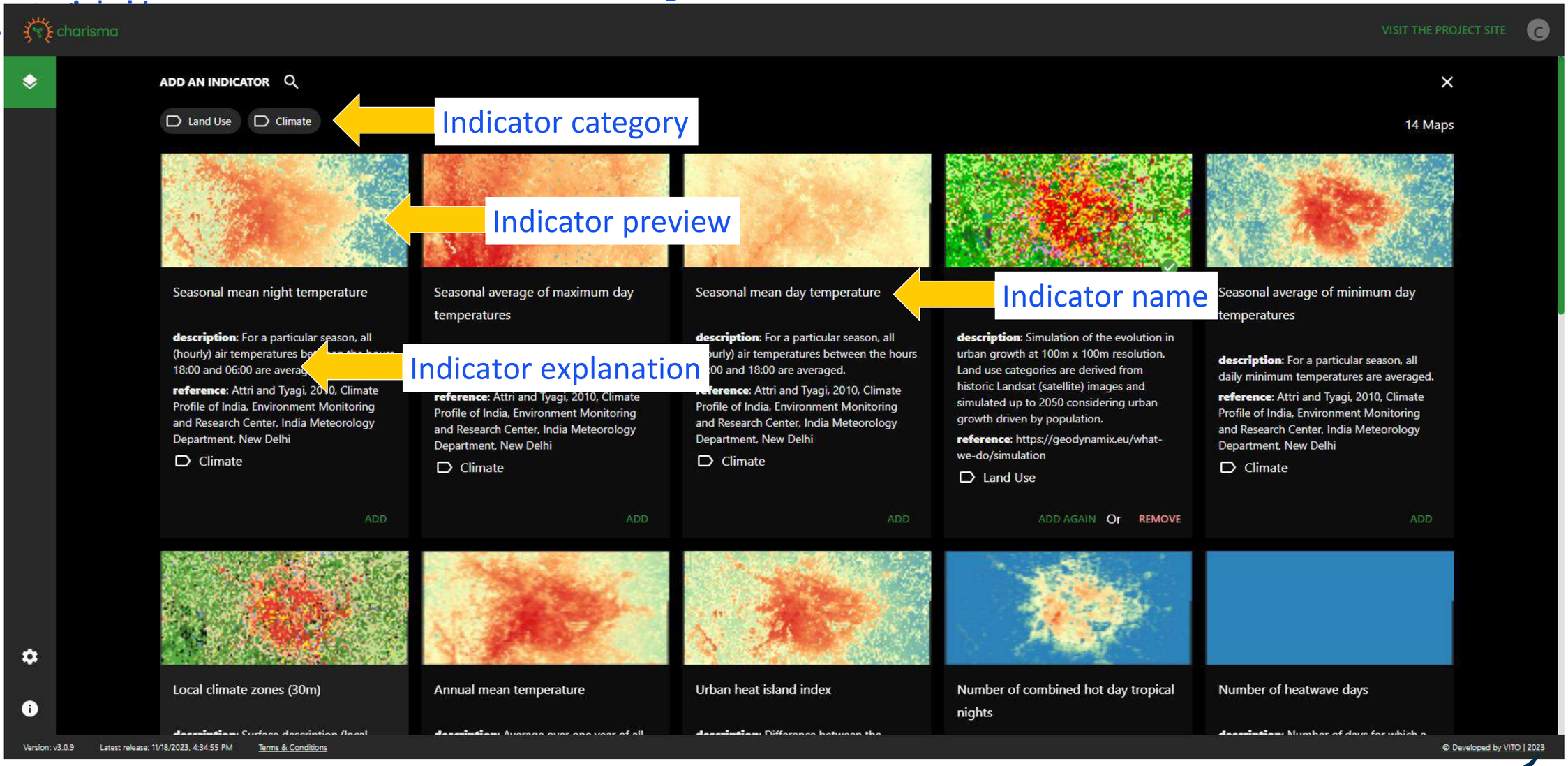
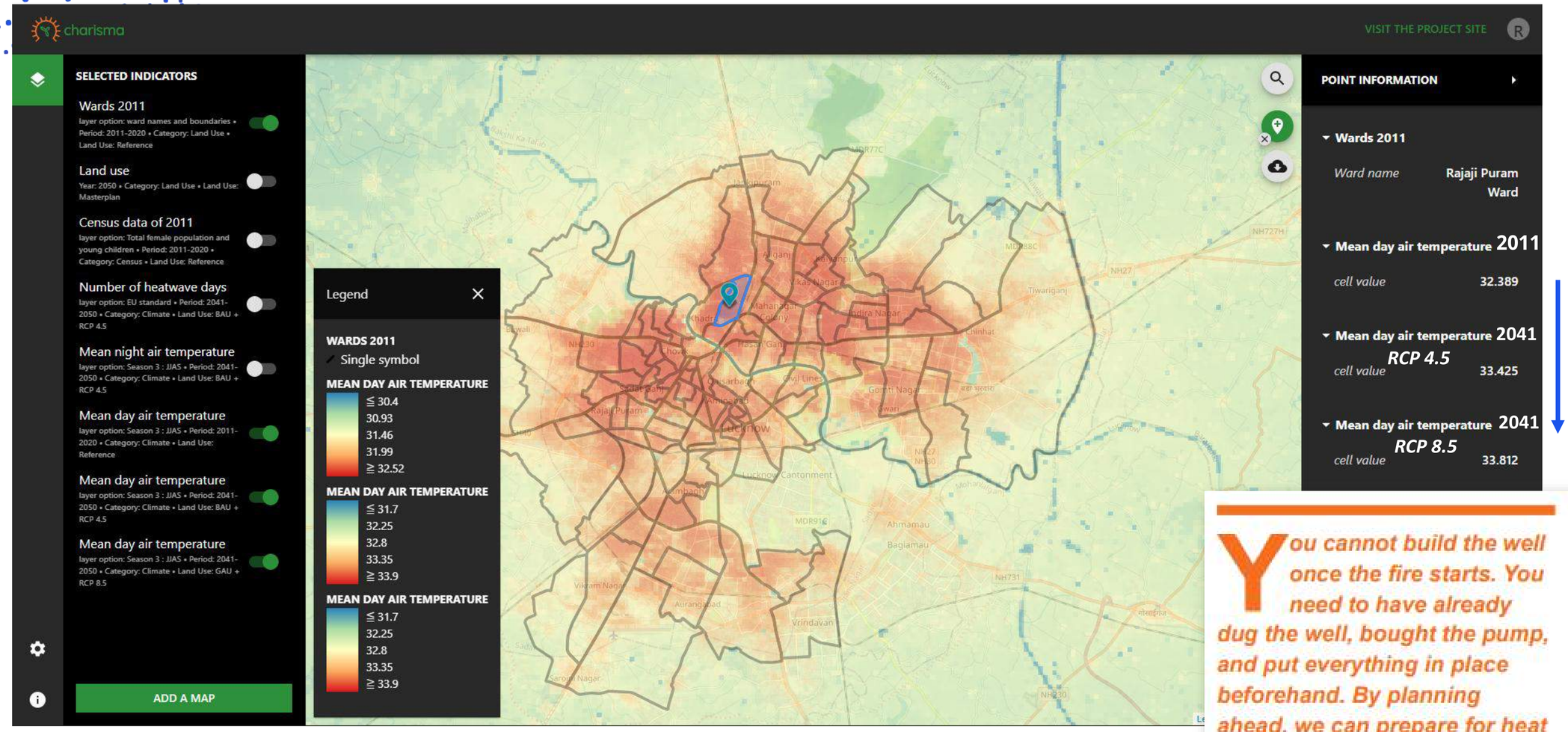
Resulting Geospatial Decision-Support Tool for Indian Cities



Data Inventory



Interactive Features



Mean

+1,0°C

+1,5°C

- Shelter
- Cool spots
- Provision of water
- Cooling of hospitals
- Health centres
- Etc.

You cannot build the well once the fire starts. You need to have already dug the well, bought the pump, and put everything in place beforehand. By planning ahead, we can prepare for heat waves before they hit and save many more lives.

– Dr Dileep Mavalankar, Dean of the Indian Institute of Public Health, Gandhinagar

Health Impact

Wards where women and children are exposed to higher night temperatures

charisma

SELECTED INDICATORS

Wards 2011
layer option: ward names and bc
Period: 2011-2020 • Category: La
Land Use: Reference

Land use
Year: 2050 • Category: Land Use • Land Us
Masterplan

Census data of 2011
layer option: Total female population and young children • Period: 2011-2020 • Category: Census • Land Use: Reference

Mean night air temperature
layer option: Season 1 : JF • Period: 2011-2020 • Category: Climate • Land Use: Reference

Mean day air temperature
layer option: Season 1 : JF • Period: 2011-2020 • Category: Climate • Land Use: Reference

ADD A MAP

Nighttime temperature and human sleep loss in a changing climate

NICK OBRADOVICH, ROBYN MIGLIORINI, SARA C. MEDNICK, AND JAMES H. FOWLER Authors Info & Affiliations

SCIENCE ADVANCES • 26 May 2017 • Vol 3, Issue 5 • DOI: 10.1126/sciadv.1601555

Articles

The effects of night-time warming on mortality burden under future climate change scenarios: a modelling study

Cheng Hu, Ho Kim, Masahiro Hashizume, Whanhee Lee, Yasushi Honda, Sathyel Estella Kim, Patrick L Kinney, Alexandra Schneider, Yuqiang Zhang, Yiming Zhu, Lu Zhao, Renjie Chen, Haidong Kan

Summary

Background The health impacts of climate warming are usually quantified based on daily average temperatures. However, extra health risks might result from hot nights. We project the future mortality burden due to hot nights.

Methods We selected the hot night excess (HNE) to represent the intensity of night-time heat, which was calculated as the excess sum of high temperature during night time. We collected historical mortality data in 28 cities from three east Asian countries, from 1981 to 2010. The associations between HNE and mortality in each city were firstly examined using a generalised additive model in combination with a distributed lag non-linear model over lag 0–10 days. We then pooled the cumulative associations using a univariate mesa-regression model as the national or regional levels. Historical and future hourly temperature series were projected under two scenarios of greenhouse-gas emissions from 1980–2099, with ten general circulation models. We then projected the attributable fraction of mortality due to HNE under each scenario.

Findings Our datasets comprised 28 cities across three countries (Japan, South Korea, and China), including 9 185 598 deaths. The time-series analyses showed the HNE was significantly associated with increased mortality risks, the relative mortality risk on days with hot nights could be 50% higher than on days with non-hot nights. Compared with the rise in daily mean temperature (lower than 20%), the frequency of hot nights would increase more than 30% and the intensity of hot night would increase by 50% by 2100s. The attributable fraction of mortality due to hot nights was projected to be 3·68% (95% CI 1·20 to 6·17) under a strict emission control scenario (SSP126). Under a medium emission control scenario (SSP245), the attributable fraction of mortality was projected to increase up to 5·79% (2·07 to 9·52), which is 0·95% (–0·39 to 2·29) more than the attributable fraction of mortality due to daily mean temperature.

Interpretation Our study provides evidence for significant mortality risks and burden in association with night-time warming across Japan, South Korea, and China. Our findings suggest a growing role of night-time warming in heat-related health effects in a changing climate.

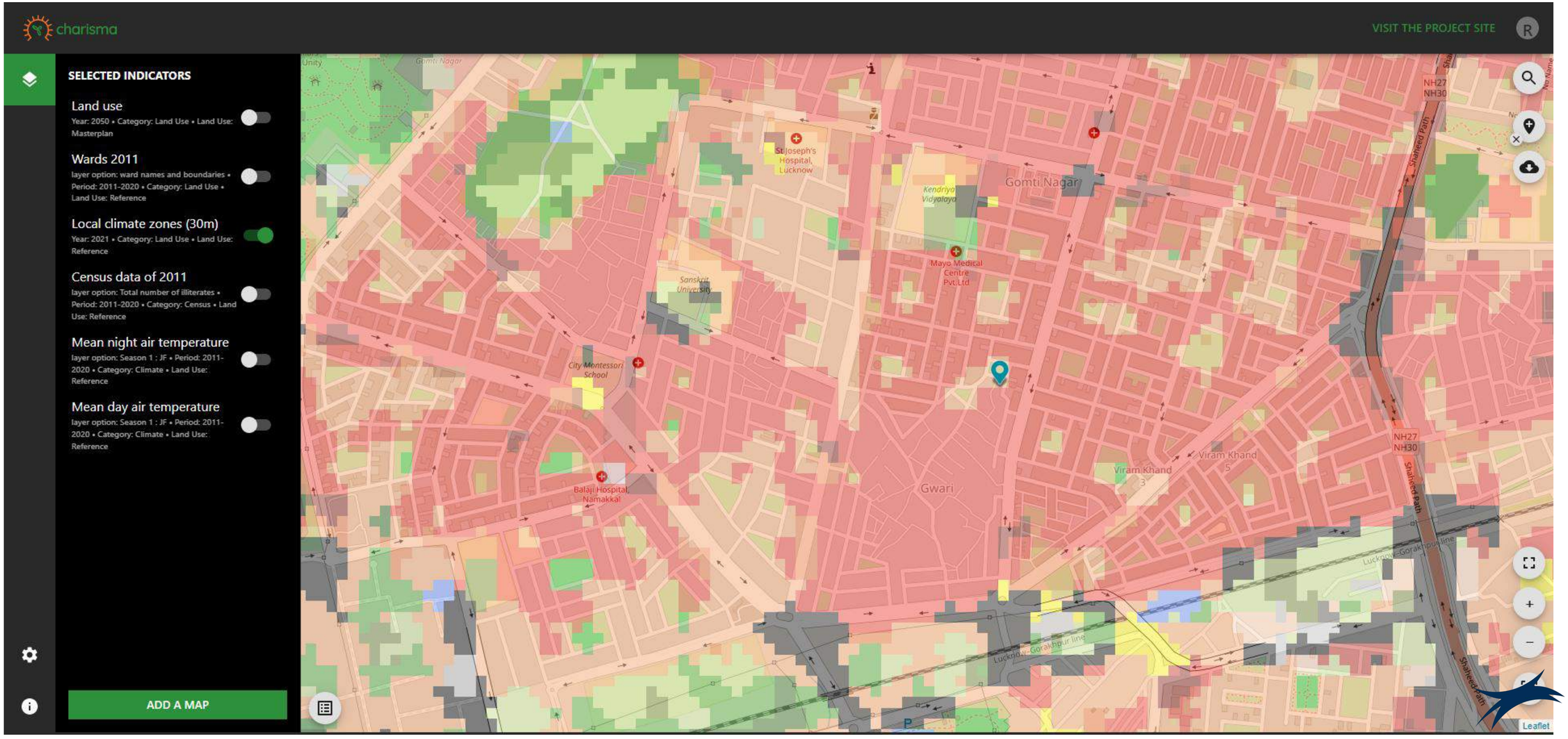
Funding The National Natural Science Foundation of China, Shanghai International Science and Technology Partnership Project.

Lancet Planet Health 2022; 6: e648–57

School of Public Health, Shanghai Institute of Infectious Disease and Biosecurity, Key Lab of Public Health Safety of the Ministry of Education and NHC Key Lab of Health Technology Assessment, Fudan University, Shanghai, China (C He PhD, Y Zhu MS, L Zhao MS, Prof R Chen PhD, Prof H Kan PhD); Department of Biostatistics and Epidemiology, Graduate School of Public Health, Seoul National University, Seoul, Republic of Korea (Prof H Kim PhD); Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan (Prof M Hashizume PhD); Department of Environmental Medicine, College of Medicine (W Lee PhD), Institute of Ewha-SCI for Environmental Health, College of Medicine (W Lee), Ewha Womans University, Seoul, South Korea; Center for Climate Change Adaptation, National Institute for Environmental Studies, Tsukuba, Japan (Prof Y Honda PhD); Prof S E Kim PhD); Faculty of Health and Sport Sciences, University of Tsukuba, Tsukuba, Japan (Prof Y Honda, Prof S E Kim); School of Public Health, Boston University, Boston, MA, USA (Prof P L Kinney PhD); Institute of Epidemiology, Helmholtz Zentrum München – German Research Center for Environmental Health GmbH), Neuherberg, Germany (Prof A Schneider PhD); Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Durham, NC, USA (Y Zhang PhD); Children's Hospital of Fudan University, National Center for Children's Health, Shanghai, China (Prof H Kan)

Adaptation Planning

Where and how can we act?



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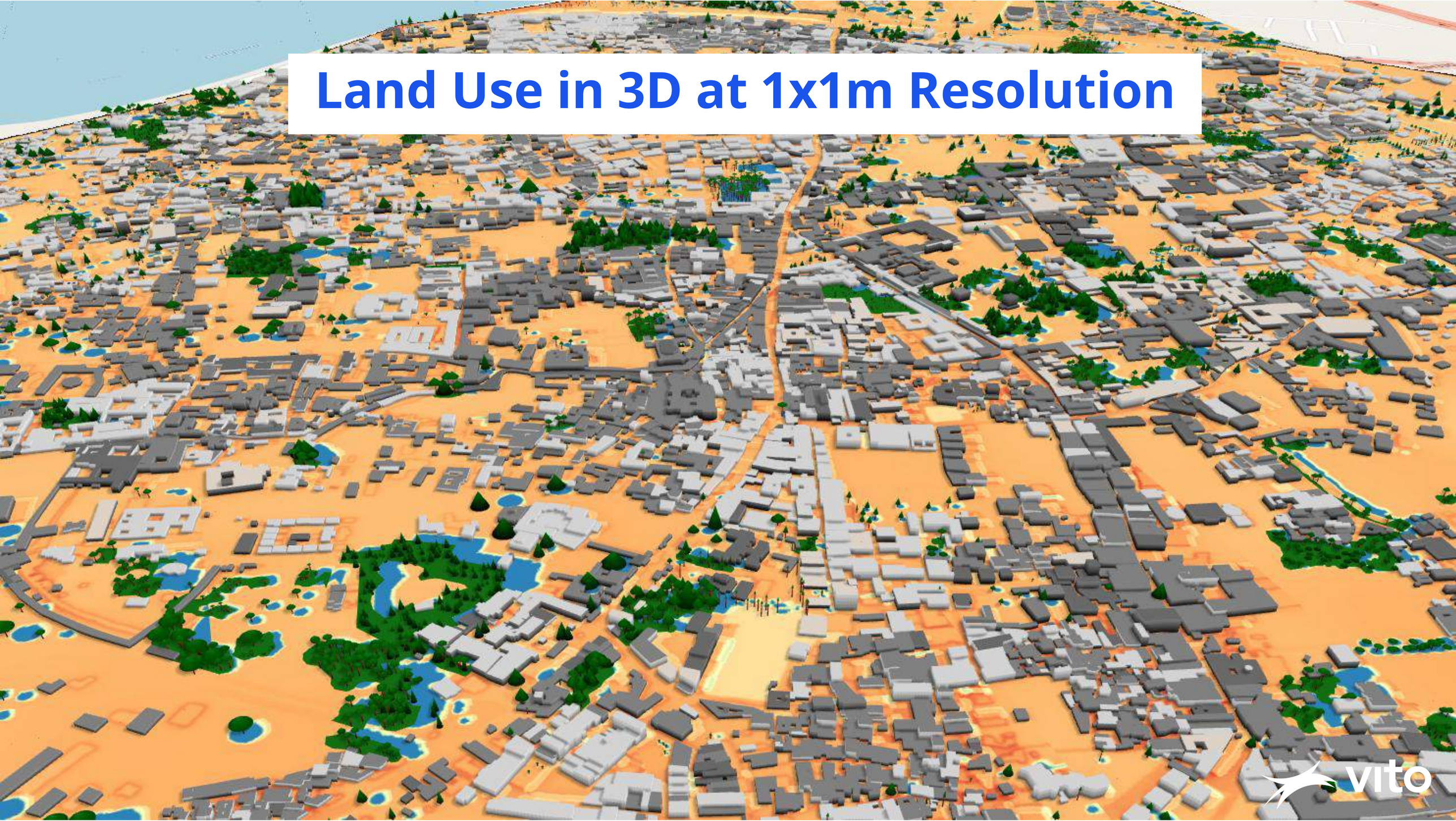
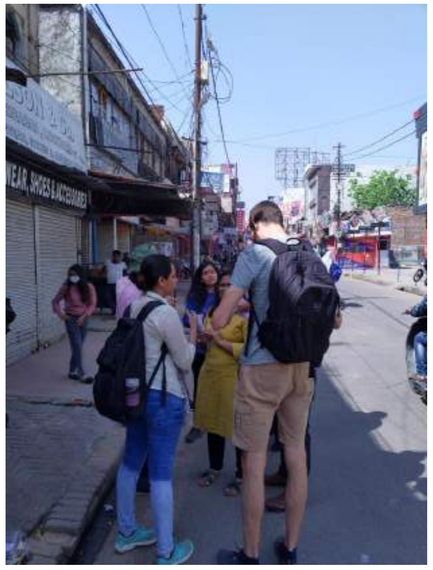
Land Use in 3D at 1x1m Resolution



Capacity Building

Urban field visits

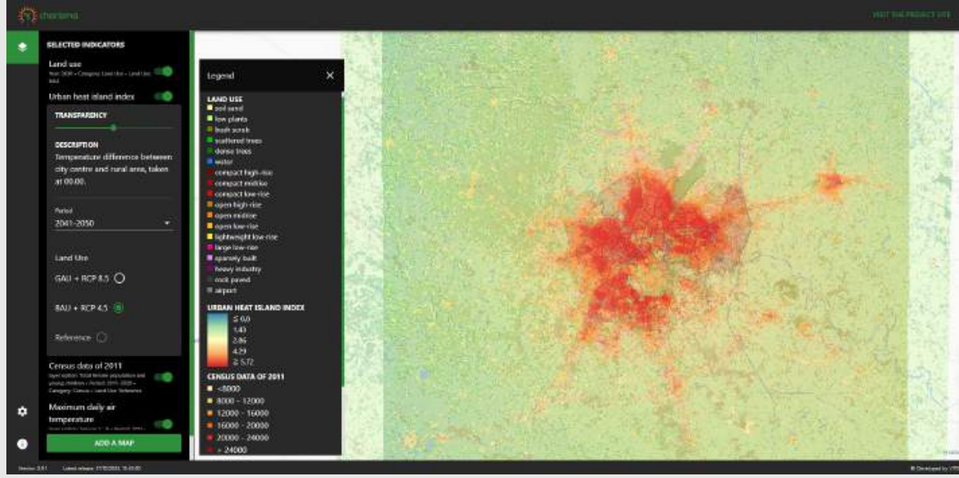


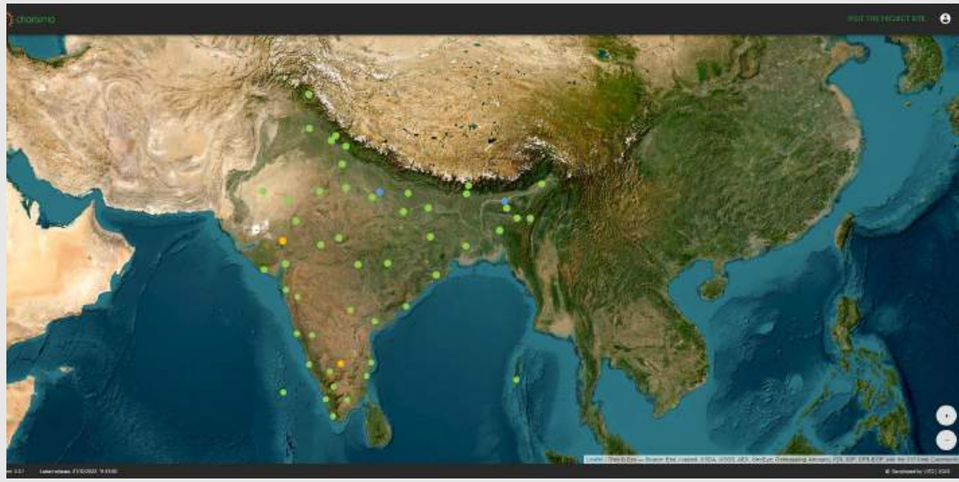
Technical demonstrations

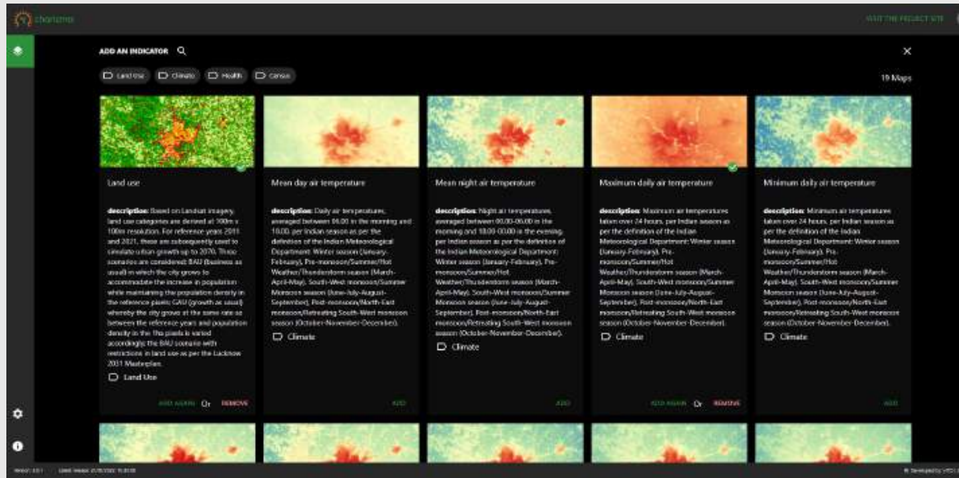
Make solutions not only data-driven but also community-supported and institutionally grounded

Workshops & hands-on trainings

Q&A


SELECTED INDICATORS
Land use
Urban heat island index
TRANSPARENCY
DESCRIPTION
Temperature difference between city centre and rural area, taken at 00:00.
Period
2041-2050
Land Use
GAU + RCP 8.5
BAU + RCP 4.5
Reference
Census data of 2011
Maximum daily air temperature
ADD A MAP
Legend
LAND USE
URBAN HEAT ISLAND INDEX
CENSUS DATA OF 2011




ADD AN INDICATOR
Land Use
Climate
Health
Census
19 Maps
Land use
Mean day air temperature
Mean night air temperature
Maximum daily air temperature
Minimum daily air temperature

Applications of EO by VITO

A. **Introduction VITO.**

B. **Deep Dive into Earth Observation (EO) & Spatial Analysis Tools in Urban Development.**

1. Urban Growth and Climate Impact (India)

2. Waste Management (Democratic Republic of Congo)

3. Flood Risk Management (Belgium, Vietnam, India, and China)

C. **Q&A Panel.**

Global Gateway

2. Earth Observation and Community Mapping for Urban Resilience in Kinshasa

As part of the World Bank Kin Elenda project

Jente Broeckx

THE WORLD BANK

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Case Study Presentation Outline

- **Objectives & Advantages**
- **Tasks**
- **Field Data Collection**
  - Other examples: 3D mapping of buildings and trees
  - Alternatives to field data collection
- **Study Area**
- **Evaluation of OpenStreetMap**
  - Buildings and roads
- **Digitization of Green Spaces**
- **Field Mapping of Urban Layers**
  - Drainage and solid waste analysis
- **Project Video**
- **Q&A**

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Objectives & Advantages

- **Enhance and generate data layers** of **solid waste**, **drainage networks**, and **urban green spaces** using **EO data** in combination with **field data** collection.
- **Train** students/youth and officials in the generation and management of high-resolution baseline data for the city.

➔ 500+ local youth close to communities and officials capacitated to collect and process EO and field data.

➔ A digital repository of geospatial layers, for data-driven urban planning and disaster risk management.

➔ Local maintenance, updating and expansion of the database.

➔ Deployment of open-source software, tools and data that are suitable in the local context.

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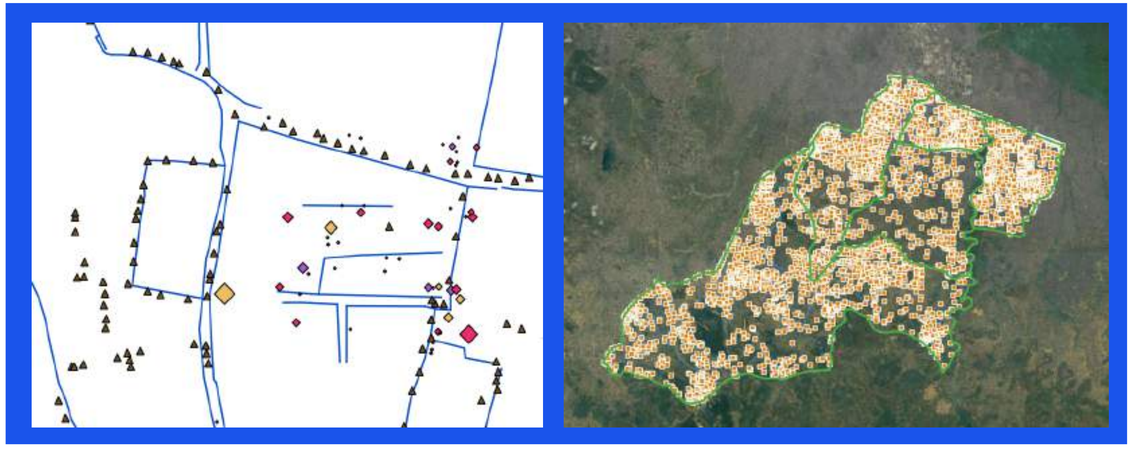
Tasks

Computer Exercise

- Qualitative and Quantitative Evaluation of OpenStreetMap (OSM)
- Digitization and classification of land cover with a focus on green spaces on high resolution satellite imagery.

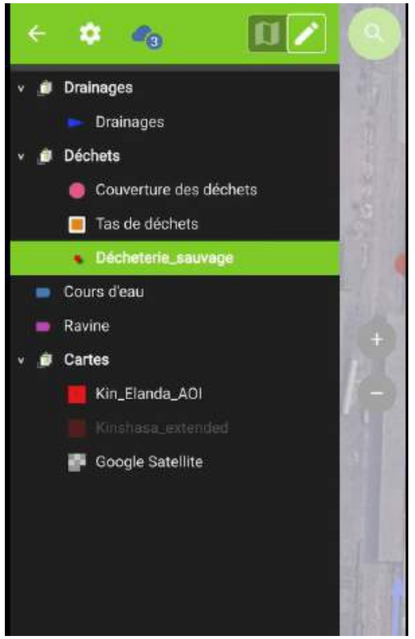
Field Exercise

- Mapping Urban Data Layers: solid waste, drainage, ravines

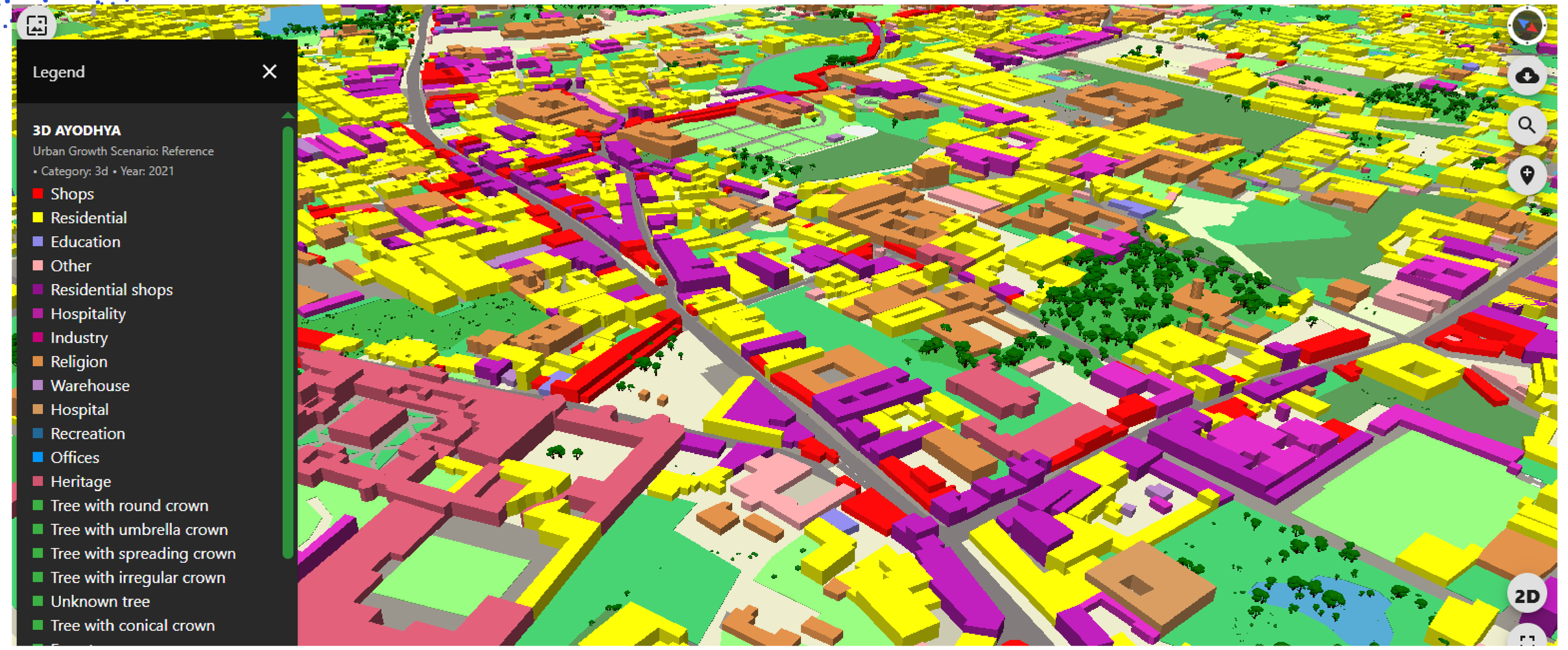


Field Data Collection

- Field work: more challenging, but better results.
- Demonstrated a unique set-up with self-training materials, sessions and hands-on training and testing before going in the field.
- Flexibility to deploy in any other context and to any other spatial data need in urban and other environments.

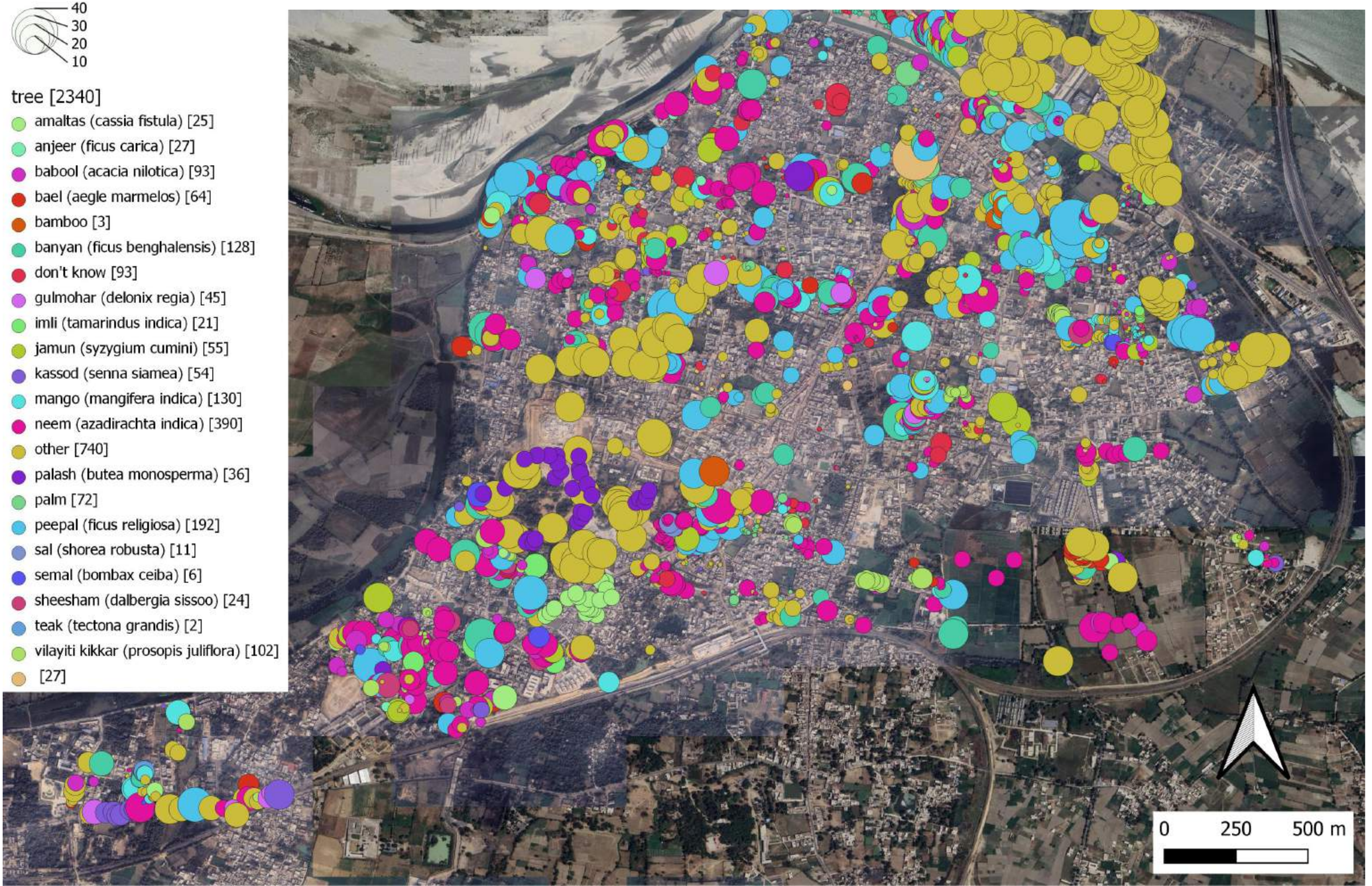


3D City Field Mapping: Buildings & Vegetation



3D data can be collected in the field for urban inventorying and heat stress analysis (example of city of Ayodhya, India).

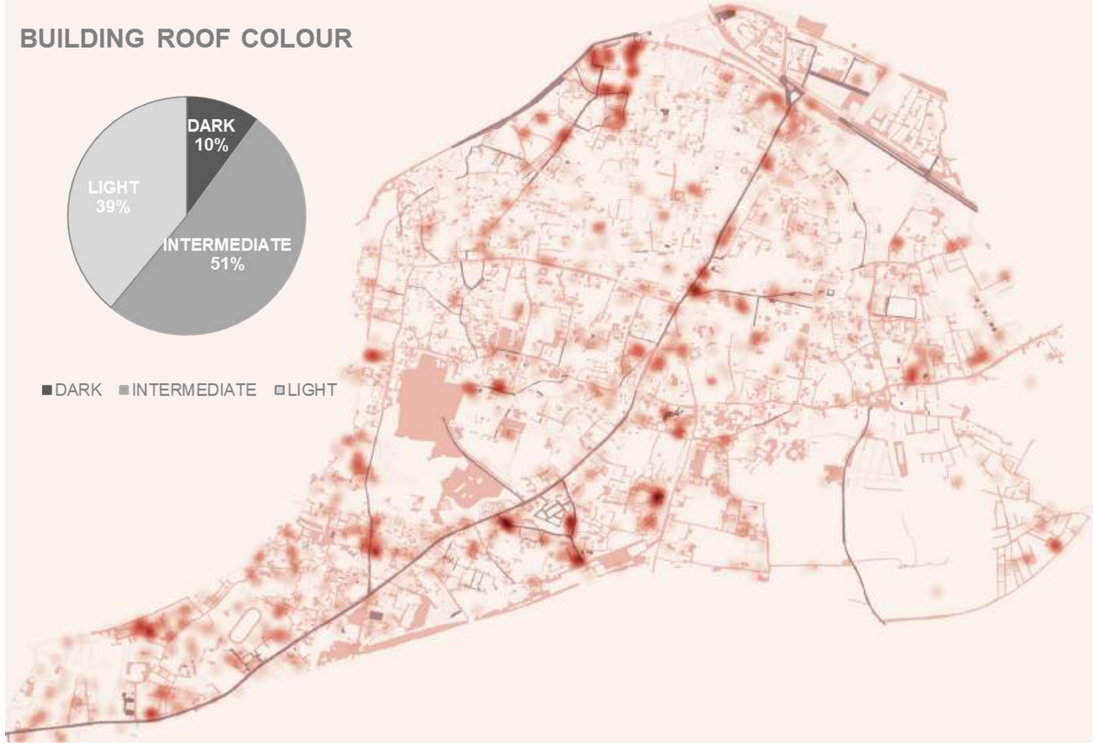
Map of Tree Species and Crown Size



Tree data collection for green space and biodiversity evaluation, with colours indicating different tree species and the size of the circles indicating the crown diameter.

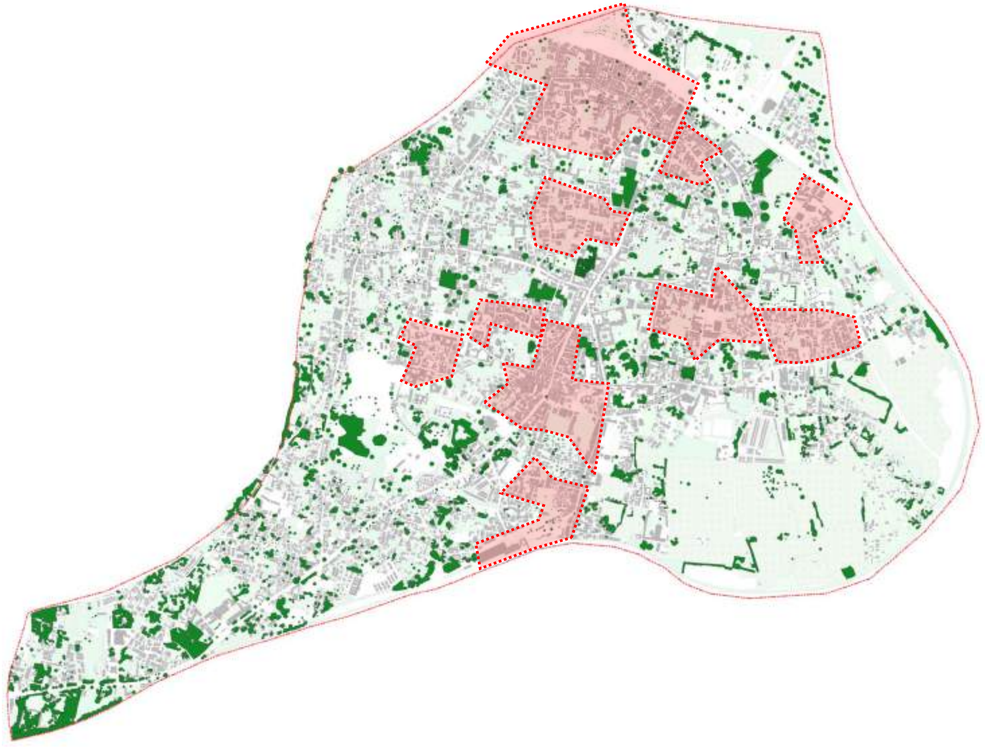
Urban Planning Applications with Field Data

Dark red spots indicate high absorption of solar radiation, increasing indoor heat. Pie chart indicates the distribution of roof colour across the city.



3-30-300: urban tree cover rule for a green city.

- 3 trees visible from every house.
- 30% tree coverage in every neighbourhood.
- 300m maximum distance to a green space with trees.



Alternatives to Field Data Collection

satellite

drone

field

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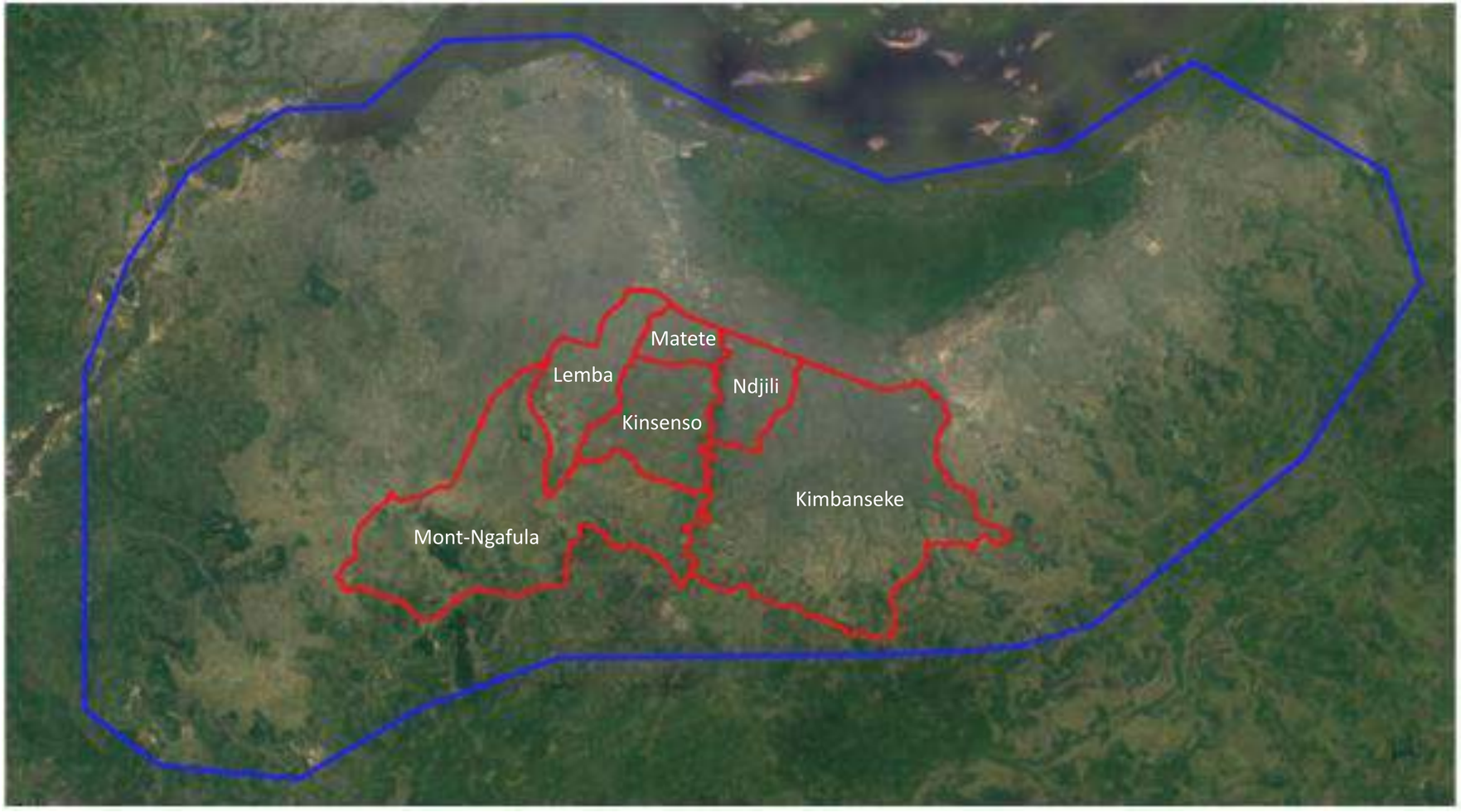
Study Area (Kinshasa)

Satellite image of Kinshasa:

- in **blue** the study area for desktop mapping, encompassing the entire city of Kinshasa and some of its surrounding rural areas.
- in **red** the 6 communes considered for field mapping.



< 1000 km² **< 200km²**

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Evaluation of OpenStreetMap (OSM)

- Quantitative and qualitative evaluation
- Buildings and roads evaluated

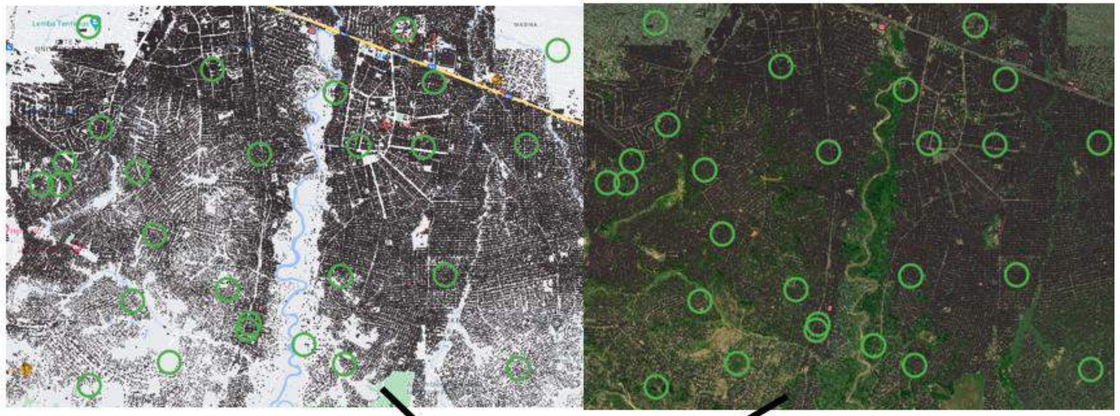
buildings — Features Total: 333211, Filtered: 333211, Selected: 0

	full_id	osm_id	osm_type	building
379	w207040303	207040303	way	yes
380	w207040305	207040305	way	yes
381	w207040309	207040309	way	yes
382	w211001594	211001594	way	yes
383	w211001792	211001792	way	yes
384	w211001793	211001793	way	yes
385	w211001794	211001794	way	yes
386	w211014924	211014924	way	school
387	w211022536	211022536	way	yes
388	w211022538	211022538	way	yes

highway — Features Total: 22777, Filtered: 22777, Selected: 0

full_id	osm_id	osm_type	highway
w4631614	4631614	way	tertiary
w4631627	4631627	way	tertiary
w4631650	4631650	way	unclassified
w4631656	4631656	way	unclassified
w4631691	4631691	way	tertiary
w4631718	4631718	way	tertiary
w4631720	4631720	way	tertiary
w4631728	4631728	way	tertiary
w4631731	4631731	way	unclassified
w4631732	4631732	way	tertiary
w4631741	4631741	way	unclassified

Building and road labels



Poorly/unidentified buildings

Unidentified route

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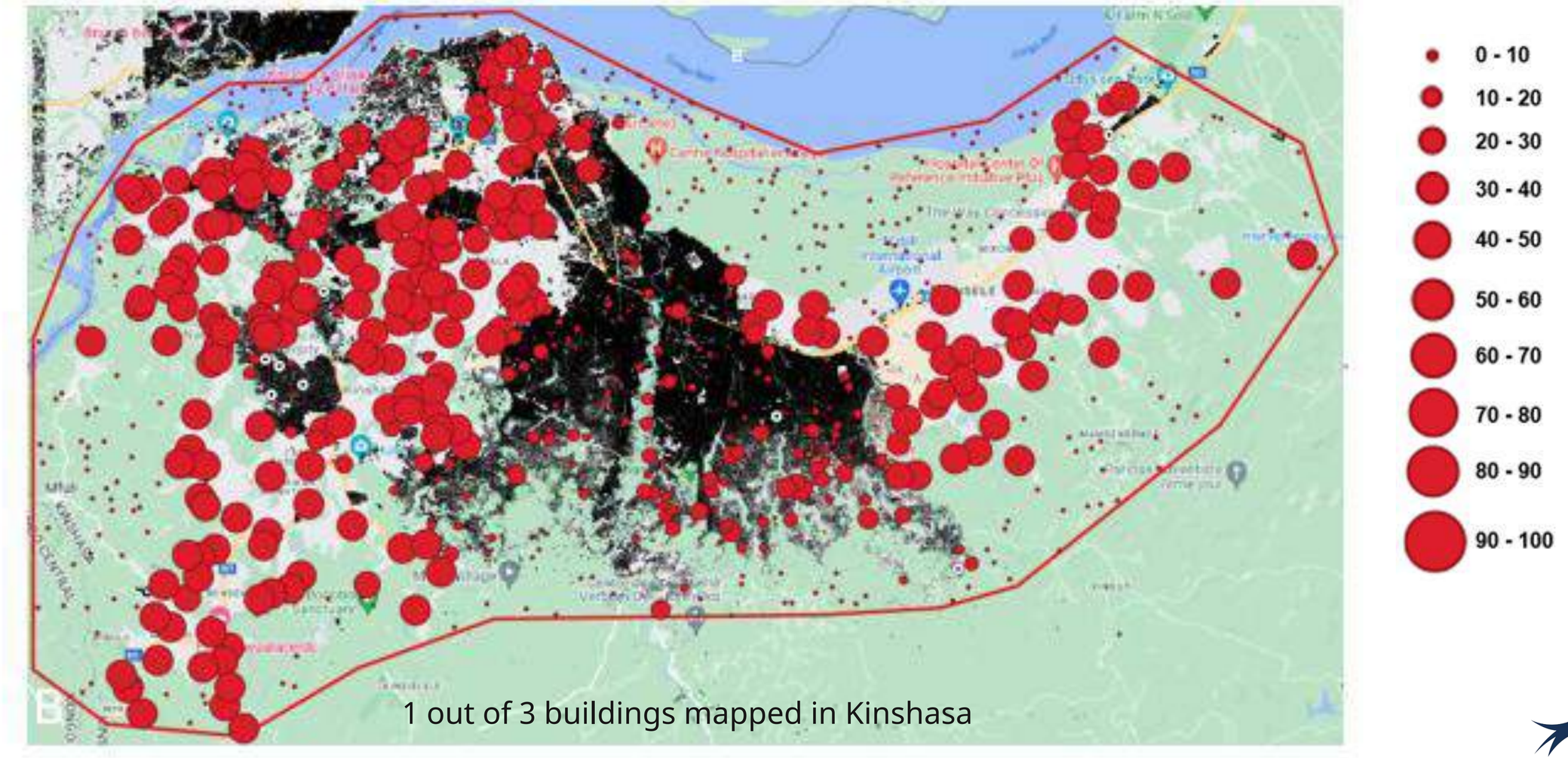
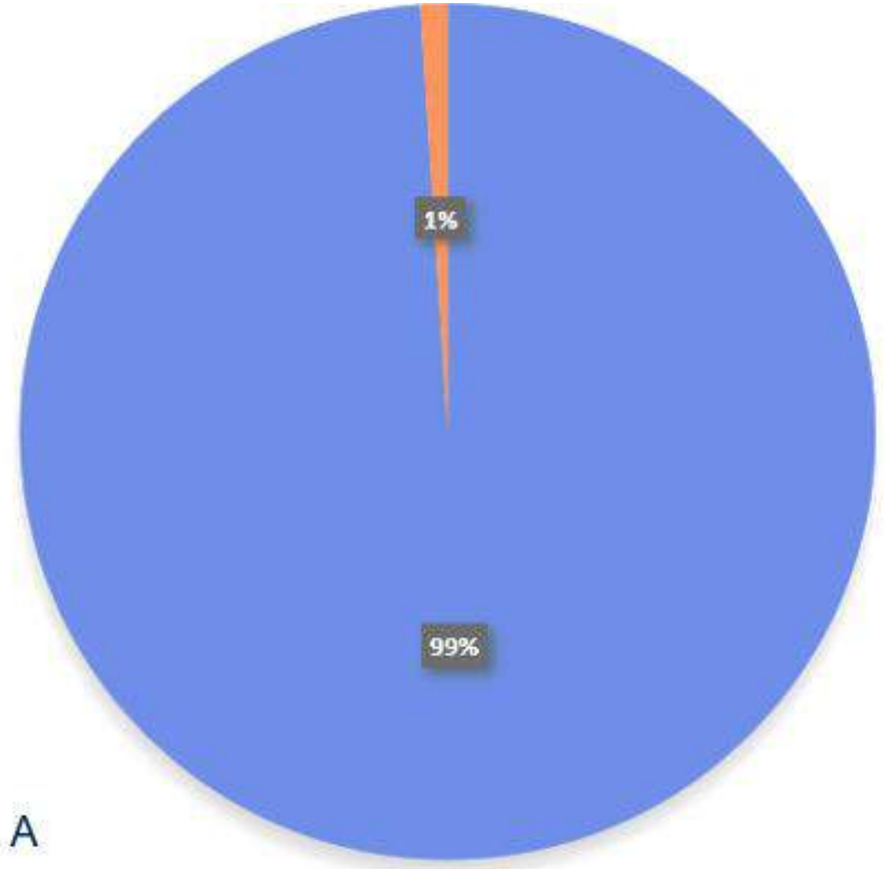
Building Completeness in OSM

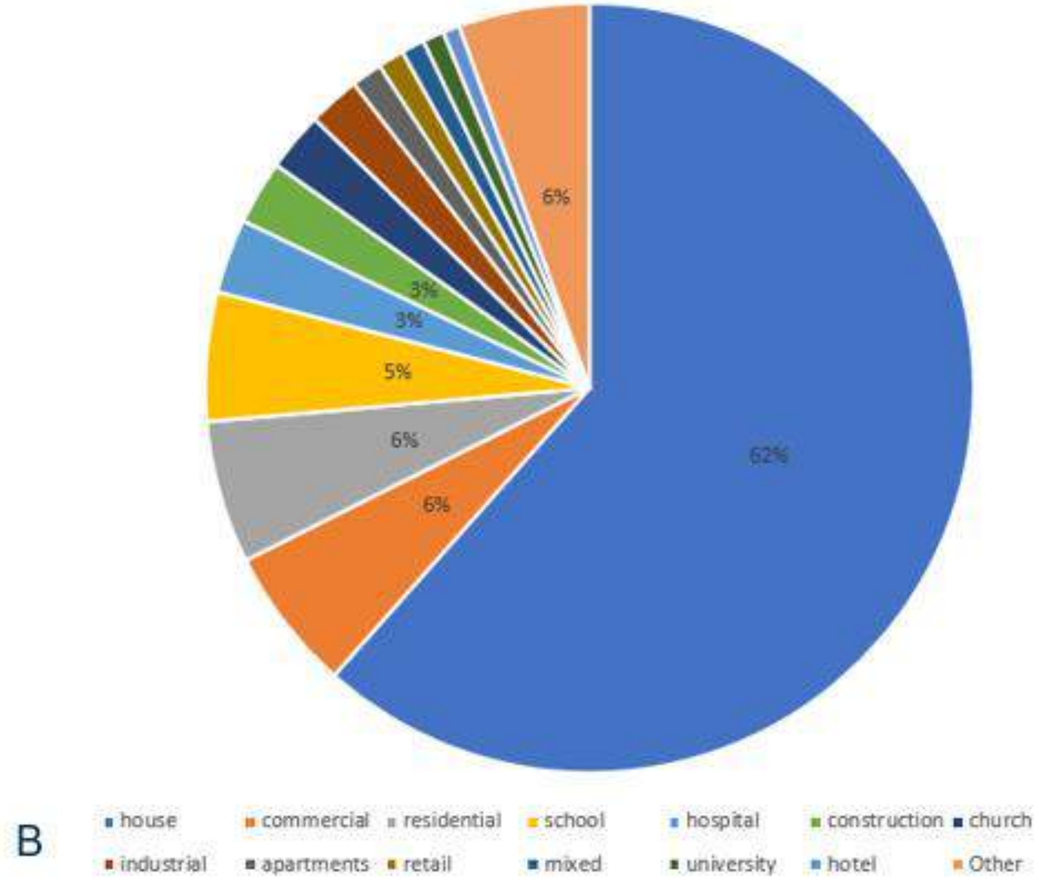
Evaluated polygons shown by size indicating the percentage of building incompleteness, with in black the building footprint of OSM



1 out of 3 buildings mapped in Kinshasa

Building Classification in OSM

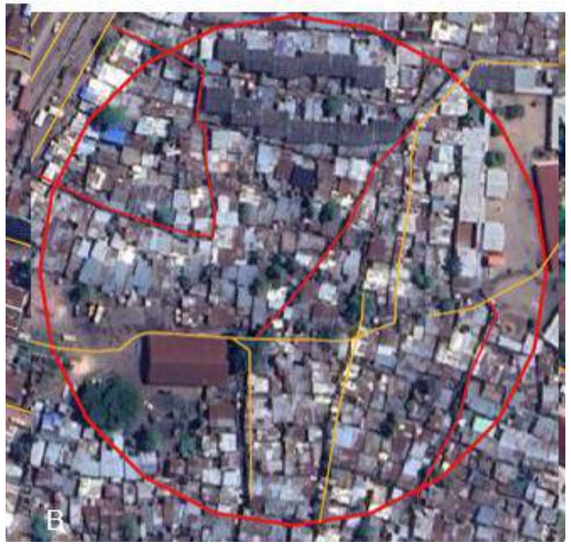


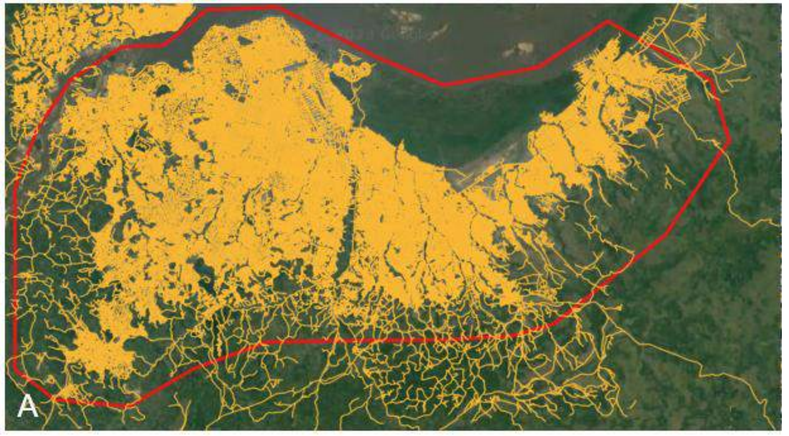


Percentage of classified buildings (1% classified)

Distribution of classified buildings over different classes.

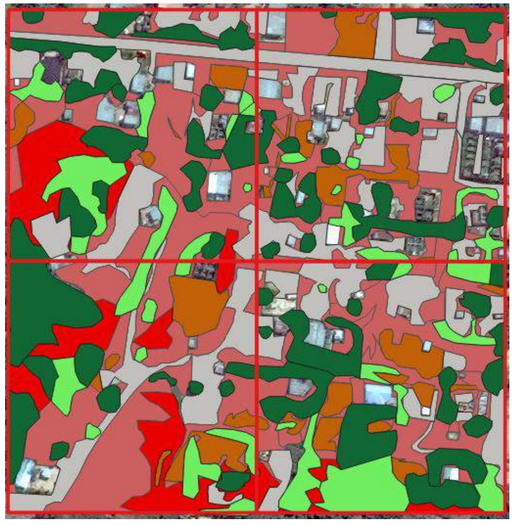
Road Completeness in OSM

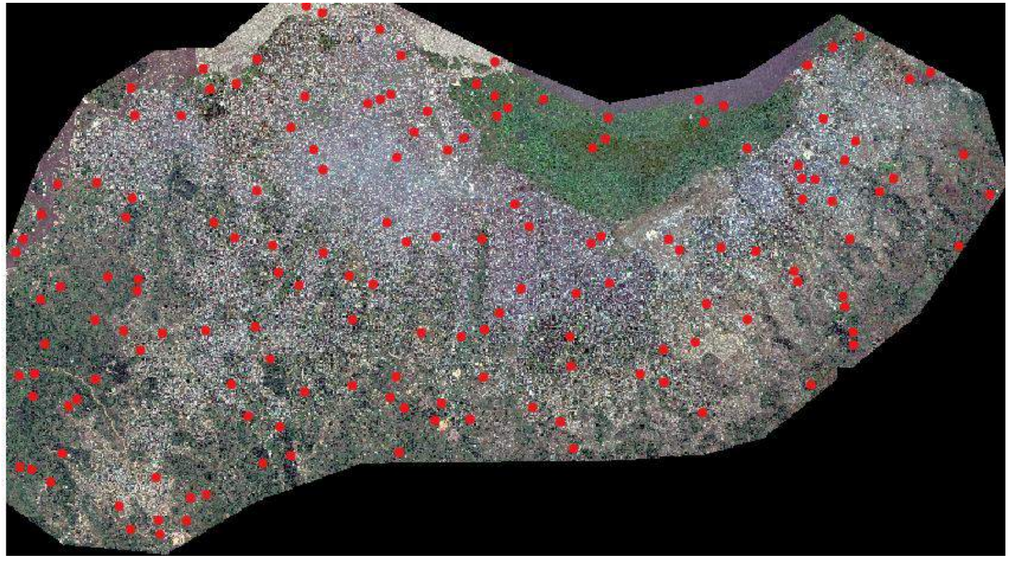


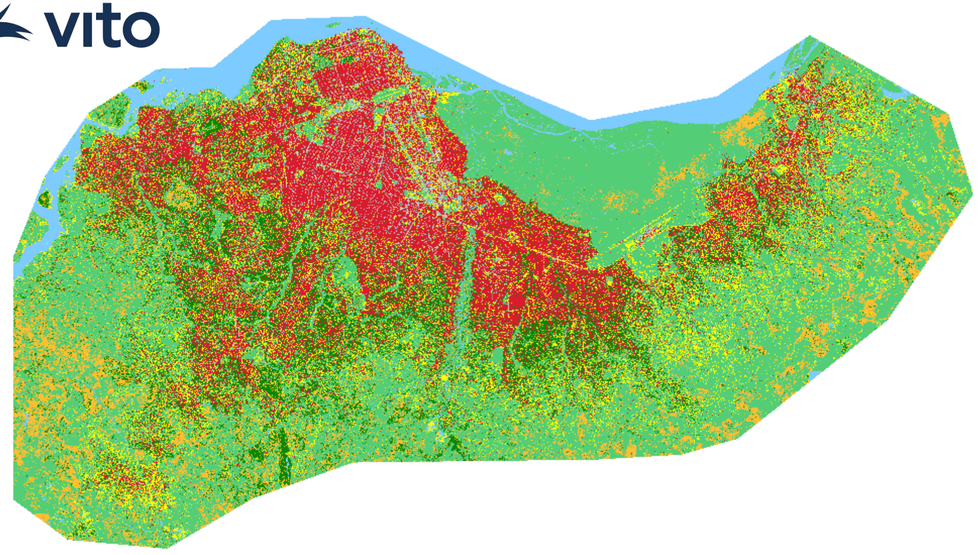


Around 90% completeness and correct classification for roads in OSM.

Digitization of Green Spaces







Field Mapping of Urban Layers

Waste can be found everywhere: scattered on the streets, in drainages, concentrated on waste heaps and on large dumpsites.

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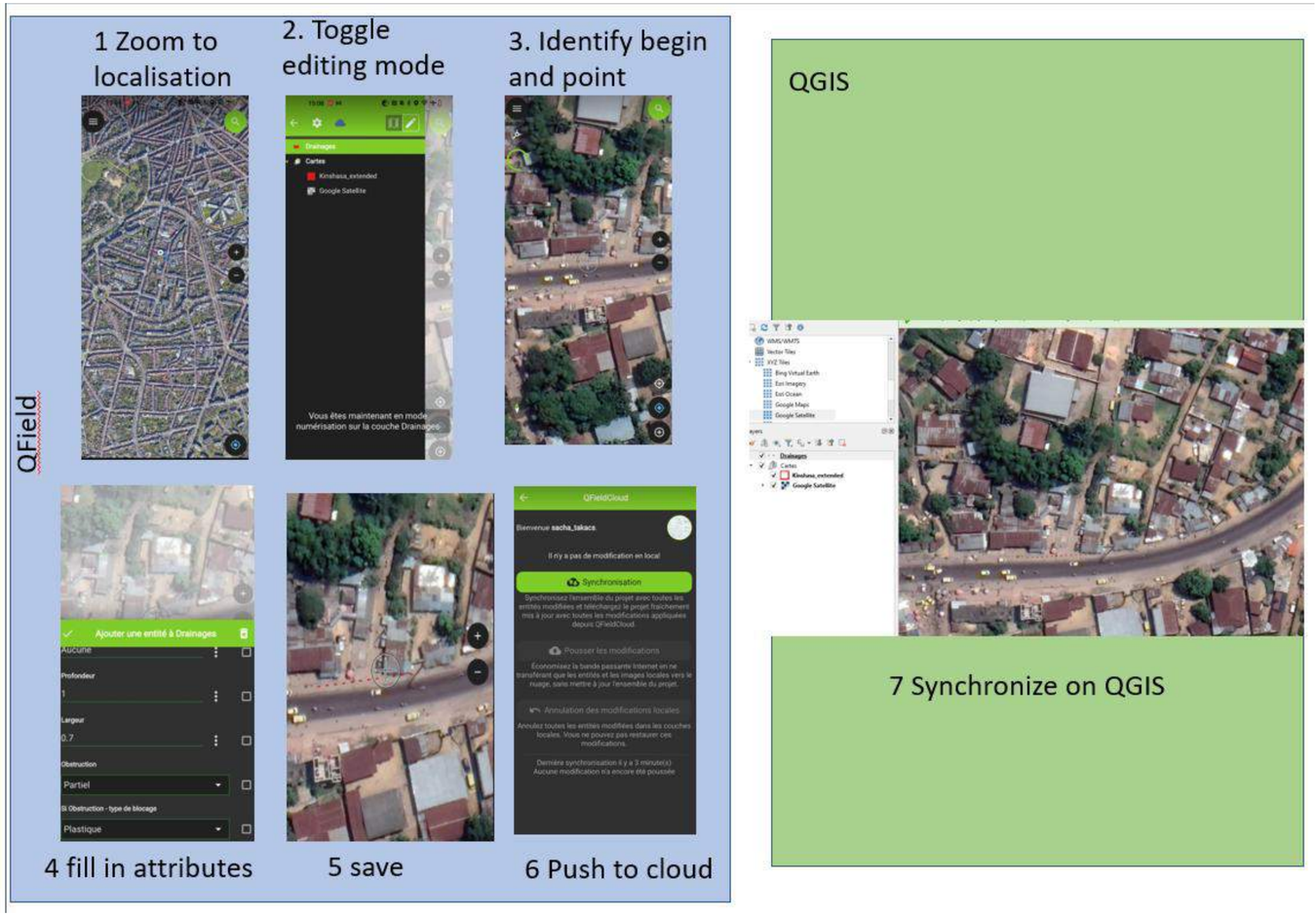
Field Mapping of Urban Layers

Training of participants for field mapping



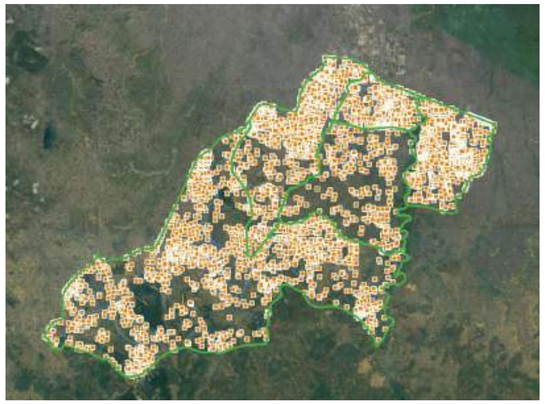
Field mapping steps to digitize geospatial features through QField

Field Mapping of Urban Layers

- More than 3,000 **drainage lines** identified
- More than 30,000 **waste cover points** recorded
- More than 5,000 **waste heaps** inventoried
- More than 200 **illegal dumpsites** identified

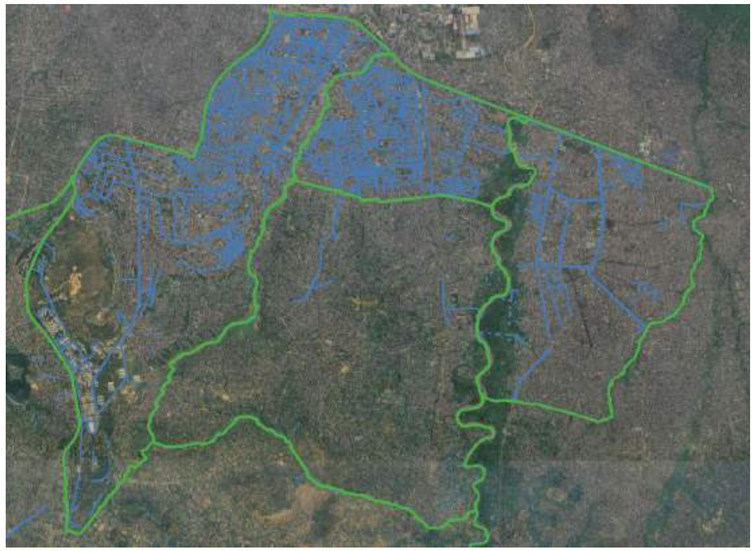
Illegal dumpsite at gully

Mapped waste heaps

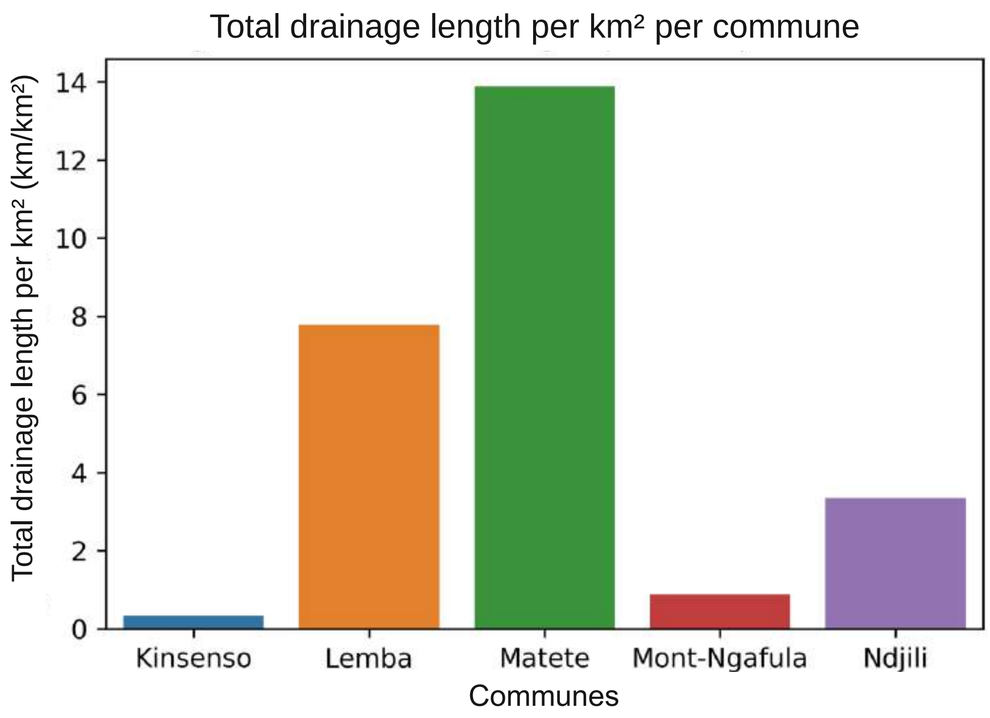


Mapped waste cover points

Mapped drainages

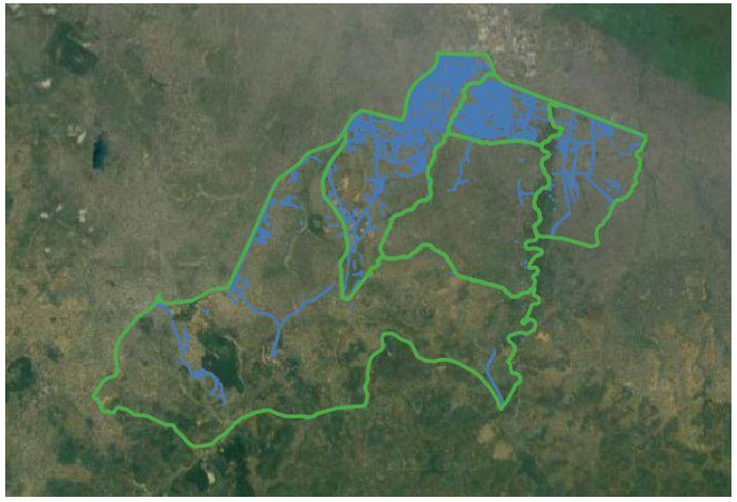


Drainage Results



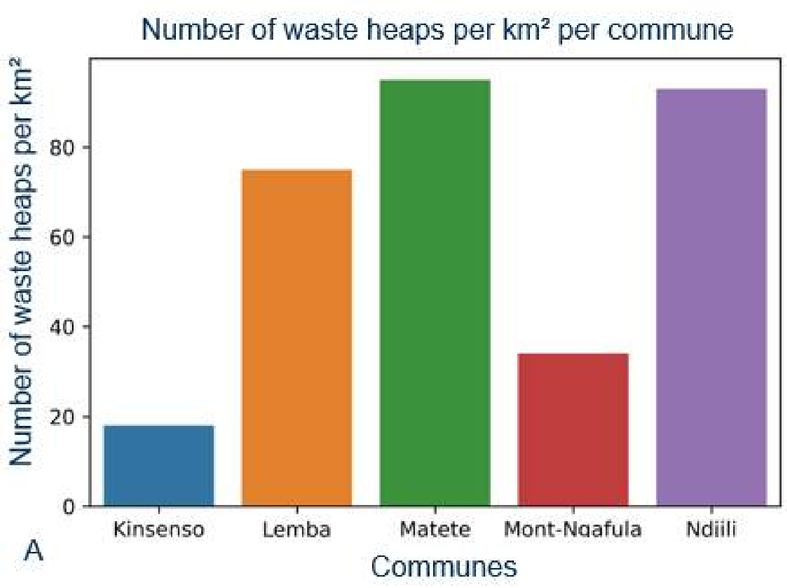
Total drainage length per community per km²

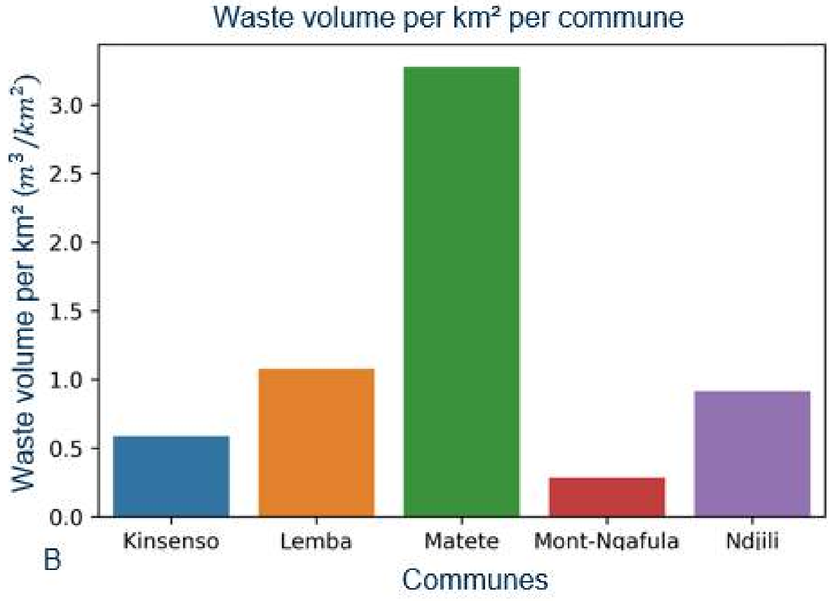
Example of drainages in Kinshasa unities

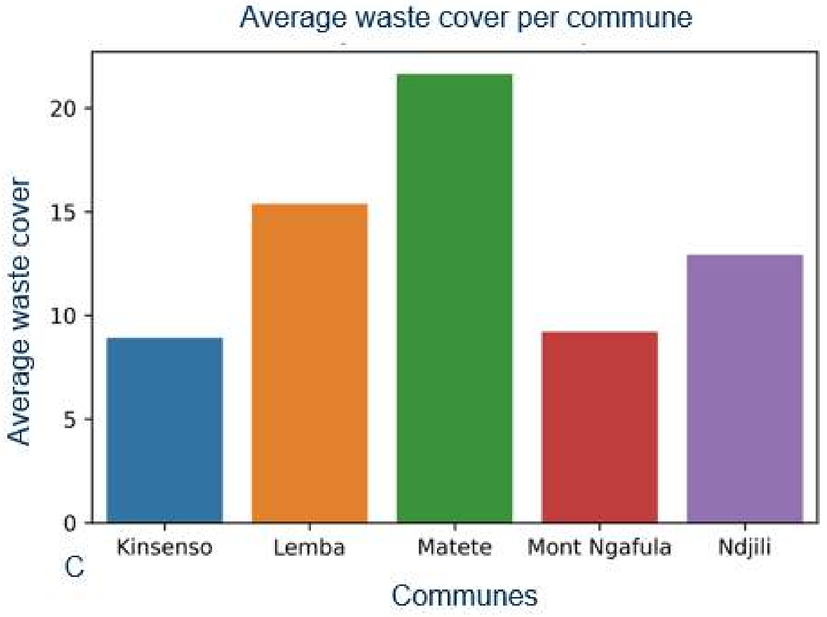


Mapped drainage lines

Solid Waste Analysis







Questions that can be answered with these data, e.g.:

- What is the relative cleanliness of communes?
- What is the total quantity of waste to be cleaned up in every place?

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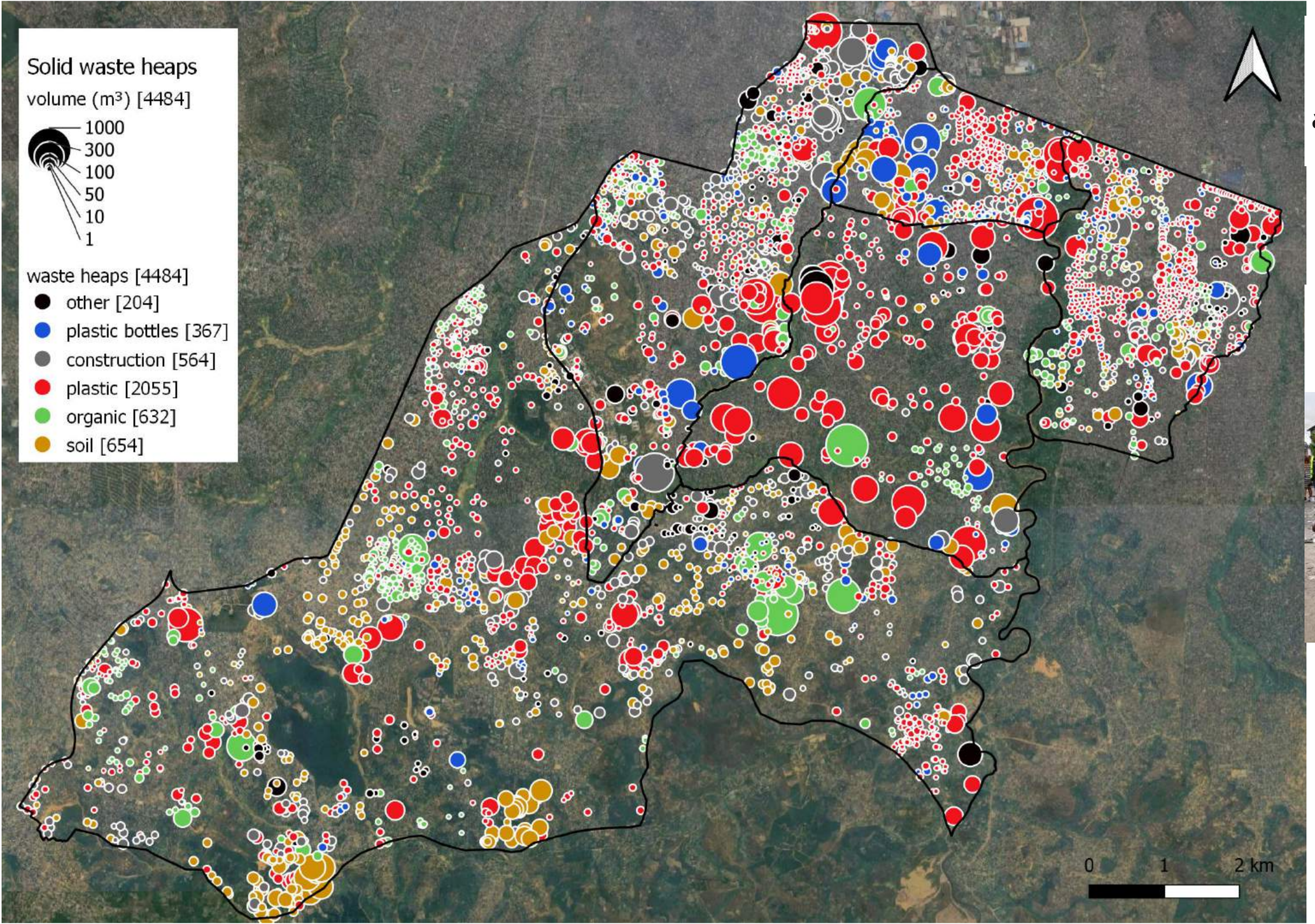

Map of solid waste heaps by type (colour) and volume (circle size)

Example of waste heap (a concentrated pile of waste)

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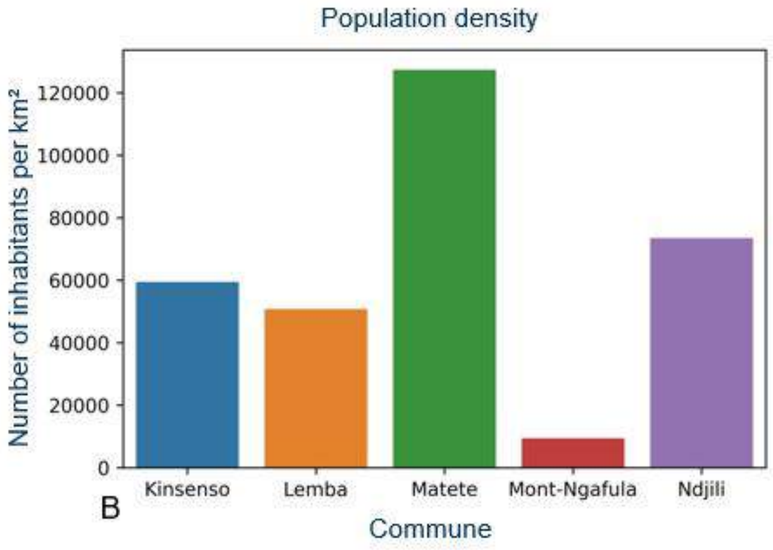
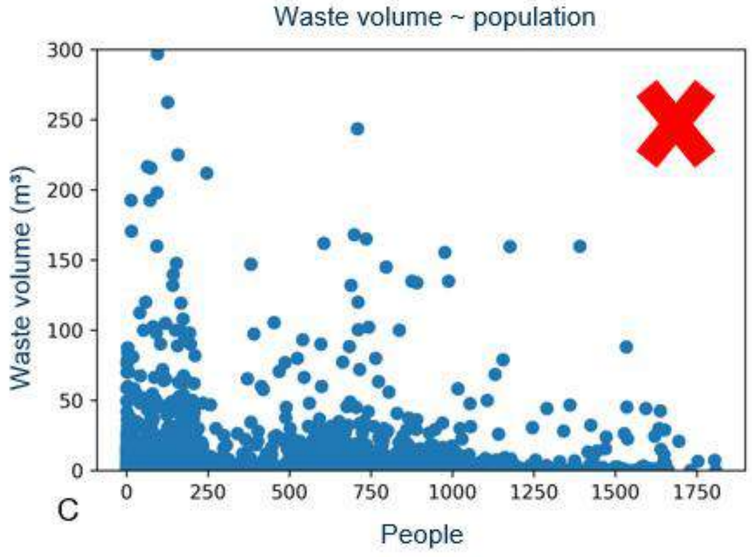
THE WORLD BANK

Solid Waste Analysis

Population density
(red: high, blue: low)



Population density
per commune



Waste volume vs people
in 300m grid cell,
no correlation between both

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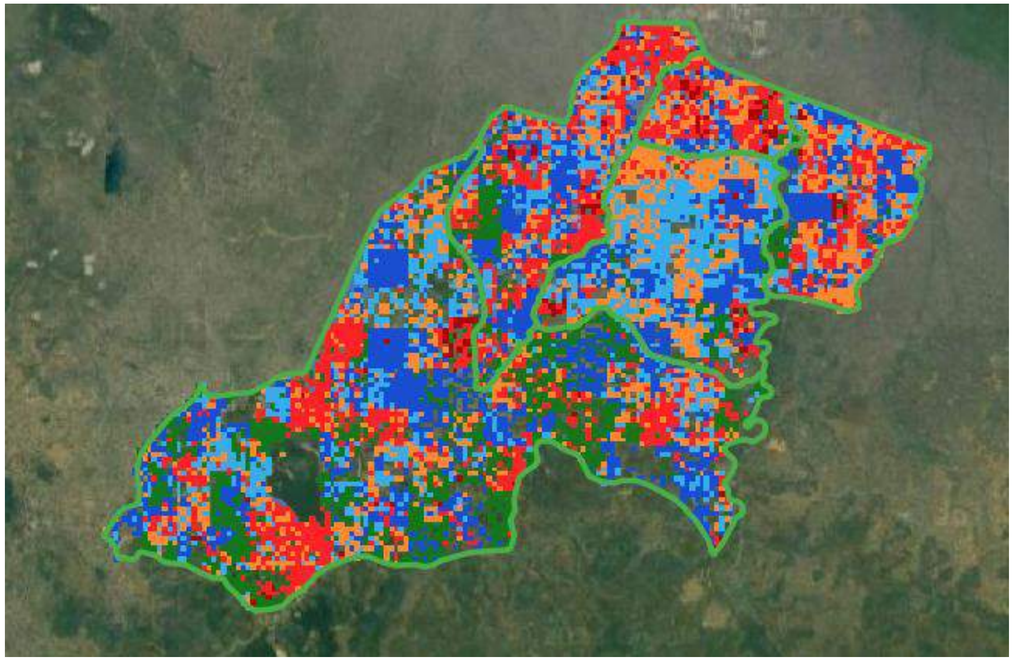
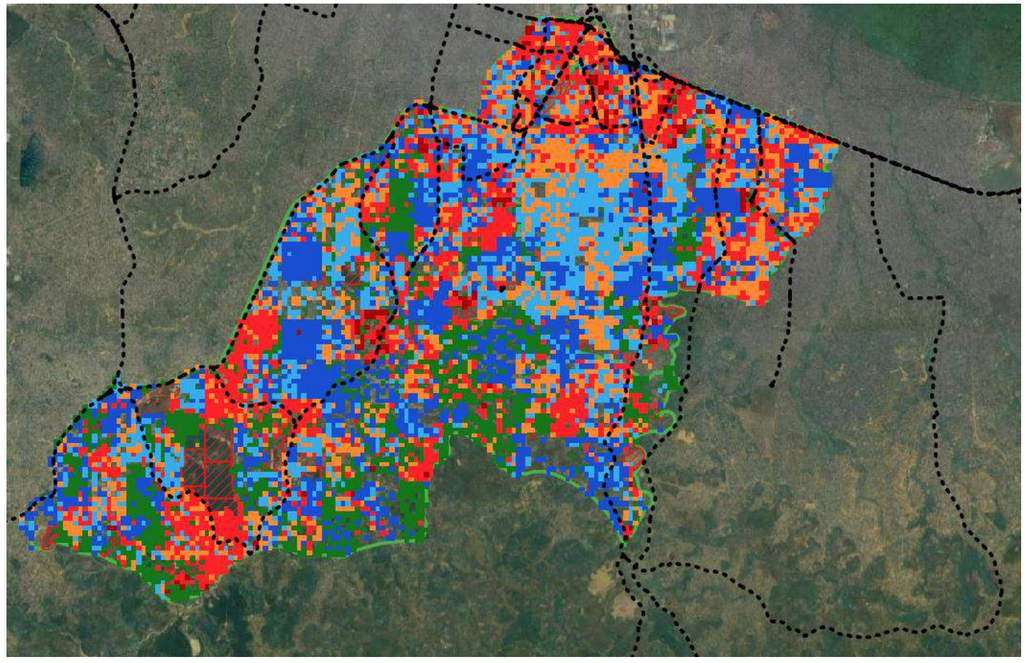
Solid Waste Analysis

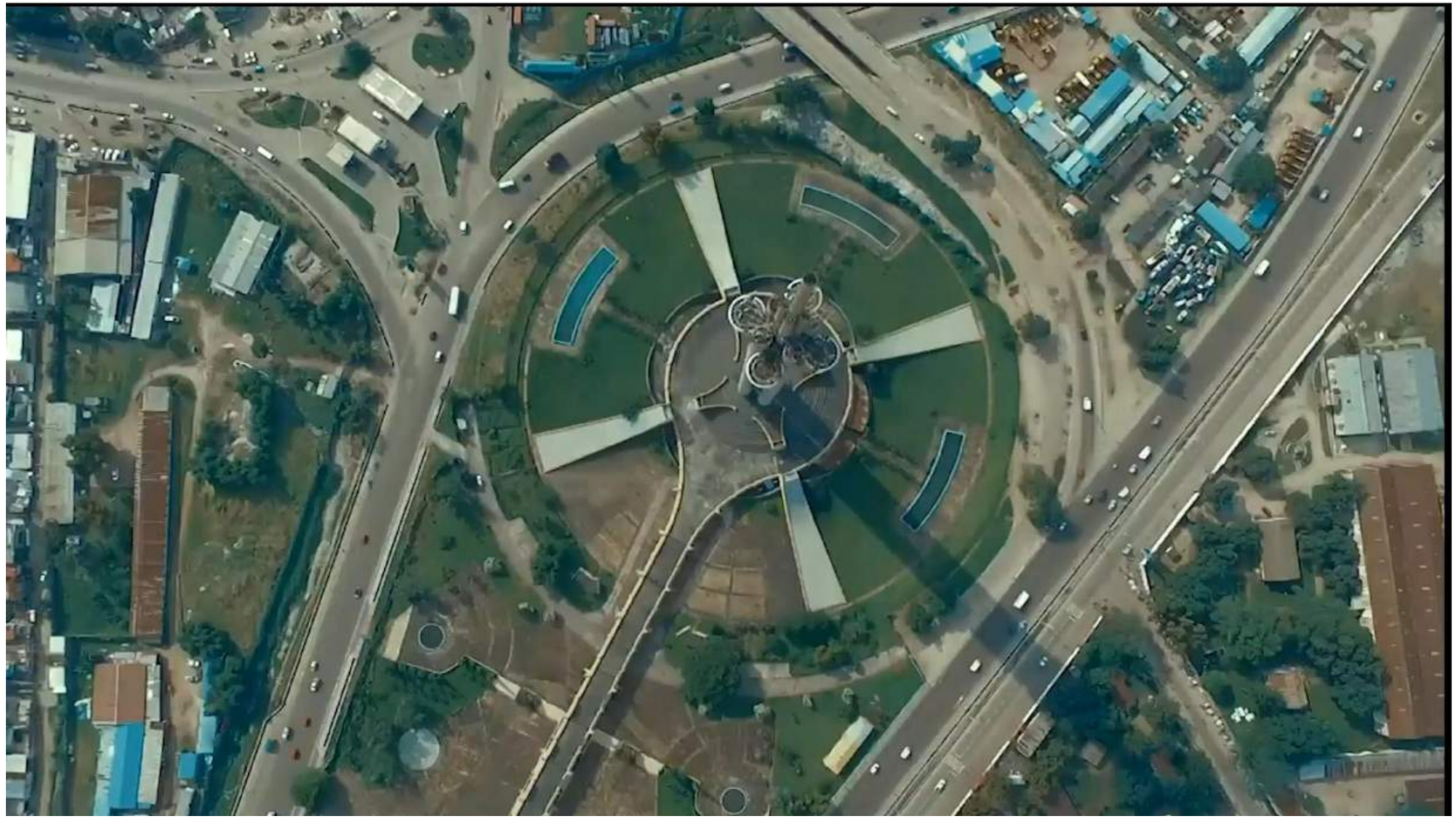


Concentration of waste cover points
(red: high and blue: low)



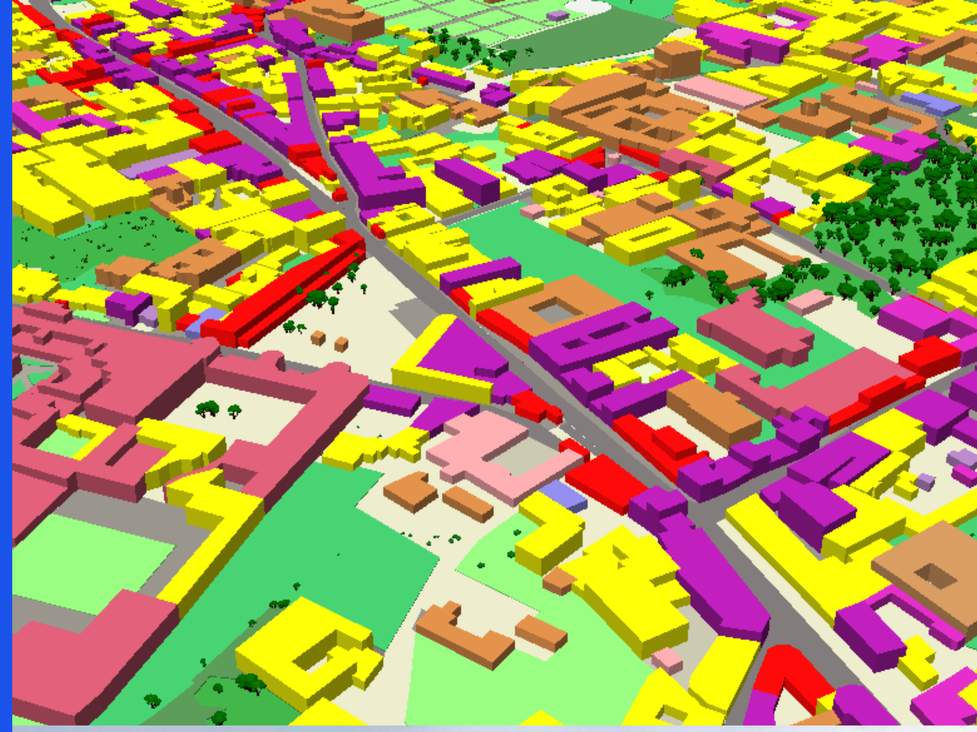
The black dotted lines show primary roads.

Project Video: Earth Observation and Community Mapping for Urban Resilience in Kinshasa



https://vimeo.com/christianmorgan/review/891672175/8b1b9d8e75

Q&A



Applications of EO by VITO

A. **Introduction VITO.**

B. **Deep Dive into Earth Observation (EO) & Spatial Analysis Tools in Urban Development.**

1. Urban Growth and Climate Impact (India)

2. Waste Management (Democratic Republic of Congo)

3. Flood Risk Management (Belgium, Vietnam, India, and China)

C. **Q&A Panel.**

Global Gateway

3. Urban Resilience and Risk Reduction – Flood Risk Management (Belgium, Vietnam, India and China)

- What is the urban flooding challenge?
- What environmental modelling tools do we have available?
- Case study: Belgium, Vietnam, India and China
- Q&A

Michel Craninx

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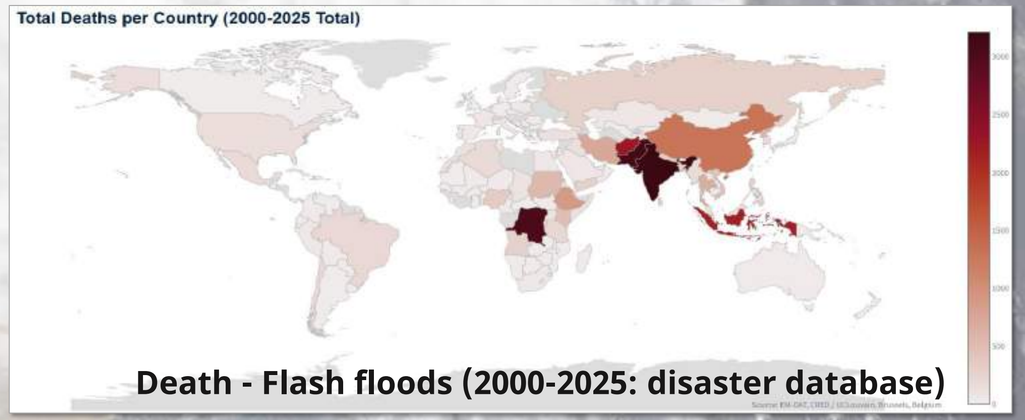
Urban Floods

Urban flooding → world-wide problem

Many studies confirm:

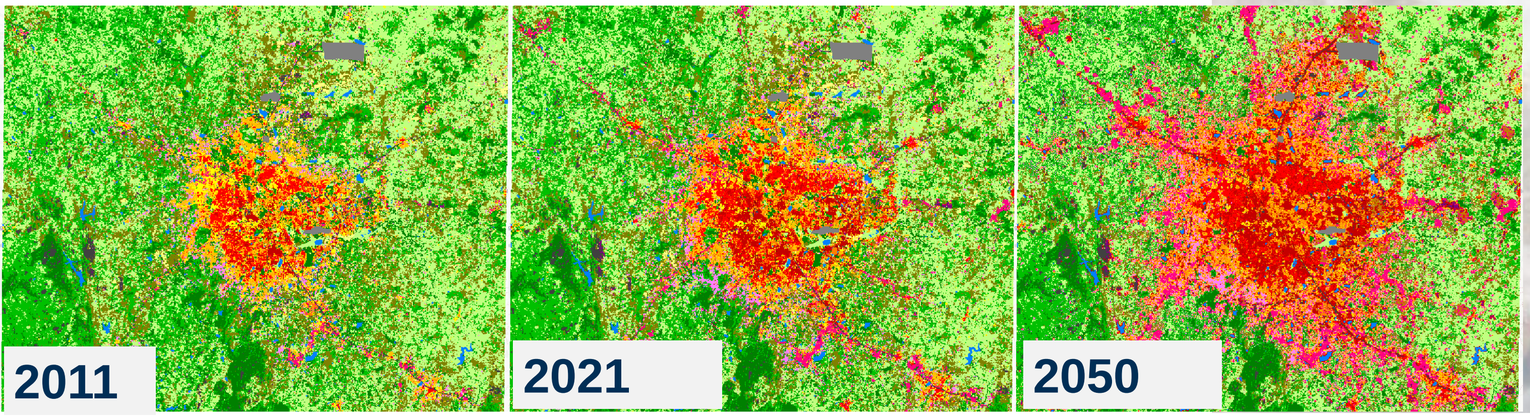
- High impact cities!
- **Climate impact**:
  Urban floods: high confidence (IPCC)
- Impact: **urbanization - land use changes**
  High confidence (IPCC)

(Wateraid, 2025)

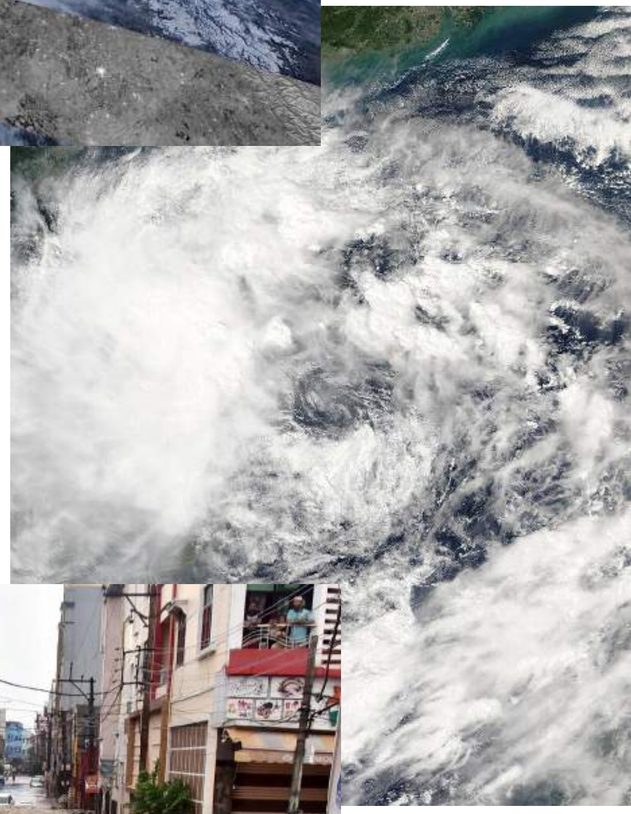


Death - Flash floods (2000-2025: disaster database)

Bangalore (2021) UrbClim model VITO



Why Flood Mapping?



Flood **risk** mapping and modelling:

→ **Where** are floods occurring **now** and in the **future**?

→ **What** can we learn from these flood maps?
e.g. post event analysis

Flood **resilience** measures

→ **What** can we do to reduce the impact?

Simulate the measures in a model
to see if the impact will be as expected

- Urban drainage planning and engineering

- Local climate impact analysis and adaptation scenarios

Operational use

→ Use of flood models in real-time flood situations

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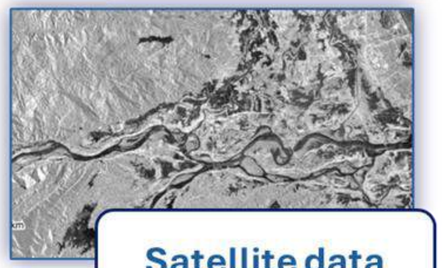
Process?

Data collection

Flood modelling

Validation with stakeholders

Local knowhow



Satellite data

Validated flood maps

Transfer of knowhow

Develop solutions

Climate scenarios

scenario models

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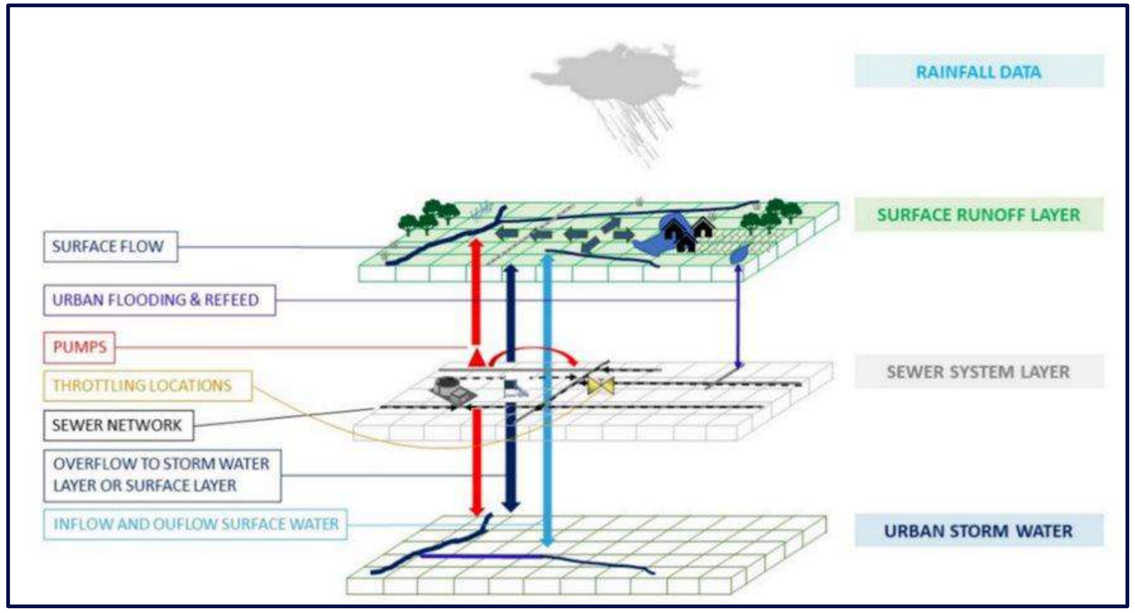
Approaches

Remote Sensing

Flood Modelling



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Remote Sensing: SAR (Synthetic Aperture Radar) Imagery

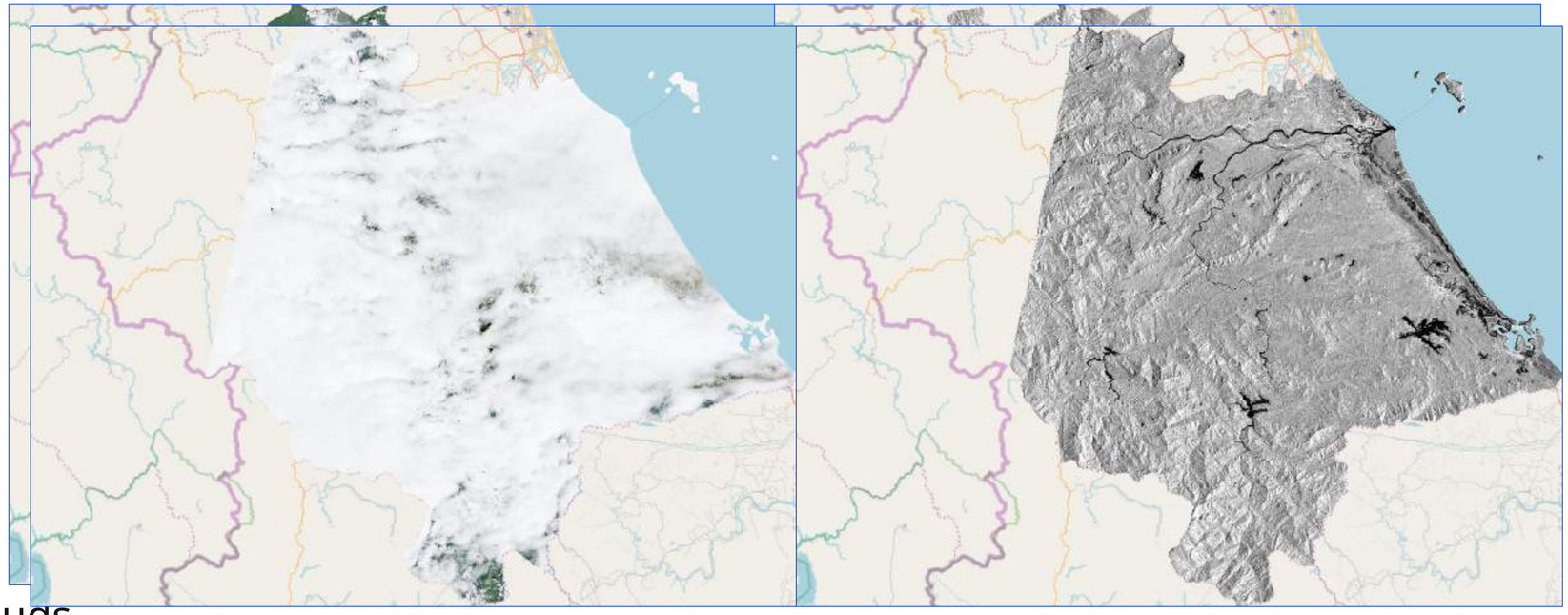
- Open access, global images
- First launch in 2014

Sentinel-2:

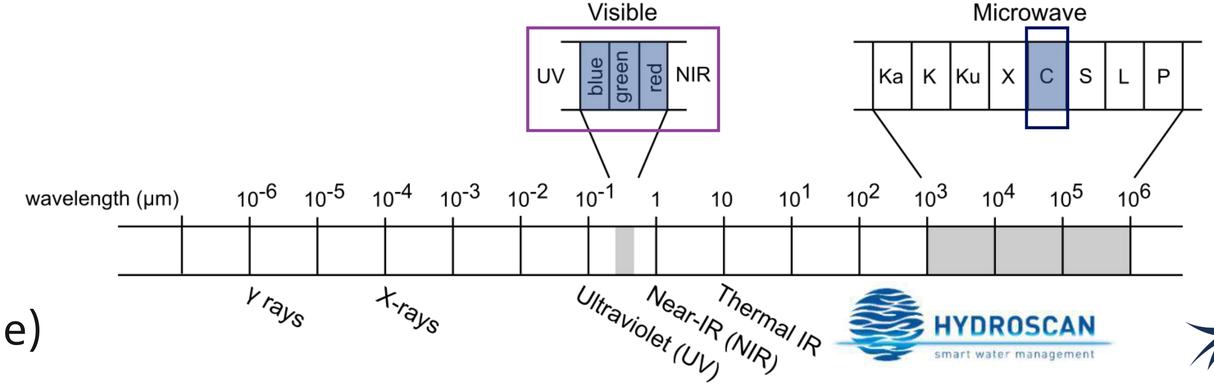
- Multispectral
- easy to interpret
- Clouds!
- 20-60m
- every 5 days

Sentinel-1:

- Radar
- not hampered by clouds
- 10 m
- every 2-12 (6) days



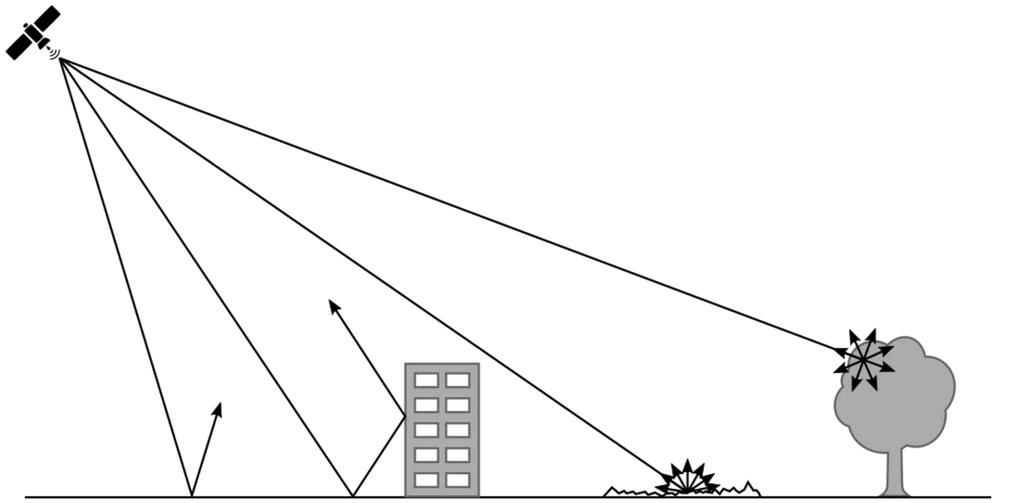
Sentinel-2 Sentinel-1



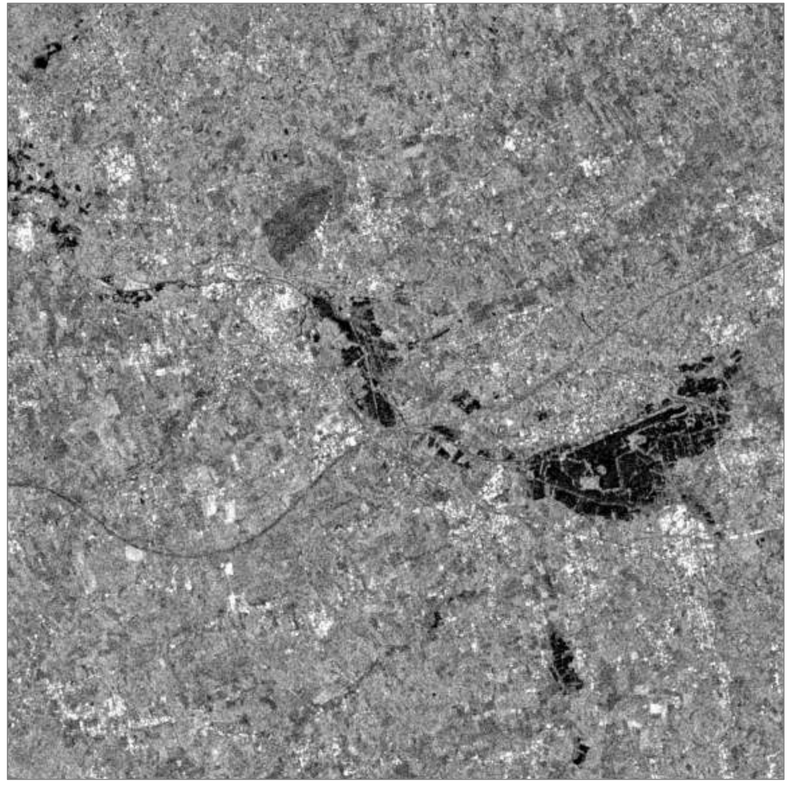
Advantages and disadvantages:

- Advantage: large areas
- Disadvantage: miss flood/historic floods (revisit time)

Remote Sensing: SAR (Synthetic Aperture Radar) Imagery

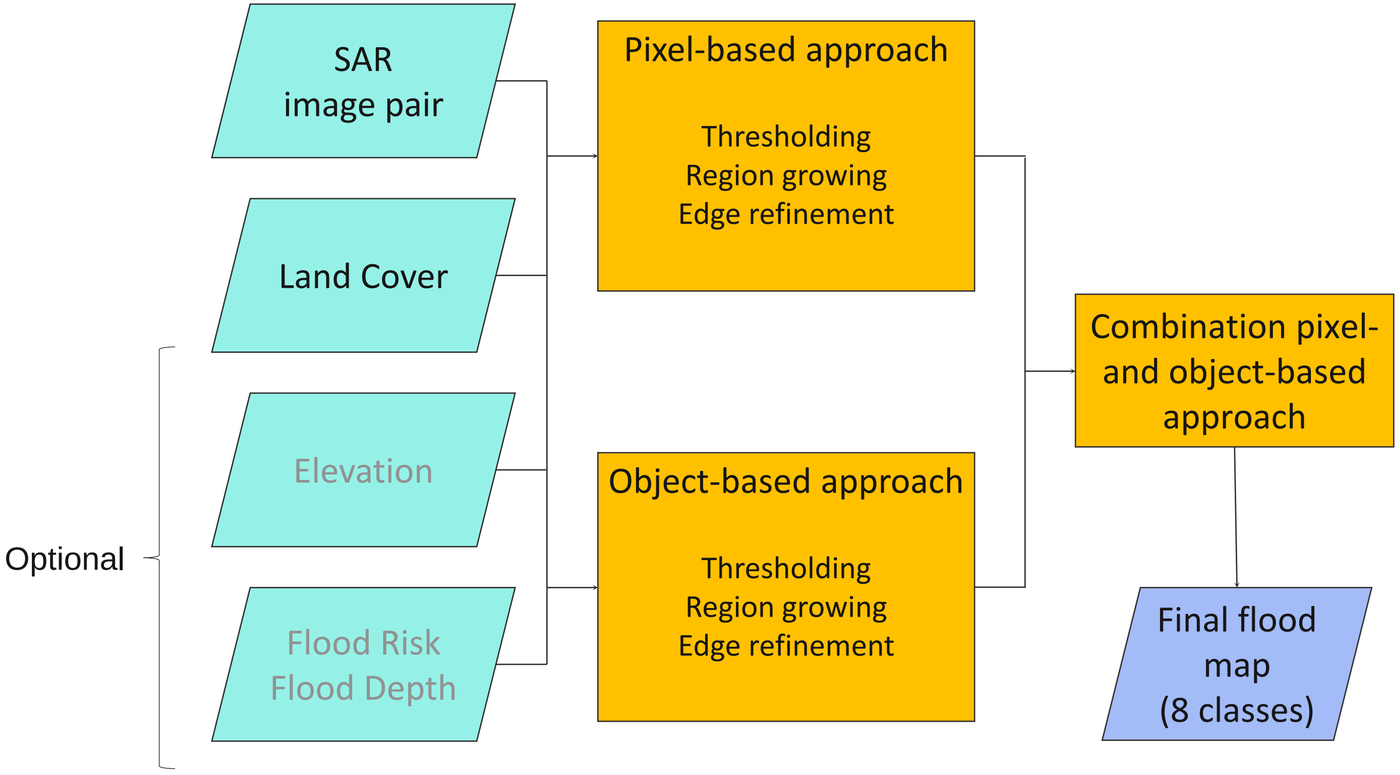


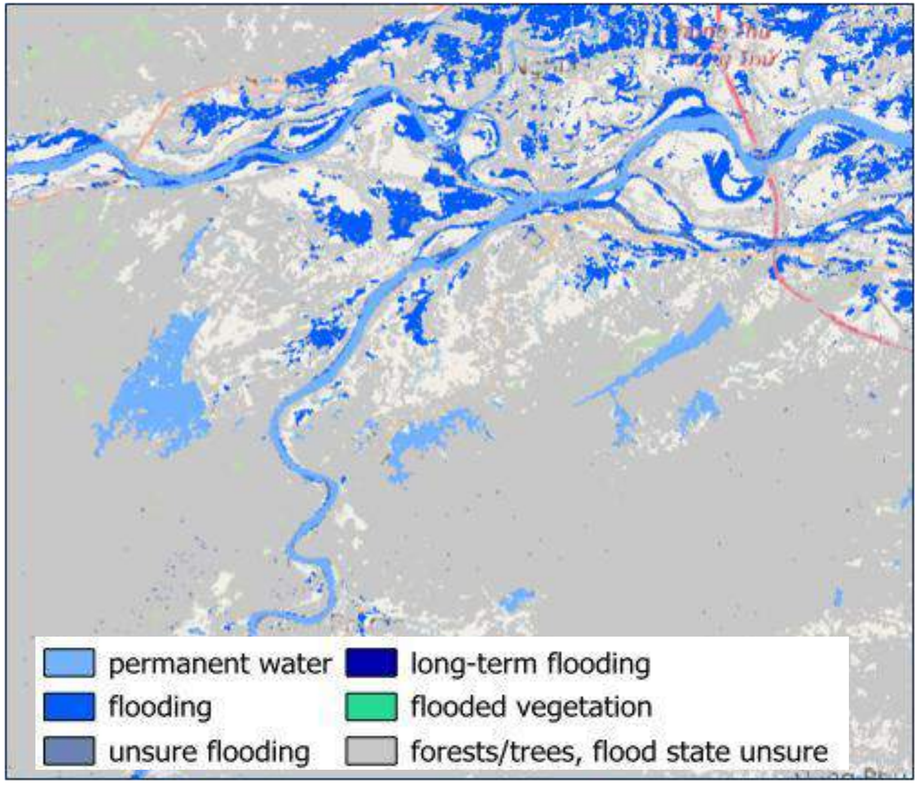
Scattering mechanism	specular reflection	corner reflection	diffuse scattering	volume scattering
Image tone				



Flood Mapping Using Remote Sensing

Flood mapping using Sentinel-1 SAR satellite data: methodology → **change detection**





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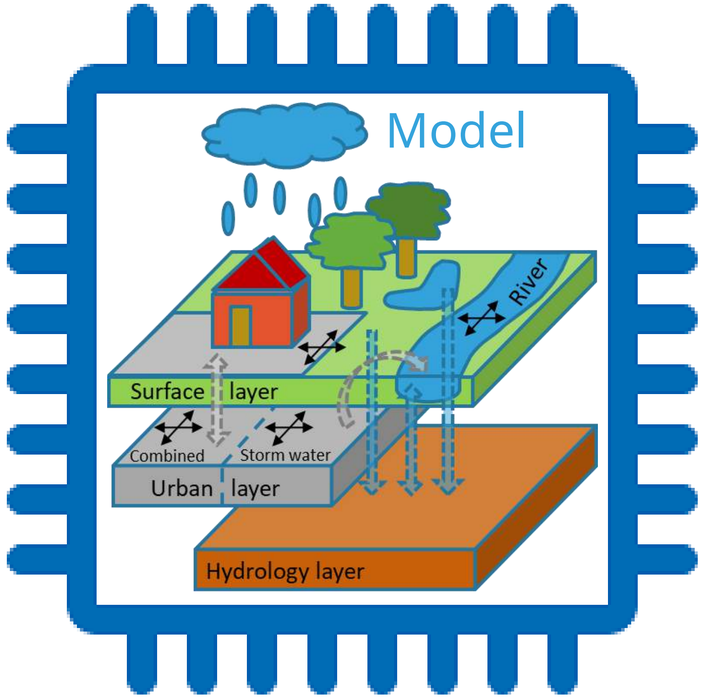
Flood4Cast Masterplanner

Flood4Cast Masterplanner overcomes **typical issues** related to the set-up of a **physically based <u>hydrodynamic</u> flood models**:

- **Extensive** data requirements
- Set-up often **time-consuming** task
- **High computational** demands



<u>Flood4Cast Masterplanner:</u>

- ✓ **Limited data needed**
- ✓ **Semi-automatic set-up**
- ✓ **Fast model runs**

… can be used for

- → **general pluvial flood mapping**
- → **climate impact analysis**
- → **land use changes**
- → **adaptation scenarios**

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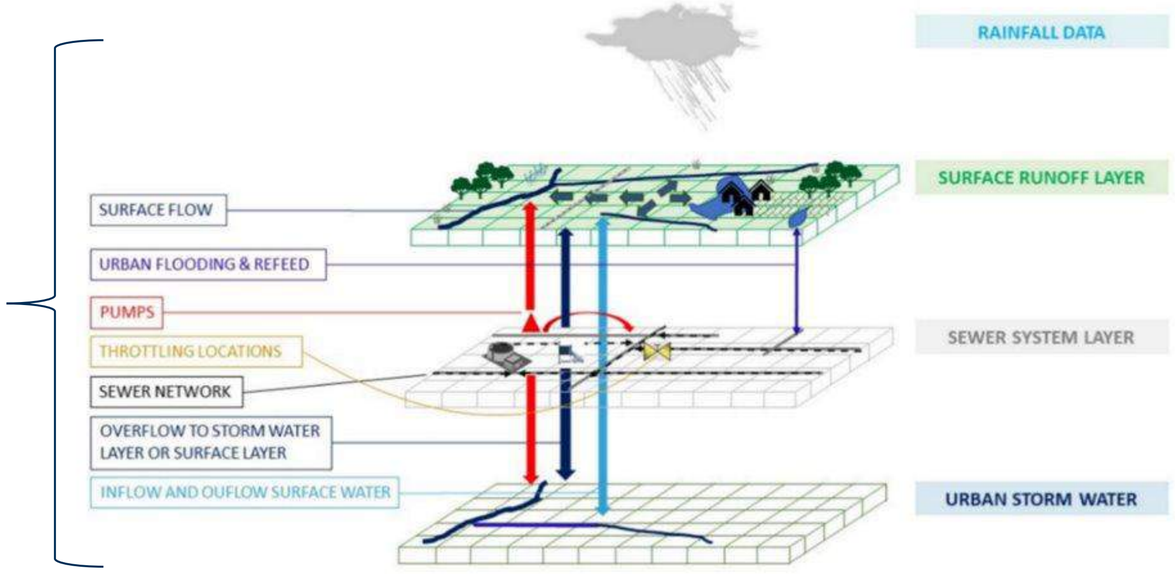
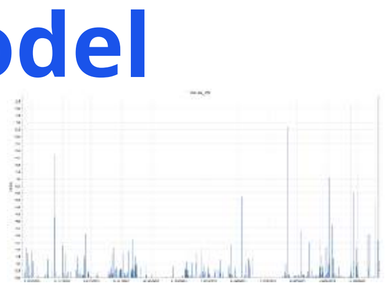
Flood4cast Masterplanner: Model

Integrated modelling approach of Flood4Cast Masterplanner

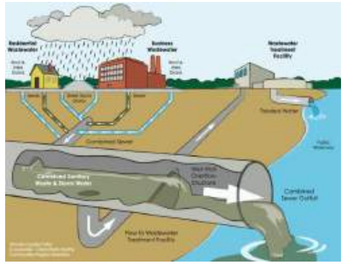
Interactions between layers and hydraulic structures



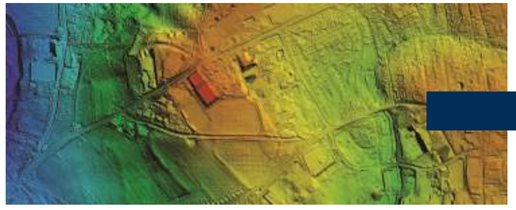


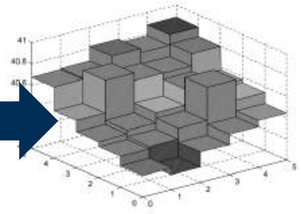
Rainfall timeseries

Radar data



Topography





Translation high resolution data (1-10m) to coarse model resolution (100m)

Subgrid method

Model development 2016 – 2021: collaboration VITO and HydroScan NV
This research was funded by VLAIO (Flemish Innovation and Entrepreneurship)

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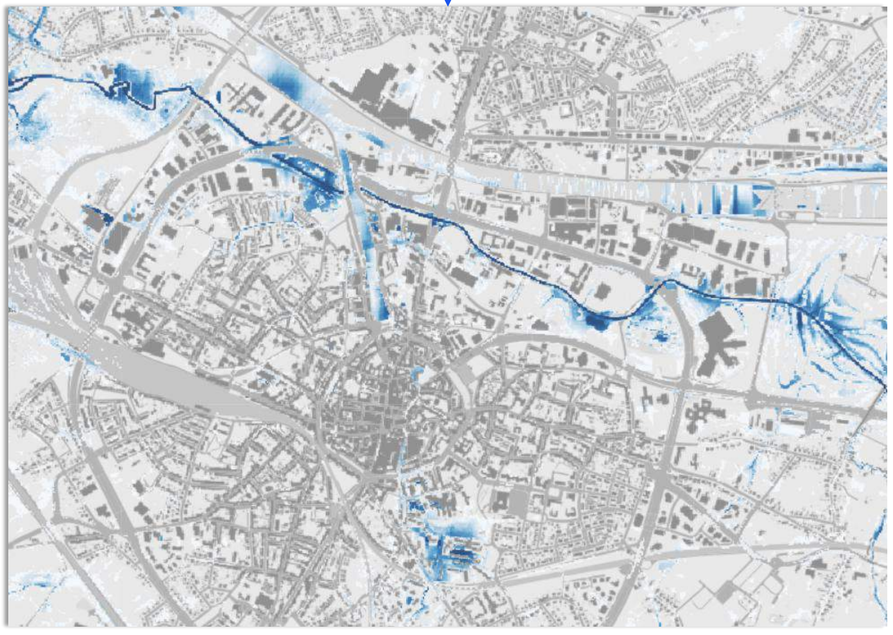
Results

Current Climate

2050 (High **Climate Impact** Scenario)



2050 (High Climate Impact Scenario)
with **Adaptation Measures**

Recent Flood-Related Projects

Different topography and climate

Different data availability

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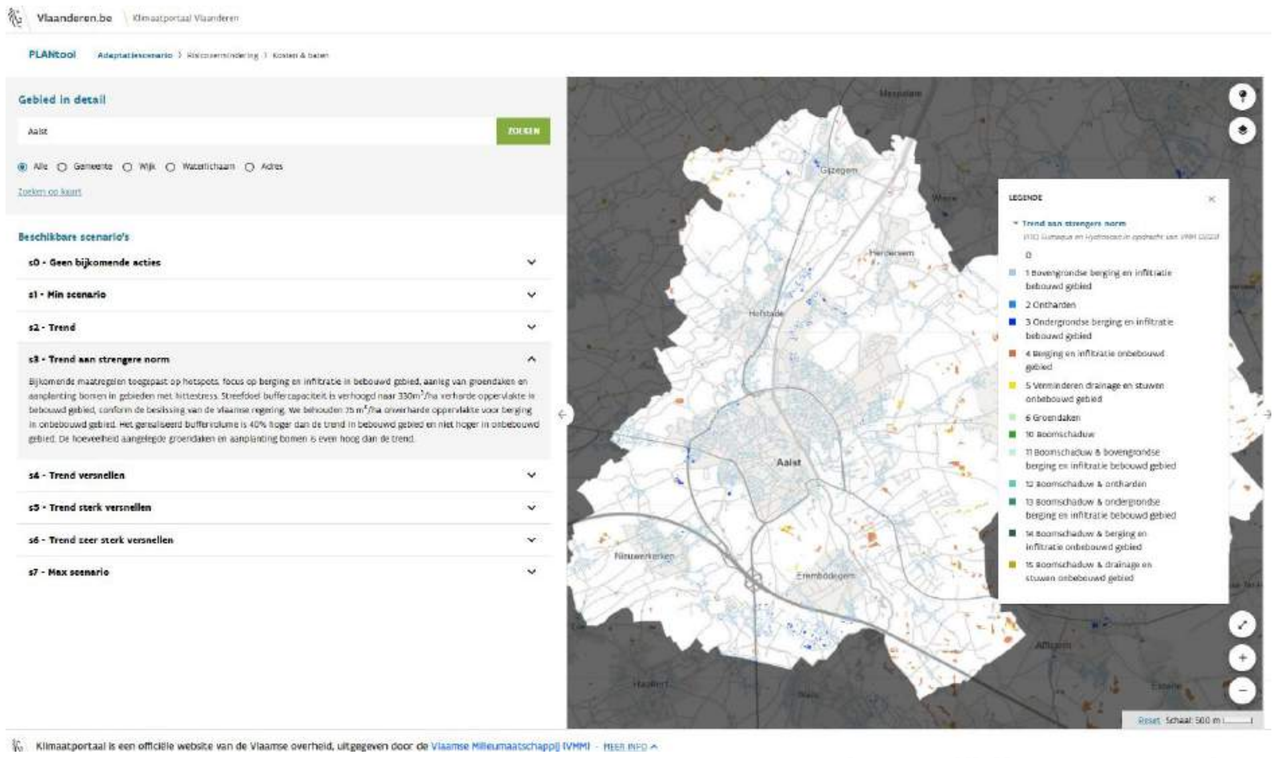
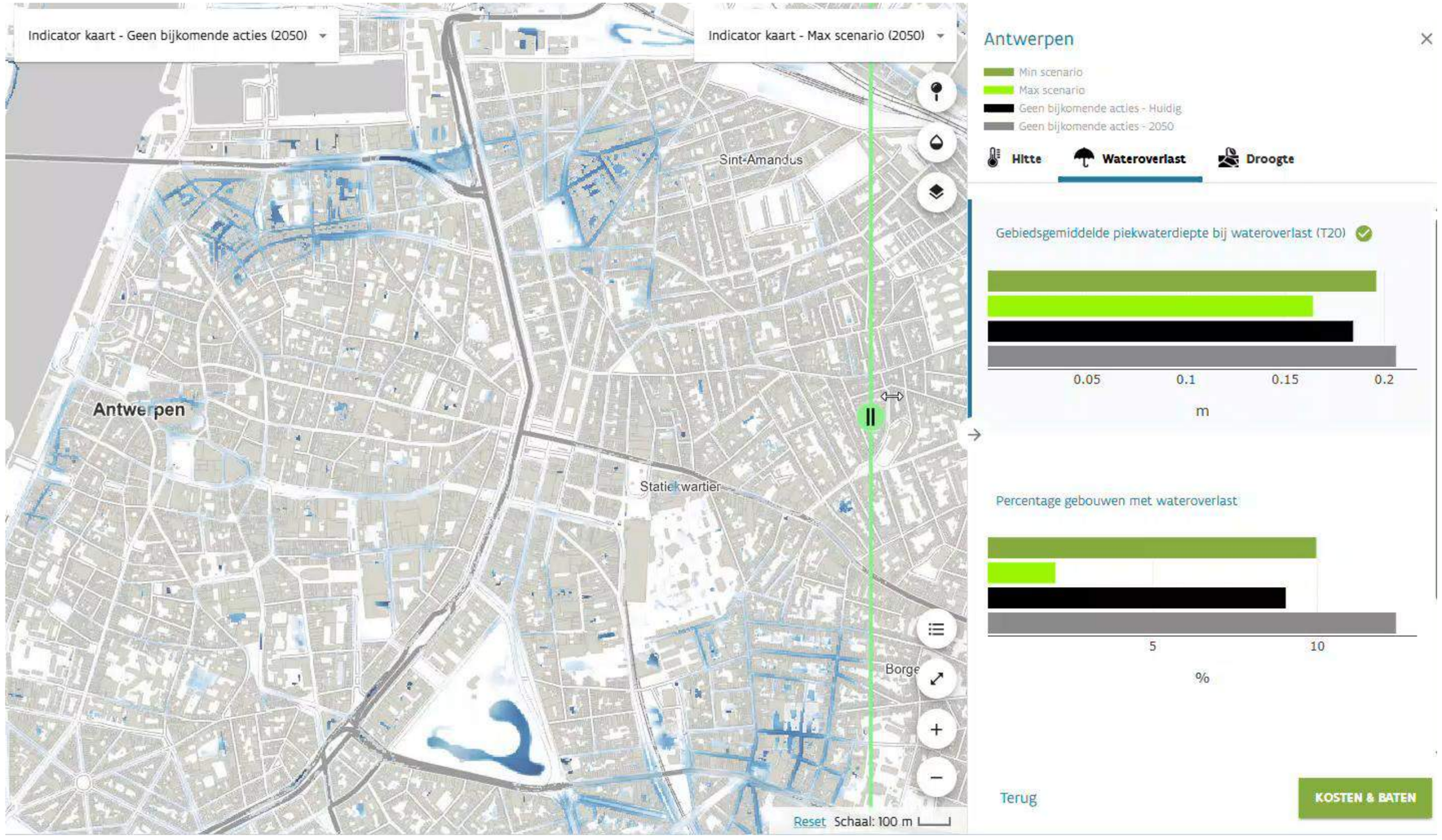
Climate Portal Flanders (Belgium)

- Internet portal developed by the Flemish environment agency, VITO, HydroScan, and SumAqua
- Supports local / regional governments to assess the consequences of climate change on:
  - **Floods**
  - **Droughts**
  - **Heat waves**
- Supports in identifying and assessing the effectiveness of climate adaptation measures



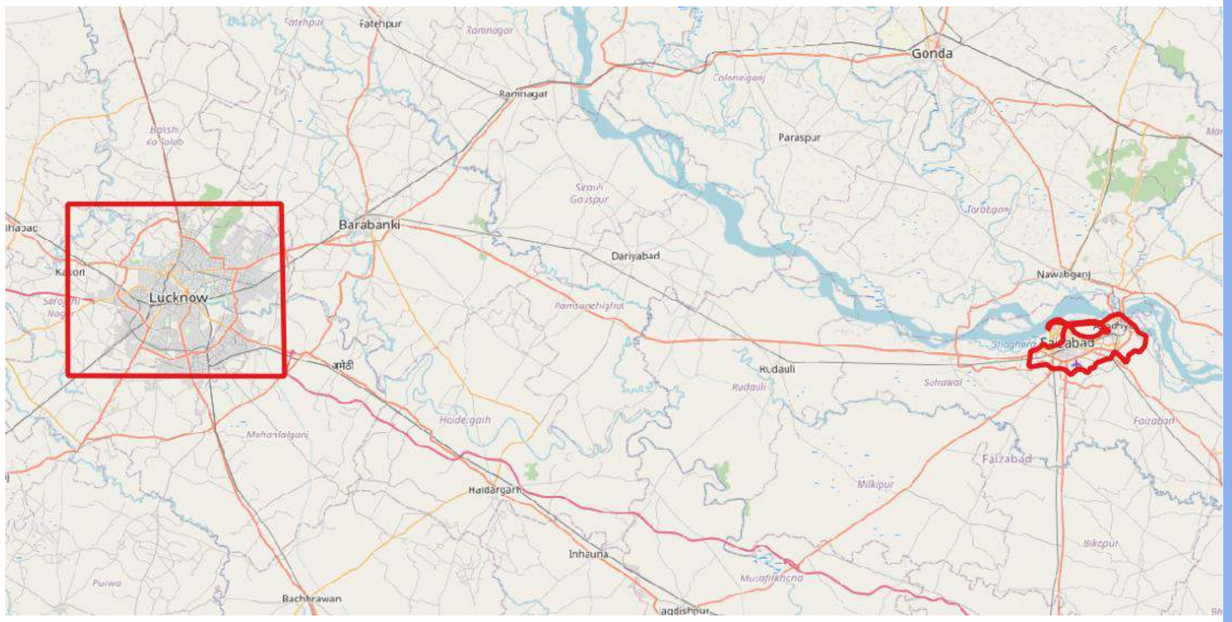
Source: https://klimaat.vmm.be

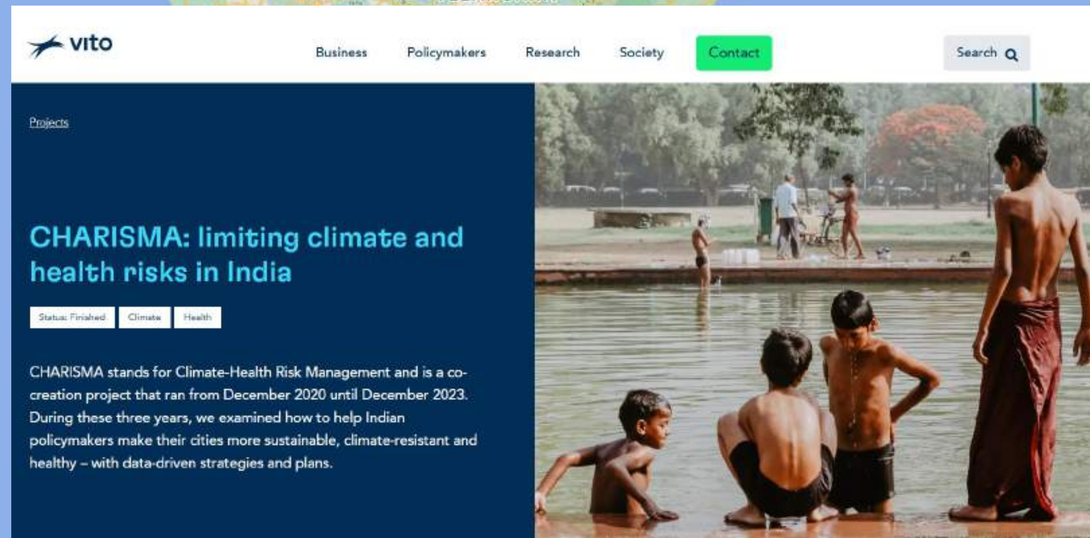
Climate Portal Flanders (Belgium)



Flood Mapping (India)

- Lucknow (Uttar Pradesh)
- Ayodhya (Uttar Pradesh)





GOAL
Set-up flood model in limited time and with (**very) limited data input**

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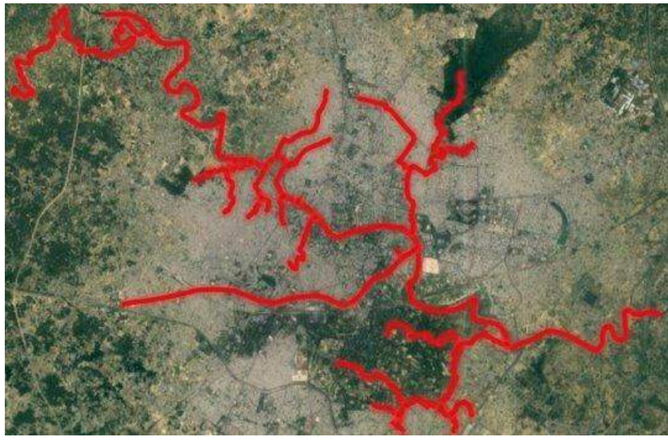
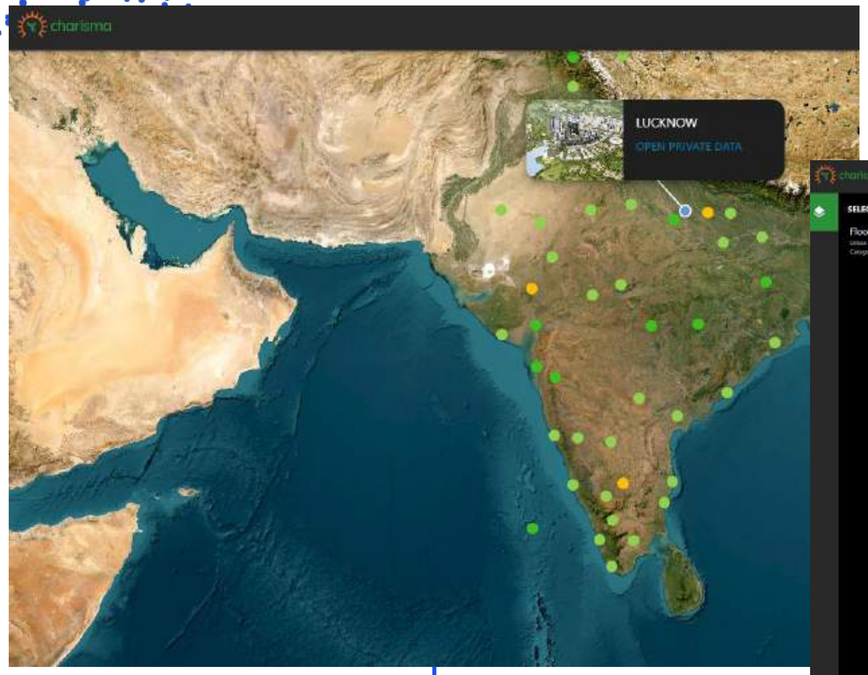
Flood Mapping (India: Lucknow)

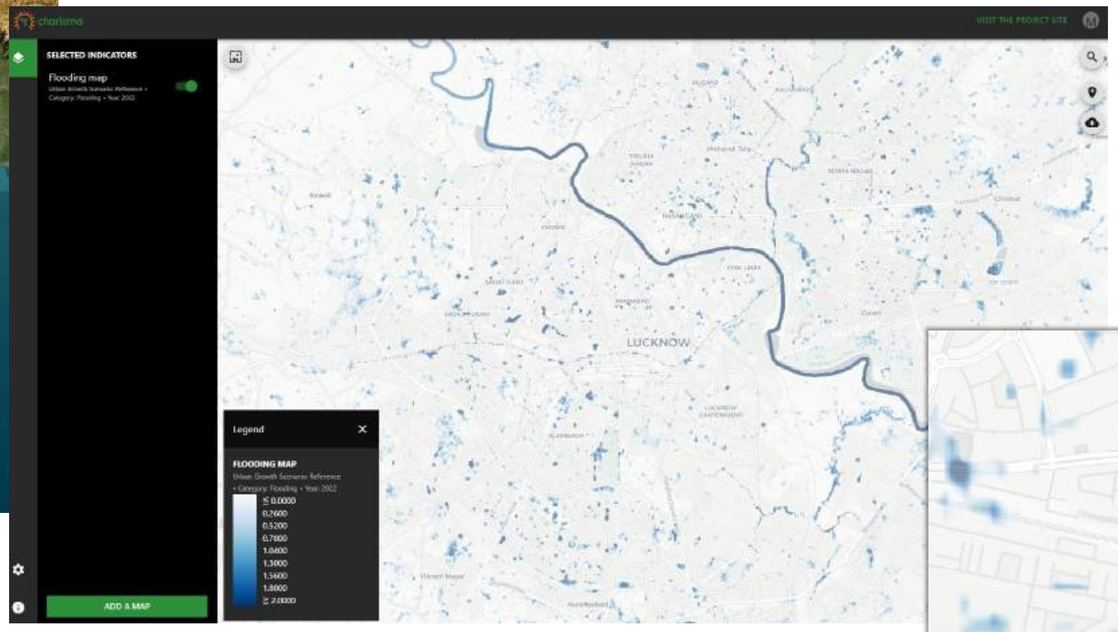
- Open-source data (topography, land use, and rivers) & literature
- Information recent floods (news)
- **Flood model**
  - Central river
  - Open drains/nalas
  - Major portion sewers choked and/or broken
  - The severe flooding in monsoon period is believed to originate from insufficient drainage capacity



Flood Mapping (India: Lucknow)

September 16, 2022

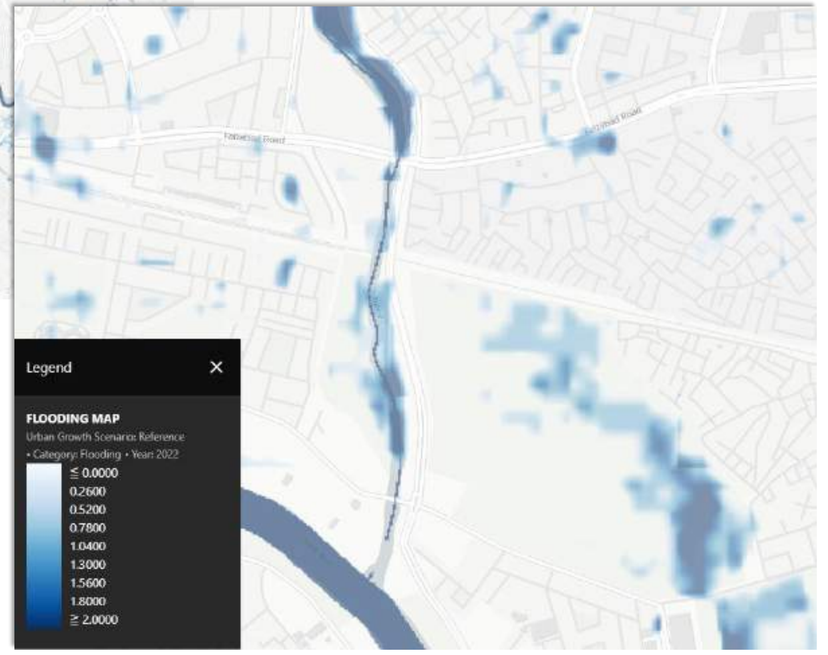




September 16, 2022

First estimate of urban flood extent based on **global maps** on Charisma portal

Local experts – validation and adaptation



✓ **Experience – validation with local data is hard**
✓ **Satellite data !**

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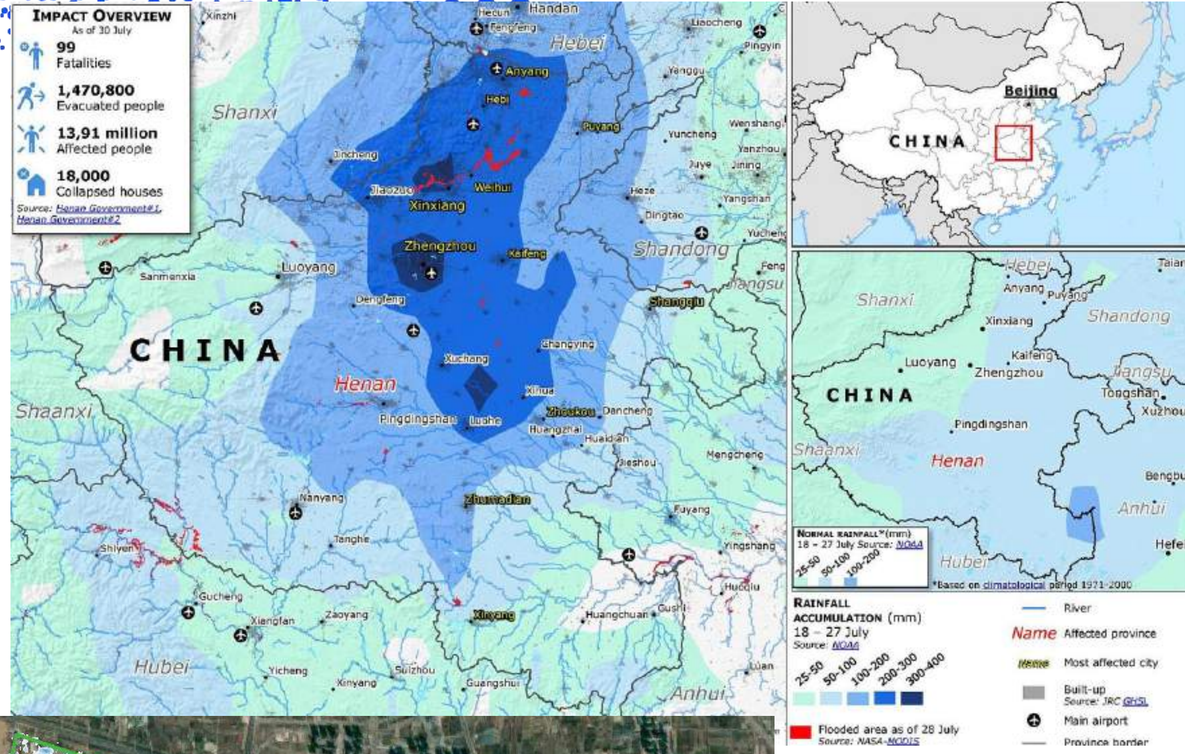
Flood Mapping (China)

China: Zhengzhou

- Project in China 2021
- **Spong city**
- Focus: set-up model in case of **limited data**
- Very severe urban flood in 2021 (**T>1000 years**)



HYDROSCAN
smart water management

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Flood Risk Platform (Vietnam)

- Quang Nam **often** hit by tropical storms with **urban floods**
- **Satellite-based flood mapping approach combined with urban flood model**
- Validated urban flood model
  → scenario-analysis
  → real-time flood model
  → economical flood damage

HYDROSCAN smart water management

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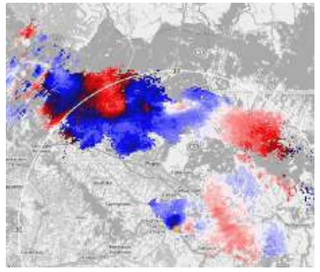
Flood Risk Platform Quang Nam (Vietnam)

Operational DSS for flood warning in Vietnamese conditions

Flood4Cast **Real-time** Alerter, including water level measurements

Installation of X-band rain radar



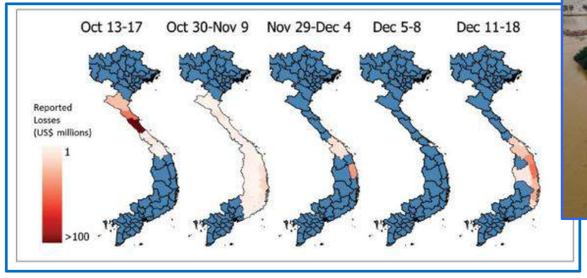
Flood maps

Integrated flood model, flood maps of the existing situation, validation with Sentinel-1 satellite

Flood maps for future climate

To provide insight into the economic impact of floods

Economic Flood Risk Model and Economic Flood Risk and Damage Maps

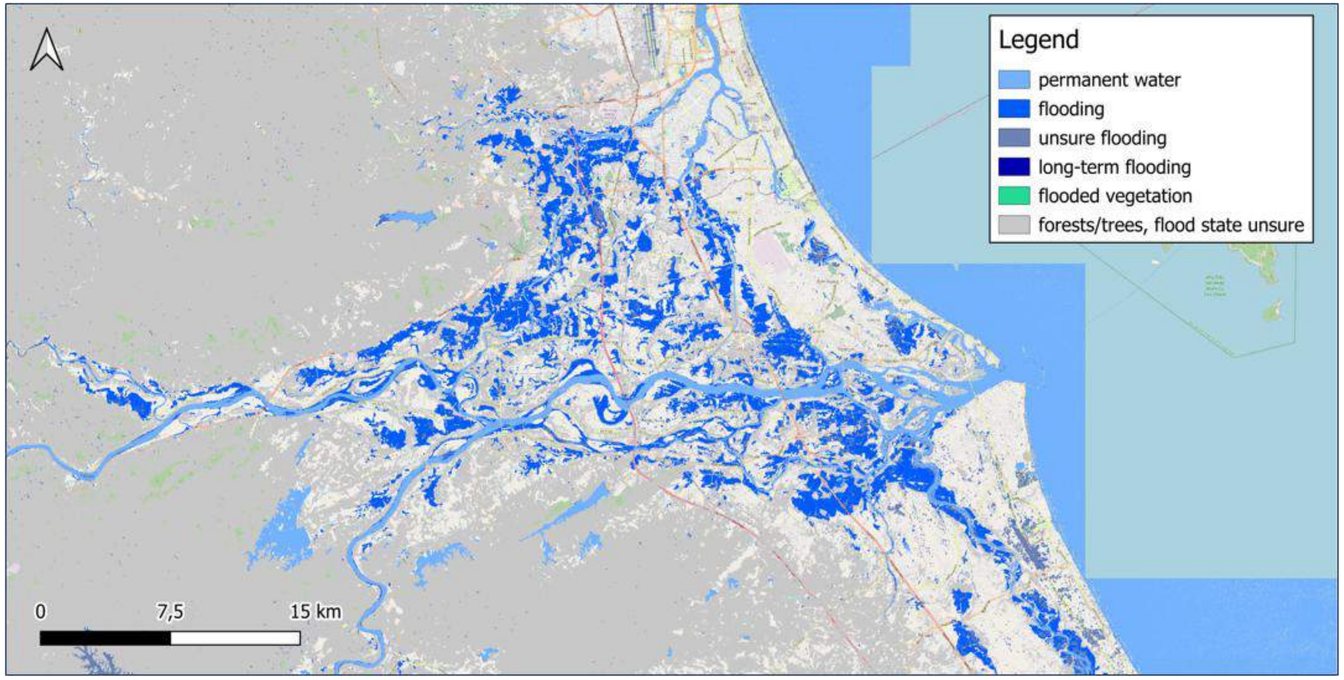


Awareness and preparedness, transfer of know-how

Increasing flood awareness and preparedness for all stakeholders and users

Quang Nam (Vietnam): Flood Mapping Using Remote Sensing

Sentinel-1 based flood map for 2022 storm (2022-10-15)



June 2025 (not in monsoon period)

Extreme rain and floods caused by storm No. 1, appearing only once in 40 years

According to the National Center for Hydro-Meteorological Forecasting, the flood caused by storm No. 1 (Wutip, meaning butterfly) is special, unusual and extreme, rarely seen in the history of hydro-meteorology in the Central region.

Báo Công an Nhân dân • 17/06/2025

Q&A

Global Gateway

Q&A Panel

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Ask the Experts

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Jente Broeckx

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Thank you!

Please give us your opinion

Scan the QR code to fill in the survey.

INTPA F4 - Urban Development Technical Facility UDTF.

The UDTF focuses on supporting partner countries in their urban development challenges. It delivers technical assistance and policy advice to improve the quality and impact of the EU's interventions in urban development at all levels - local, regional and global - with a focus on Africa, Asia, the Caribbean, and Latin America.