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**SDG 11 Make cities and human settlements  
inclusive, safe, resilient and sustainable**

## SDG Goal 11

- ① 11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
- ② 11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons
- ③ 11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
- ④ 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage
- ⑤ 11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

## SDG Goal 11

- ⑥ 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management
- ⑦ 11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities
  - 11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning
  - 11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels
  - 11.c Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

## Efficient land use

The average share of the built-up areas of cities in open space in public ownership

Proportion of urban population living in slums

Protected areas data, overlaid onto urban spatial data

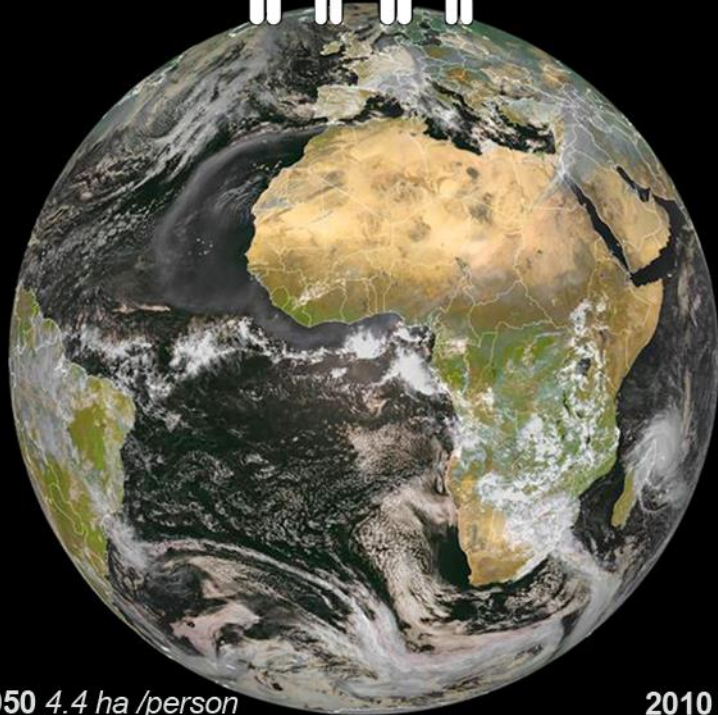
Ratio of land consumption rate to population growth rate at comparable scale



# The % of world population and absolute number residing in urban areas

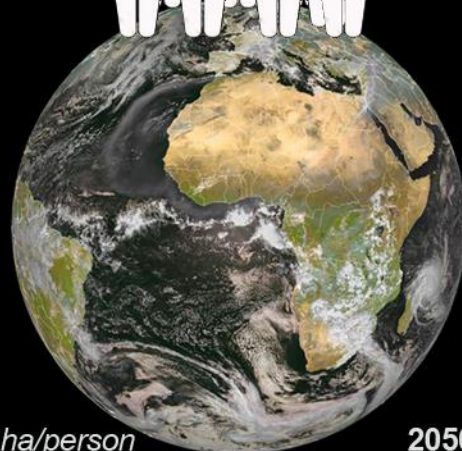


2525779000



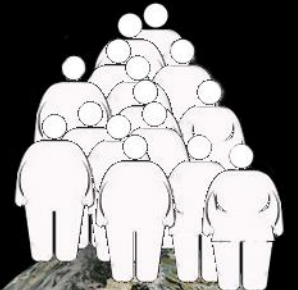
1950 4.4 ha /person

6916183000

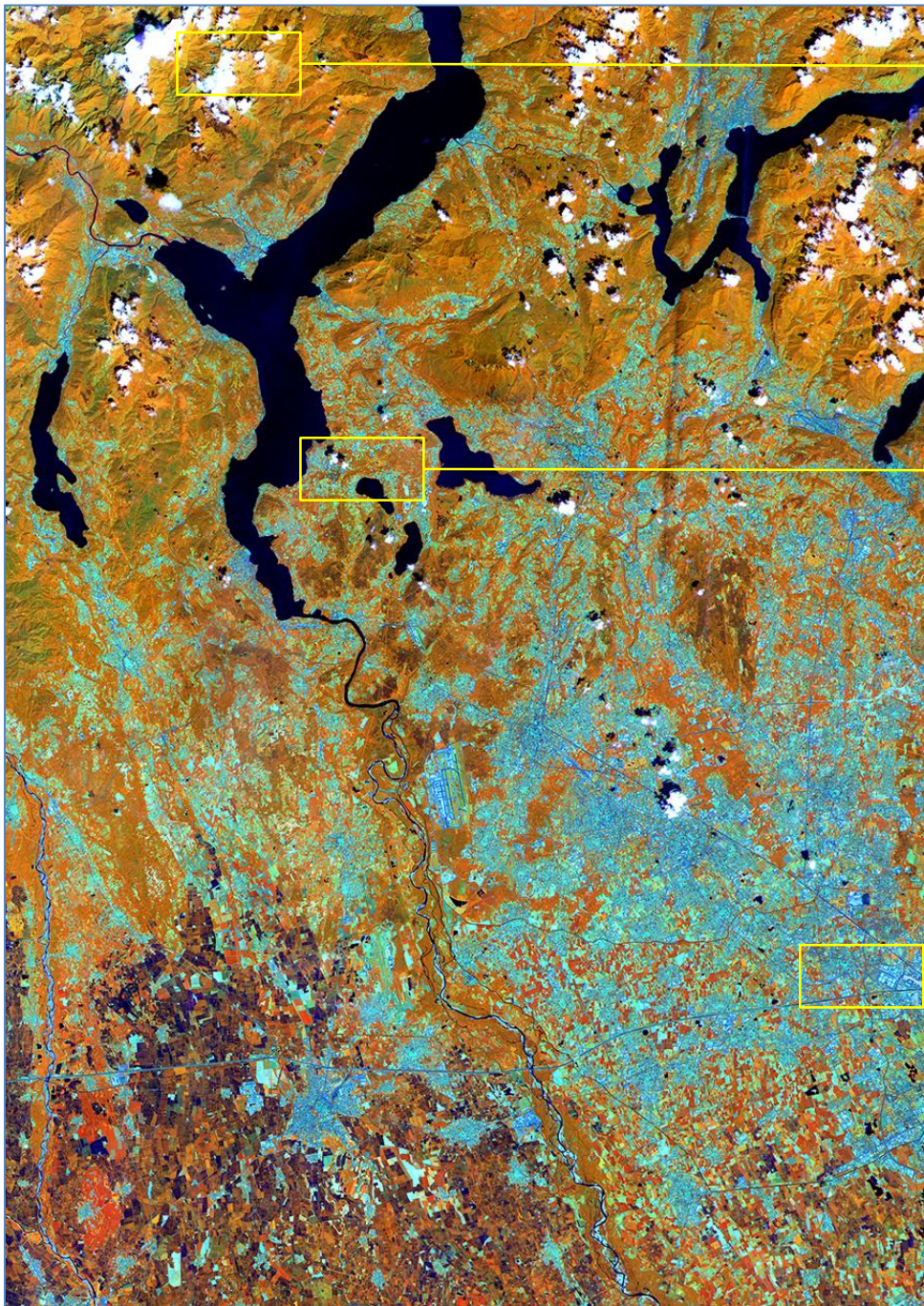


2010 1.6 ha/person

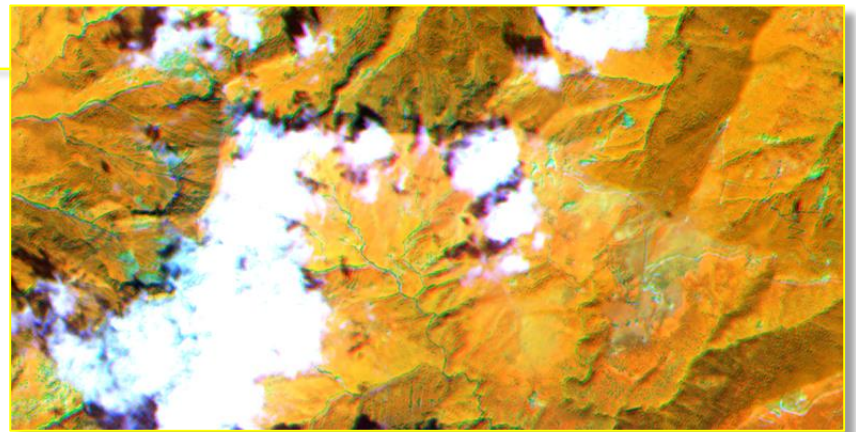
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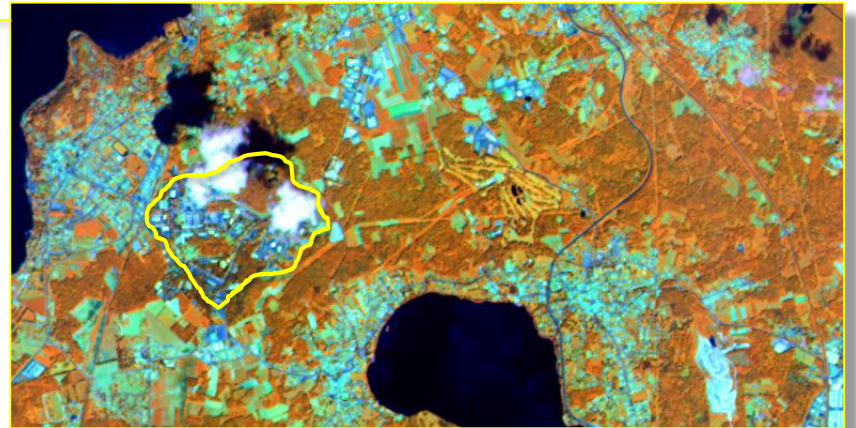
2050 1.2 ha/person



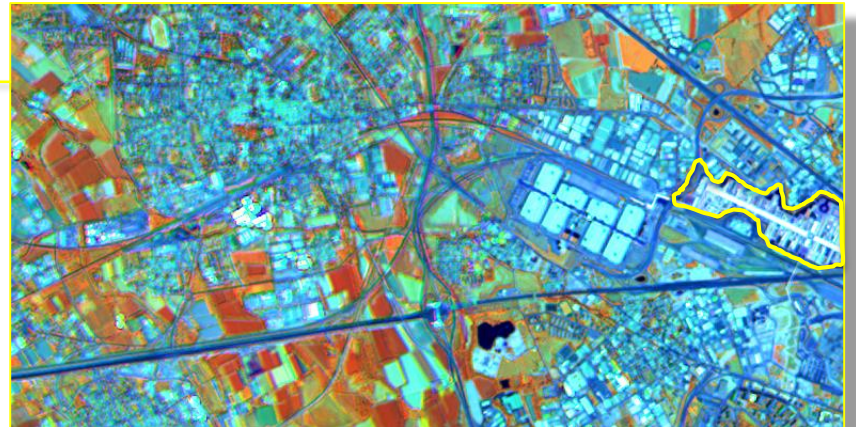
Sentinel 2a Lake Maggiore, 27<sup>th</sup> June 2015



Val Grande National Park

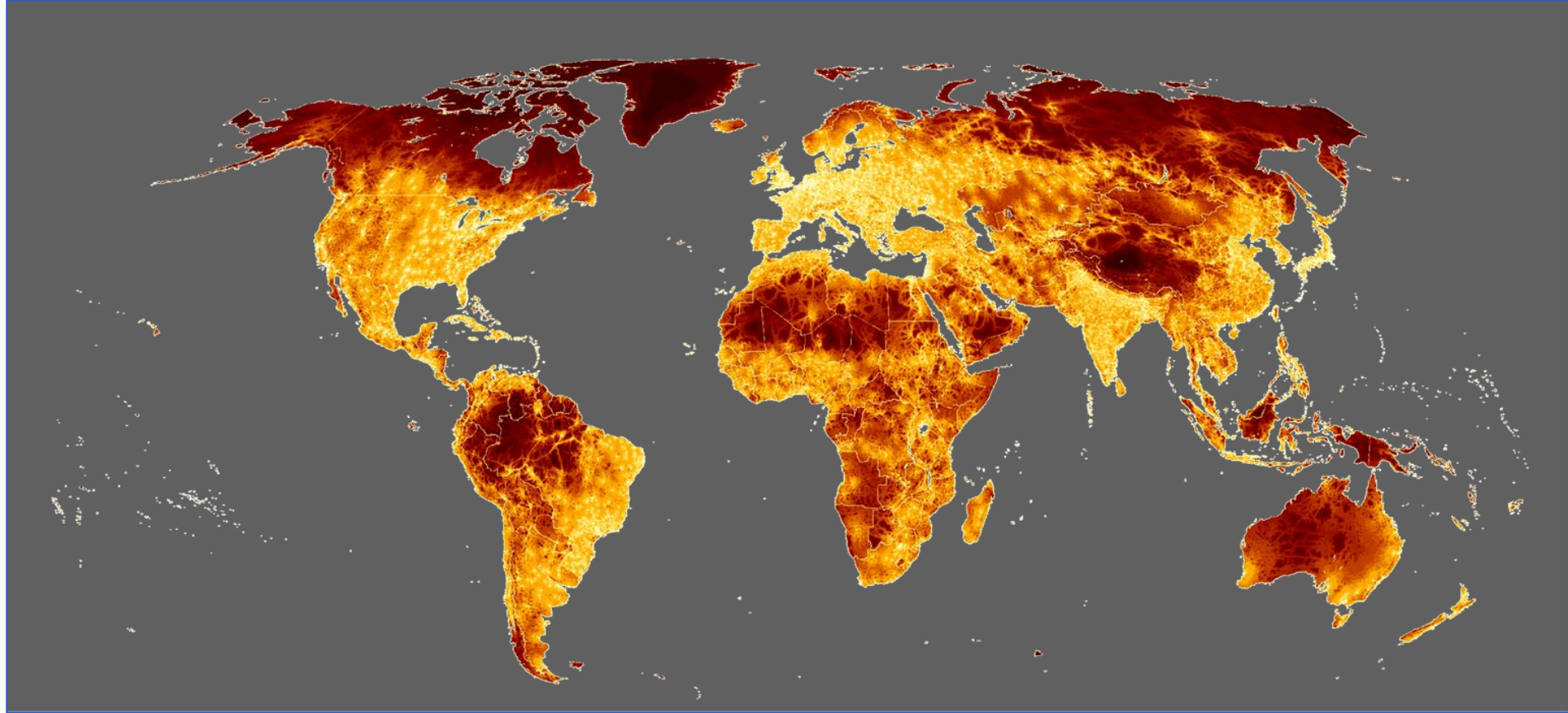


Joint Research Centre, Ispra

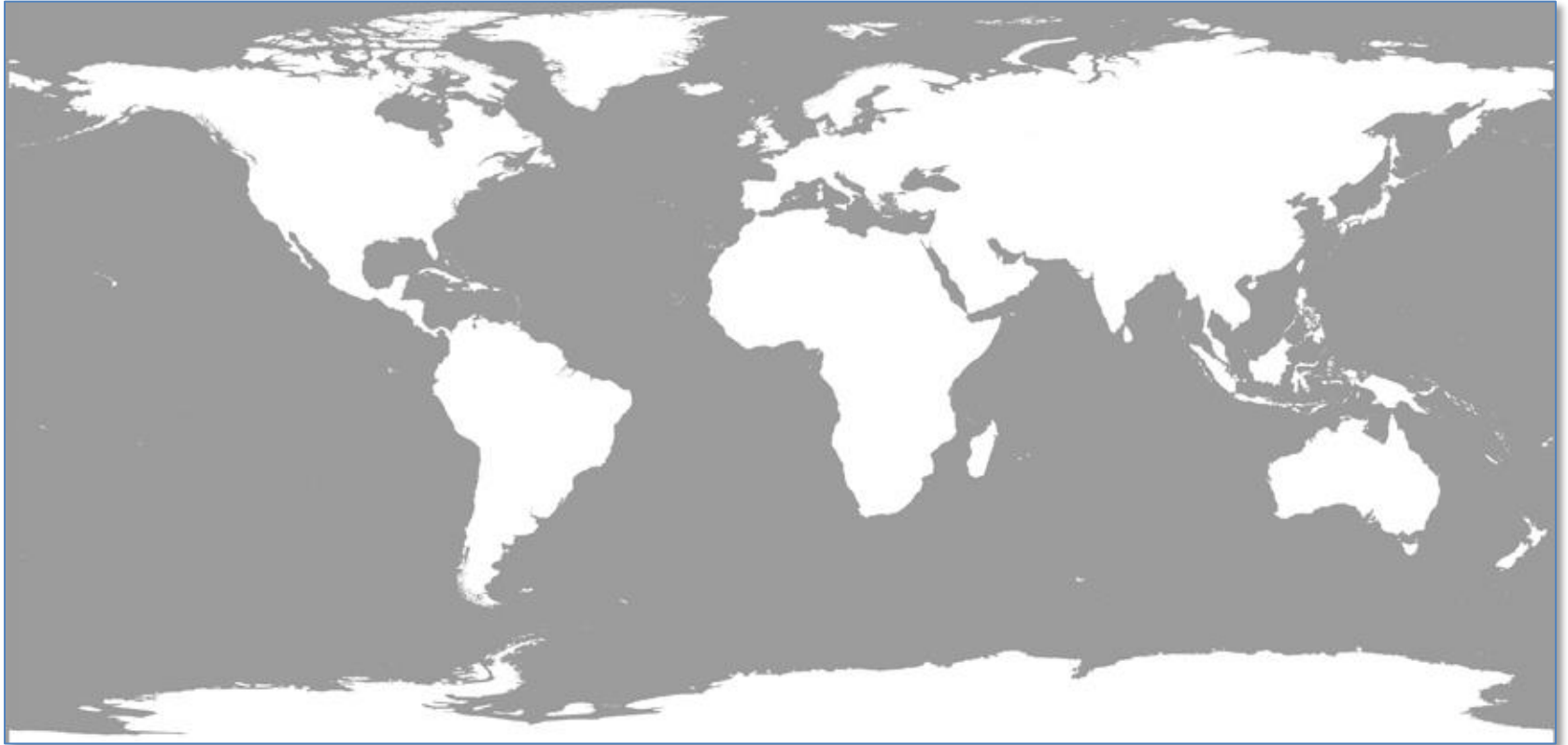


EXPO 2015



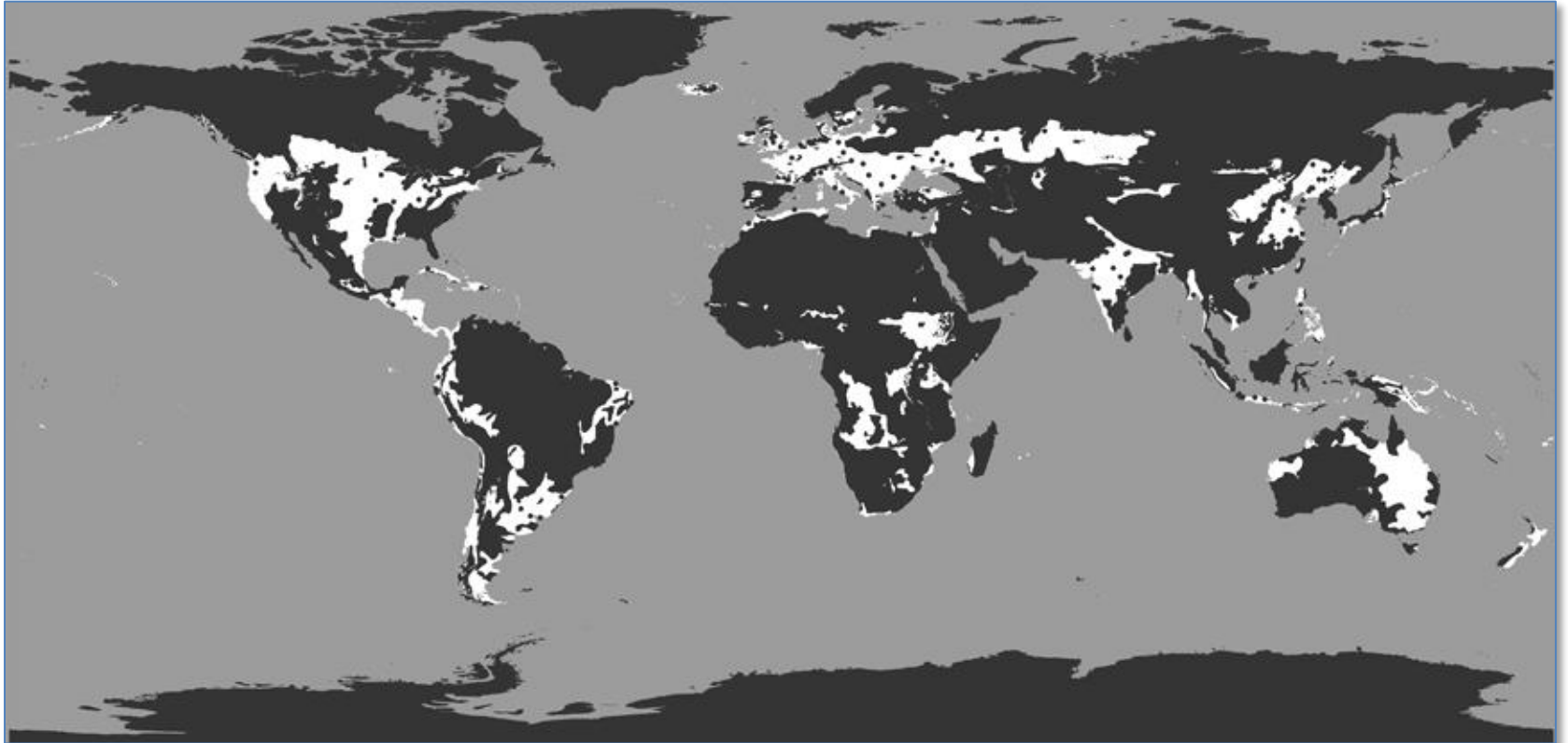


Travel time (hours, days) needed to reach a city of 50,000 people or more  
A. Nelson (JRC) developed for World Bank 's World Development Report (2009)



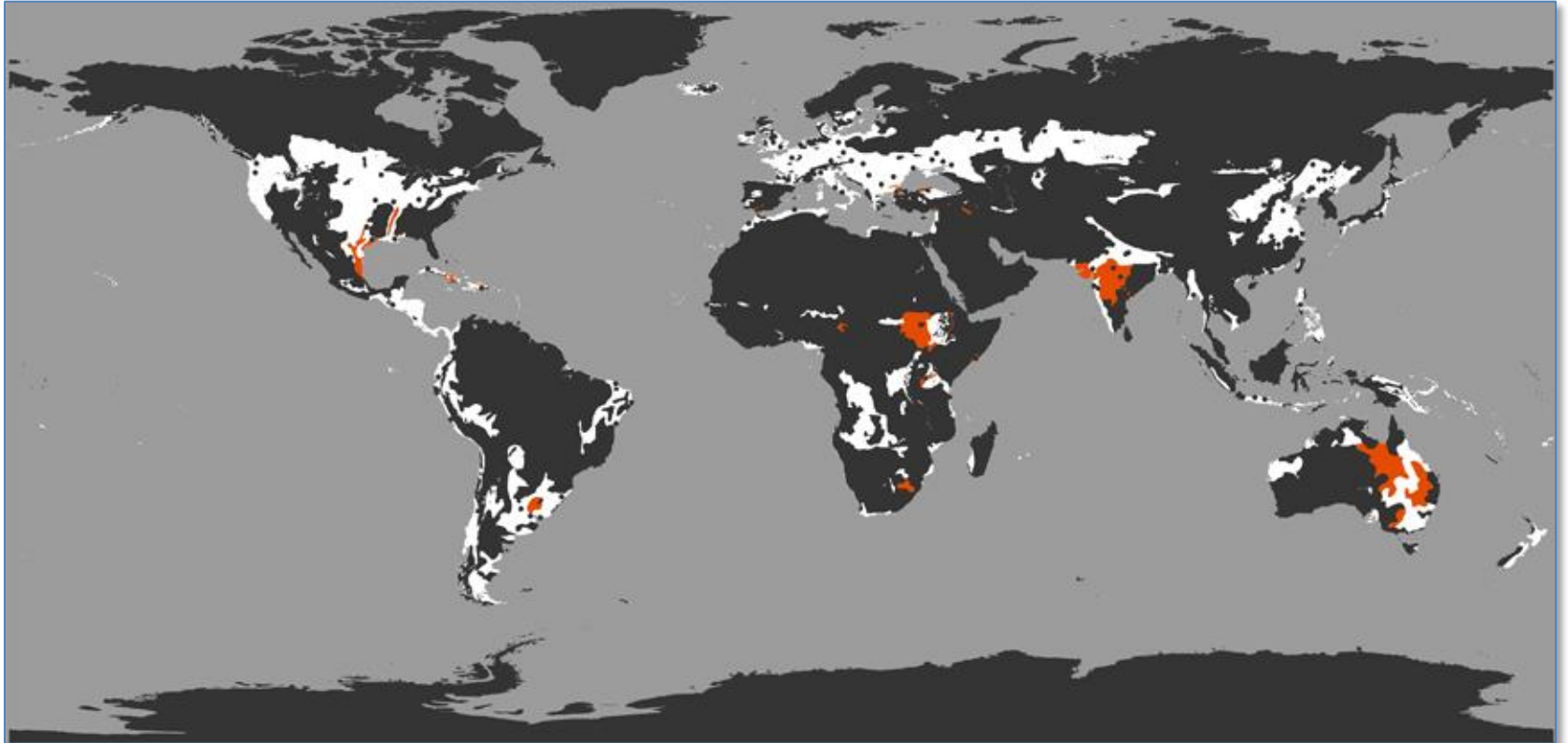
**Two-thirds of the planet's surface is water – but less than 5% of global calories come from the sea, lakes and rivers (FAO figures)**

**At least 95% of our calories come from the land, but how much of the land can be used for food production?**



**Areas in white are the naturally highly-fertile soils that feed the world**

**In reality, this amounts to around 13% - 18% of the land surface**



**... and even these are under threat**

**Soil sealing, pollution, erosion, poor land management, over production, desertification and climate change**

# Travel time to major cities

Travel time map and accessibility model by Andrew Nelson, Agglomeration Index by Hirotsugu Uchida (The World Bank, URB) and Andrew Nelson. Land cover data from the Global Land Cover 2000 Project, <http://www.glm.jrc.ec.europa.eu/glc2000/>.  
UN urban population data from the United Nations World Urbanization Prospects, <http://esa.un.org/urwp/>.

Global Environment Monitoring Unit  
Institute for Environment and Sustainability  
Joint Research Centre of the European Commission  
Via Enrico Fermi 2749, I-20097 Ispra (VA), Italy

<http://www.jrc.ec.europa.eu>  
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*"Accessibility is relevant at all levels, from local development to global trade."*

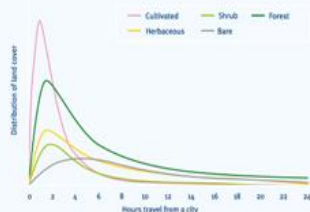
*"95% of the people are concentrated on just 10% of the land."*

*"Accessibility links people with places, goods with markets and communities to vital services."*

*"Only 15% of people in developed countries are more than one hour from a city. In developing countries it is 65%."*

## Land cover patterns around cities

Travel time zones around a city can be used to define regions where particular economic activities are likely to take place. Almost 60% of all cultivated land is within two hours of a city. As urban areas expand, there is huge pressure to convert agricultural land to urban uses, and to convert more distant forests, grasslands and shrublands to agriculture. These patterns of land use around urban areas mirror one of the most important models of economic geography, Johann Heinrich von Thünen's model of the Isolated State, which links transport costs to land value.



## Travel time in hours and days to the nearest city of 50,000 or more people



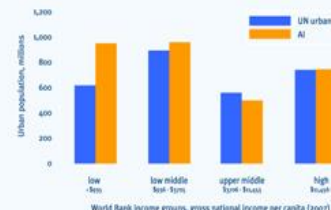
## Travel time to major cities: A global map of Accessibility

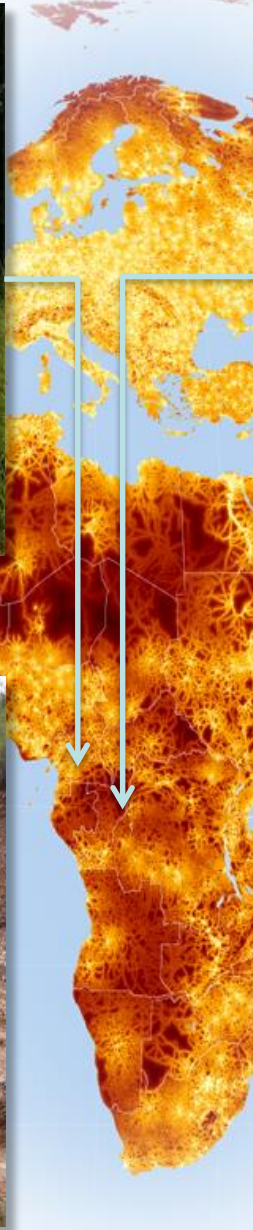
Developed by the European Commission's Joint Research Centre for the World Bank's World Development Report 2009 "Reshaping Economic Geography".

Map colours represent travel time to the nearest city (8,518 cities with 50,000 or more people in the year 2000). Modes of travel are land and water based. The data resolution is 30 arc seconds. The map projection is Robinson. Digital datasets, the accessibility model, input data and more information at <http://www.tem.jrc.ec.europa.eu/accessibility>. The World Development Report is available at <http://econ.worldbank.org>. The delineation of national boundaries must not be considered authoritative.

## Agglomeration Index (AI): A new measure of urban concentration and a more urbanised world

There is no standard definition of 'urban'. A new Agglomeration Index (World Bank & JRC), based on this Accessibility map, suggests that the global urban population in 2000 was 3.21 billion compared to the UN's total of 2.85 billion (53%, compared to 47% of the world). Most of the difference is in the developing world. This alternative definition of urbanisation suggests that the world may have passed the urbanisation tipping point – more people living in urban areas than in rural areas – much earlier than the 2007/8 estimate.





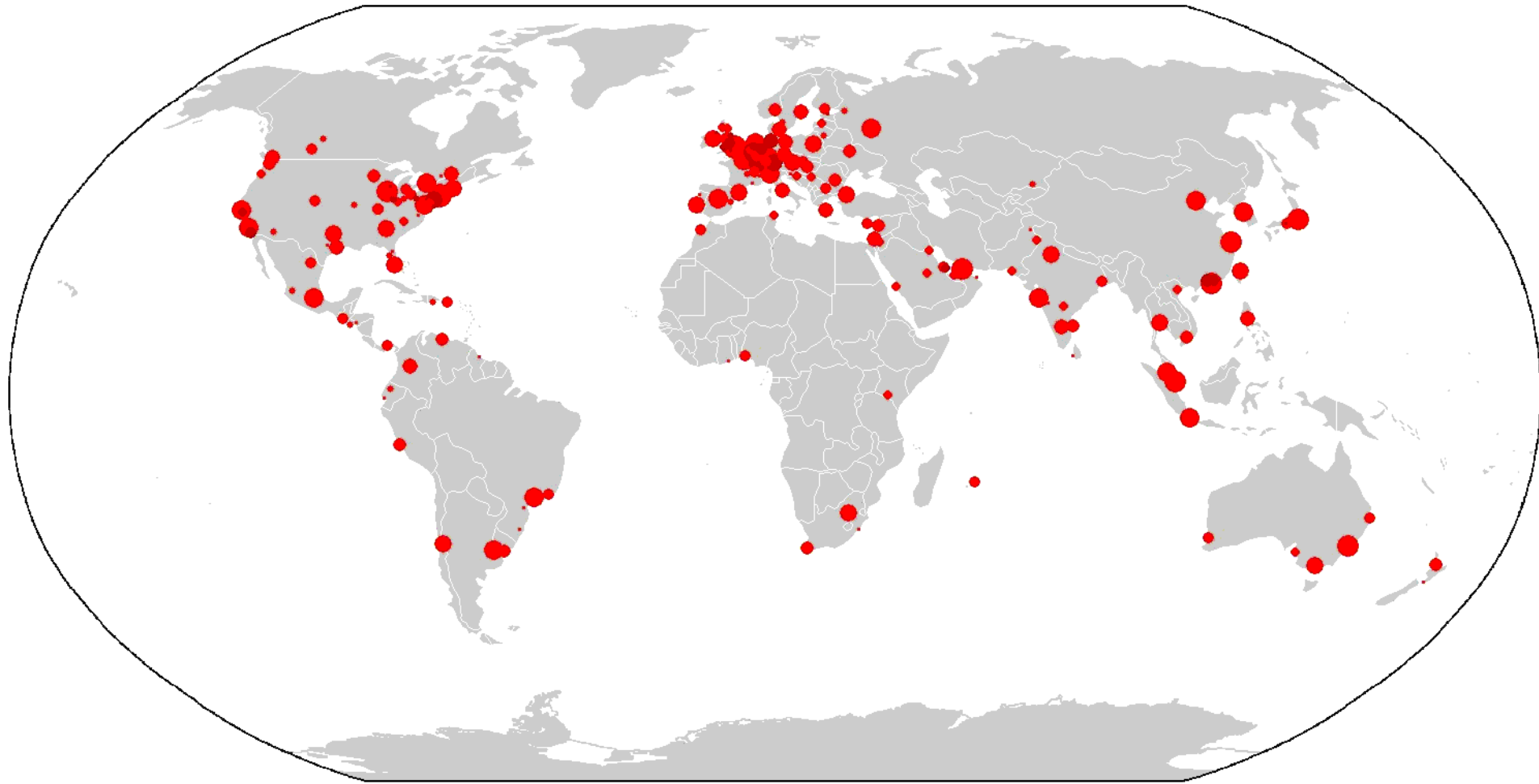
<http://www.africanbirdclub.org/countries/Gabon/images/Gabon-loggingtruck.jpg> Photo Ron Hoff

[http://4.bp.blogspot.com/\\_9CO6qVRAhol/Rk3TNiZujEI/AAAAAAAKc/h7GKpcqNzm4/s400/IMG\\_1933%5B1%5D](http://4.bp.blogspot.com/_9CO6qVRAhol/Rk3TNiZujEI/AAAAAAAKc/h7GKpcqNzm4/s400/IMG_1933%5B1%5D)

[http://lh6.ggpht.com/\\_Tat1FT59RxQ/R8p55NU\\_Ktl/AAAAAAAAY8/dBXCpRCZ7Hw/s720/Barge%20Congo%20042.jpg](http://lh6.ggpht.com/_Tat1FT59RxQ/R8p55NU_Ktl/AAAAAAAAY8/dBXCpRCZ7Hw/s720/Barge%20Congo%20042.jpg)

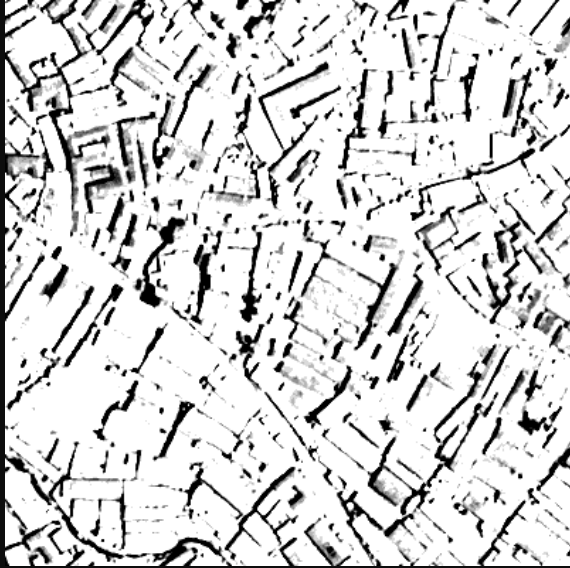
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# Globalization and World Cities

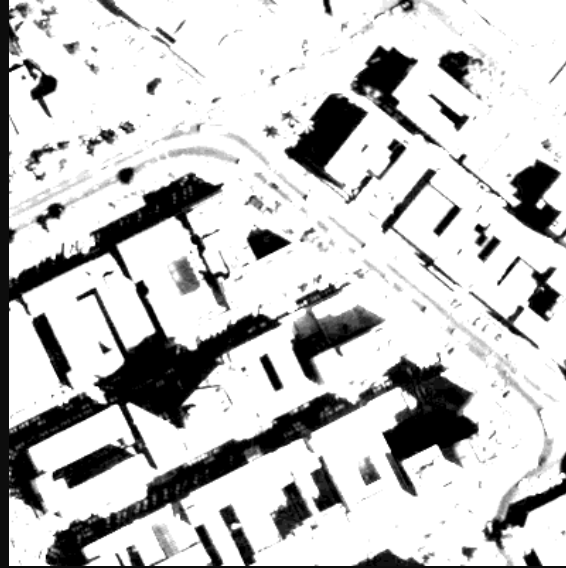


2005 – first tests on human settlement characterization using image multiscale morphological decomposition (DMP) on shadows – Nairobi, input QB 0.6-m-res

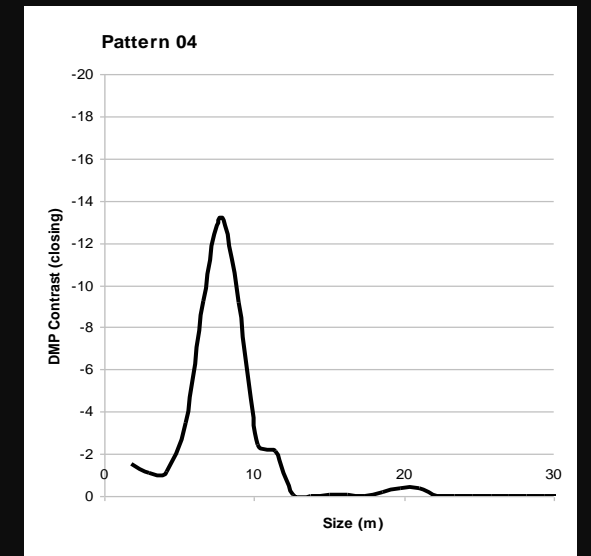
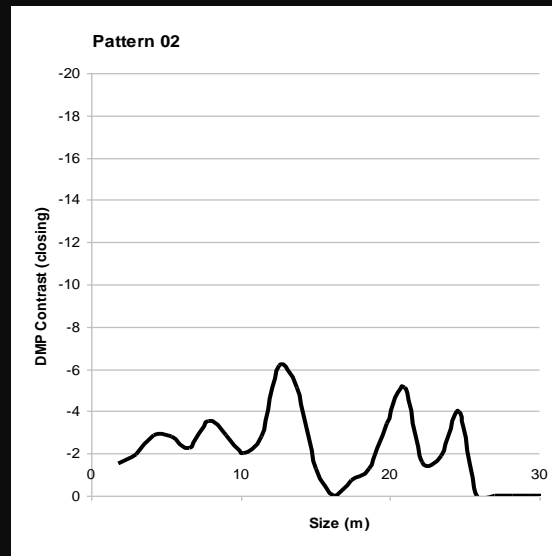
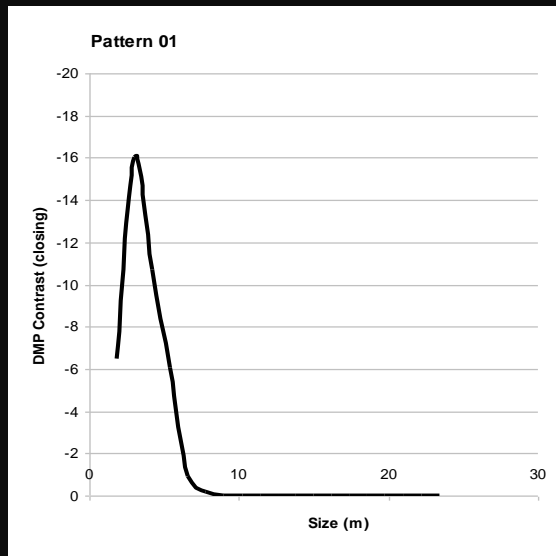
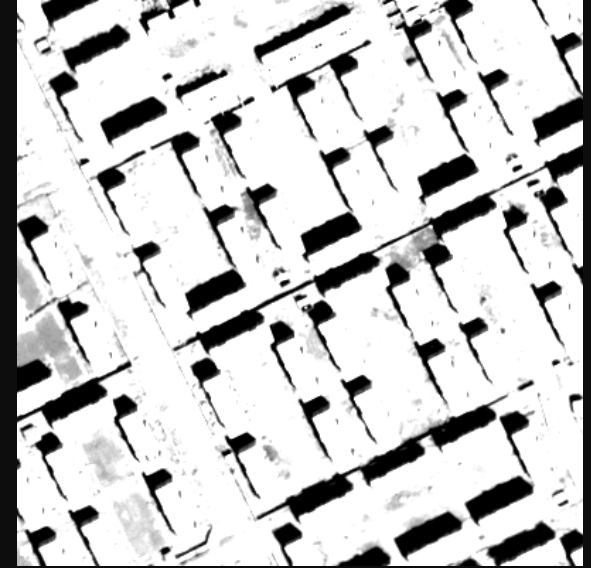
slum



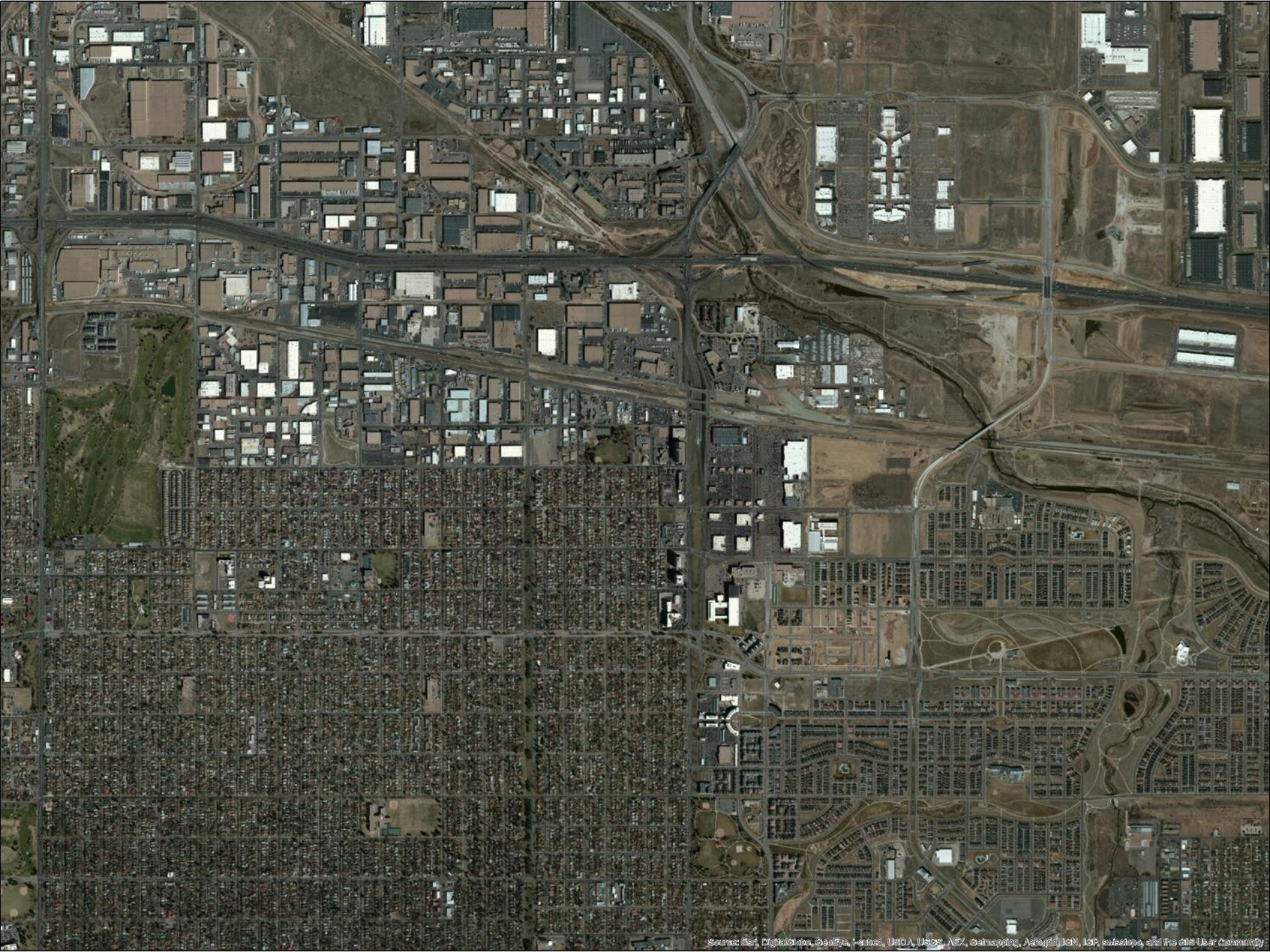
CBD

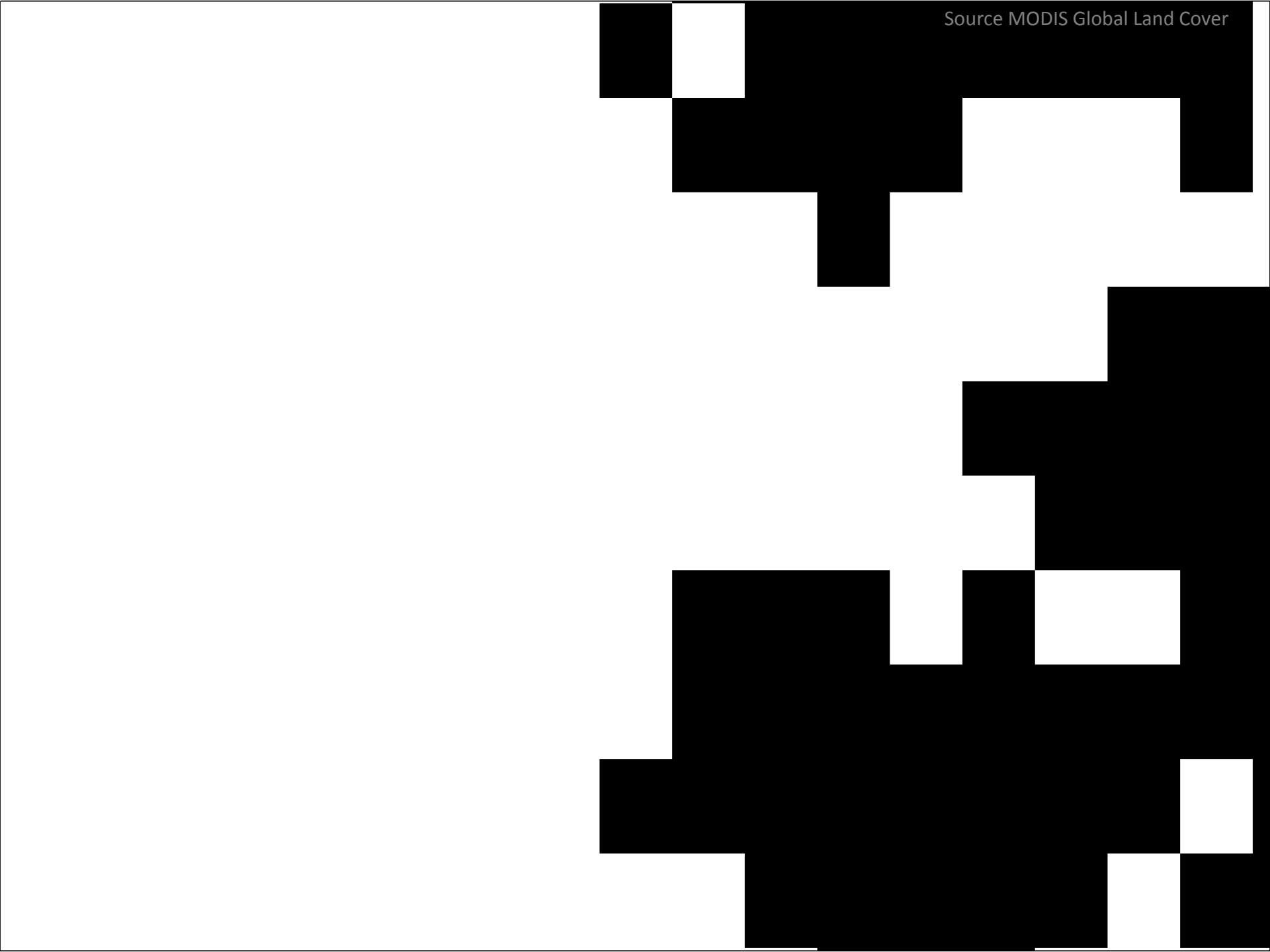


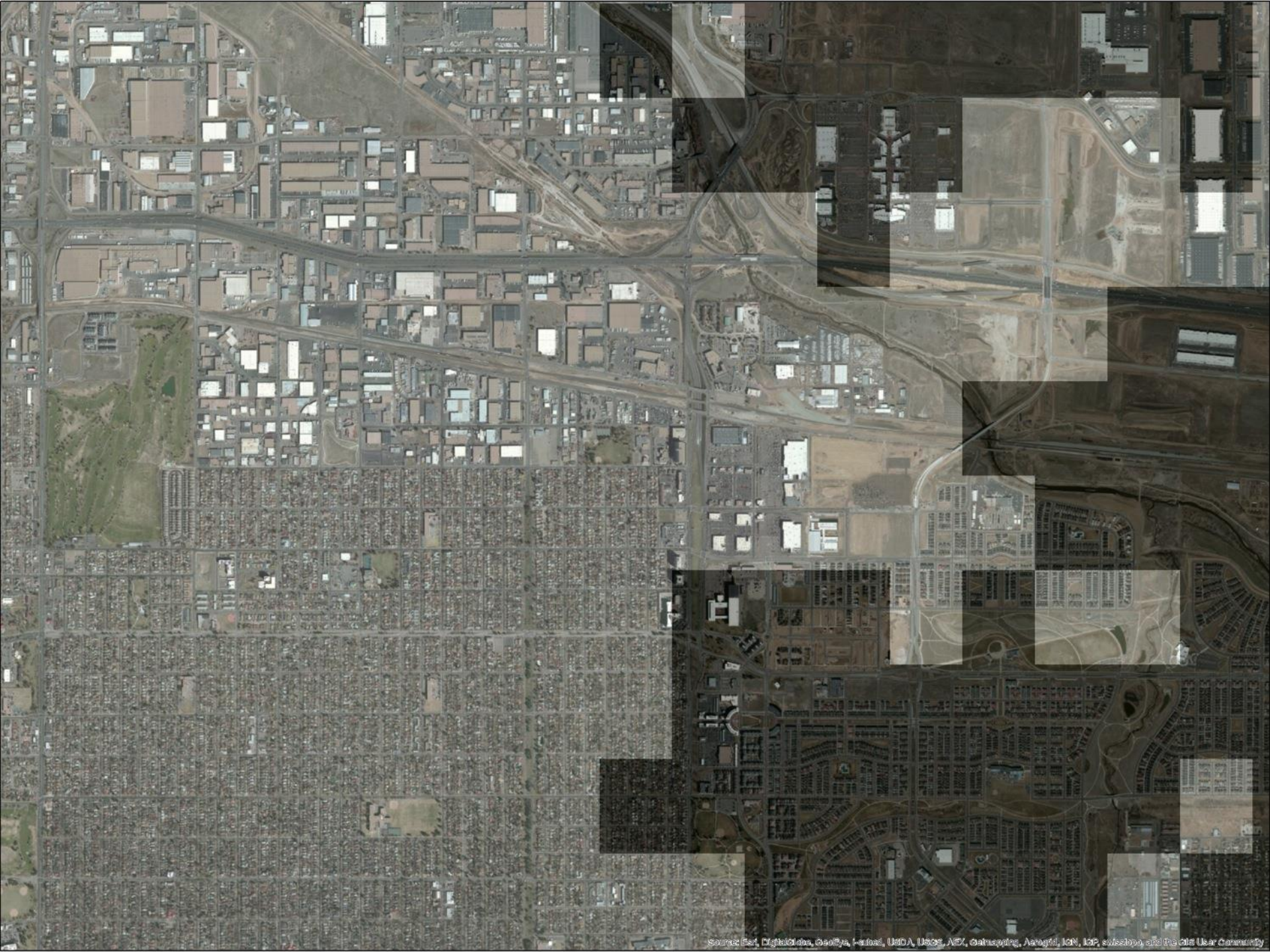
residential

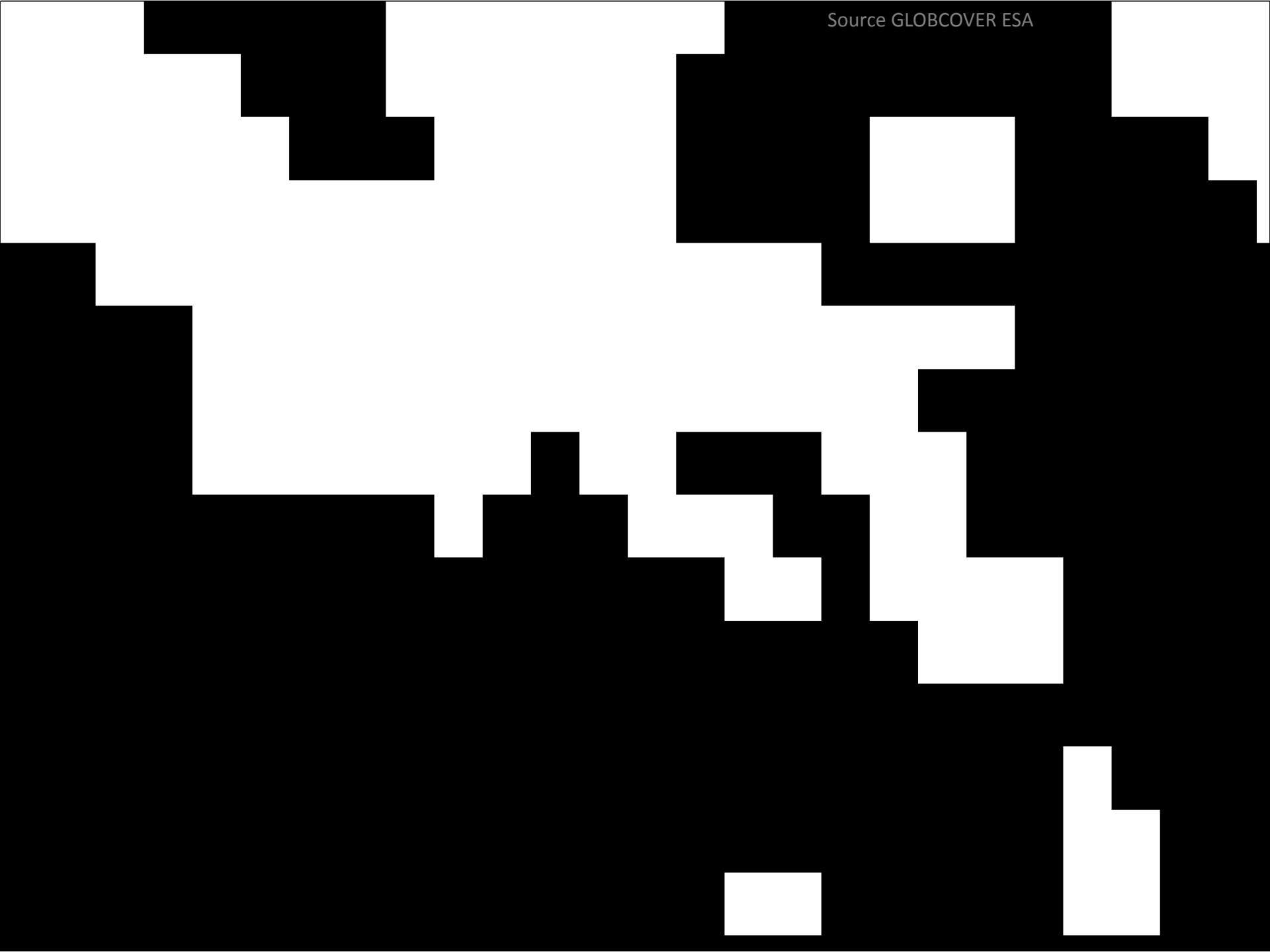


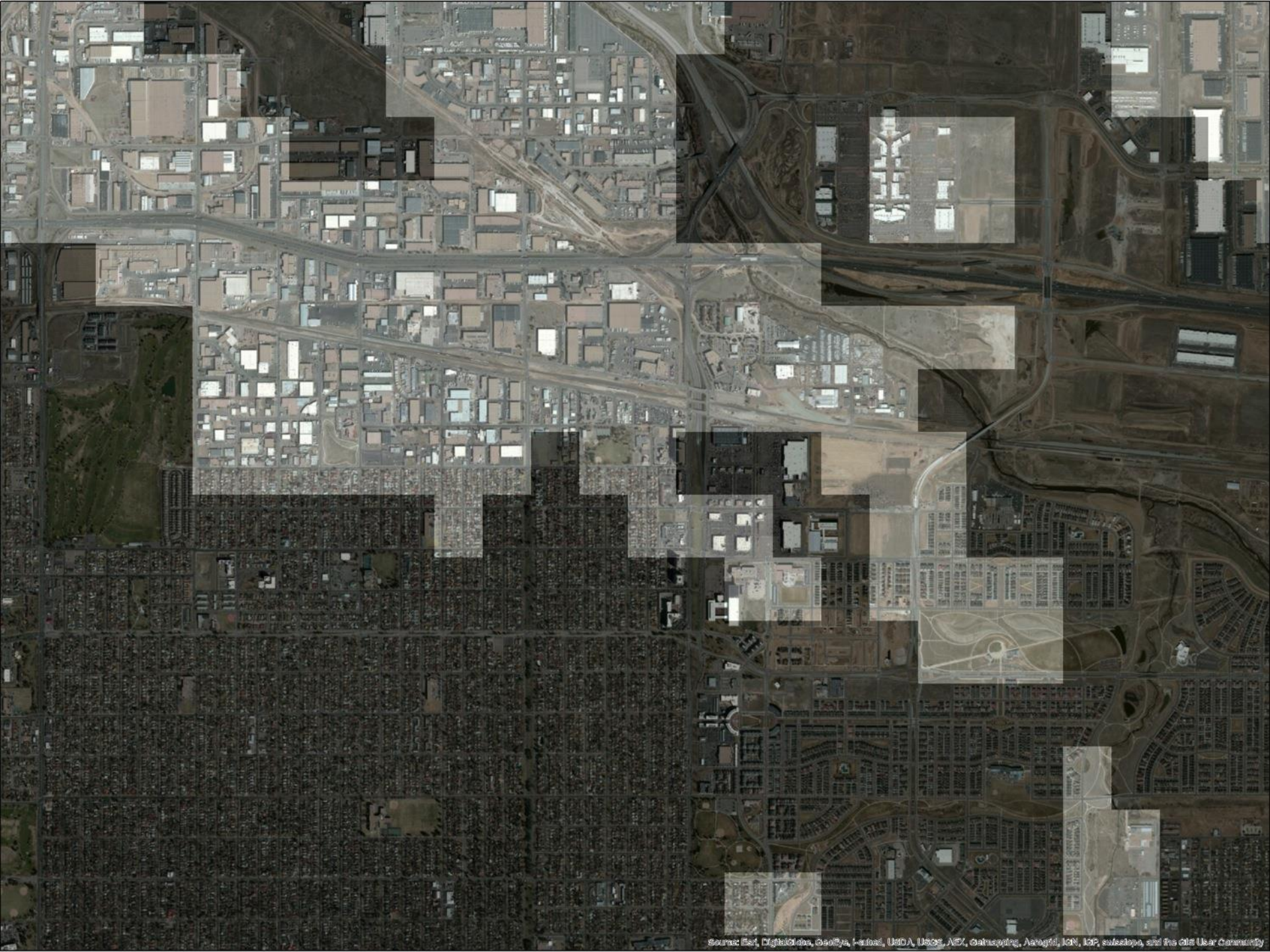


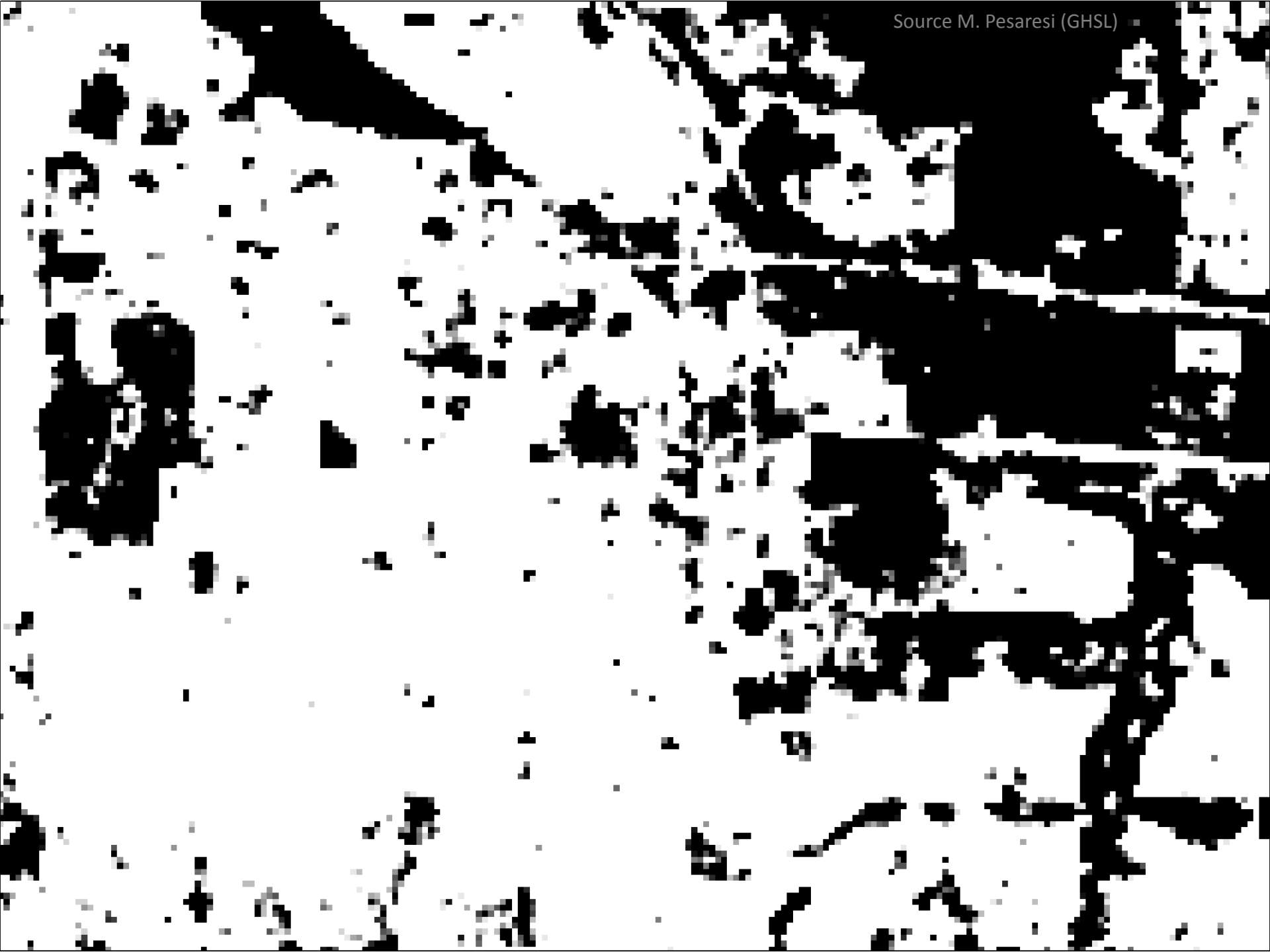




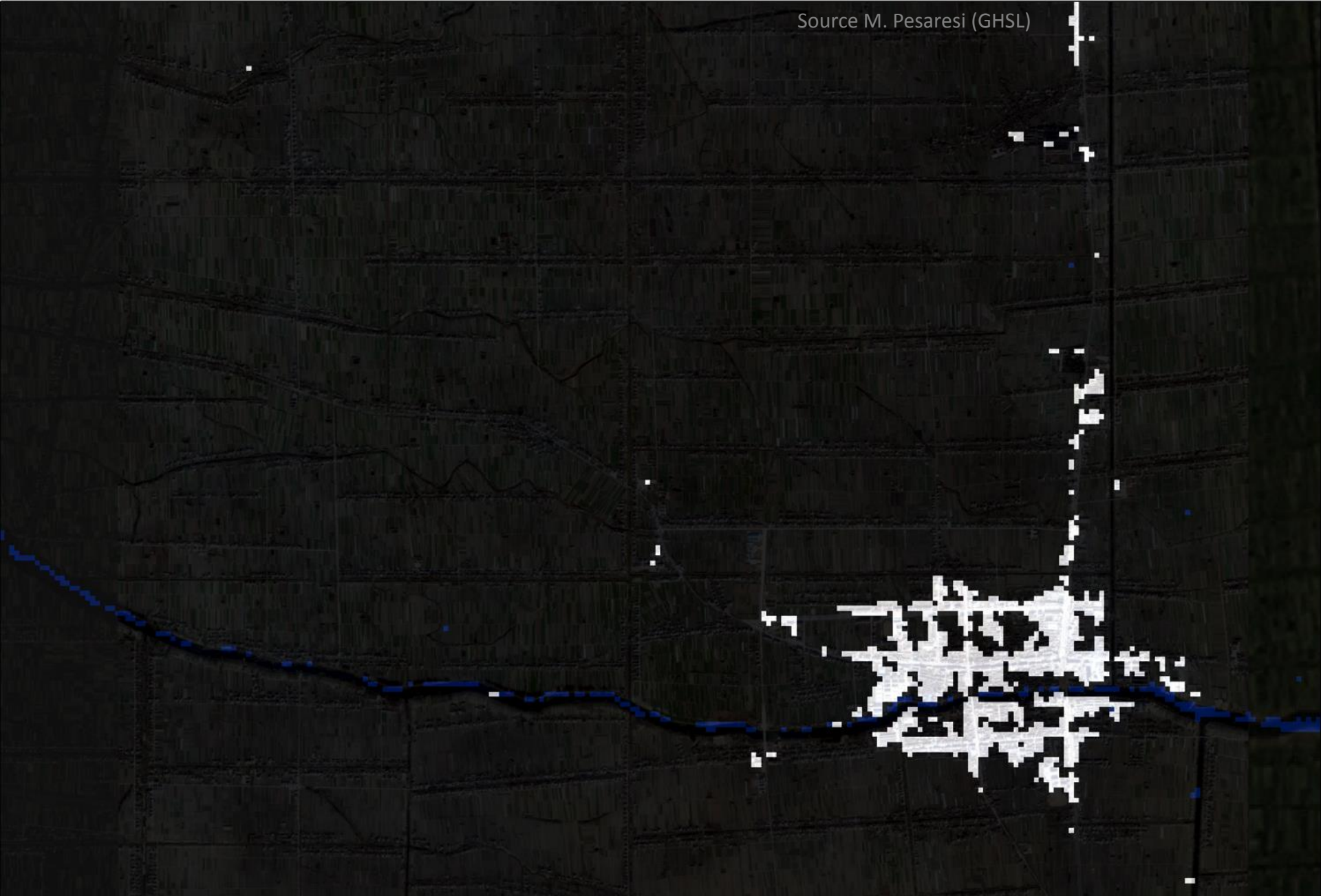










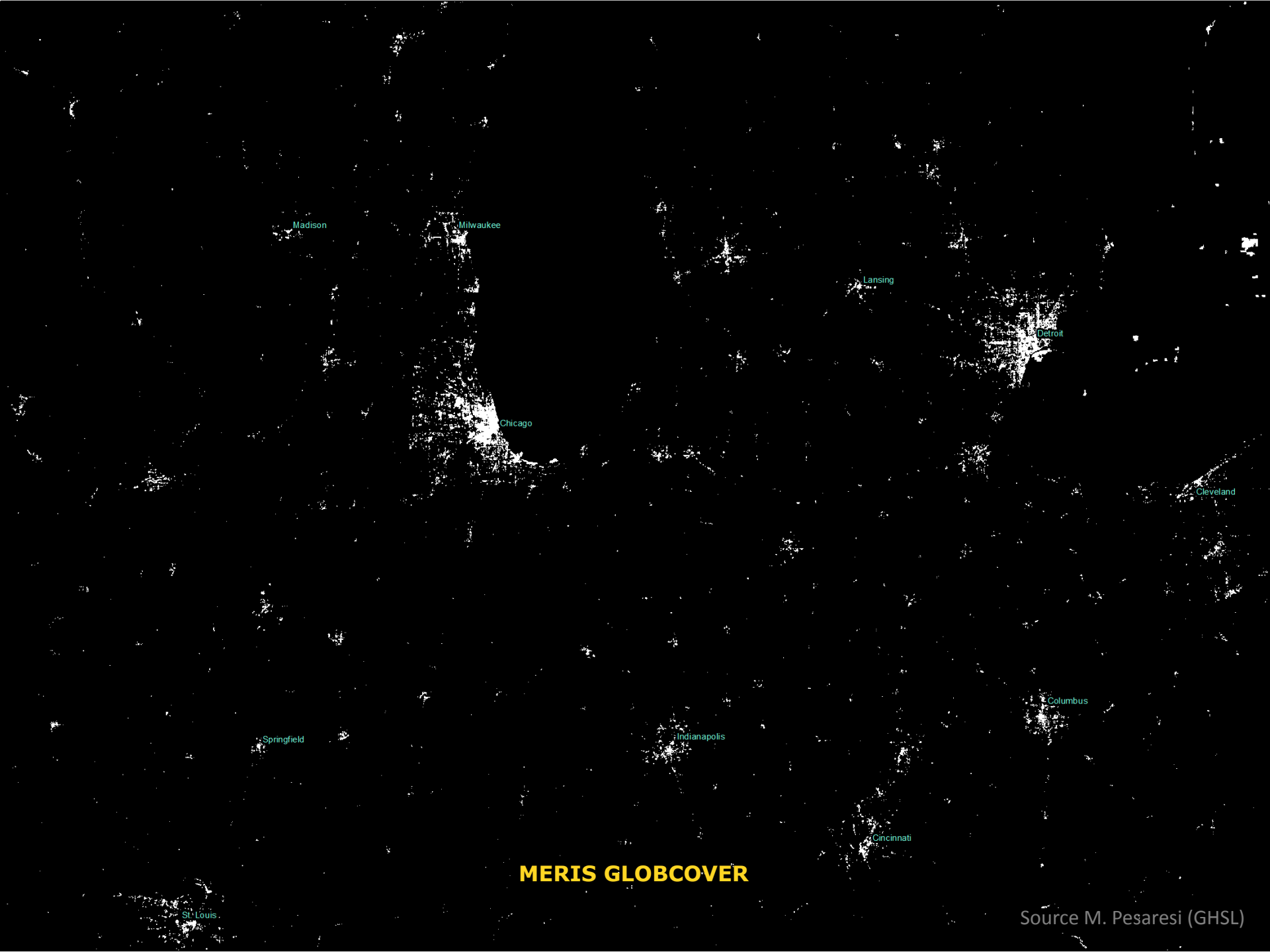


Known issues: large omission errors still in some specific settlement patterns (example from China)





Pesaresi, M.; Guo Huadong; Blaes, X.; Ehrlich, D.; Ferri, S.; Gueguen, L.; Halkia, M.; Kauffmann, M.; Kemper, T.; Linlin Lu; Marin-Herrera, M.A.; Ouzounis, G.K.; Scavazon, M.; Soille, P.; Syrris, V.; Zanchetta, L., "A Global Human Settlement Layer From Optical HR/VHR RS Data: Concept and First Results," *Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of* , vol.6, no.5, pp.2102,2131, Oct. 2013 doi: 10.1109/JSTARS.2013.227144



Madison

Milwaukee

Chicago

Indianapolis

Lansing

Detroit

Cleveland

Columbus

Springfield

Cincinnati

St. Louis

**MERIS GLOBCOVER**

Source M. Pesaresi (GHSL)



Madison

Milwaukee

Chicago

Lansing

Detroit

Cleveland

Springfield

Indianapolis

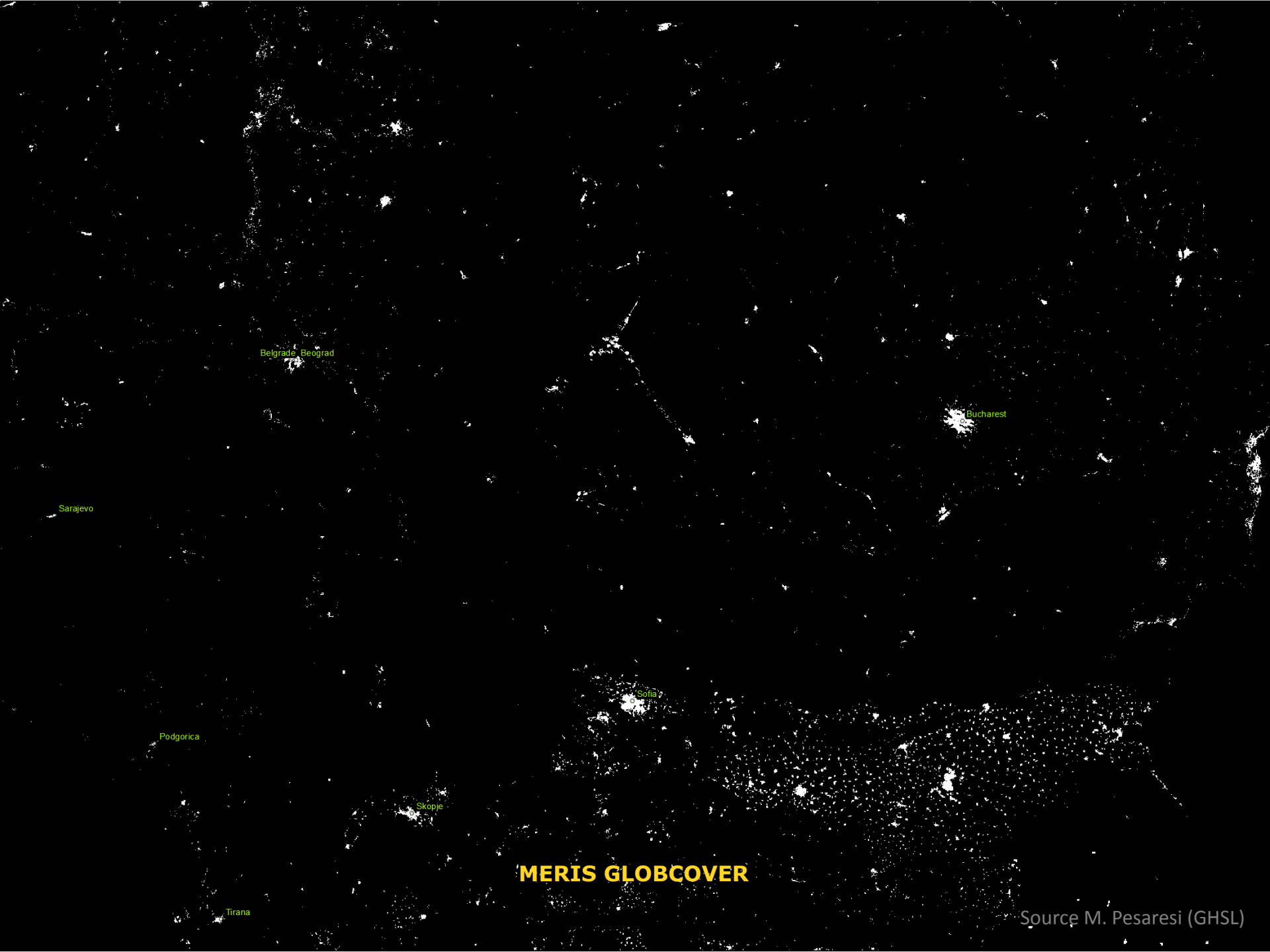
Columbus

Cincinnati

St. Louis

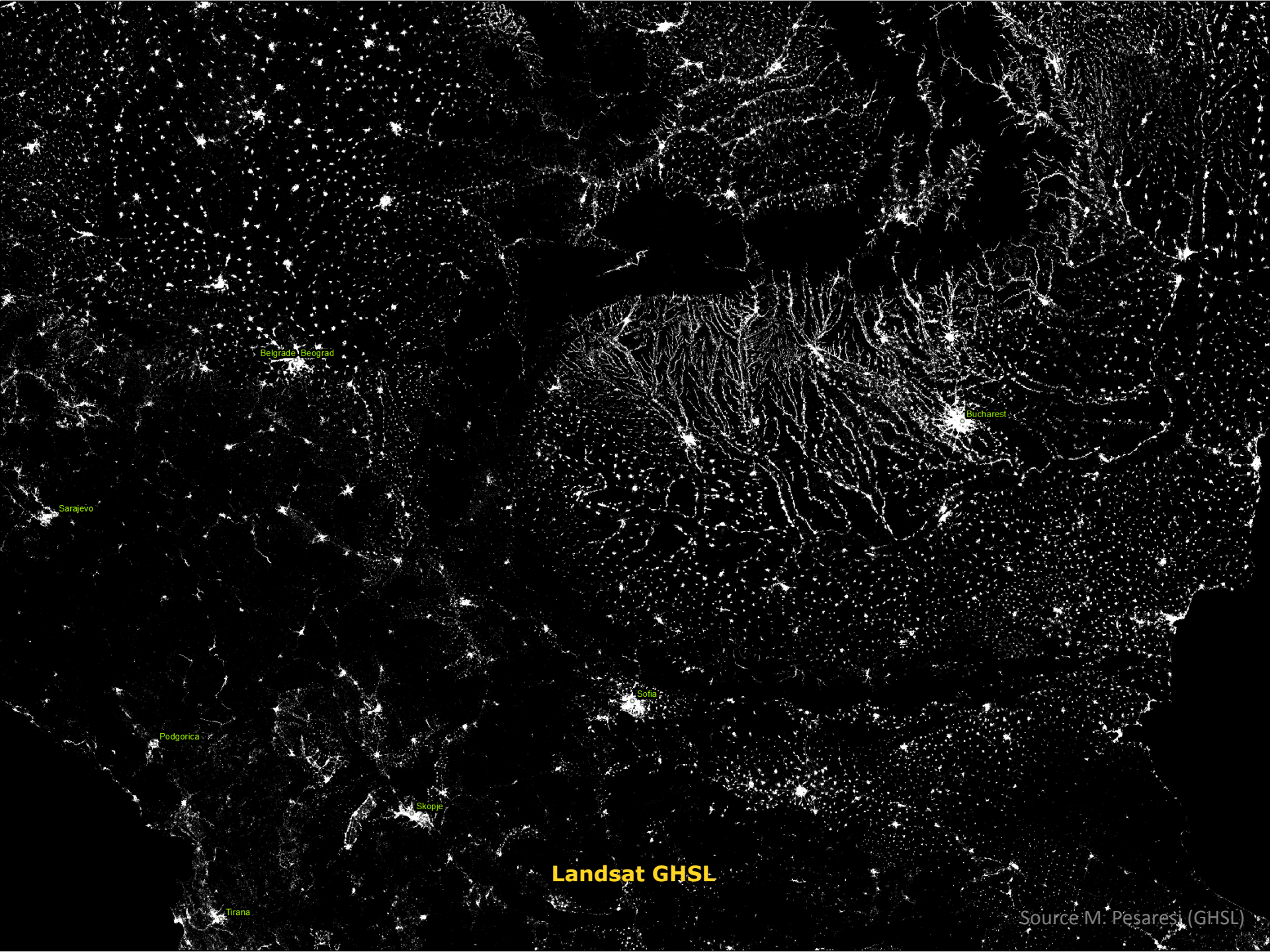
**Landsat GHSL**

Source M; Pesarèsi (GHSL)



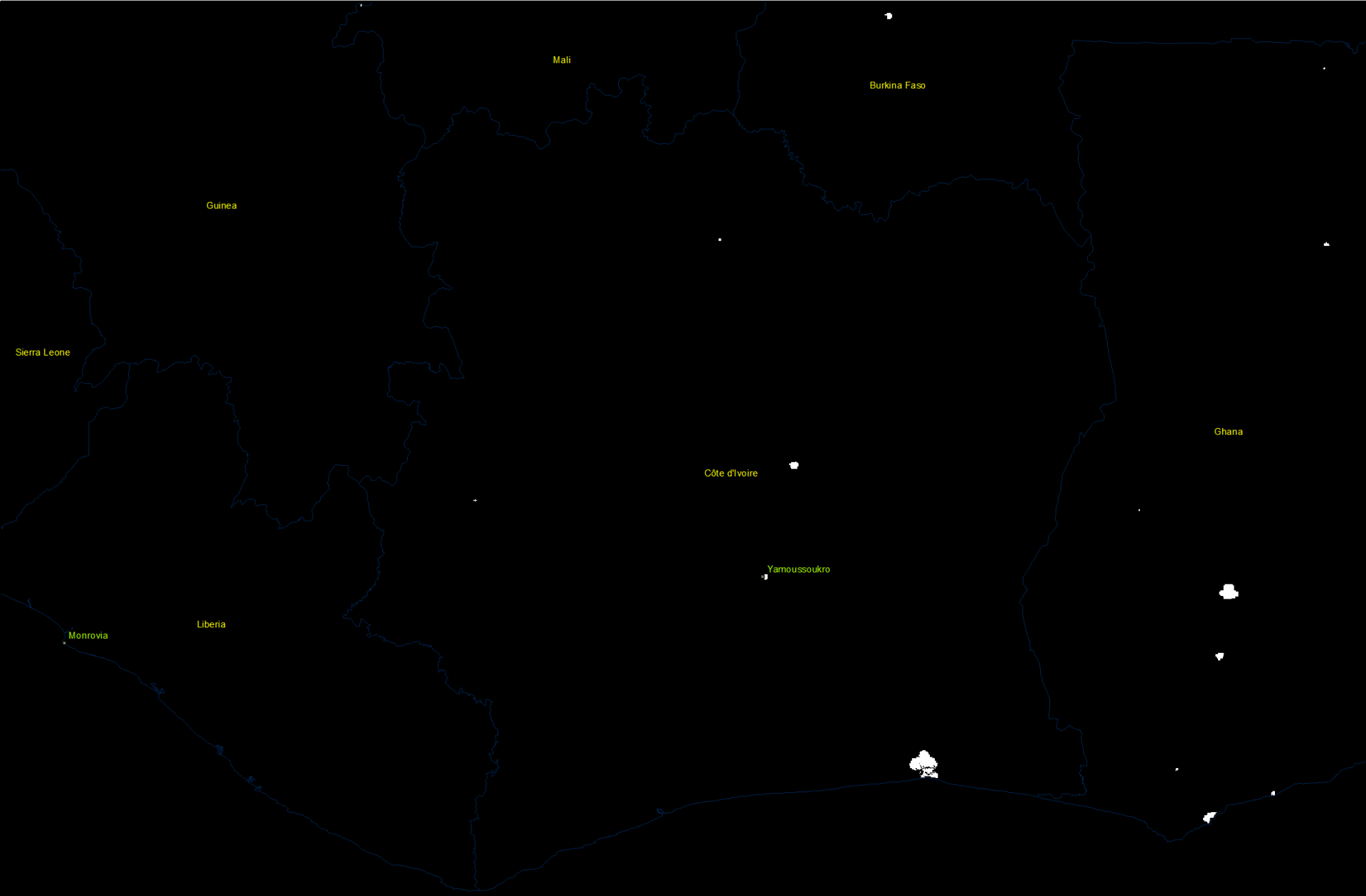
**MERIS GLOBCOVER**

Source M. Pesaresi (GHSL)



**Landsat GHSL**

Source: M. Pešaresi (GHSL)



**MERIS GLOBCOVER**

Source M. Pesaresi (GHSL)



**Landsat GHSL**

Source M. Pesaresi (GHSL)



Turkey

Syrian Arab Republic

Iraq

Baghdad

Beirut, Lebanon

Damascus

Jordan

Saudi Arabia

Amman

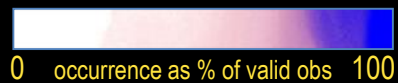
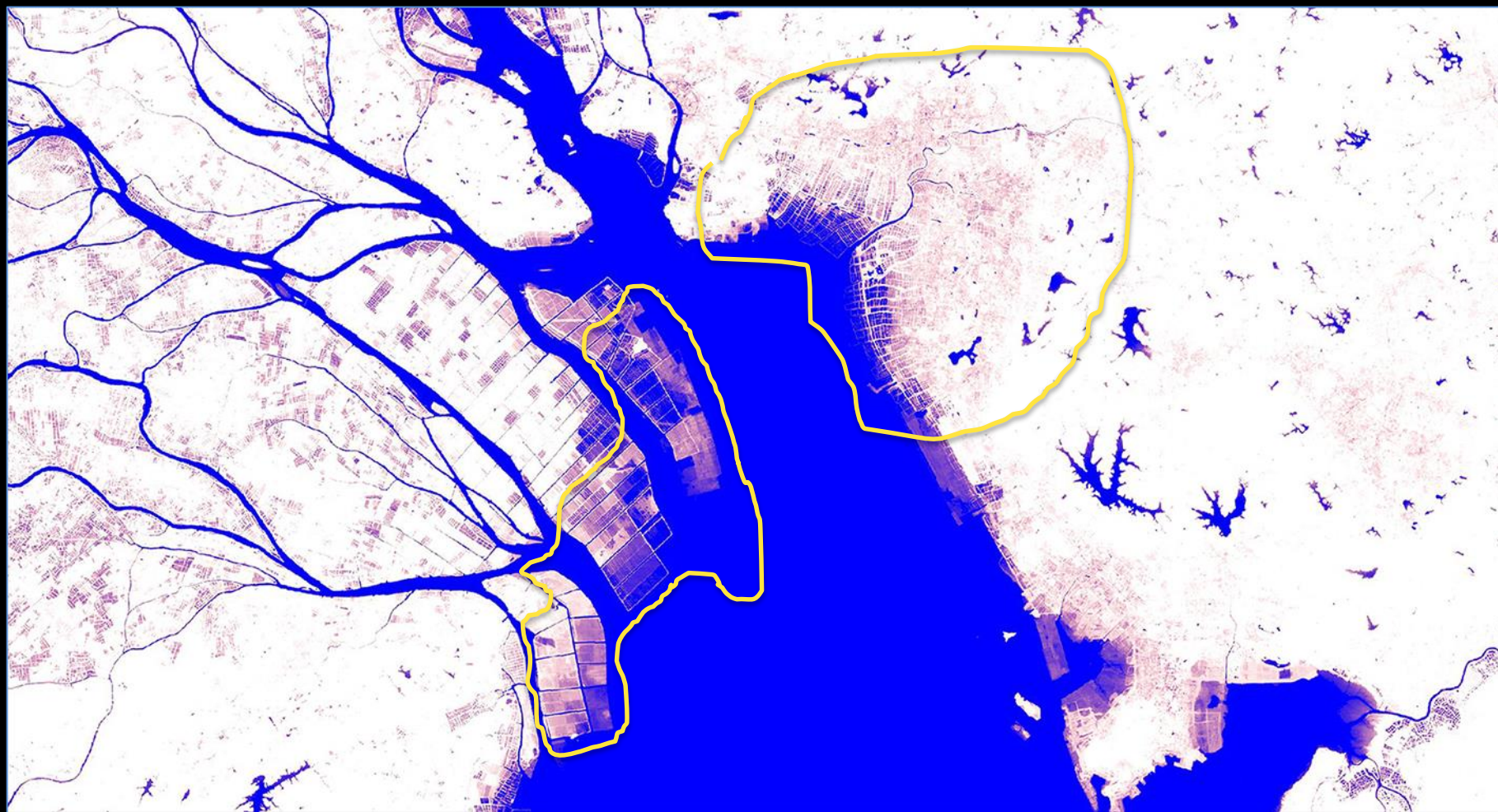
West Bank

Israel

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



# 30 year Global Surface Water Occurrence (Hong Kong region)





Hong Kong 8<sup>th</sup> December 1987, source Landsat courtesy USGS NASA



Hong Kong 19<sup>th</sup> January 2015, source Landsat courtesy USGS NASA



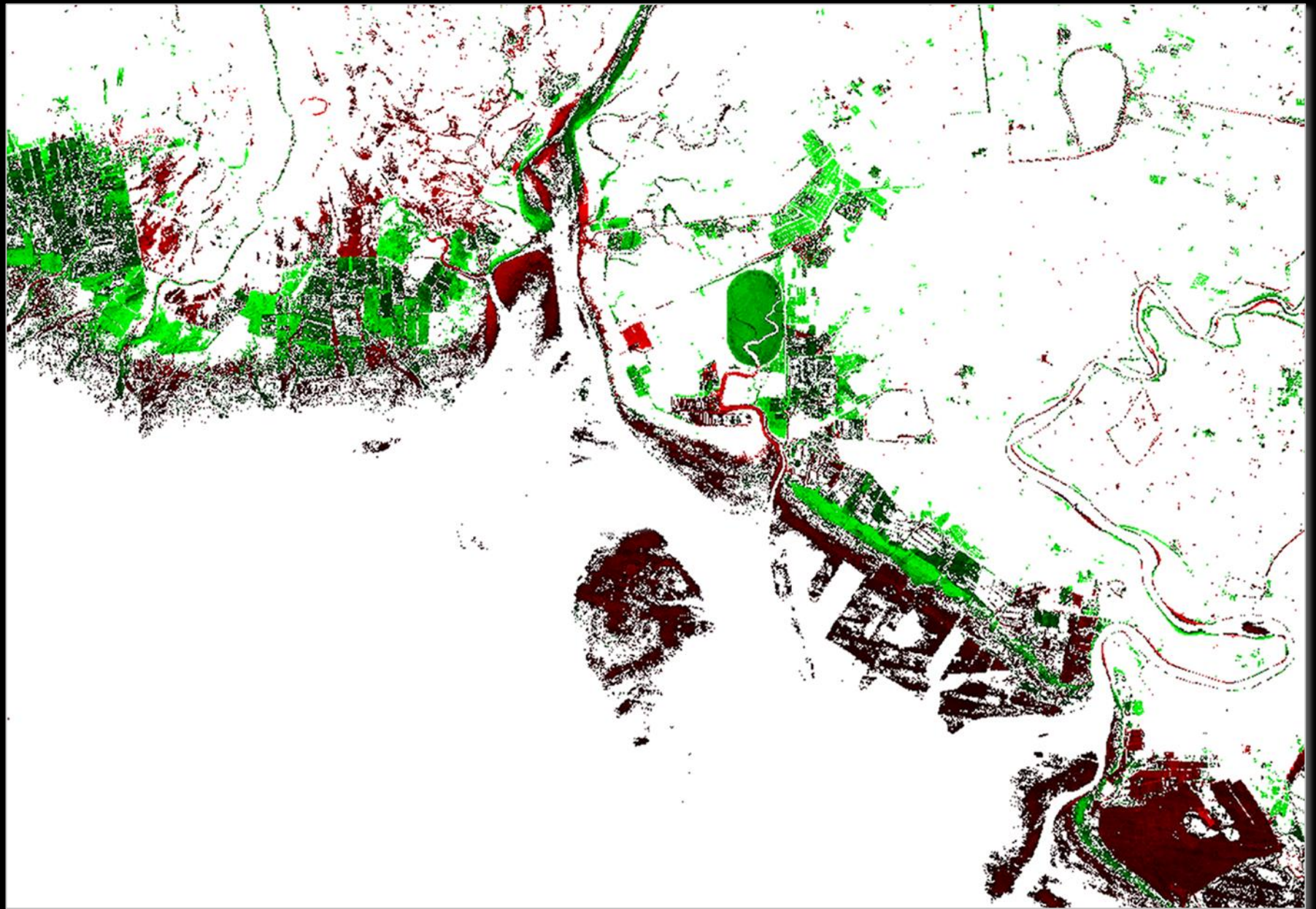
Yingkou, China, 13<sup>th</sup> July 1985

← 10 km →



Yingkou, China, 13<sup>th</sup> July 2014

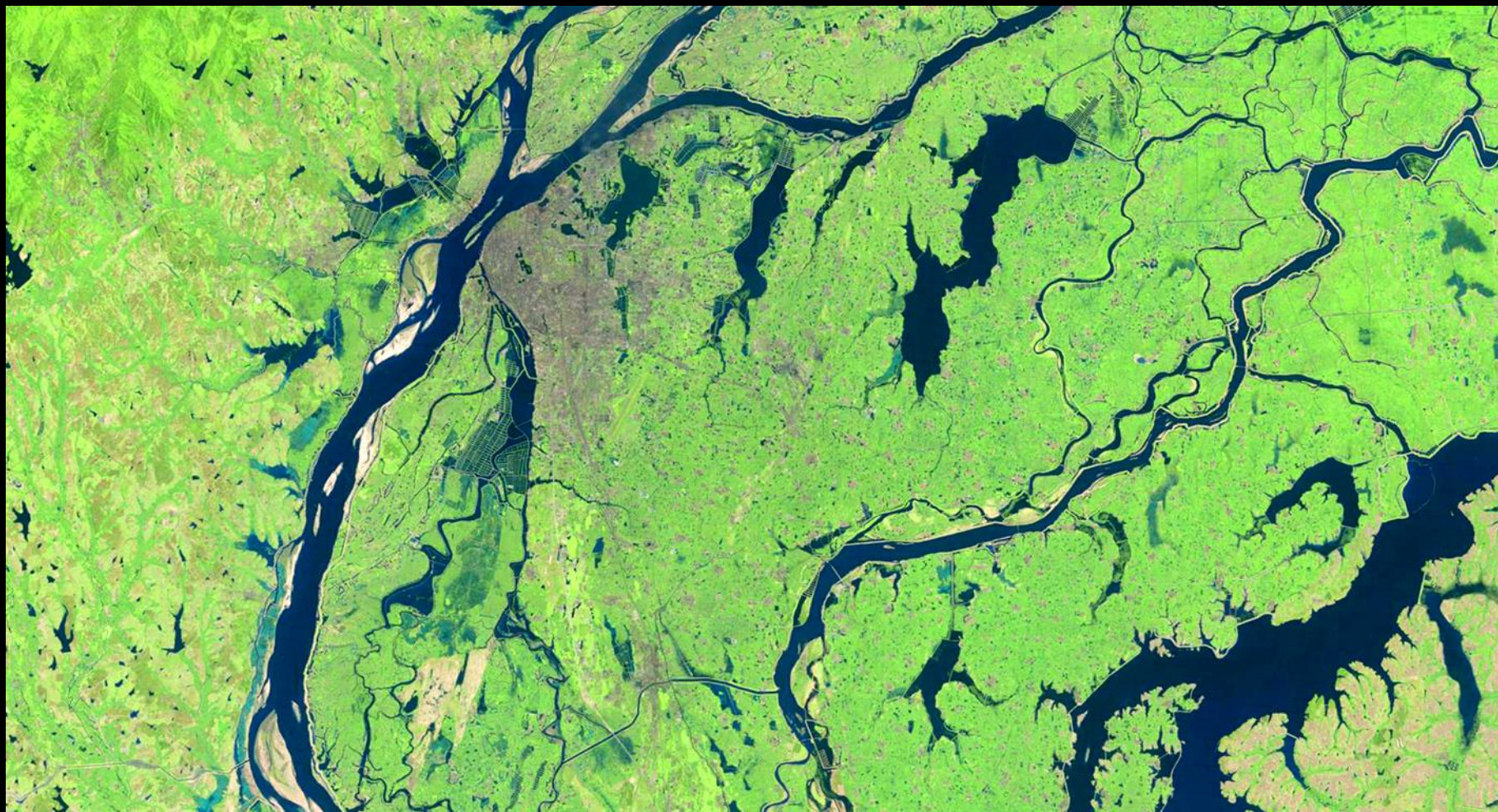
← 10 km →



Yingkou, China, 10%-100% change in water occurrence 1985 – 2015

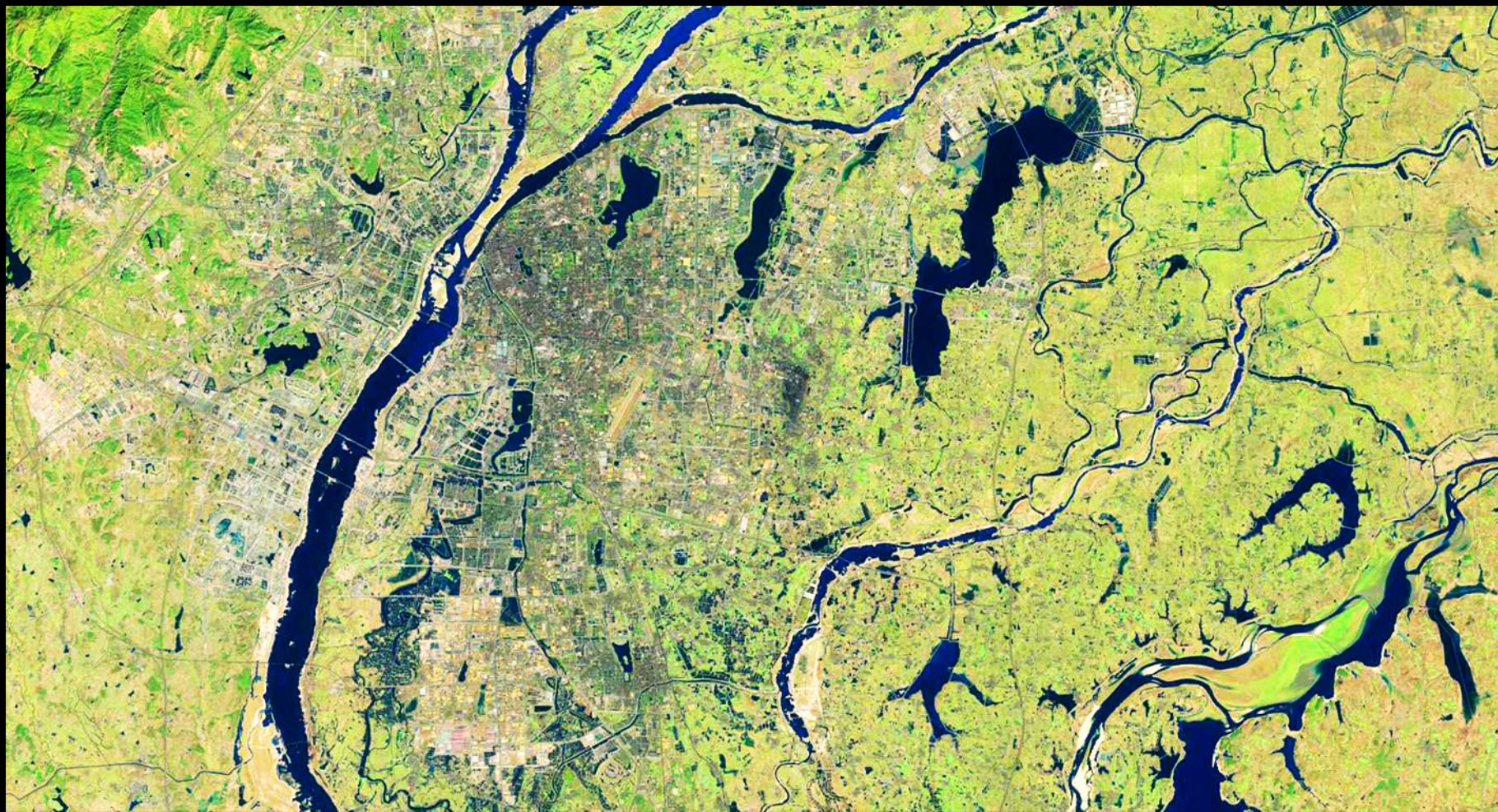
Red was water (1985-1999) Green new water (2000-2015)

← 10 km →



Nanchang 15<sup>th</sup> July 1989, Landsat image courtesy USGS / NASA

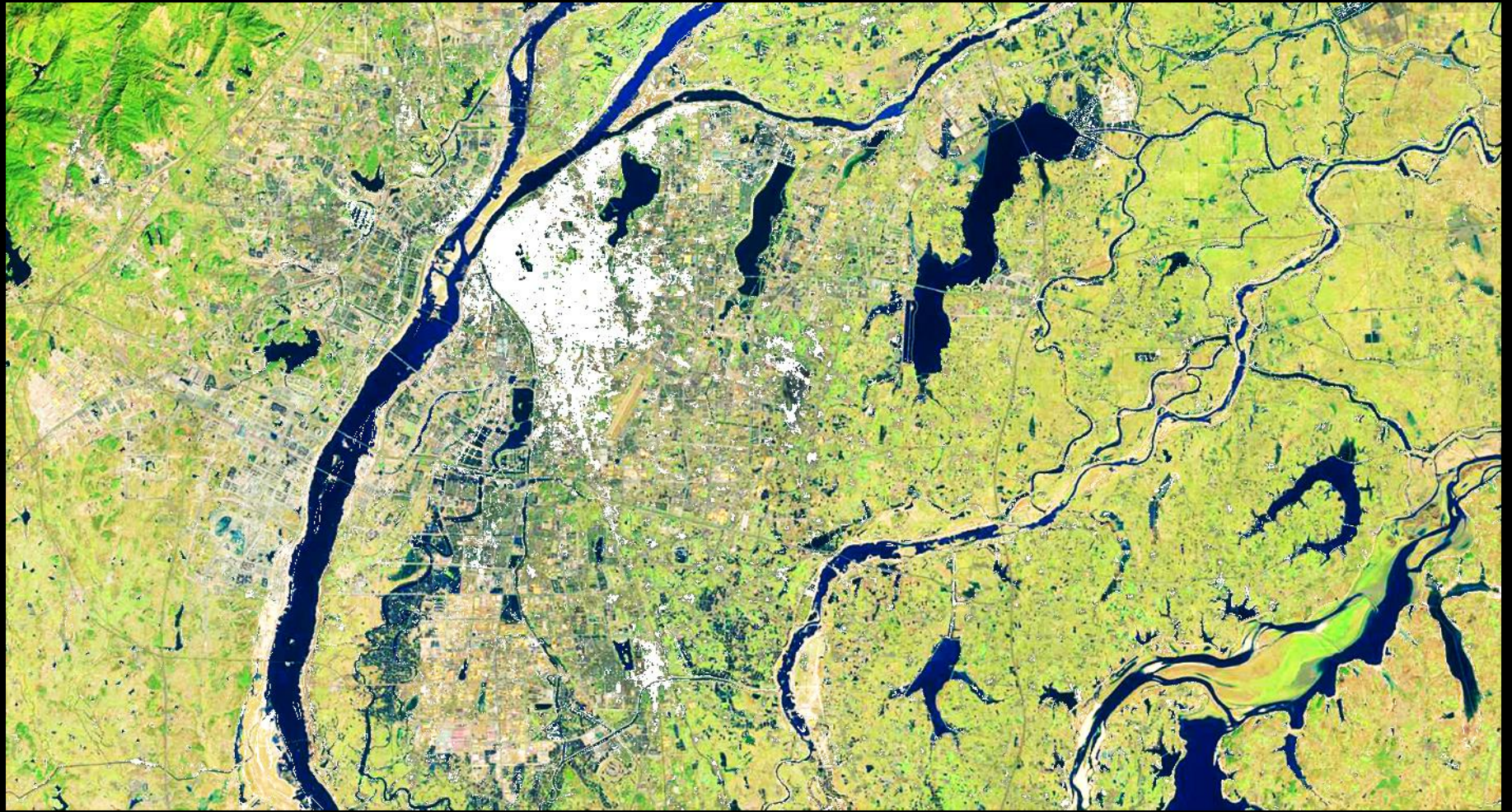




Nanchang 15<sup>th</sup> February 2015, Landsat image courtesy USGS / NASA

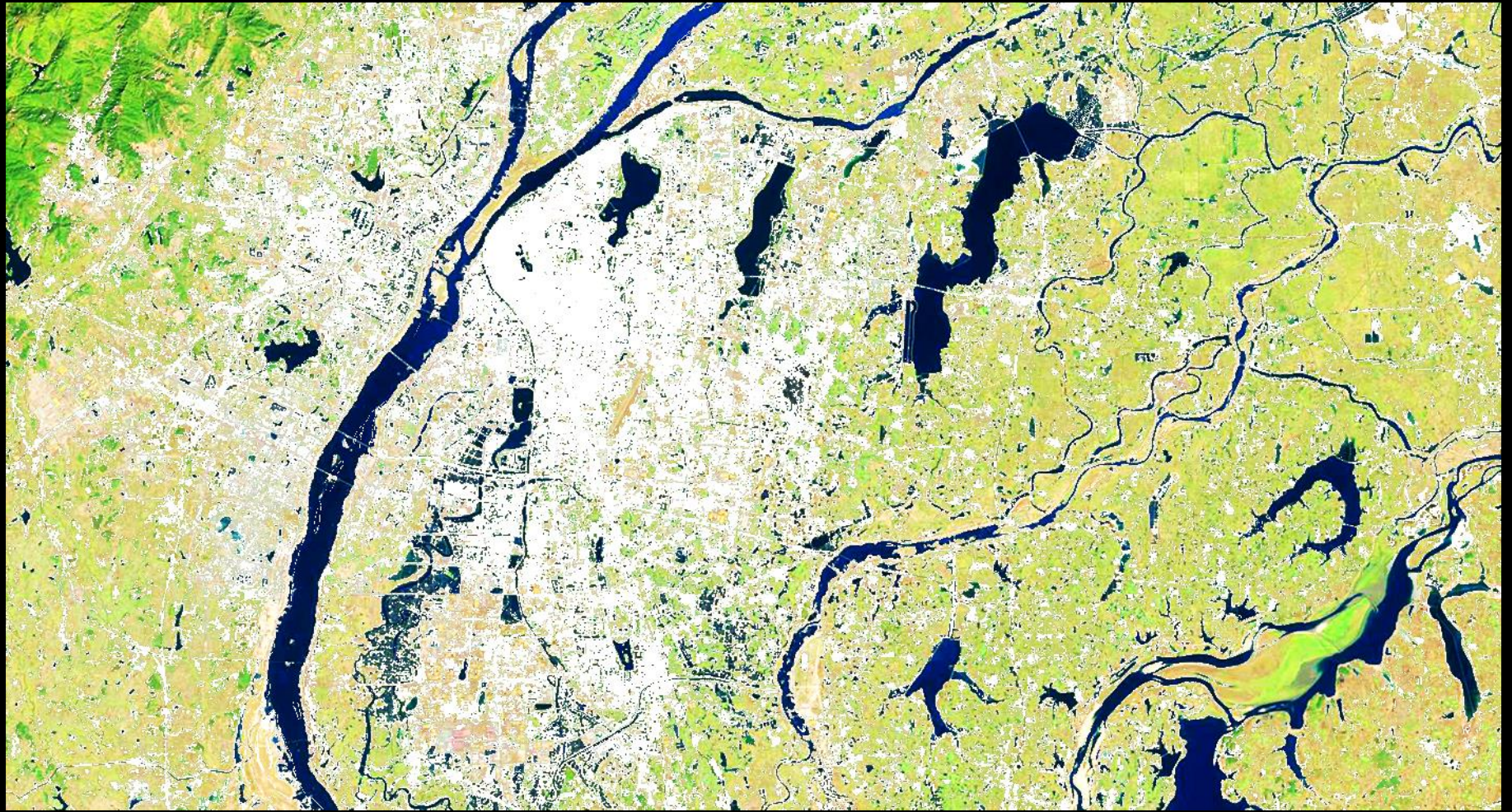
10km





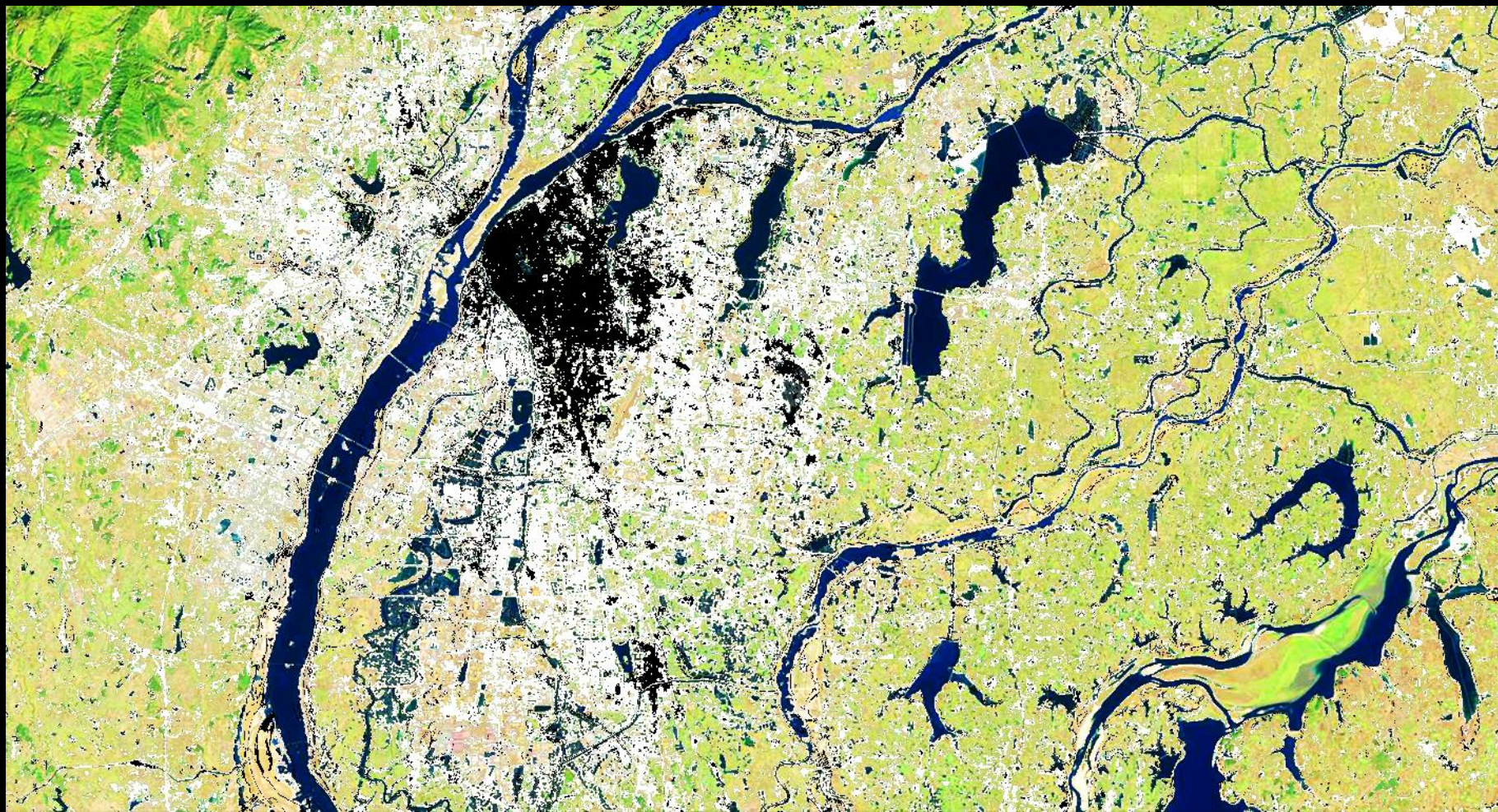
Nanchang 1989 city extent highlighted in white





Nanchang 2015 city extent highlighted in white





Nanchang 2015 city extent highlighted in white, 1989 in black

10km

## Conclusions

- ① More people live in urban areas than rural (54%)
- ② The urban population has grown rapidly and will pass 6 billion by 2050
- ③ One in 8 of us live in one of the 28 megacities... i.e. those more than 10 million inhabitants, but around half of us live in cities of less than 500,000
- ④ some cities are declining – migration (conflict), fertility rates, economic decline
- ⑤ Earth observation allows us to track from the hamlet to the megacity