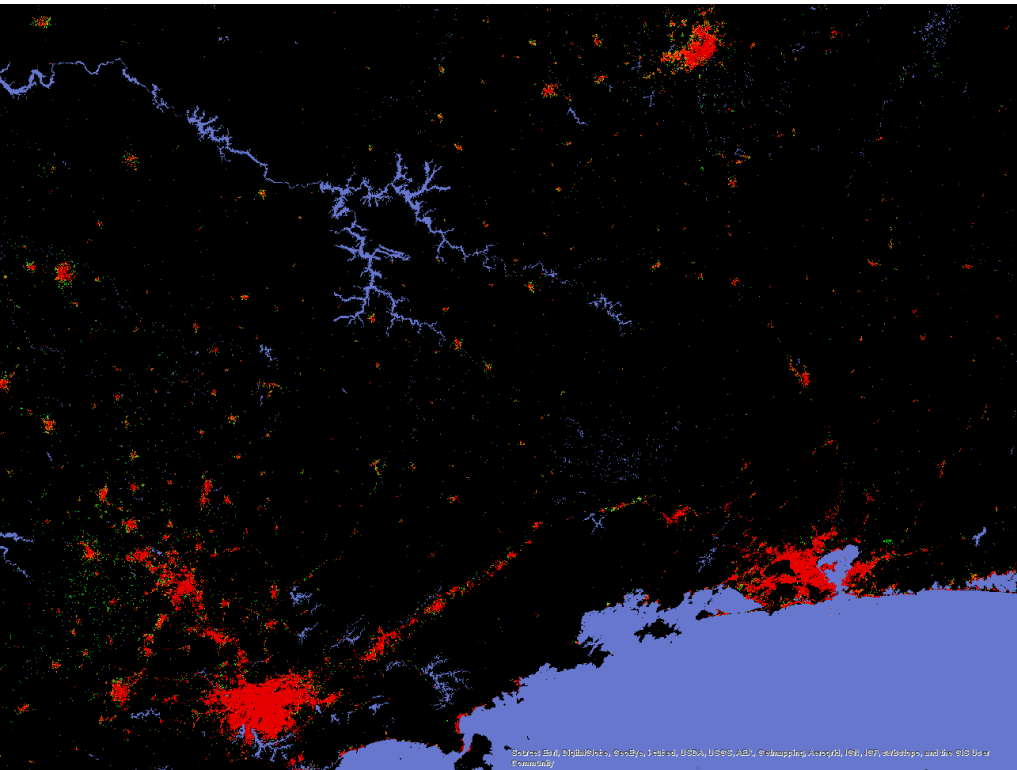


# The Need for Global Fine scale Settlement Mapping and Monitoring



**Thomas Kemper**  
European Commission  
Joint Research Centre  
Global Security and Crisis  
Management Unit

*Serving society*

*Stimulating innovation*

*Supporting legislation*

**[www.jrc.ec.europa.eu](http://www.jrc.ec.europa.eu)**

“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.”

“The informal sector already builds an estimated 70 percent of all urban housing in the developing world, making it the leading actor in the housing supply chain.”

(Reinhard Goethert, Director, School of Architecture and Planning, MIT\*)

\* “Incremental Housing: A Proactive Urban Strategy,” Monday Developments, September 2010, <http://web.mit.edu/incrementalhousing/articlesPhotographs/pdfs/PagesMondayMag.pdf>.









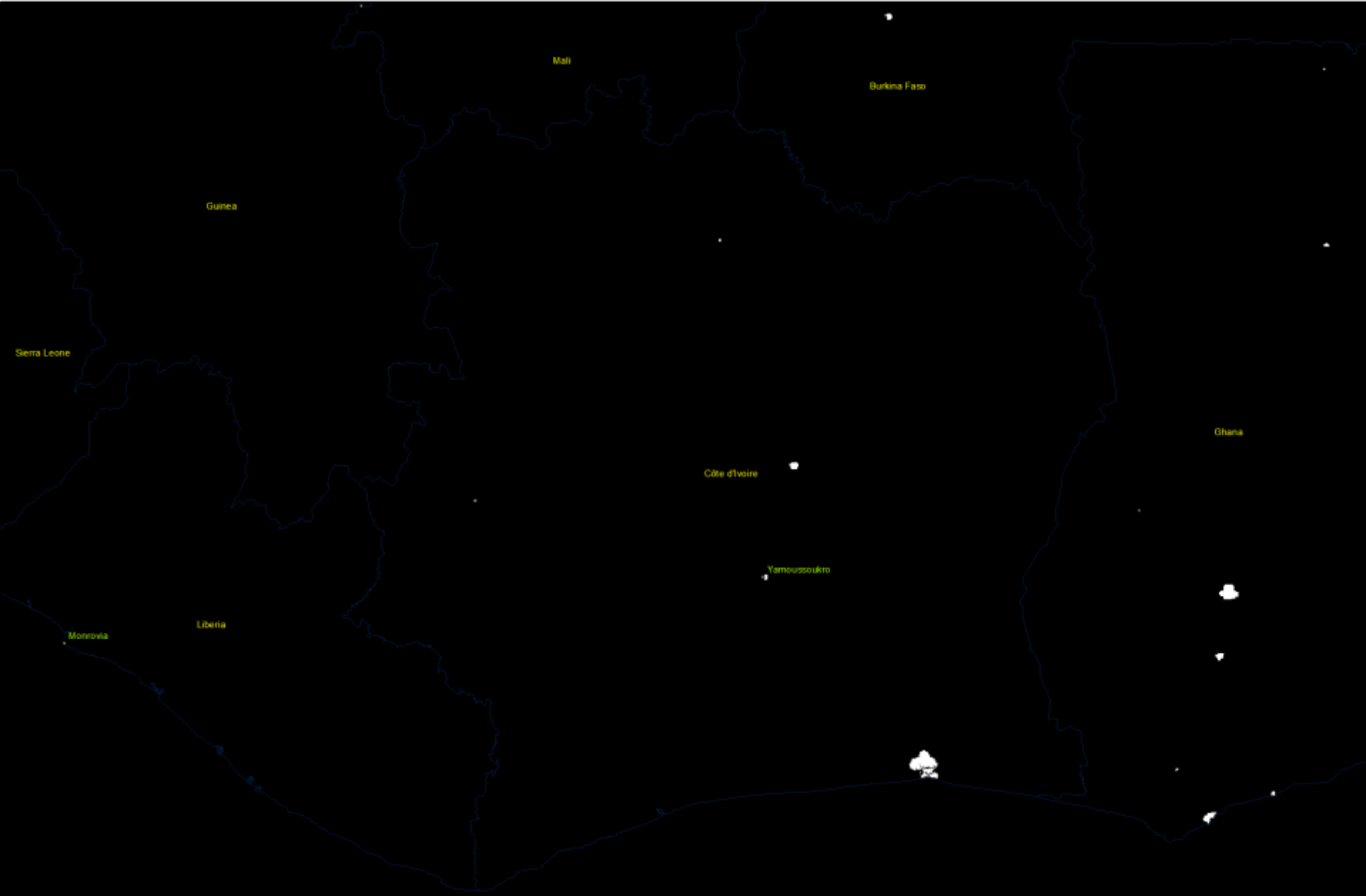


## DRR & Crisis Management

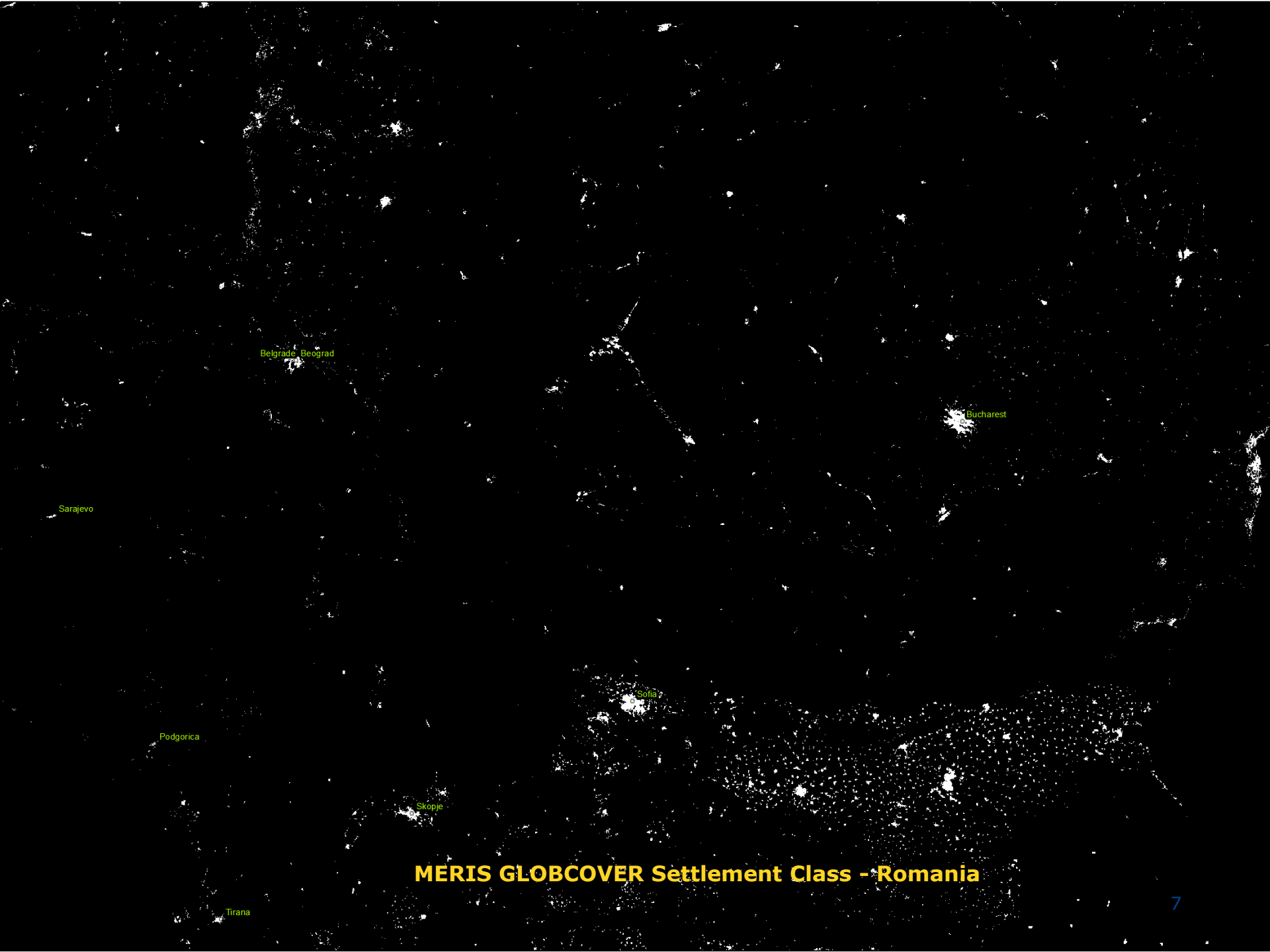
- Rapid mapping
- Damage assessment
- Disaster Risk Assessments (Exposure)
- Population estimations

## Sustainability and resilience of cities

- Regional and local planning
- Poverty mapping
- Slum upgrading



**MERIS GLOBCOVER Settlement Class – Ivory Coast**



Belgrade, Beograd

Bucharest

Sarajevo

Podgorica

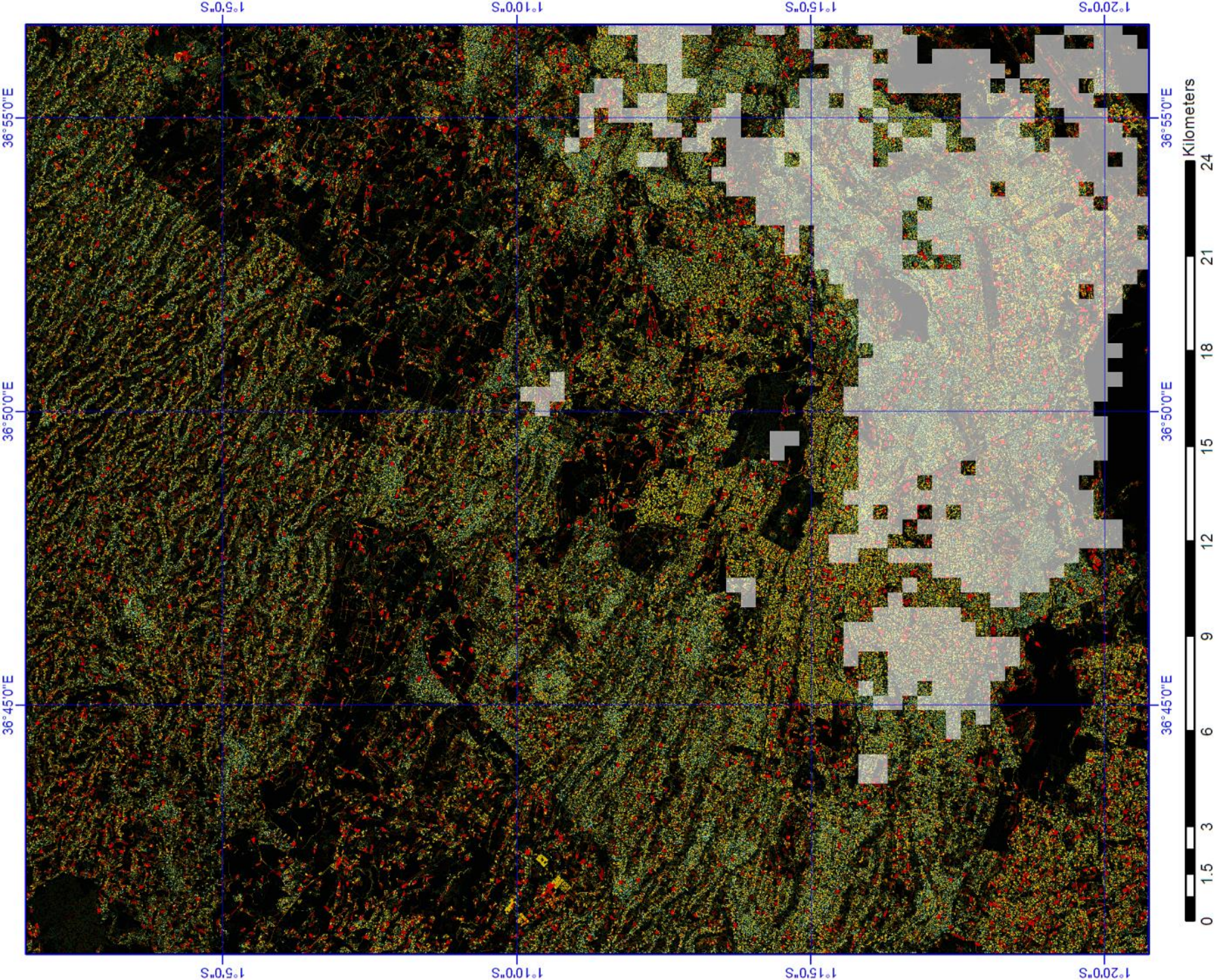
Skopje

Sofia

Tirana

**MERIS GLOBCOVER Settlement Class - Romania**

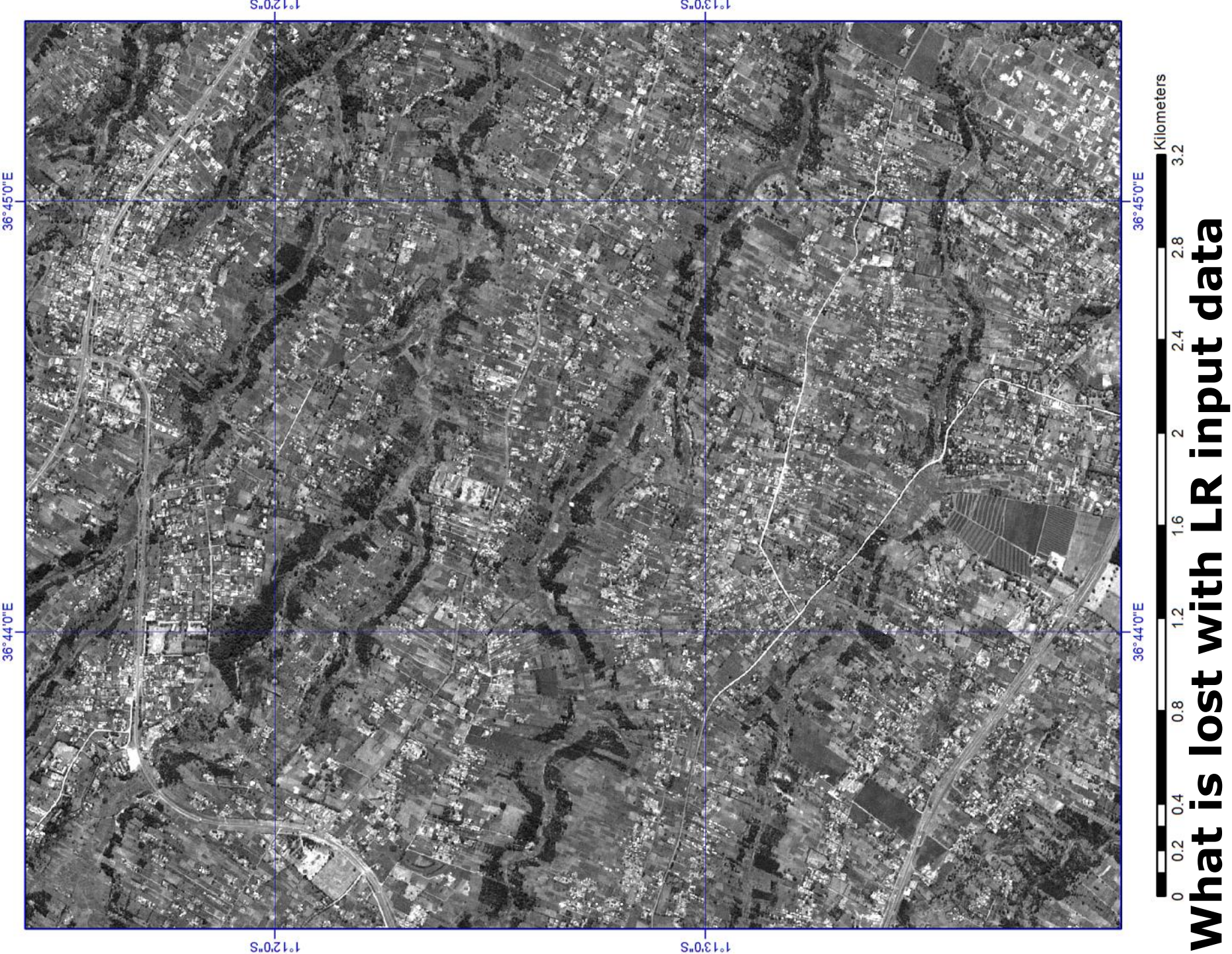




# Nairobi, HR GHSL

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





**What is lost with LR input data**

# The Global Human Settlement Layer (GHSL) Concept



- **Multi-scale vision**
  - Global ↔ Regional ↔ Local
- **Multi-sensor approach**
  - Optical airborne/satellite data 0.5-10 m for local/regional scales
  - Optical satellite data 10-30(60) m res data (Landsat, Sentinel) for regional/global scale
- **Automatic image information retrieval**
  - Quantitative information: built-up area, size, density
  - Automatic = no free parameter policy
  - Realistic data volume and quality scenarios
- **Inclusive concept of human settlements**
  - refugee/IDP camps, slums, rural hamlets



## Landsat GHSL: first available global dynamical assessment

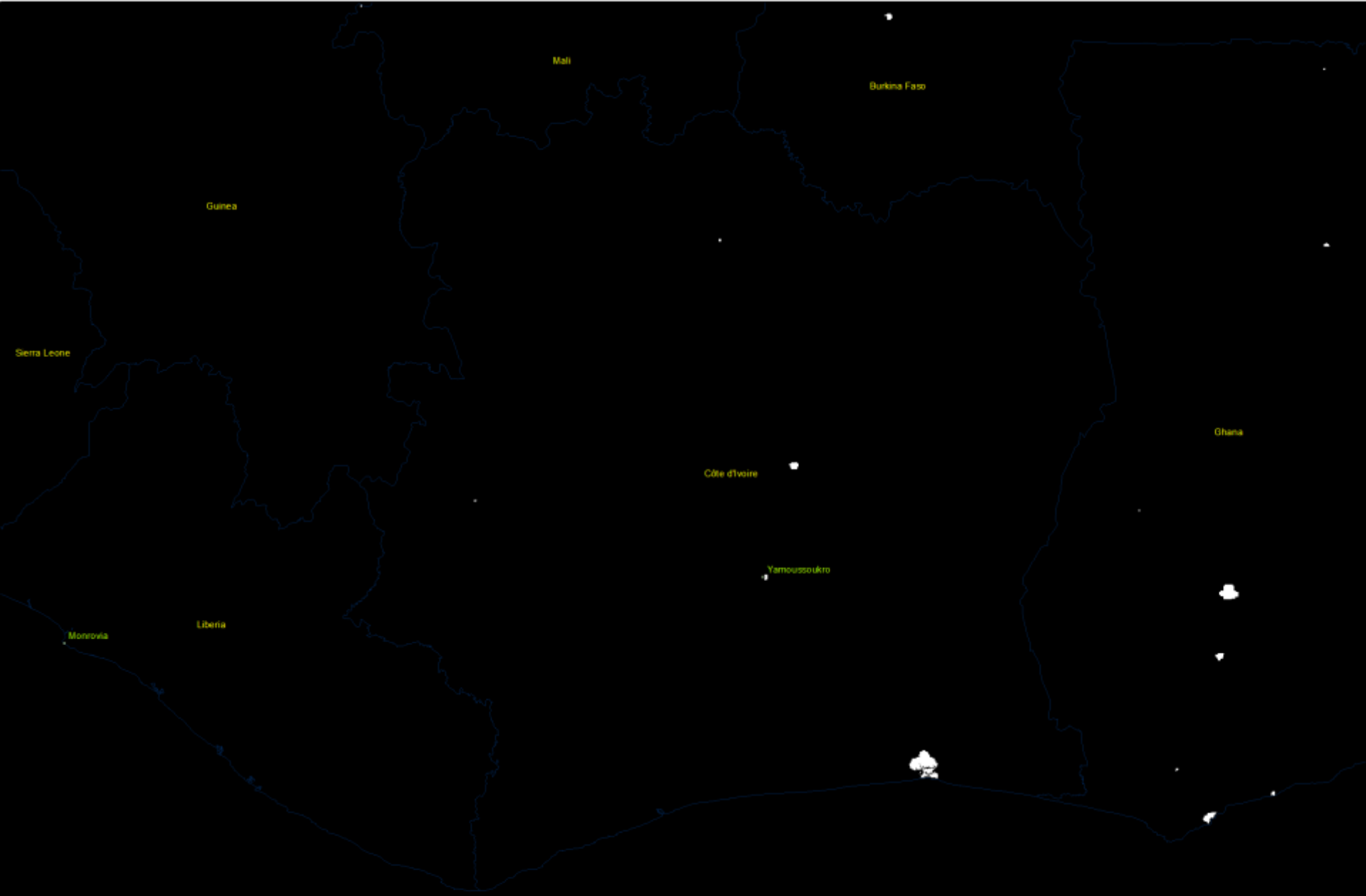


1975 -----1990-----2000-----2014



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



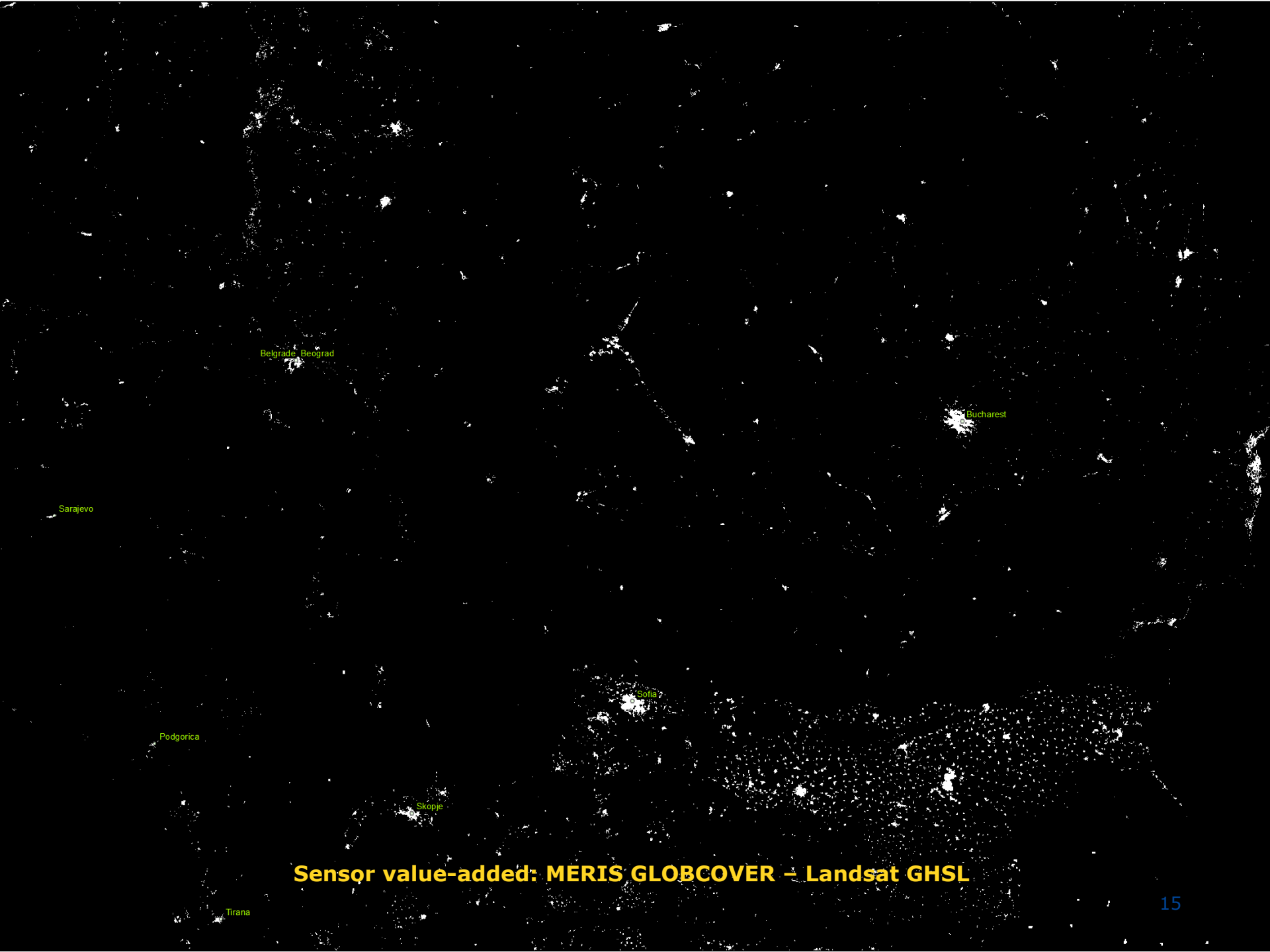


**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**



**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**



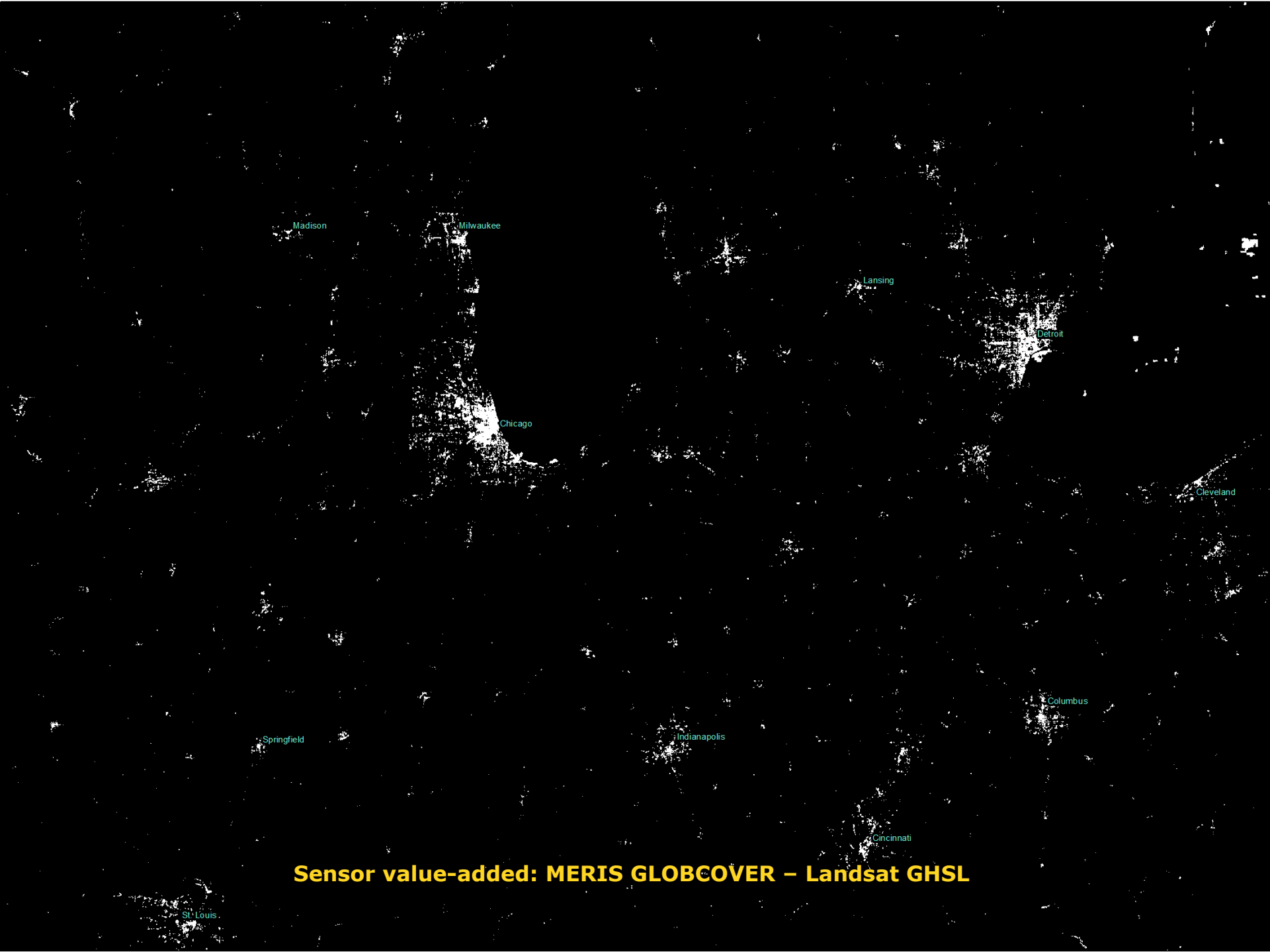


**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**



**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**





**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**

St. Louis



**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**





Qiqihar

Harbin

China

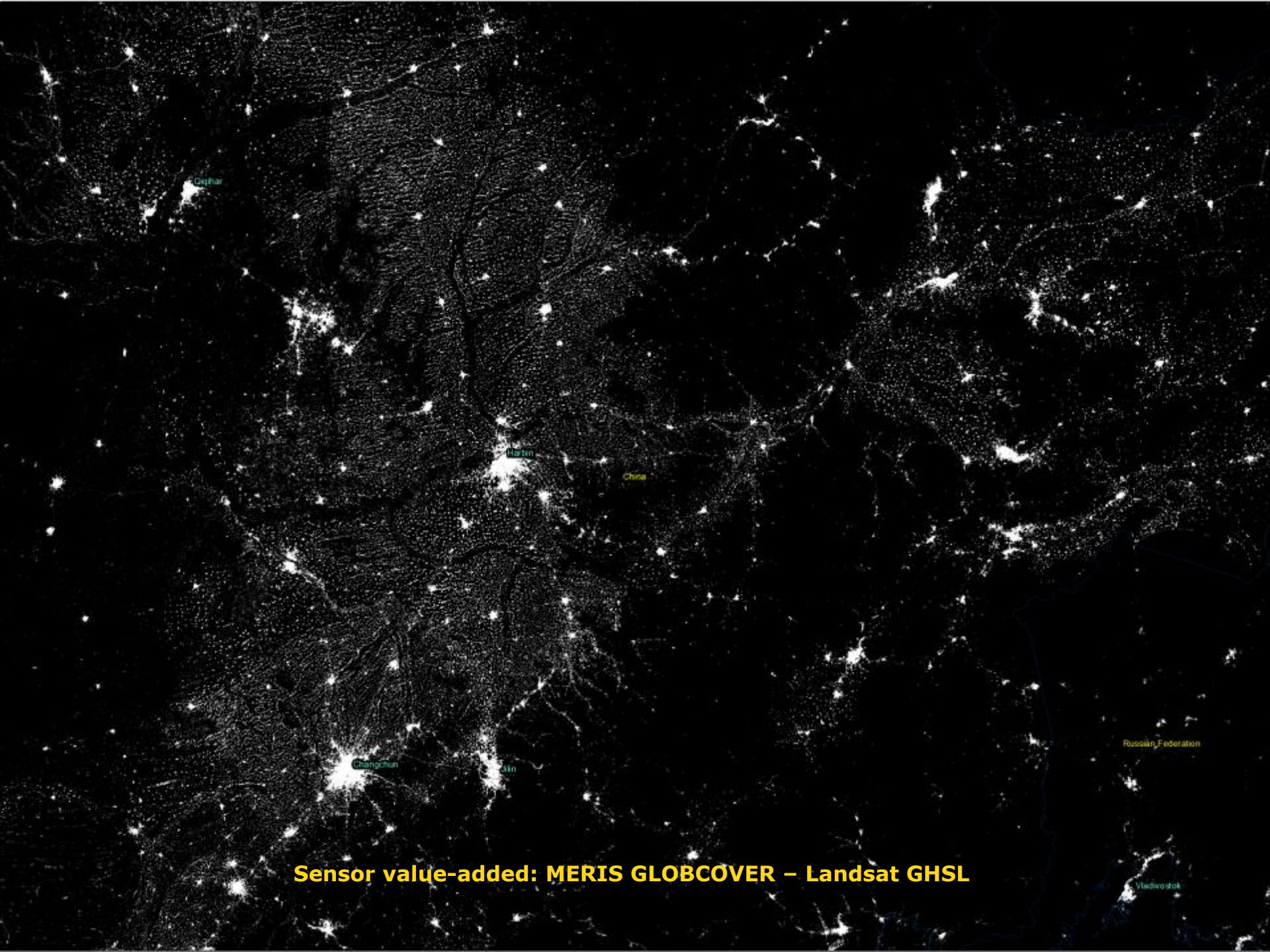
Changchun

Jilin

Russian Federation

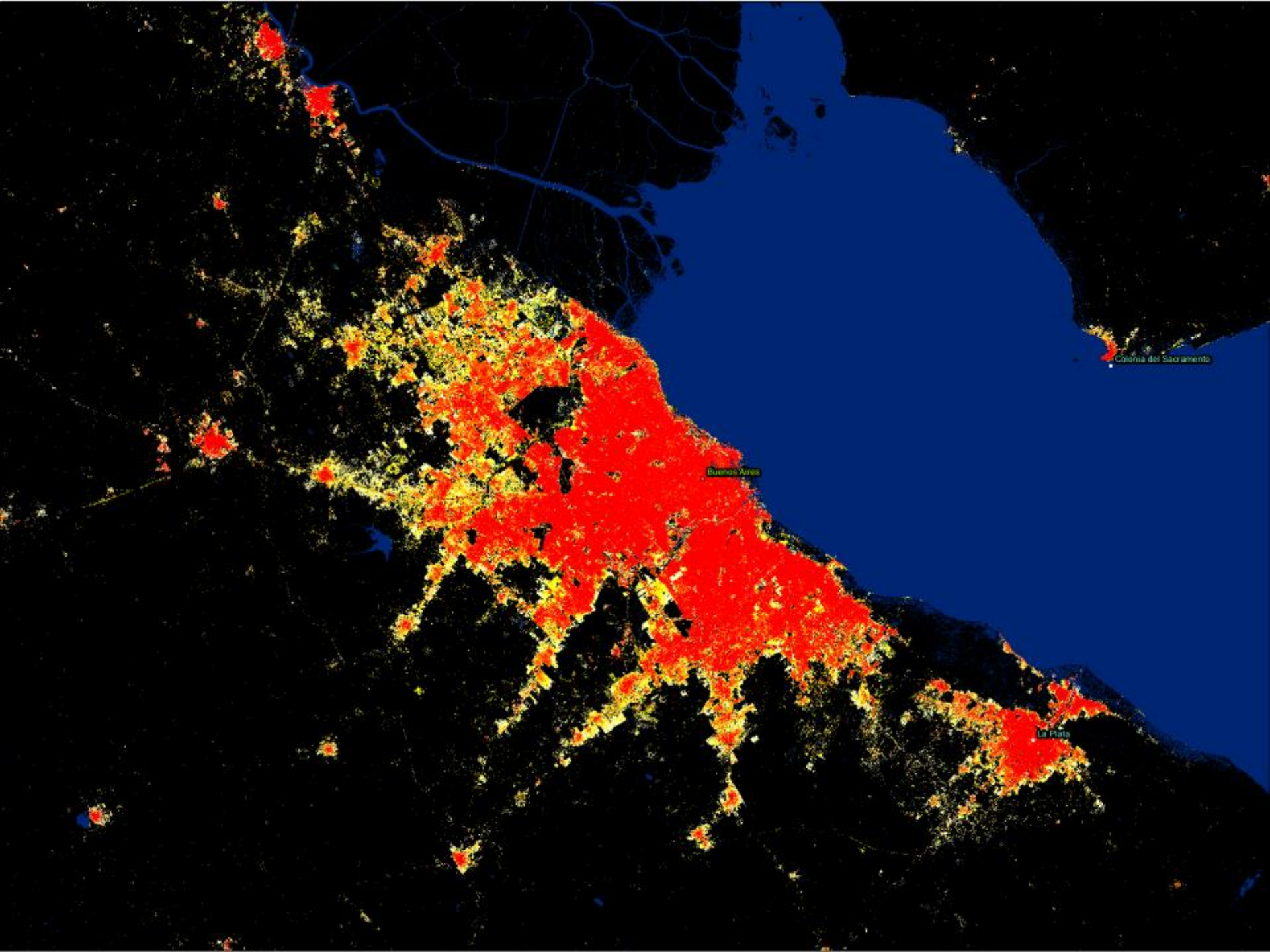
**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**

Vladivostok



**Sensor value-added: MERIS GLOBCOVER – Landsat GHSL**



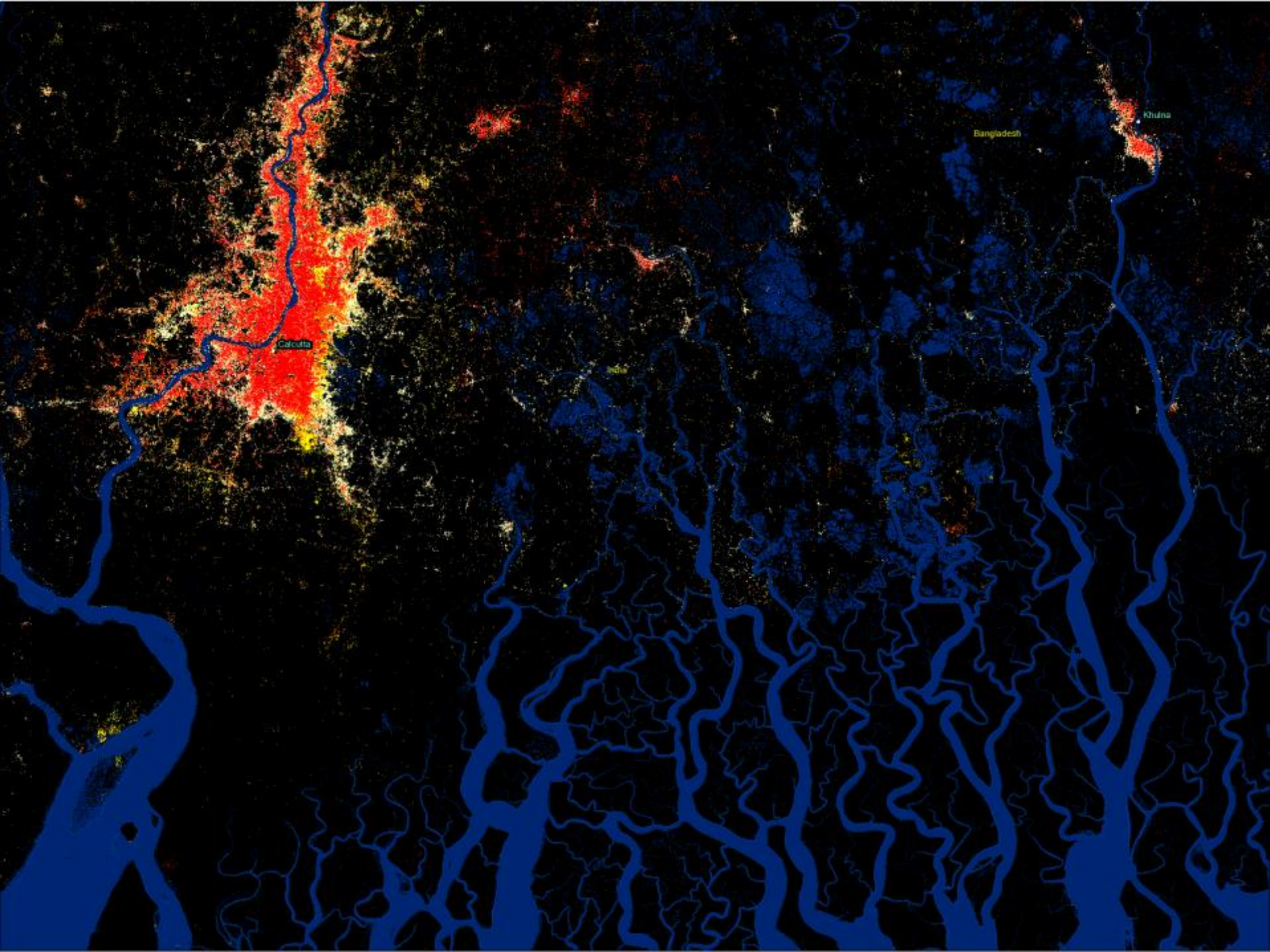


Colonia del Sacramento

Buenos Aires

La Plata



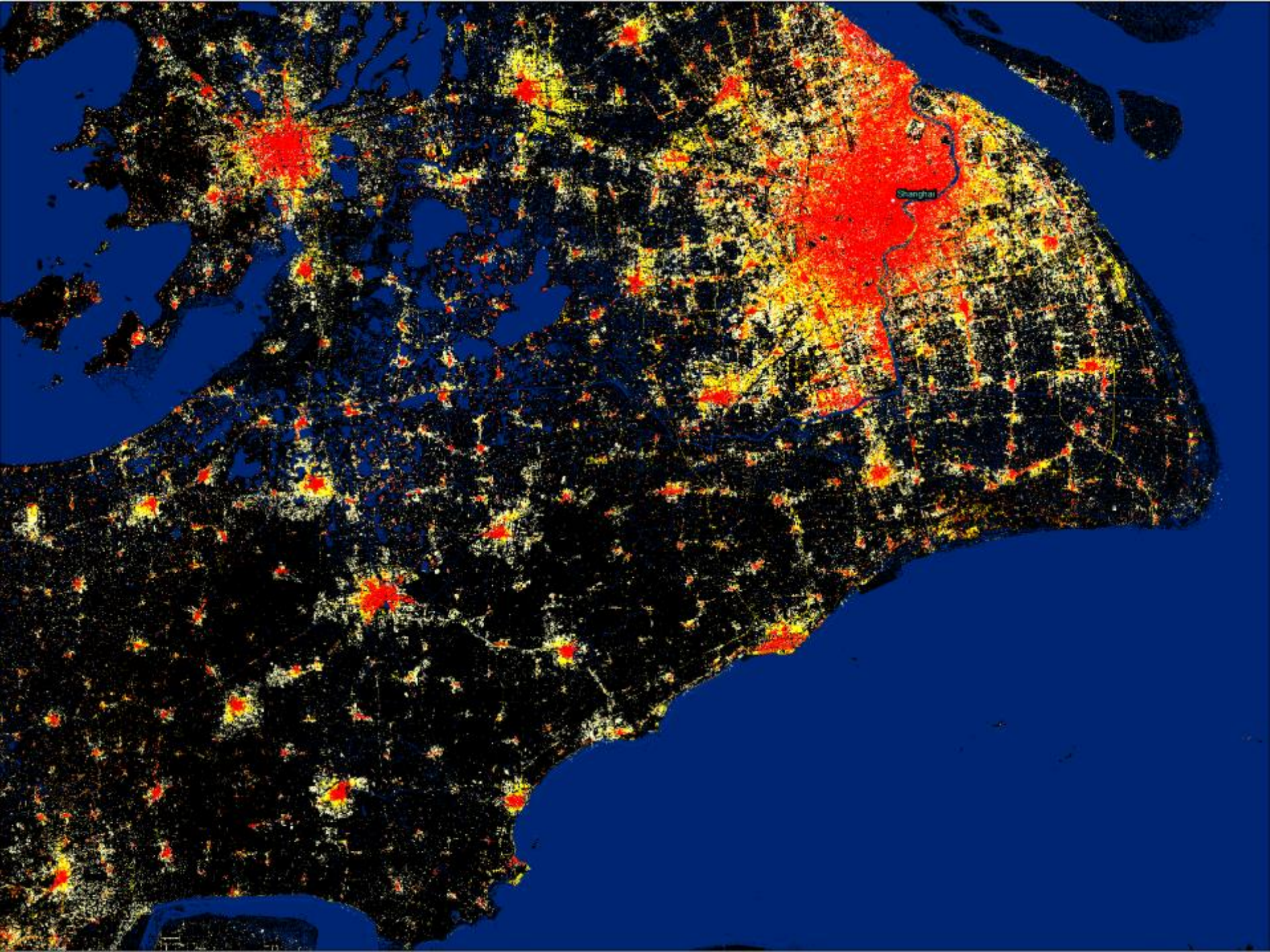


Calcutta

Bangladesh

Kulma







# Built-Up & Population Change in the last 40 years

Country		GHSI built-up areas (sq km)					WB population (millions of persons)					BU surface per capita (m <sup>2</sup> /person)			
		1975	1990	2000	2014	2014-1975	1975	1990	2000	2013	2013-1975	1975	1990	2000	2013
United States	USA	66,522	93,653	128,794	171,857	<b>105,335</b>	215.97	249.62	282.16	316.13	100.16	308.0	375.2	456.5	543.6
China	CHN	33,580	47,251	66,370	109,782	<b>76,202</b>	916.40	1135.19	1262.65	1357.38	440.99	36.6	41.6	52.6	80.9
India	IND	10,176	14,051	19,285	39,898	<b>29,722</b>	622.23	868.89	1042.26	1252.14	629.91	16.4	16.2	18.5	31.9
Russian Federation	RUS	21,139	29,997	40,147	50,479	<b>29,340</b>	134.20	148.29	146.60	143.50	9.30	157.5	202.3	273.9	351.8
Ukraine	UKR	12,018	16,367	22,937	33,239	<b>21,222</b>	48.76	51.89	49.18	45.49	-3.27	246.5	315.4	466.4	730.7
Germany	DEU	11,875	16,423	21,983	28,633	<b>16,758</b>	78.67	79.43	82.21	80.62	1.95	150.9	206.8	267.4	355.2
Brazil	BRA	16,797	19,950	27,572	33,159	<b>16,362</b>	108.22	149.65	174.50	200.36	92.14	155.2	133.3	158.0	165.5
Indonesia	IDN	11,532	14,078	18,789	27,218	<b>15,686</b>	129.21	178.63	208.94	249.87	120.66	89.3	78.8	89.9	108.9
France	FRA	8,245	11,714	15,894	21,265	<b>13,020</b>	54.03	58.41	60.91	66.03	12.00	152.6	200.5	260.9	322.1
Japan	JPN	9,335	12,483	16,294	22,106	<b>12,771</b>	111.94	123.54	126.87	127.34	15.40	83.4	101.0	128.4	173.6
Mexico	MEX	6,343	9,350	13,295	18,047	<b>11,704</b>	61.71	86.08	103.87	122.33	60.62	102.8	108.6	128.0	147.5
Italy	ITA	5,826	8,333	11,568	15,533	<b>9,707</b>	55.44	56.72	56.94	59.83	4.39	105.1	146.9	203.2	259.6
Turkey	TUR	4,250	6,155	8,831	13,540	<b>9,290</b>	39.19	53.99	63.17	74.93	35.75	108.5	114.0	139.8	180.7
Canada	CAN	6,756	9,522	13,146	15,317	<b>8,560</b>	23.21	27.79	30.77	35.16	11.95	291.1	342.6	427.2	435.6
Australia	AUS	6,306	8,882	12,257	14,605	<b>8,299</b>	13.89	17.07	19.15	23.13	9.24	453.9	520.5	639.9	631.4
Romania	ROU	4,265	5,762	8,093	12,559	<b>8,293</b>	21.29	23.20	22.44	19.96	-1.33	200.3	248.3	360.6	629.1
United Kingdom	GBR	6,648	8,864	11,436	13,813	<b>7,165</b>	56.23	57.25	58.89	64.10	7.87	118.2	154.8	194.2	215.5
Poland	POL	3,740	5,516	7,740	10,743	<b>7,004</b>	34.02	38.11	38.26	38.53	4.52	109.9	144.7	202.3	278.8
South Africa	ZAF	3,321	4,819	6,457	8,969	<b>5,648</b>	24.73	35.20	44.00	52.98	28.25	134.3	136.9	146.8	169.3
Spain	ESP	2,902	4,059	5,661	7,972	<b>5,071</b>	35.53	38.85	40.26	46.65	11.12	81.7	104.5	140.6	170.9
Nigeria	NGA	1,893	2,769	3,830	6,615	<b>4,723</b>	63.57	95.62	122.88	173.62	110.05	29.8	29.0	31.2	38.1
Argentina	ARG	3,471	4,849	6,532	7,885	<b>4,414</b>	26.07	32.62	36.90	41.45	15.38	133.1	148.6	177.0	190.2

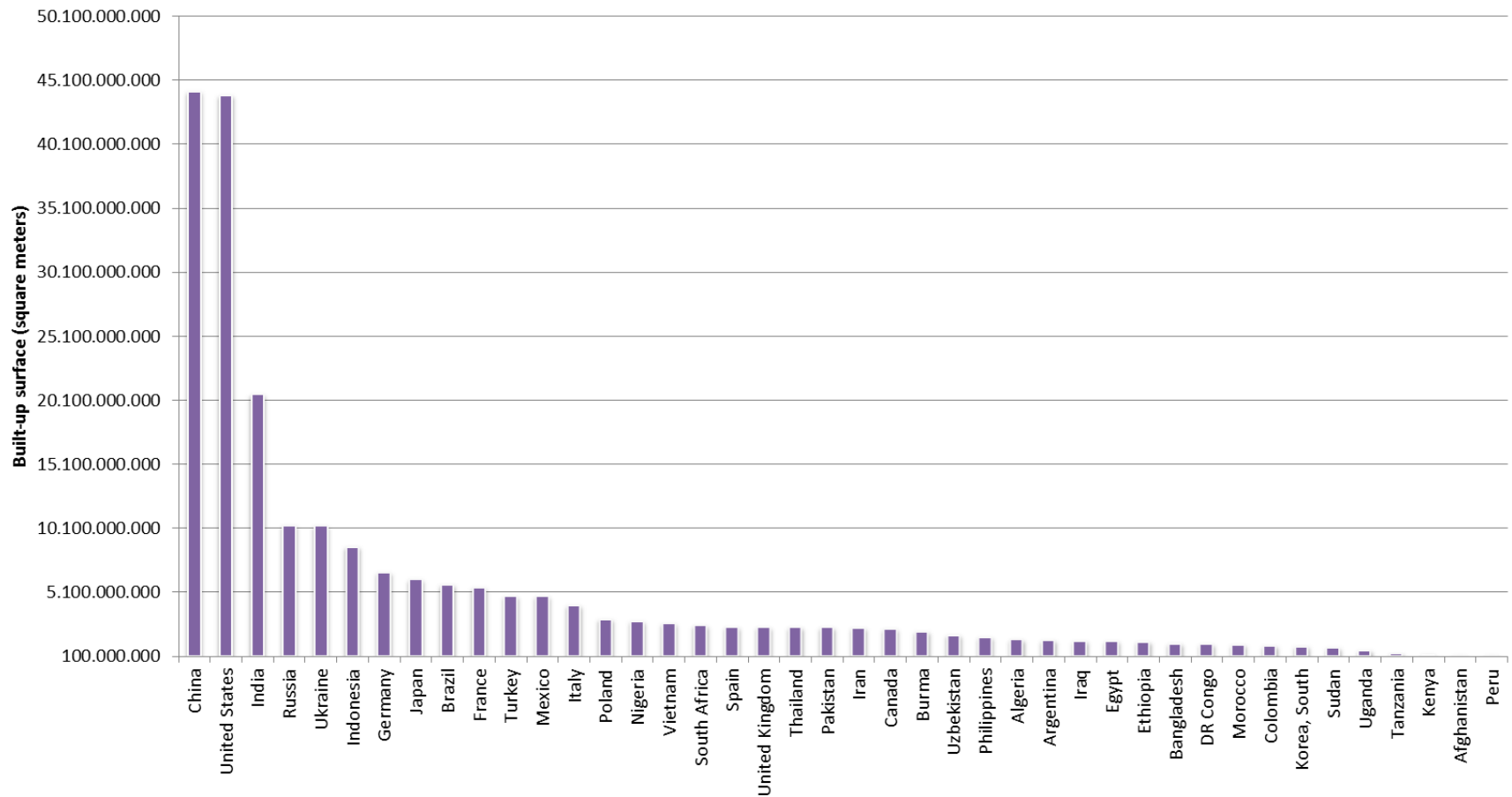
## Countries ranked by built-up change 1975-2014



# Built-Up Change 2000-2014



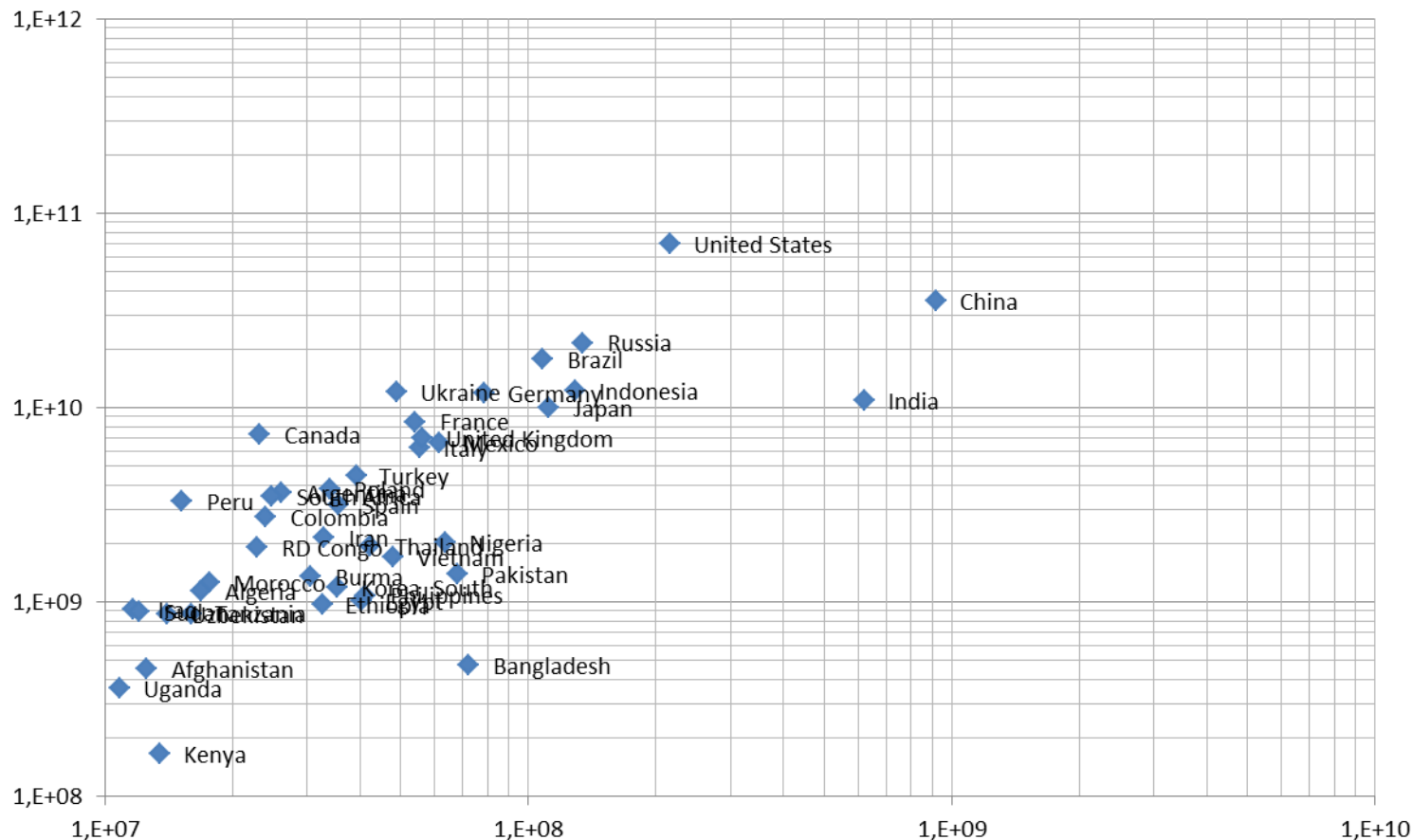
new built-up areas 2000-2014



# Built-Up & Population Change 1975-2000



s1975

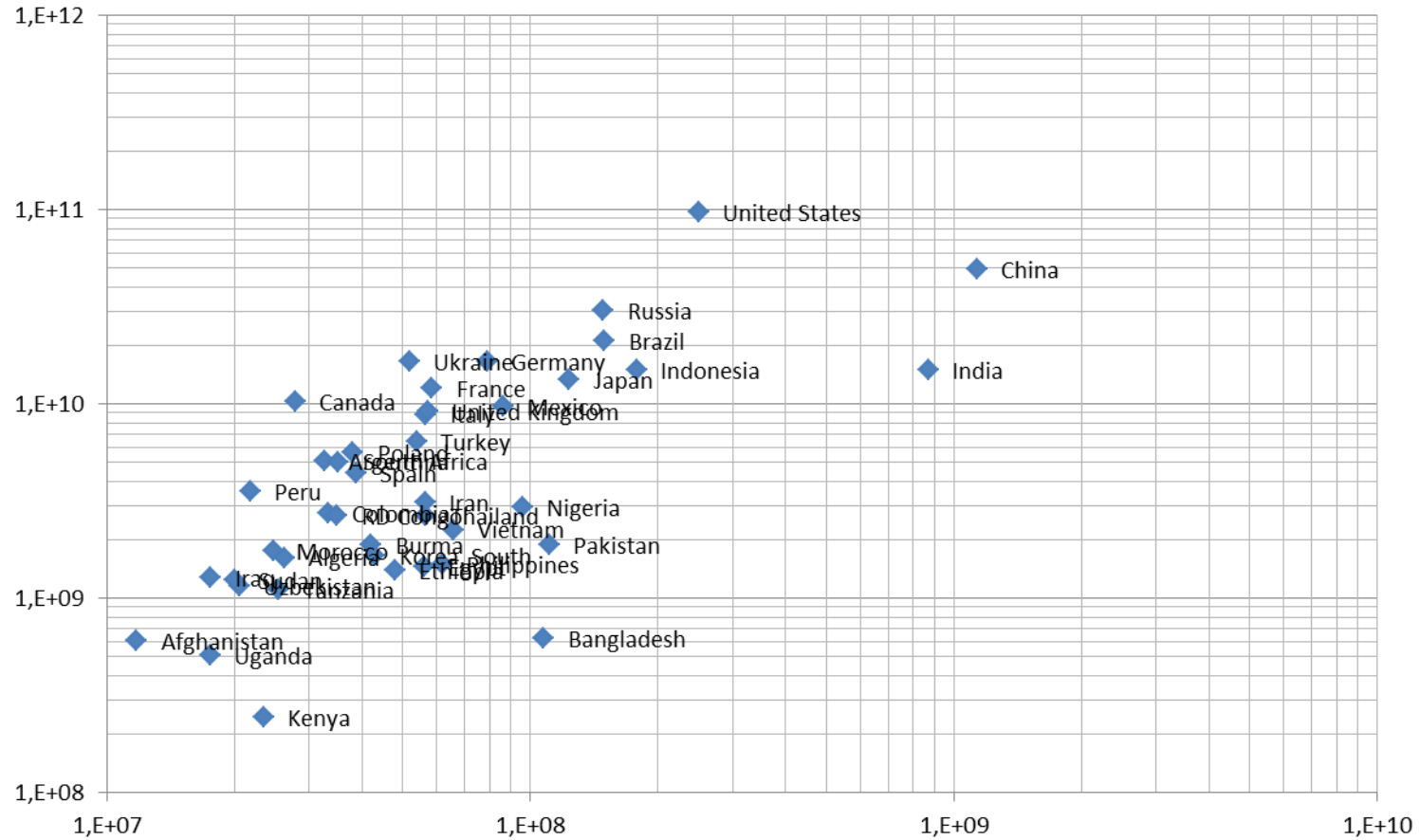




# Built-Up & Population Change 1975-2000



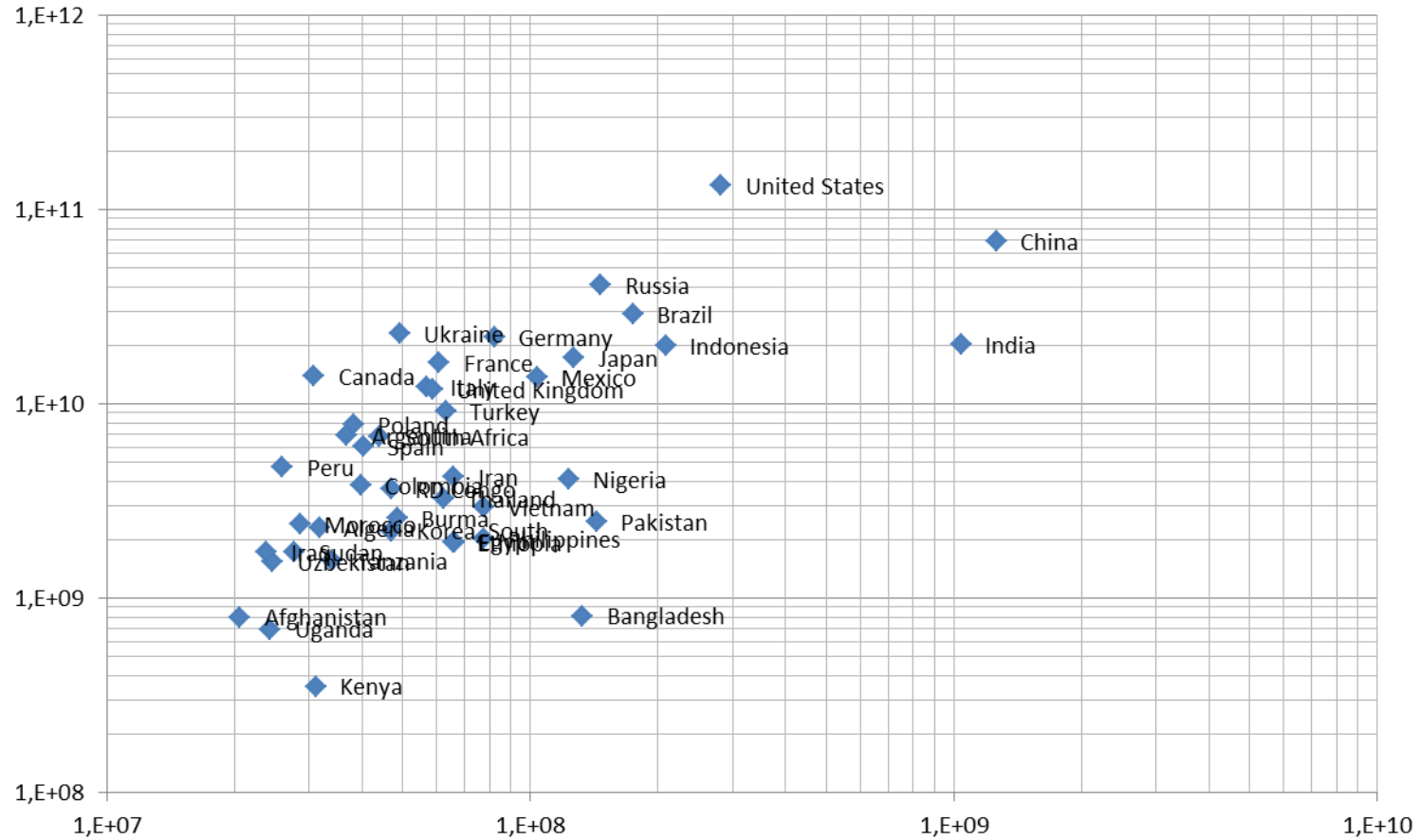
s1990



# Built-Up & Population Change 1975-2000



s2000

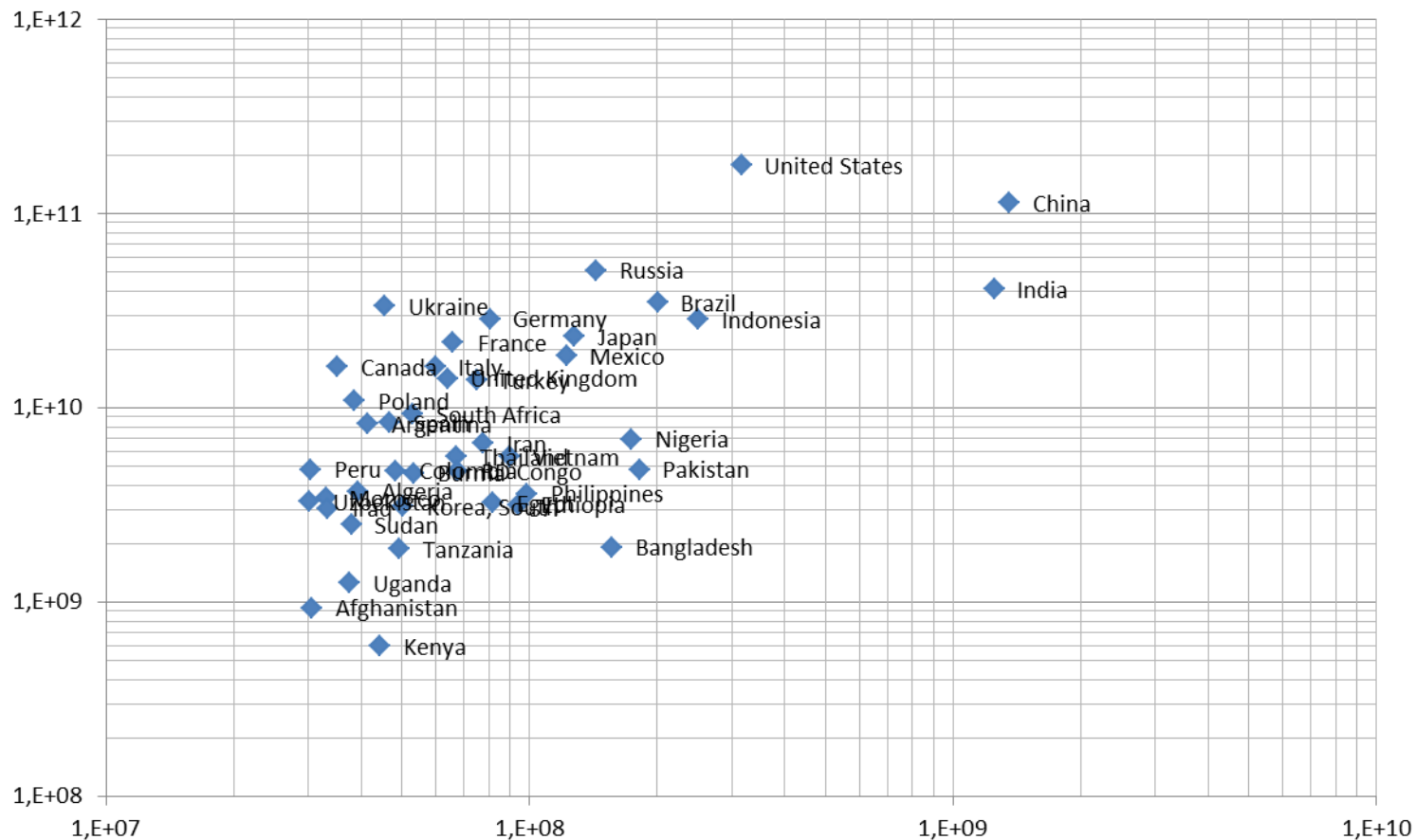




# Built-Up & Population Change 1975-2000



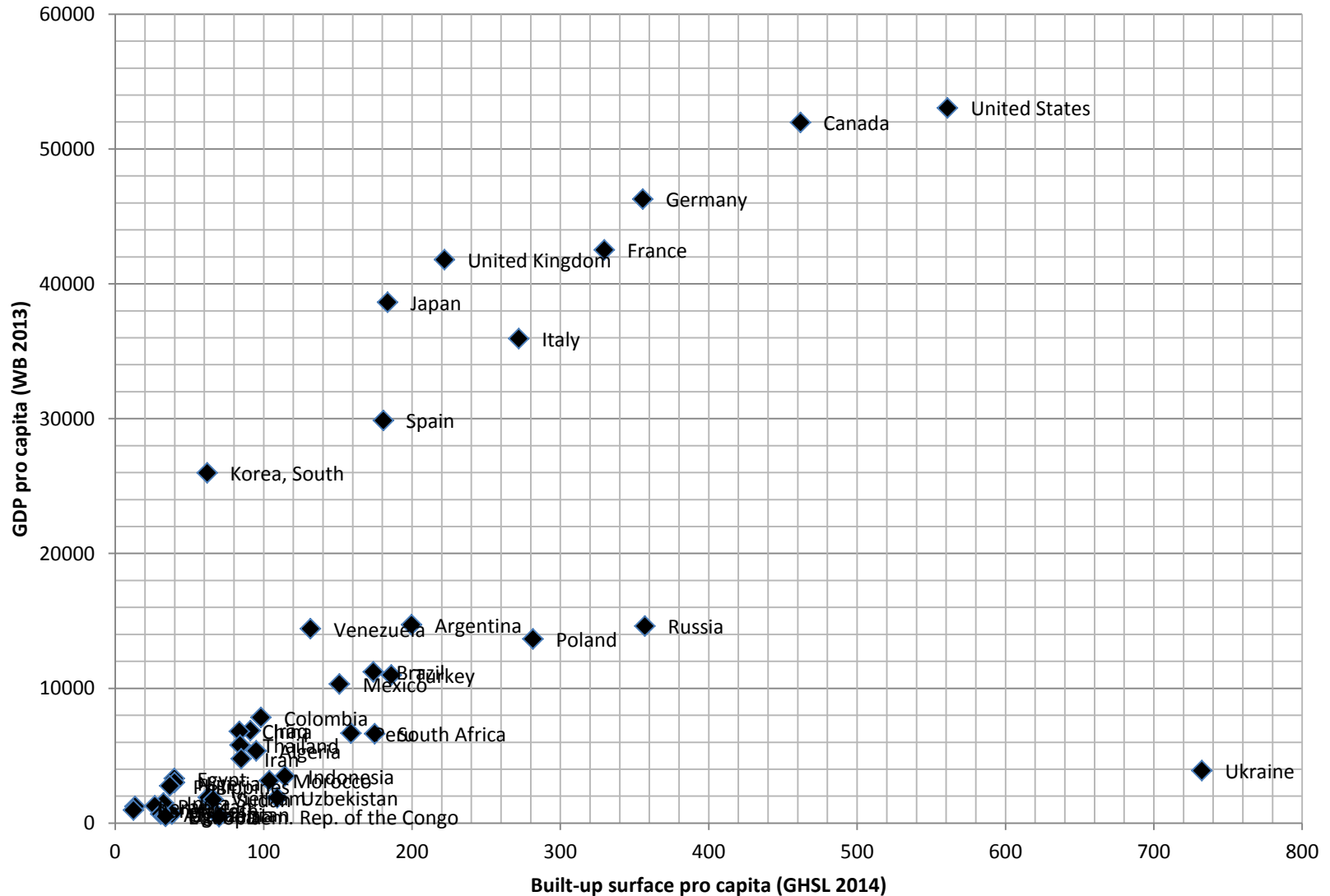
s2013



# Built-Up & GDP per capita



## Built-up vs. GDP pro capita

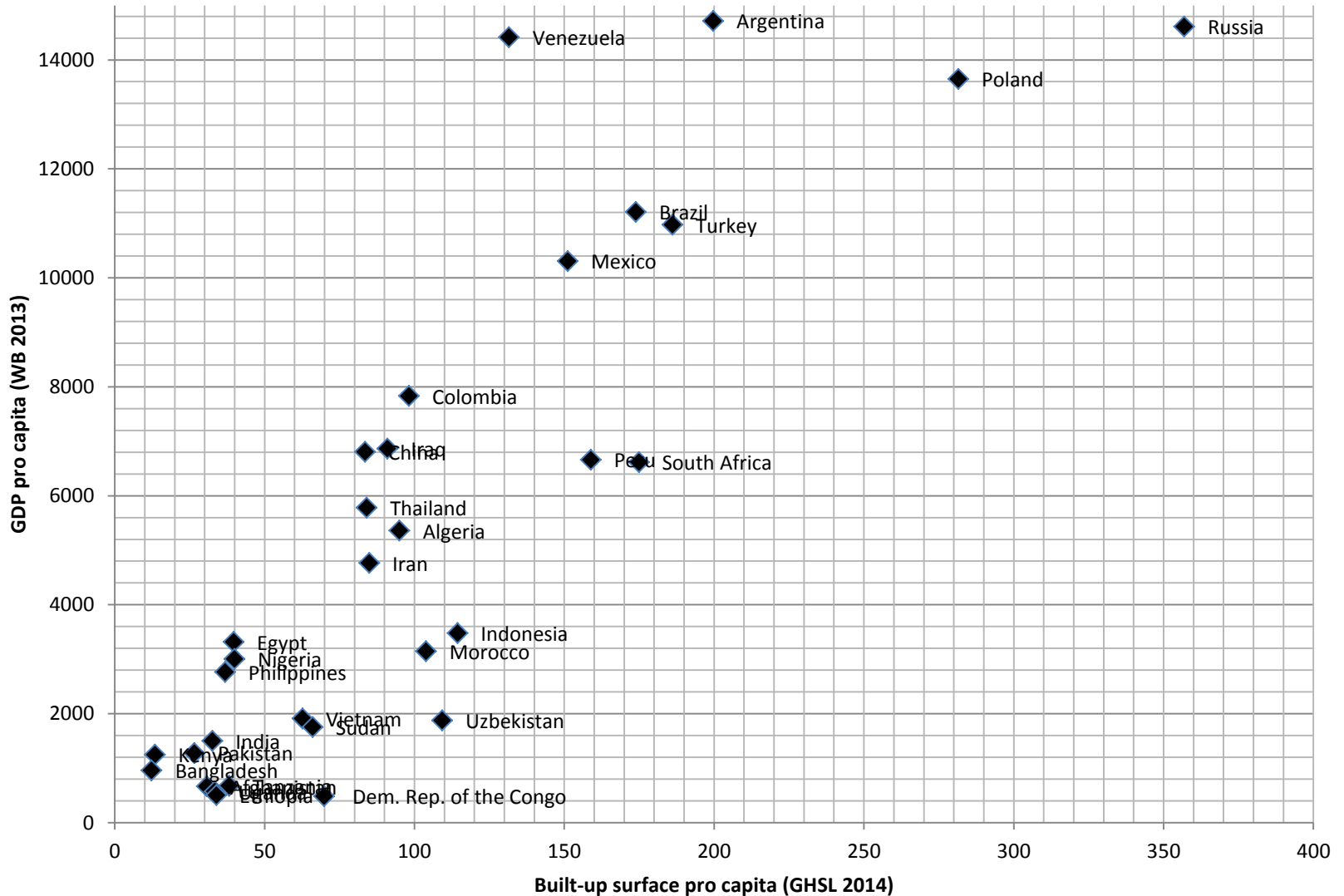




# Built-Up & GDP per capita



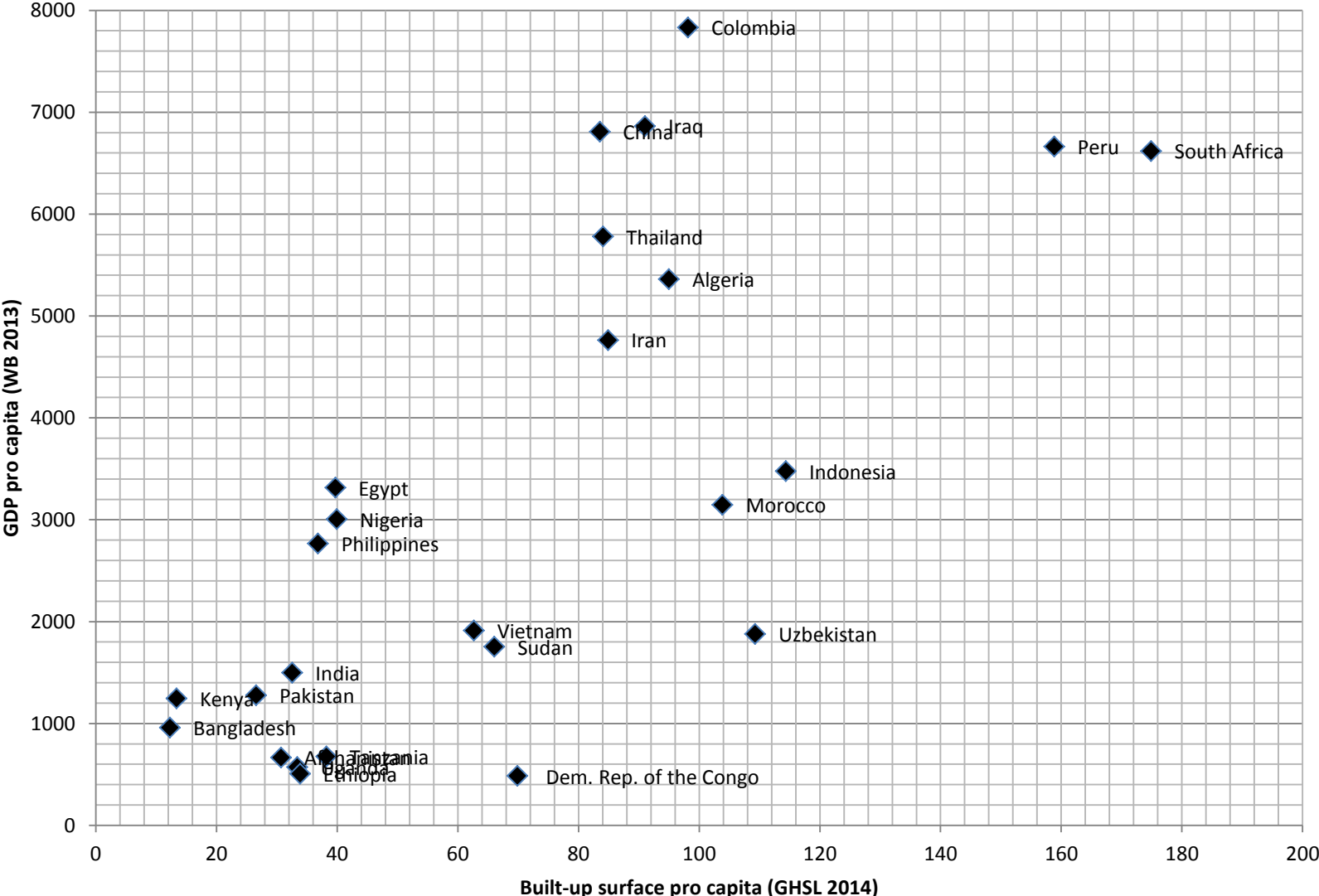
## Built-up vs. GDP pro capita



# Built-Up & GDP per capita

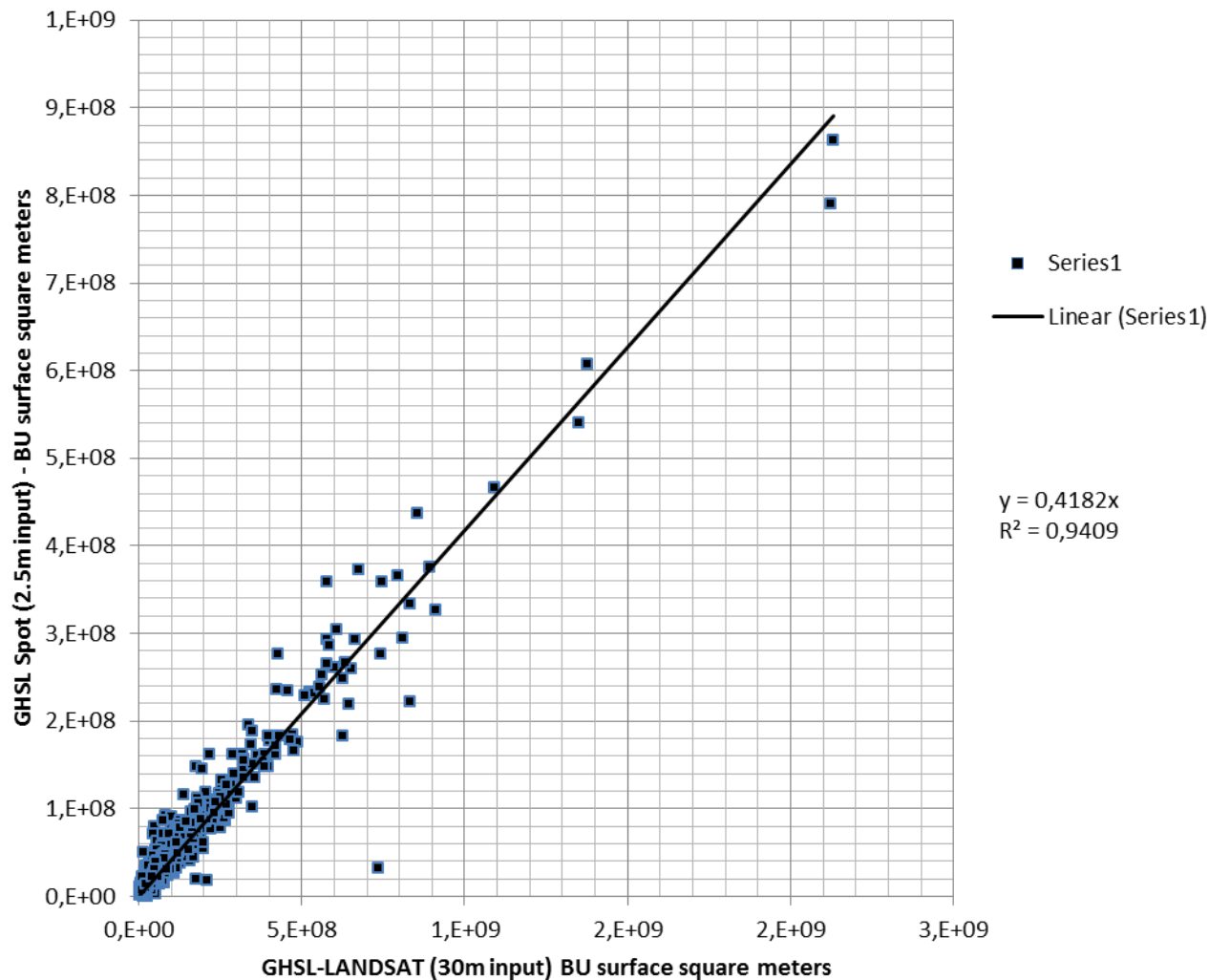


### Built-up vs. GDP pro capita





# GHSL Landsat-8 vs. SPOT-5



Earth Observation is ready to inform about the development of human settlements globally at high spatial resolution

Long term missions such as Copernicus Sentinel series and Landsat allow monitoring of future developments

But the gap between EO community and decision makers needs to be closed through development of easy-to-use indicators



# Global Human Settlement Initiative



- To develop a new generation of measurements and information products assessing new scientific evidence on global human settlements
- To support global policy processes with agreed, actionable and goal-driven metrics:
  - Sendai Framework for DRR
  - Habitat III (October 2016)
  - Sustainable Development Goals,
  - UN Framework Convention on Climate Change

# Thank you

Dr. Thomas Kemper

[thomas.kemper@jrc.ec.europa.eu](mailto:thomas.kemper@jrc.ec.europa.eu)

## Links

General information: <http://ghslsys.jrc.ec.europa.eu>

European GHSL Data: <http://land.copernicus.eu/pan-european>