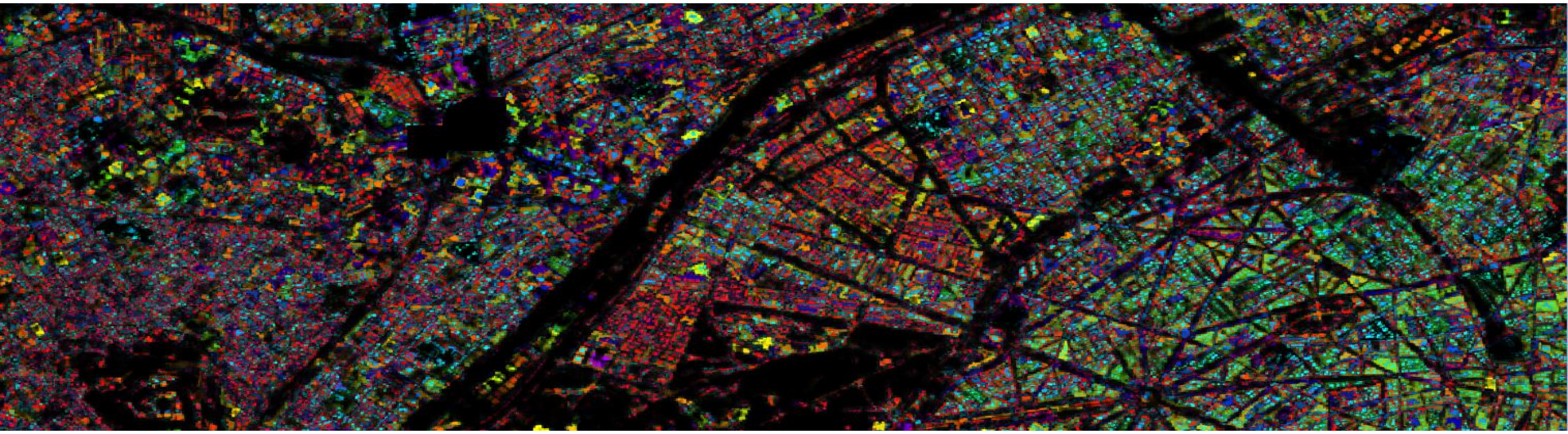
European Commission



GLOBAL HUMAN SETTLEMENT LAYER
IDEA, CONCEPT AND METHODOLOGY

Geospatial Technologies and Remote Sensing for Monitoring SDGs

ISEPEI

European Commission

esri

CEU Summer University | CENTRAL EUROPEAN UNIVERSITY

The Urban Millennium

"In the last century the world has been rapidly urbanizing.
In 2008 for the first time in history urban population outnumbered rural population" *

"It is expected that 2/3 of the pop will be living in cities"*

"The urban population in the developing world will double by 2030. The implications are staggering. One is that we have 20 years to build as much urban housing as was built in the past 6,000."

* UN Habitat global activity report 2015

Epistemology of settlement

- Physical description focused on the presence of dwellings
- Made of parts: building/dwelling, roads, open spaces
- Any dwelling included – tents to skyscraper
- Any size included – from hamlet to megacity

European Commission

Human Settlement Mapping

EARTH OBSERVATION FOR SETTLEMENT MAPPING

Advances in satellite technology

Landsat 5 (1984)

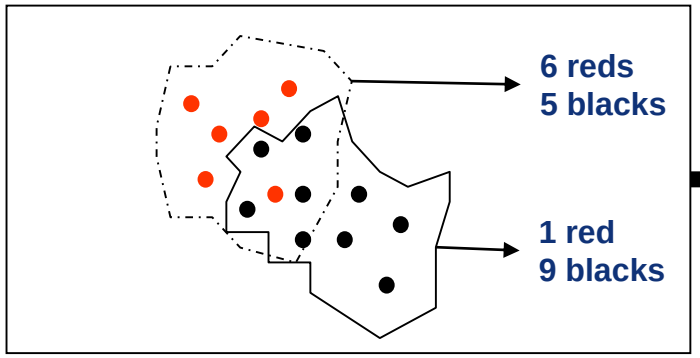
Landsat 7 (1999)

SPOT 4 (1998)

IKONOS (2000)

WorldView-2 (2010)

Addis Abbeba



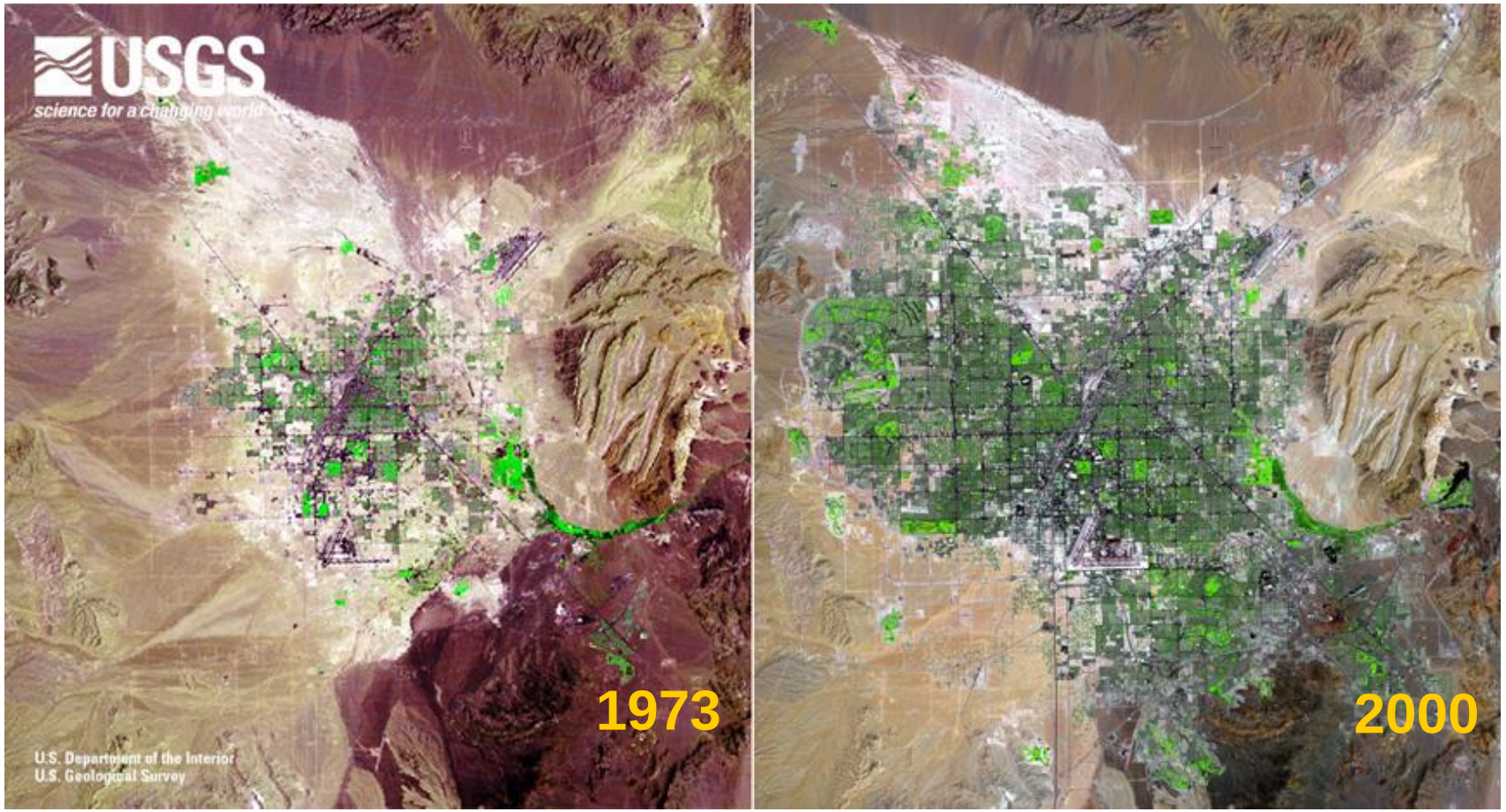
Geo-spatial information

Decisions, action

Sensor (Satellite)

Real world

Urban Growth : Las Vegas, Nevada



Population: 358,000 **1,560,000**

European Commission

Why is Google earth not sufficient?

Why is Google Earth not sufficient?

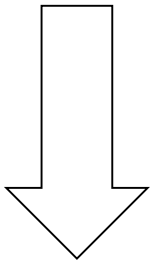
Pictures are not enough

- Nice houses, trees, etc.

We need numbers

- How many buildings?
- How much people?
- How much does a city grow?
- How much is at risk?

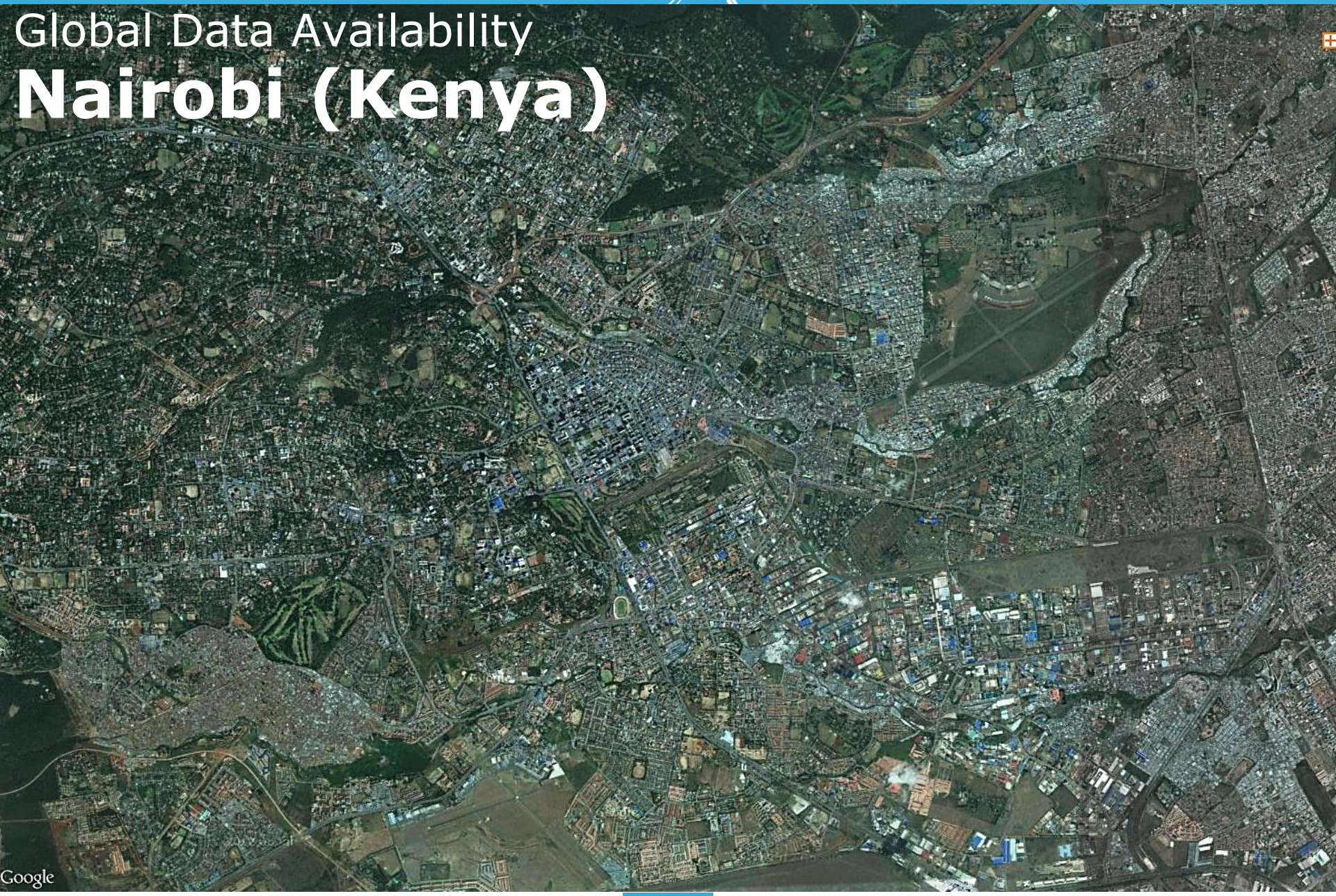
Data



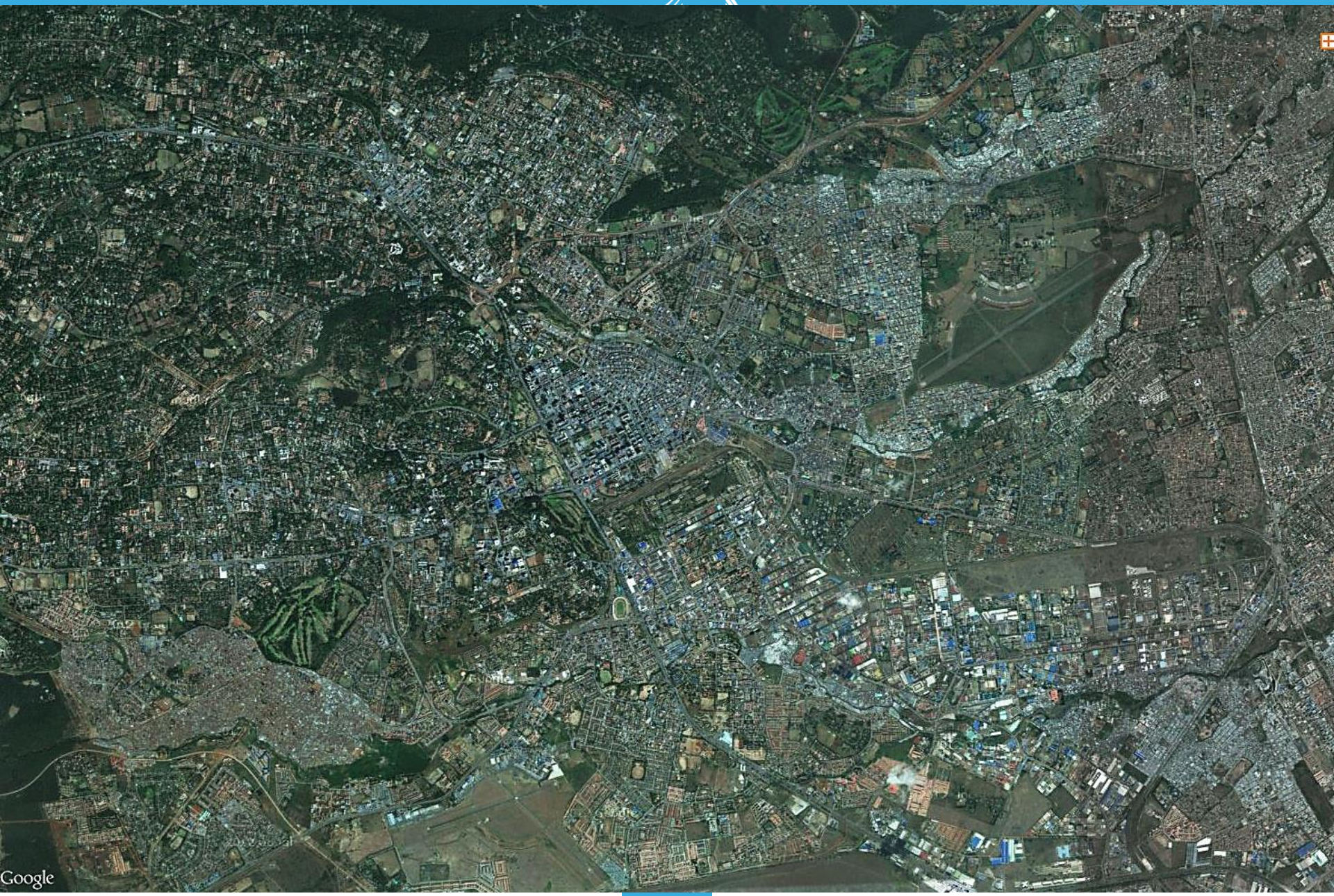
Information

Global Data Availability

Nairobi (Kenya)



Joint
Research
Centre


Google

The JRC proposal

THE GLOBAL HUMAN SETTLEMENT LAYER CONCEPT

What is GHSL?

New information layer

Global Human Settlement Layer

New technology

for automatic image information extraction designed for processing of massive volume of high or very-high resolution input images

A platform

- integrating different sources contributing to describe the human settlement facts and figures
- supporting a variety of applications including **exposure mapping, population modelling, regional analysis**

http://ghslsys.jrc.ec.europa.eu/

Data access policy

- **GHSL data is public, free and open;**
- **Global complete, fine-scale, national/admin borderless (agnostic); and**
- **Produced also in low-income countries where no census data is available**

European Union Open Data Portal

https://data.europa.eu/

Joint Research Centre

GHSL products

	GHS_BU	GHS_POP	GHS_SMOD
Definition	Global built-up grids	Global population grid	Global human settlement model
Epoch	1975, 1990, 2000, and 2015	1975, 1990, 2000, and 2015	1975, 1990, 2000, and 2015
Resolution	38 m 250 m	250 m	250 m

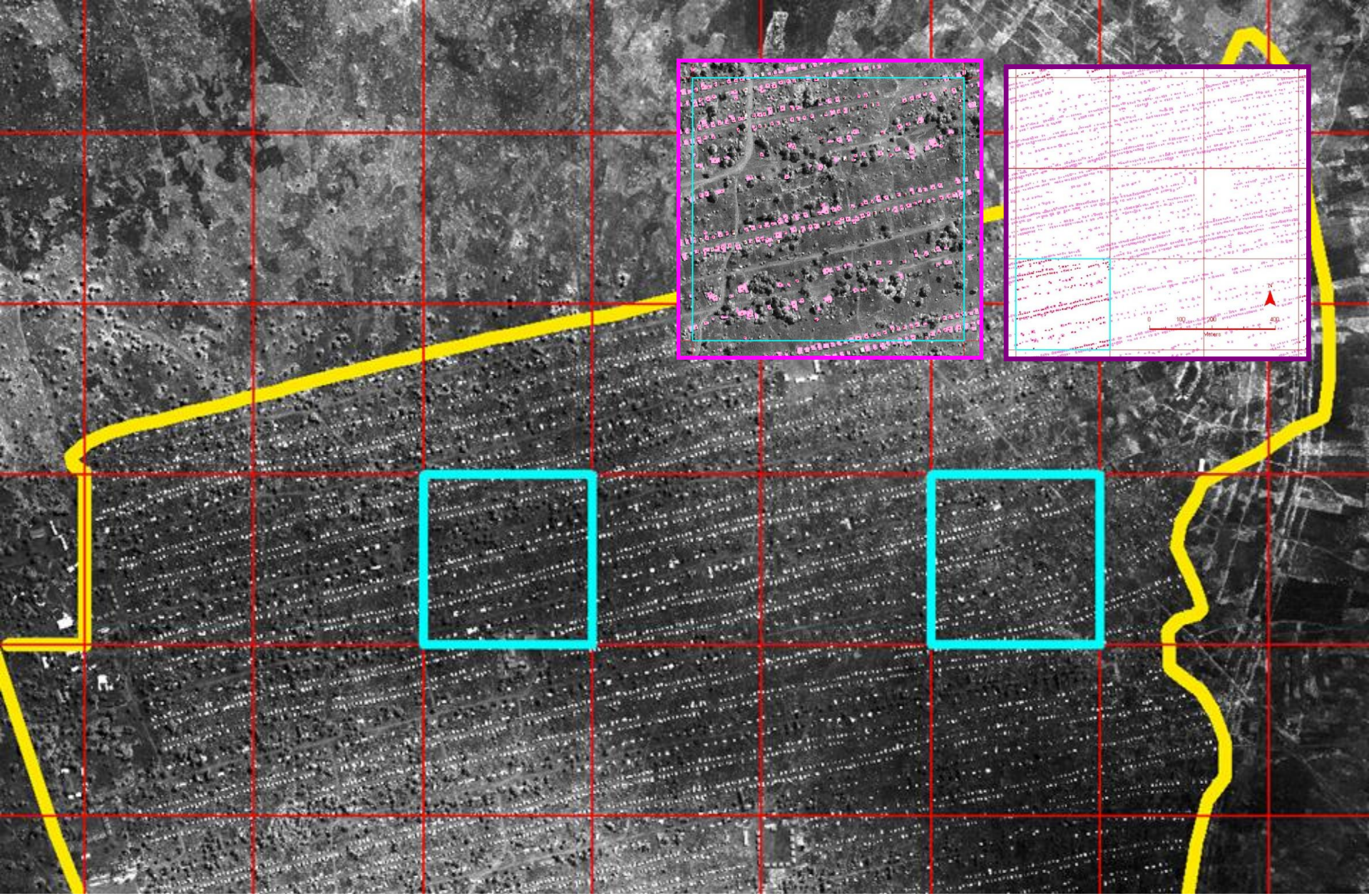
GHSL – Baseline data anatomy

Fine-scale built-up areas
1975,1990,2000,2014
Landsat 75,30,15m

Population grids
1975,1990,2000,2015
250m

Settlement model
1975,1990,2000,2015
250m , 1000m
Harmonized city spatial footprint
"from the hamlet to the megacity"

GLOBAL BUILT-UP GRIDS (GHS_BU)



2003 – first tests on automat. enumeration of tents
Lukole refugee camp, Tanzania. Input Ikonos data 1,4-m-res

HR Global Human Settlement Layer

Proof of concept 1st operational test 2012

Total 11
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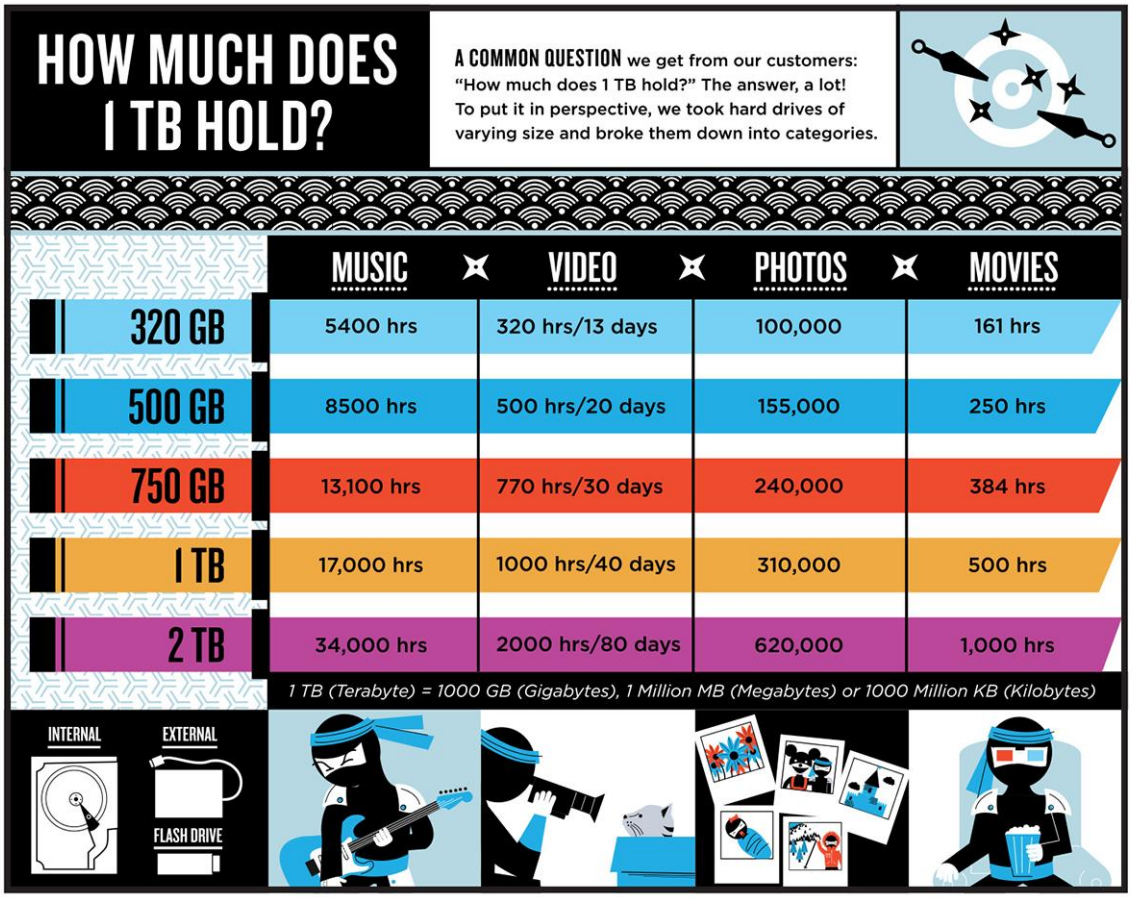
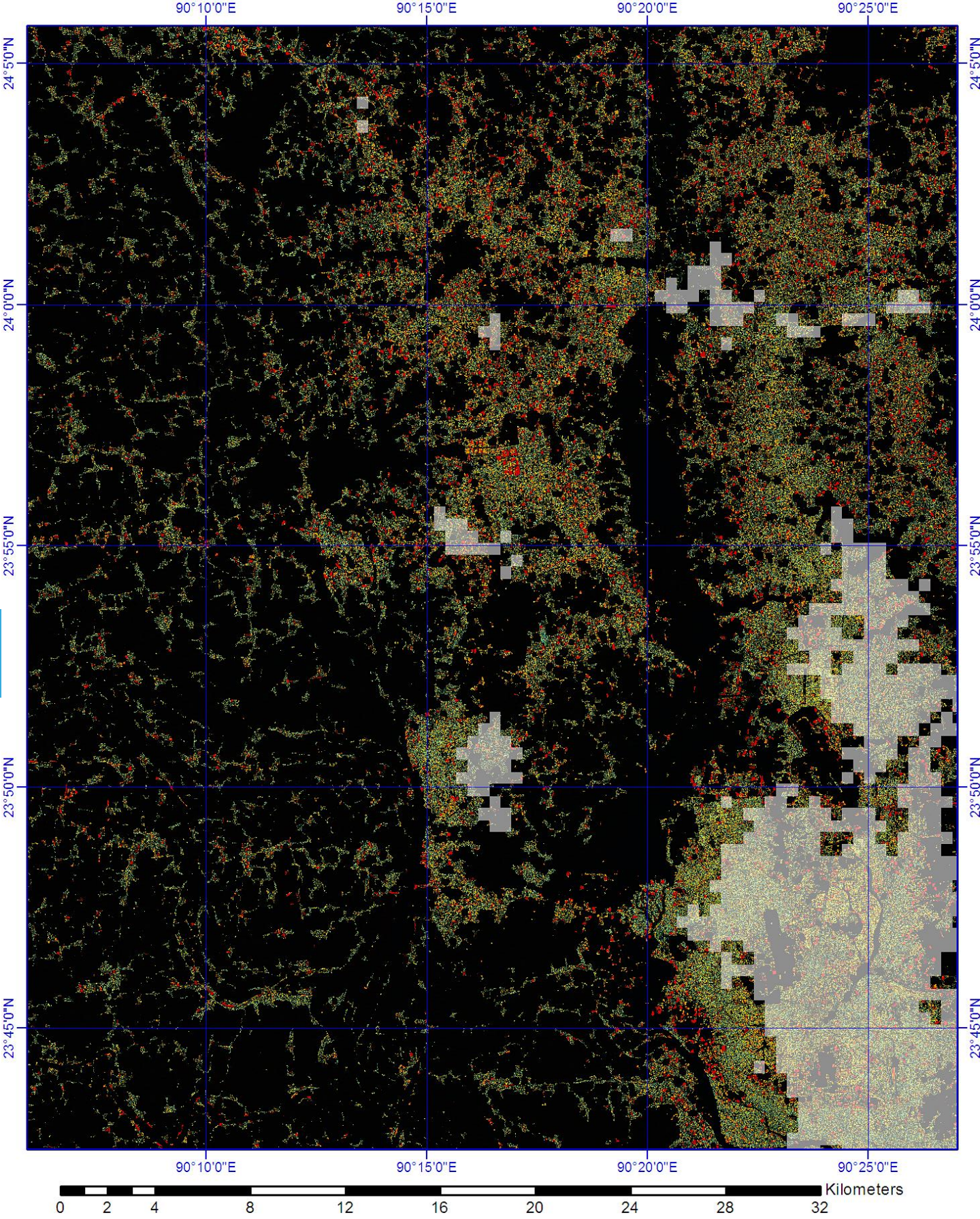
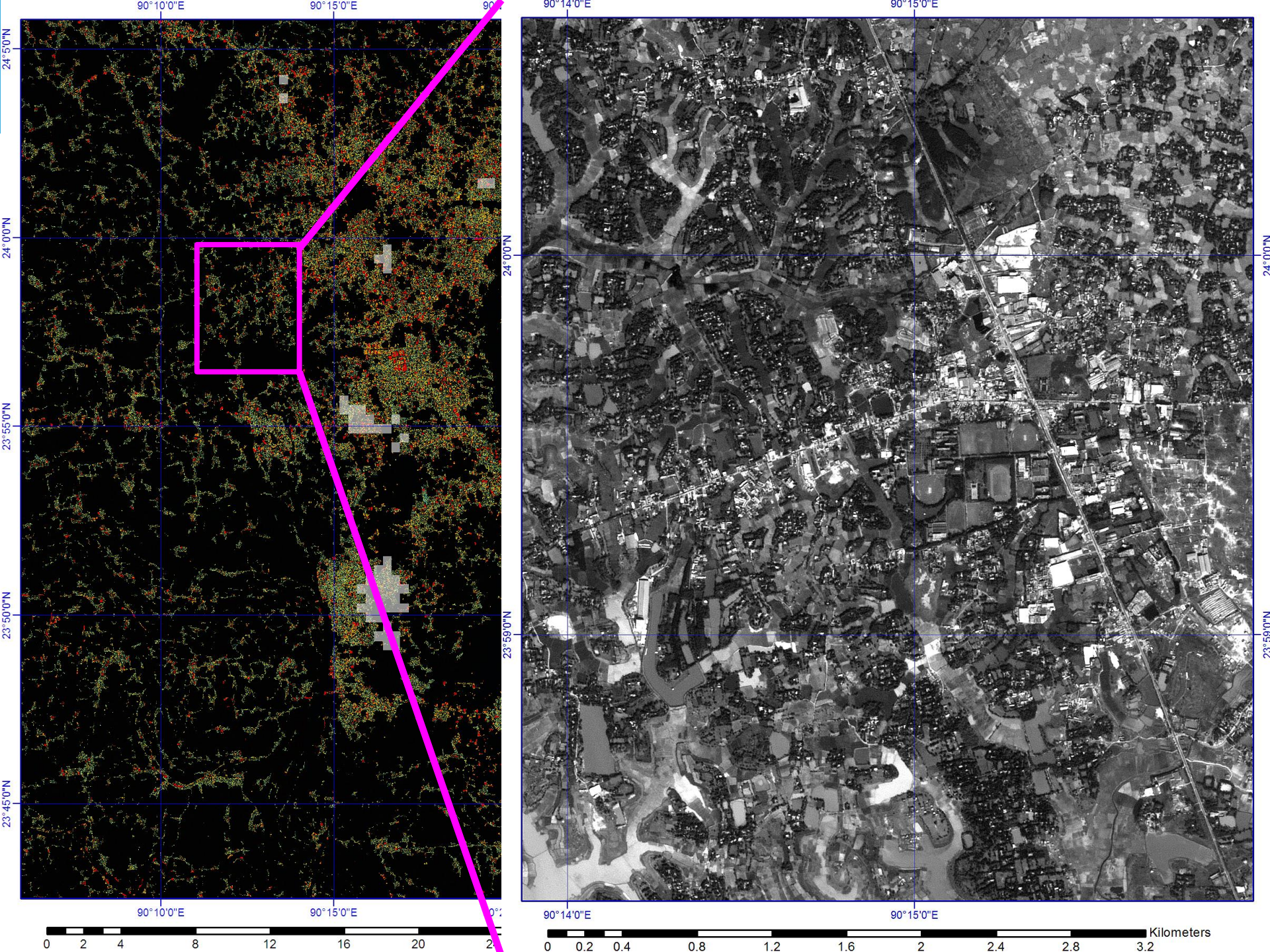




Dhaka, HR GHSL

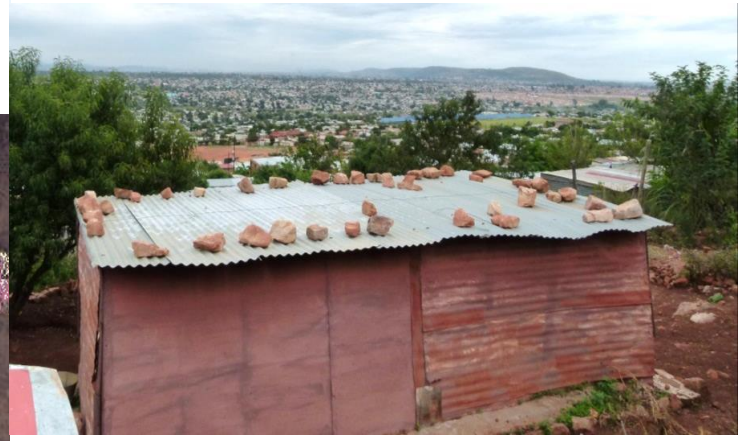
(white: LR MODIS Urban layer, color: HR GHSL)


90°10'0"E
90°15'0"E
24°5'0"N
24°0'0"N
23°55'0"N
23°50'0"N
23°45'0"N
0 2 4 8 12 16 20
90°14'0"E
90°15'0"E
23°59'0"N
0 0.2 0.4 0.8 1.2 1.6 2 2.4 2.8 3.2
Kilometers

2012: Fine scale analysis of the whole European settlements using 2.5-m-res input image data (GMES/Copernicus CORE003 2012)
Credits: European Commission, DG Regional Development /Joint Research Centre

2014: GHSL - South Africa pilot study

Development of an advanced GHSL workflow for poor settlement monitoring and characterization processing of approx. 500 SPOT-5 scenes national multi-temporal coverage

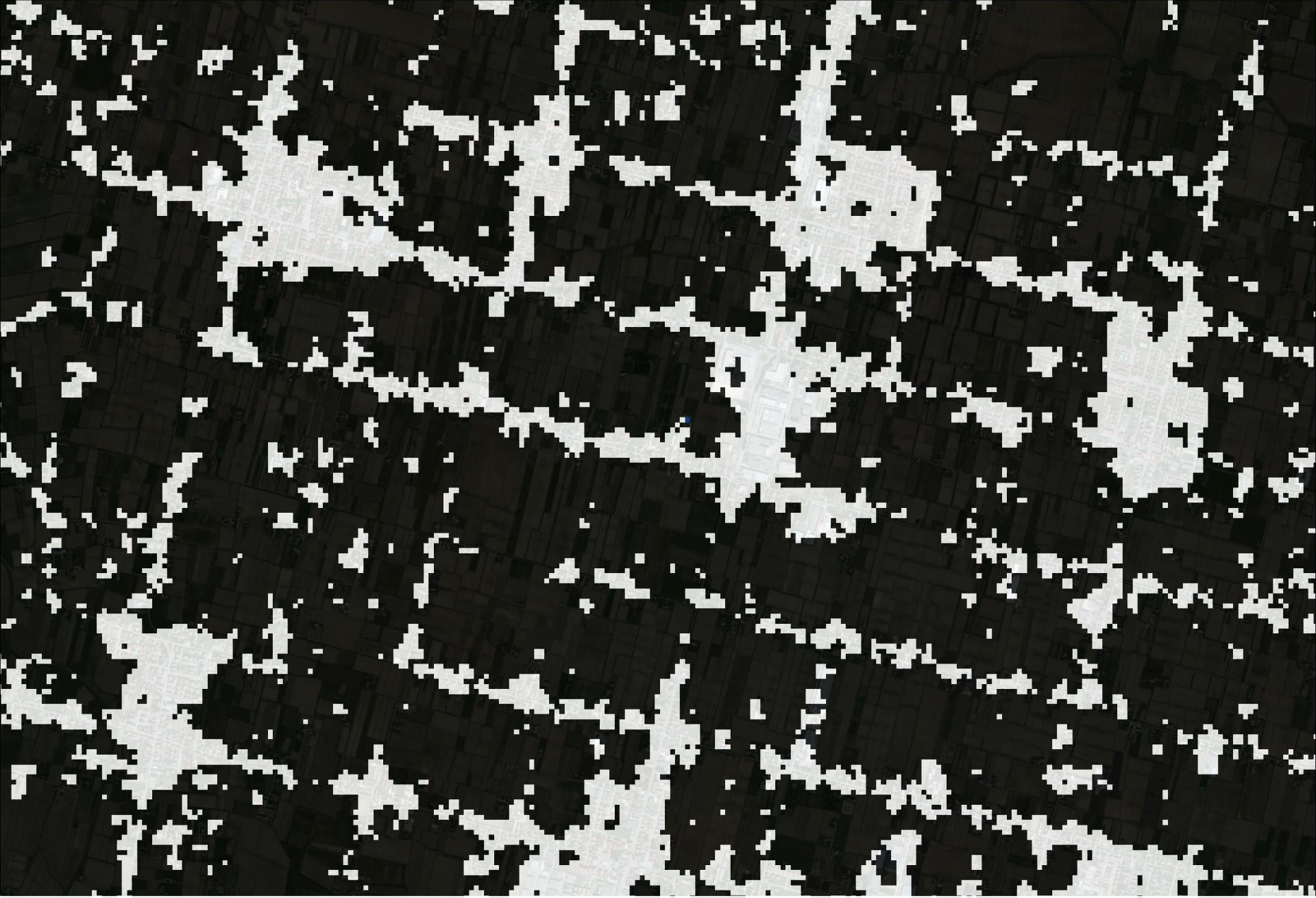


2014 – first tests on automat. assessment of global built-up areas using Landsat data GLS 1975,GLS 1990,GLS2000, and Landsat 8

Landsat GHSL: first available global dynamical assessment

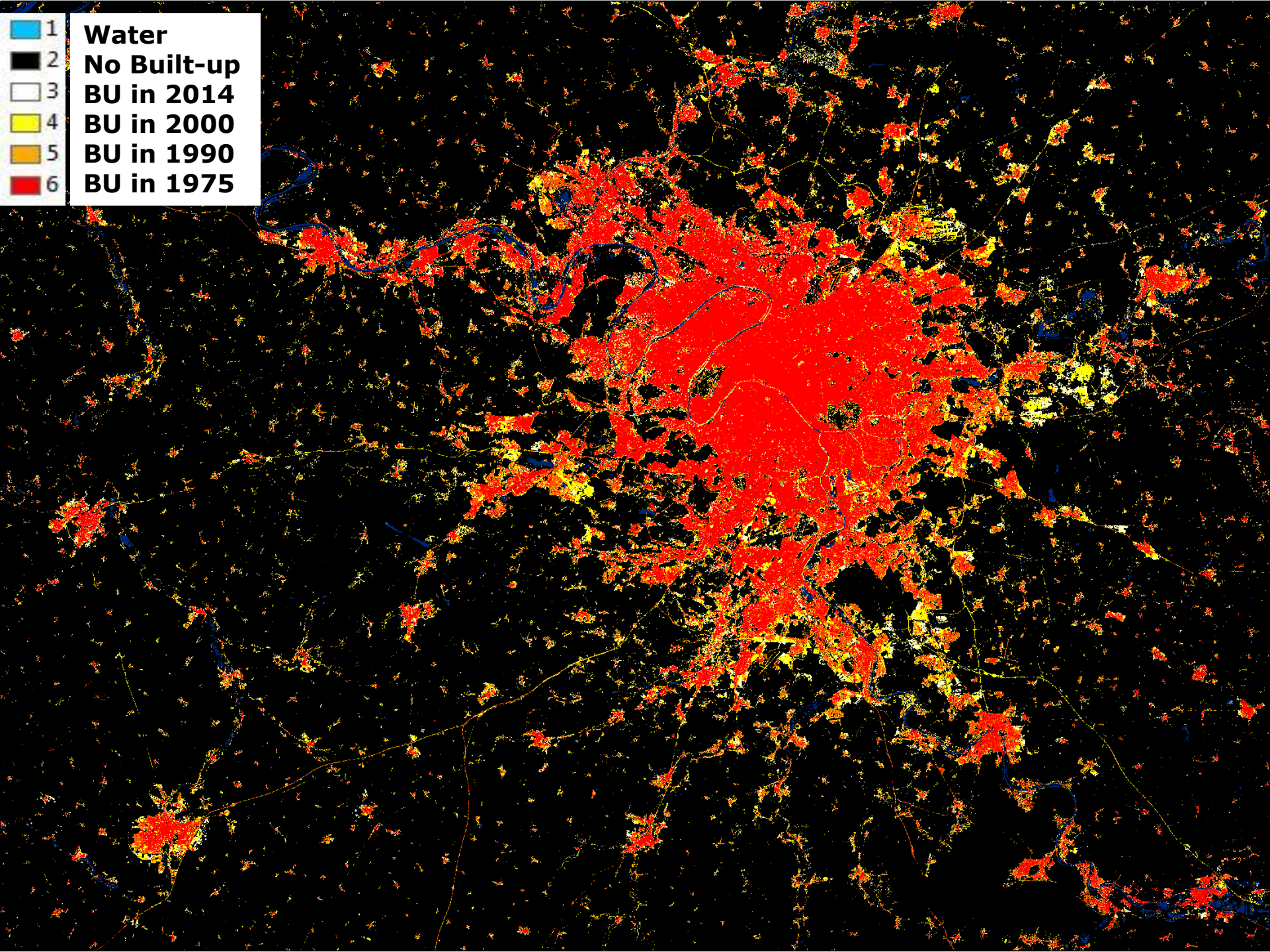
New information / methods allow to describe global settlement dynamics

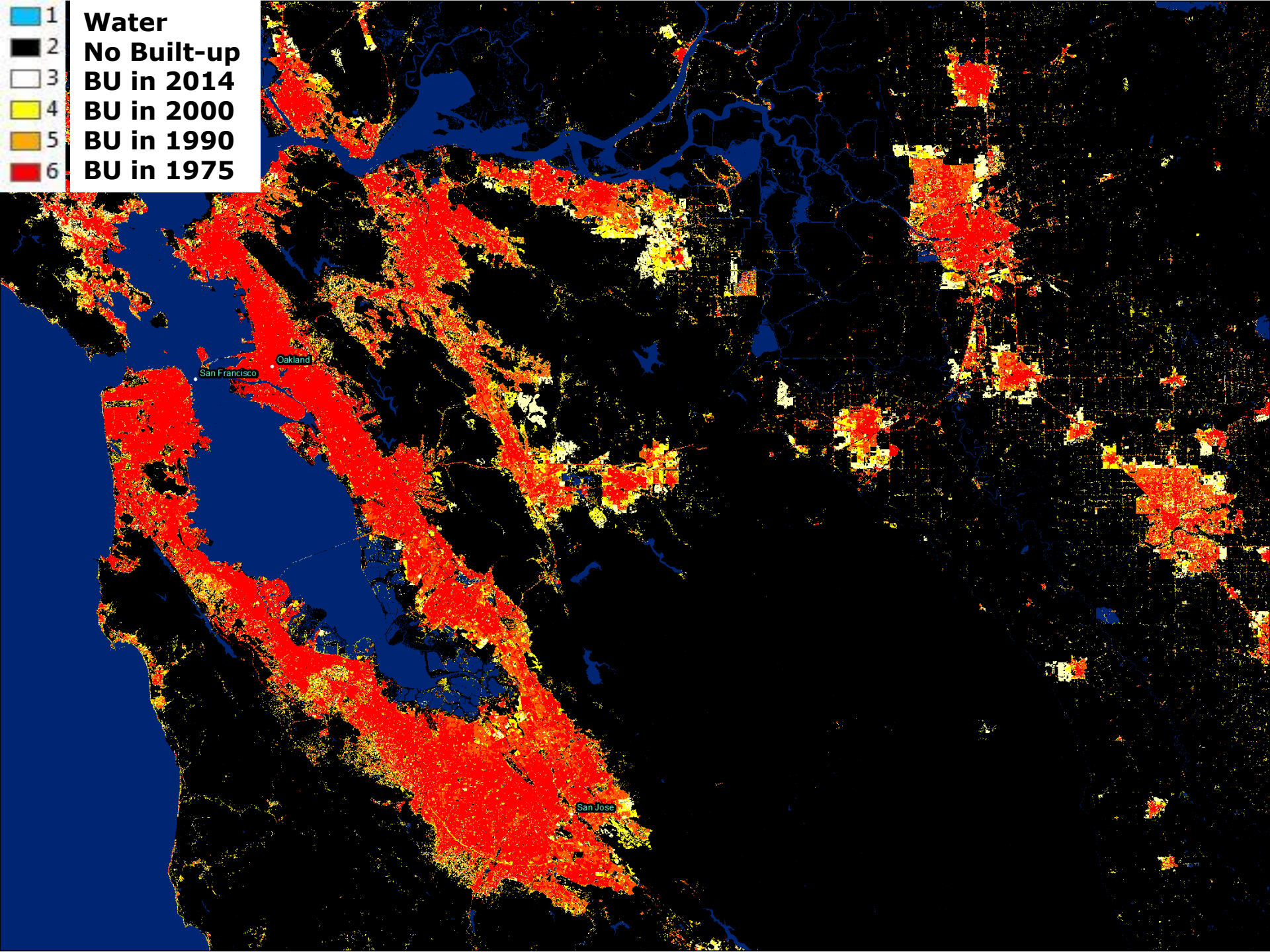
1975 ----------1990----------2000----------2014

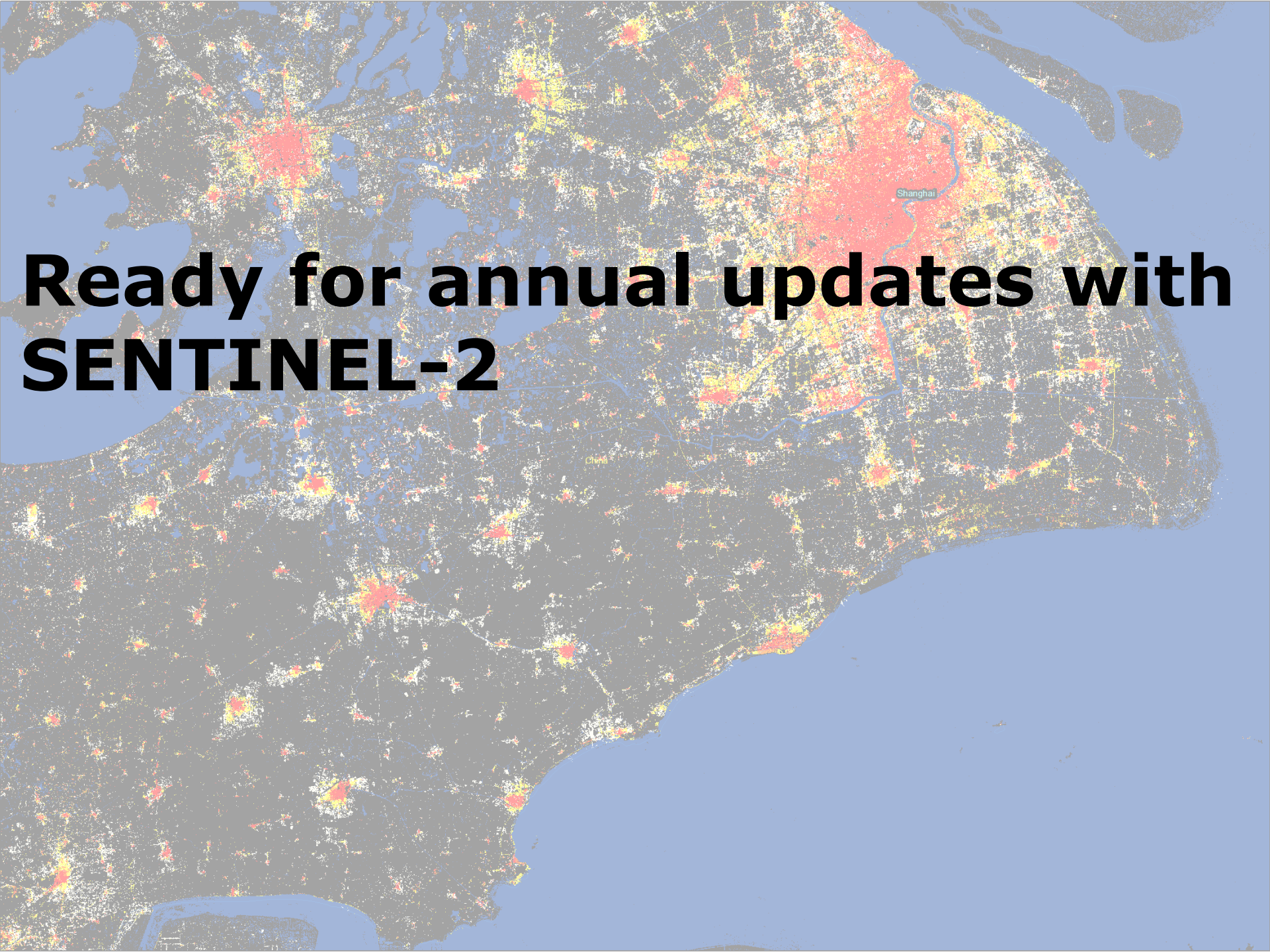


What we detect: “built-up area” = all spatial units (30x30m) where a building or part of a building can be recognized

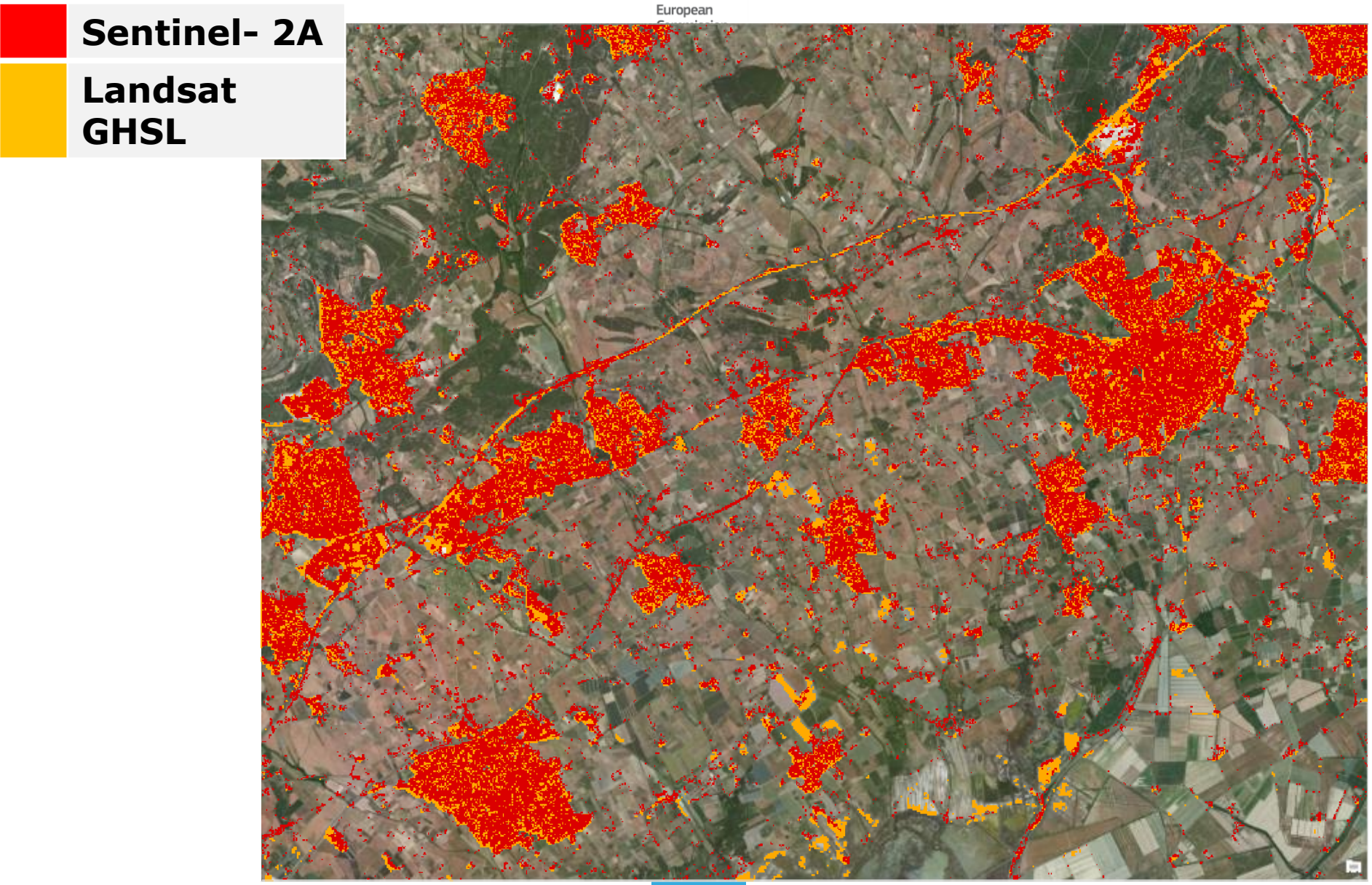

Madison
Milwaukee
Lansing
Detroit
Chicago
Cleveland
Columbus
Springfield
Indianapolis
Cincinnati
St Louis
Sensor value-added: MERIS GLOBCOVER – Landsat GHSL


1
2
3
4
5
6
Water
No Built-up
BU in 2014
BU in 2000
BU in 1990
BU in 1975


1
Water
2
No Built-up
3
BU in 2014
4
BU in 2000
5
BU in 1990
6
BU in 1975
San Francisco
Oakland
San Jose



Ready for annual updates with SENTINEL-2


Sentinel- 2A
Landsat
GHSL

GLOBAL POPULATION GRIDS (GHS_POP)

Population estimates

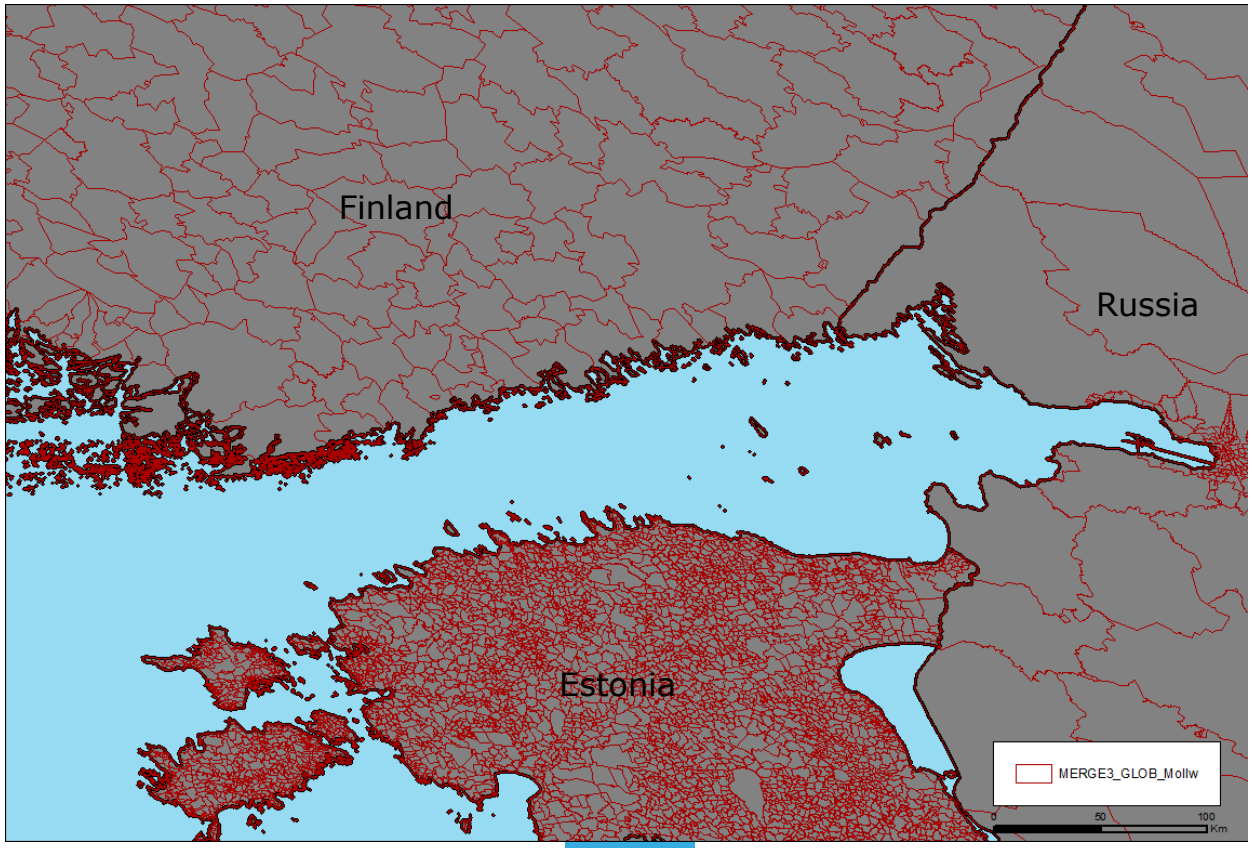
Input data – GPW features:

Source: McManus et al., Lessons Learned from the production of Gridded Population of the World Version 4 (GPW4), EFGS 2014.

Population estimates

Input data – GPW features:

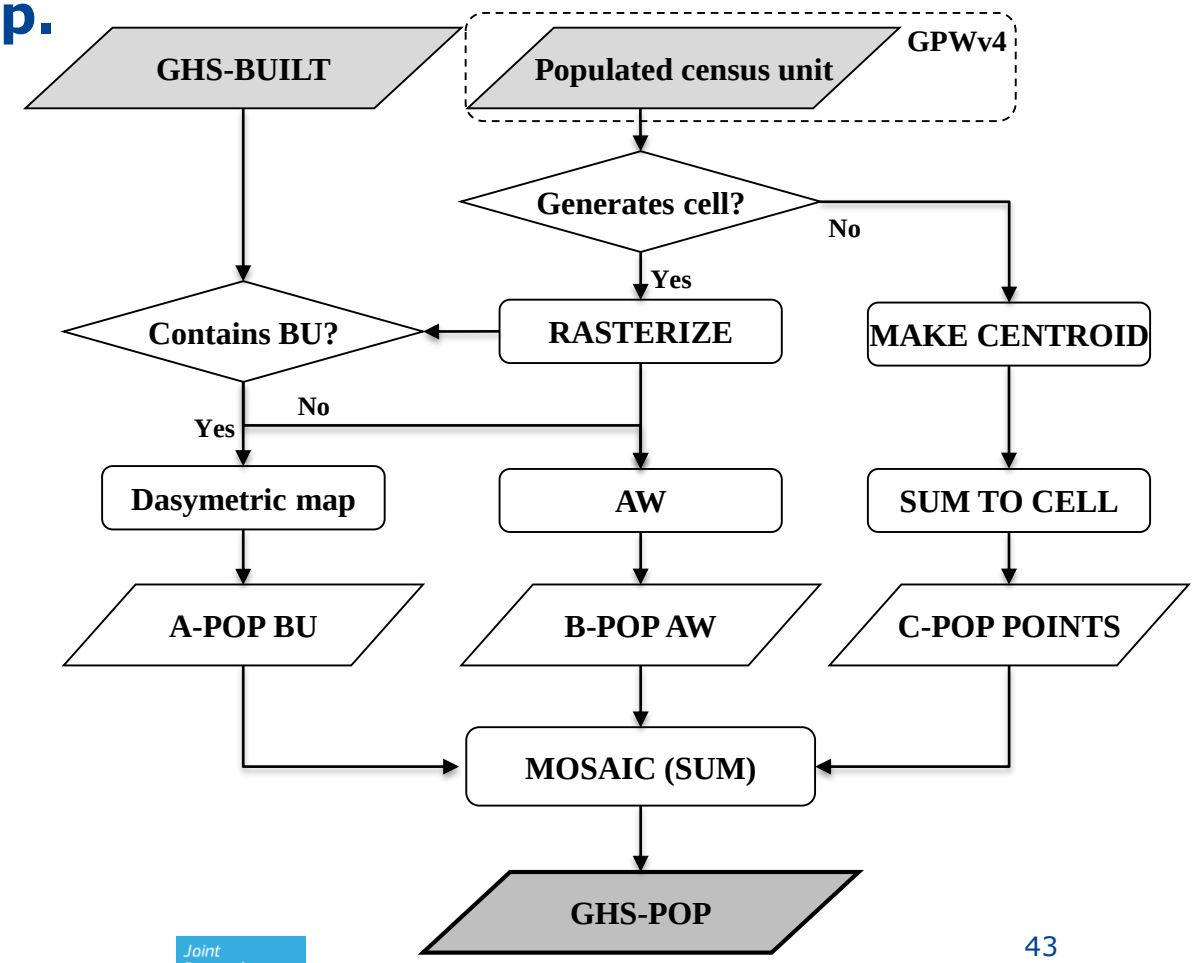
- Gulf of Finland region



GHSL-based global population grids

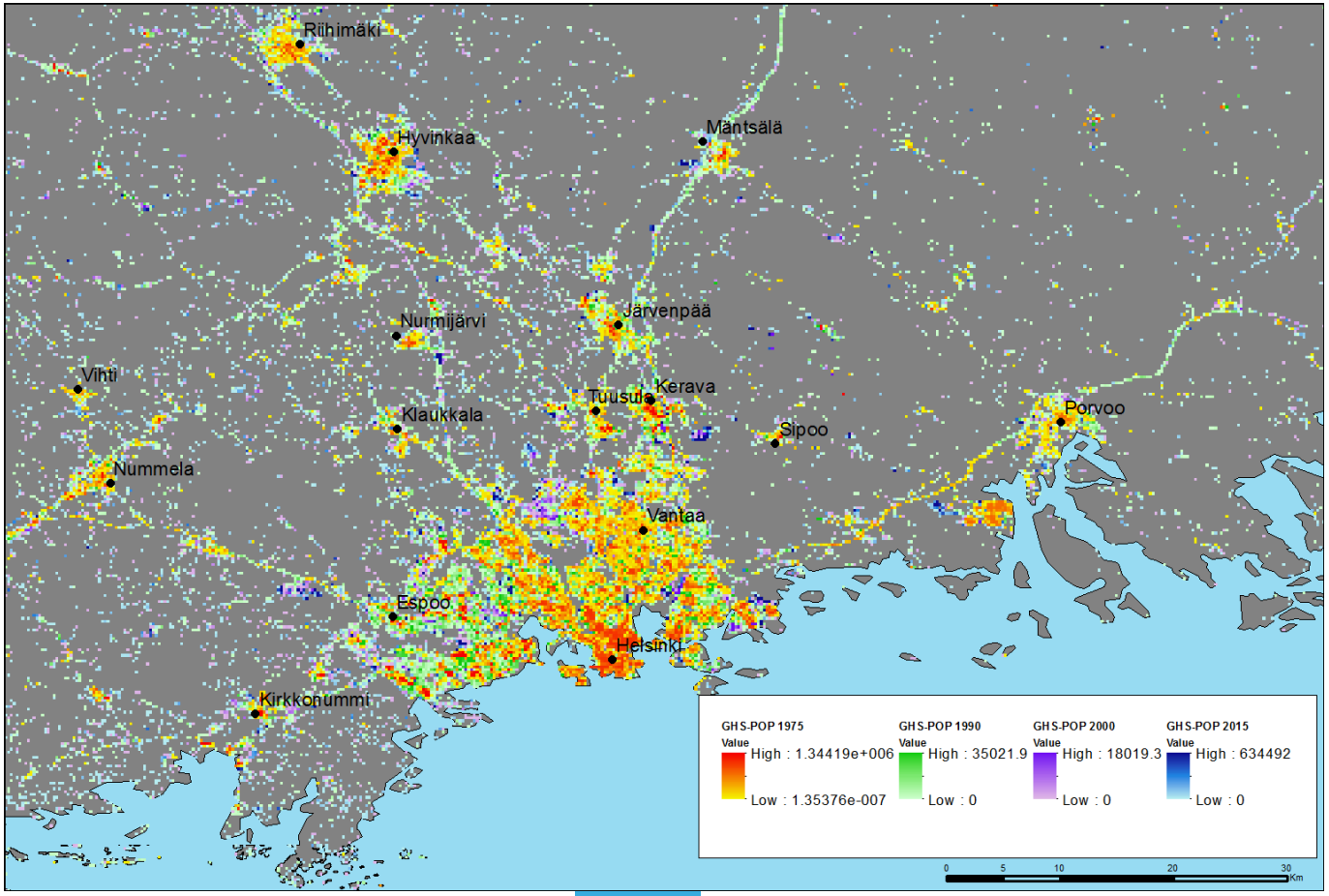
Methodology for Pop. disaggregation

- **Dasymetric mapping:**
  - Volume-preserving
  - Mollweide projection



Population grids: GHS-POP v.1

- **Pop. density 1975-1990-2000-2015 @ 250m**
- Helsinki, FI



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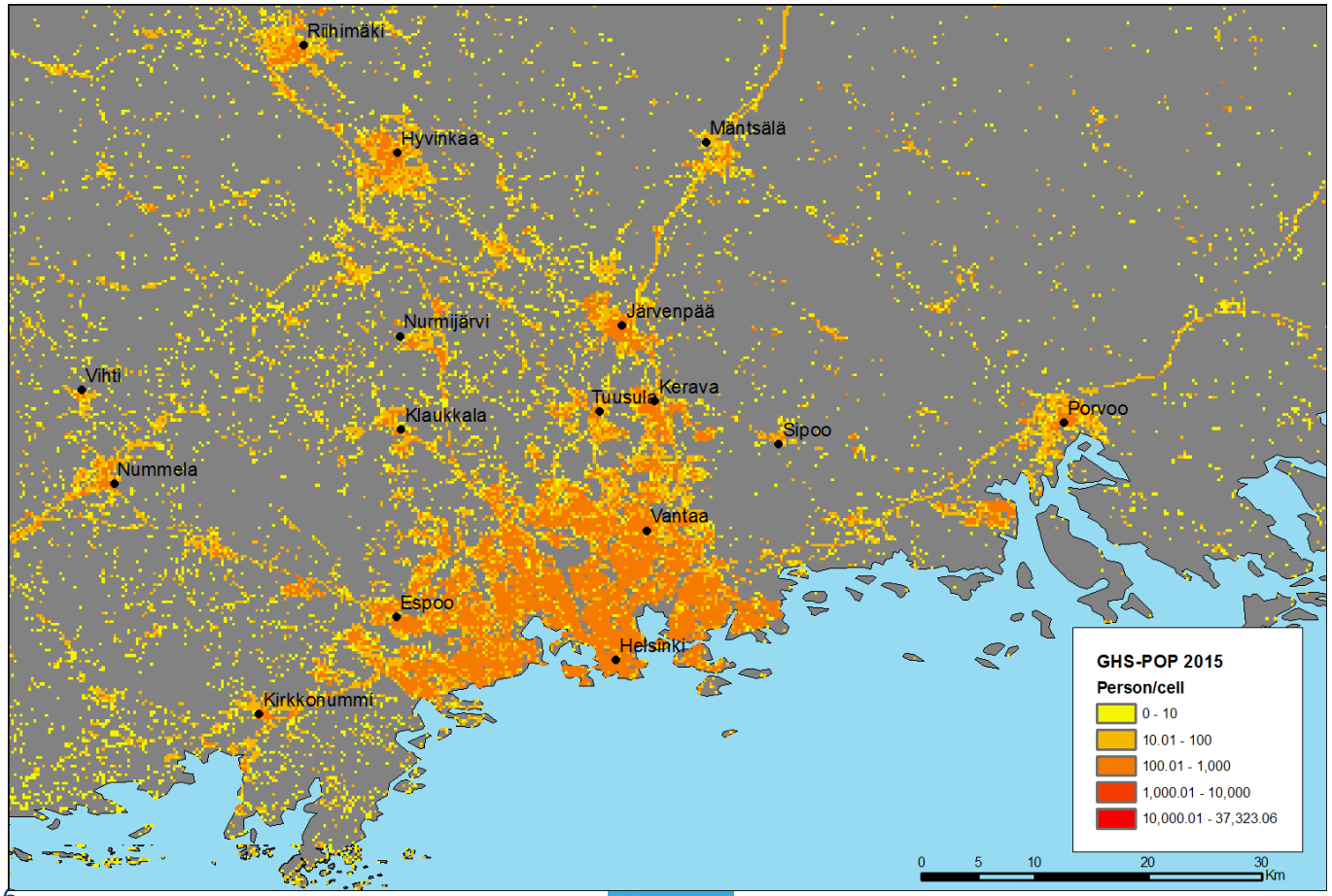
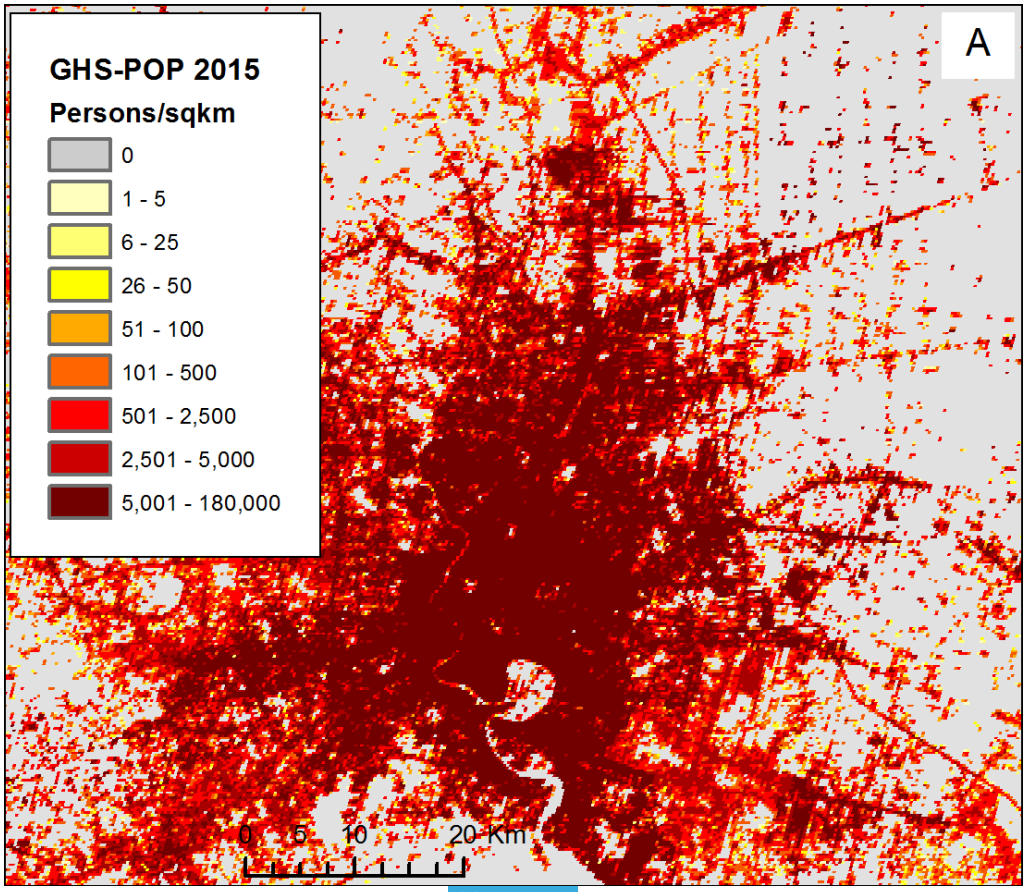
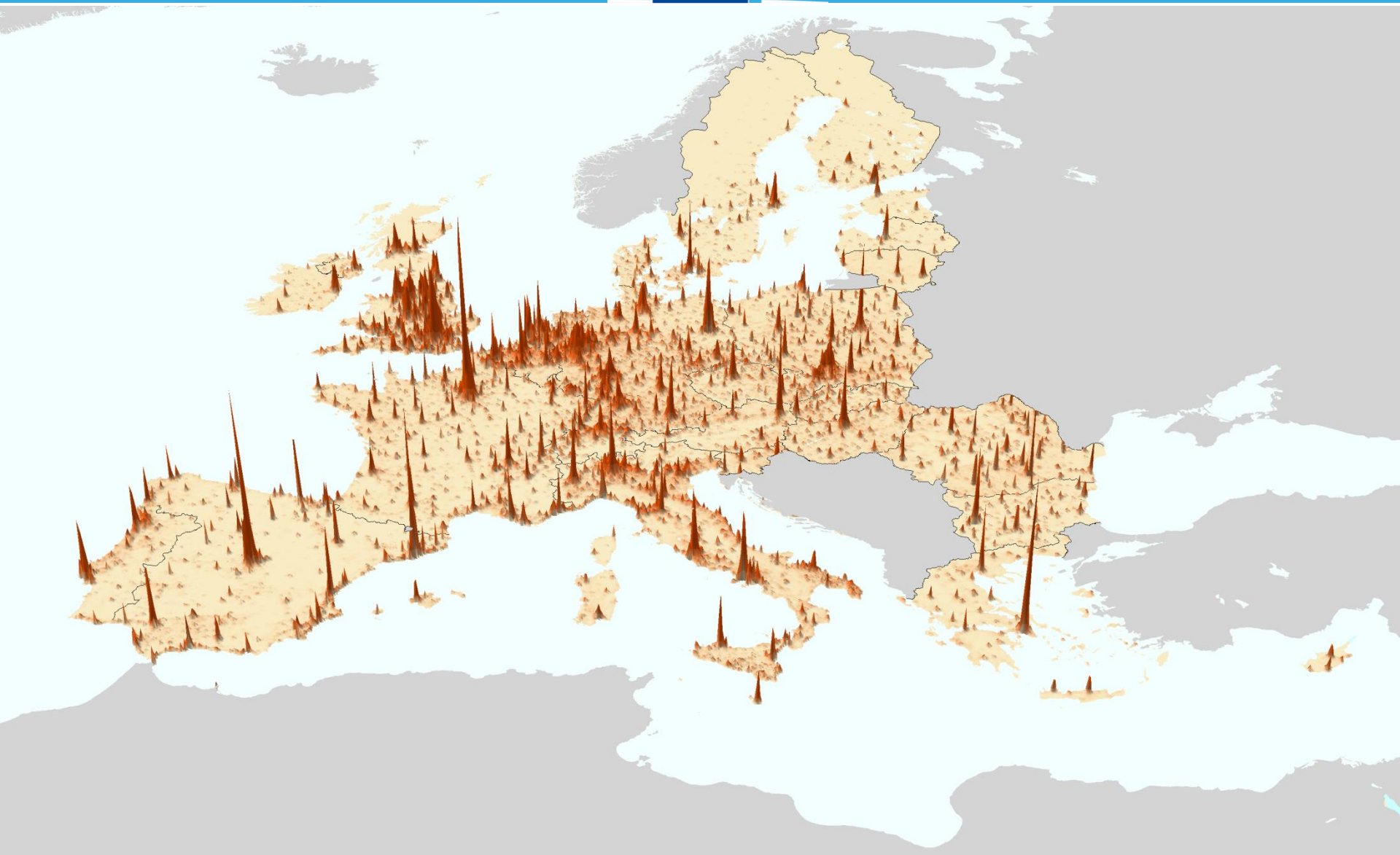


Population grids: GHS-POP v.1

- **Comparison with LandScan Global**
- Bangkok, Thailand





Joint
Research
Centre

Global Human Settlement Working Group

GROUP ON EARTH OBSERVATIONS

A new Global Human Settlement Working Group launched at the first Global Human Settlement Workshop hosted by the European Commission, Joint Research Centre, on 21-22 October 2014.

Through the establishment of the Global Human Settlement working group, a new generation of global settlement measurements and products will be developed to support the UN Third Conference on Housing and Sustainable Urban Development (Habitat III, 2016) and the concurrent post-2015 processes on sustainable development, climate change and Hyogo framework for disaster risk reduction.

The GHS partners have drafted a final statement describing the general scope and aims of the working group.

For joining the partnership or information please contact: Martino.Pesaresi@jrc.ec.europa.eu

Conclusions

JRC GHSL

- built-up areas, inclusive, continuum range (hamlet to megacity)
- RS data input, multi-sensor, multi-scale

Automatic

- open, public, reproducible outputs
- scalable to global, tested from 0.5m to 75m resolution

Landsat GHSL 1975-1990-2000-2014

- first dynamical global assessment available at this scale
- preliminary results encouraging

THANK YOU

Contact:

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Dr. Martino Pesaresi (martino.pesaresi@jrc.ec.europa.eu)