GUF+ Suite and Urban Thematic Exploitation Platform

Developing a better Picture of the Built Environment

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[b] U-TEP Consortium

[c] Google (Earth Engine)

Global Urban Footprint 2012

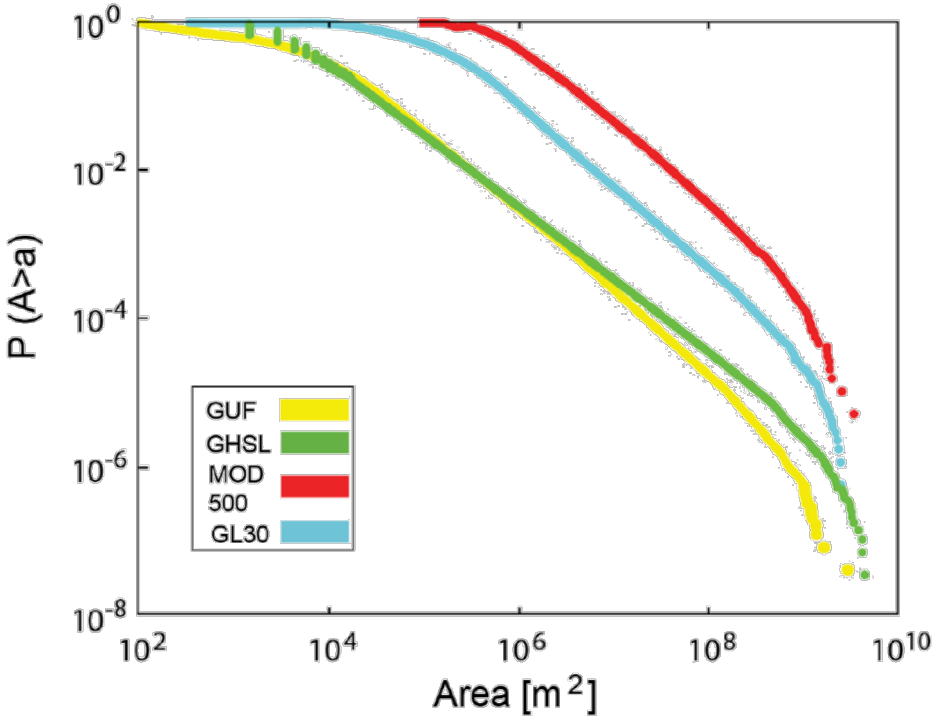
- *Release:* November 2016
- *Data base:* 182,249 radar images from TerraSAR-X/TanDEM-X (3m, 2011-2013, 308 TB)
- *Spatial resolution:* 12 m (scientific use), 84m (non-profit use)
- *User community*
  - >260 institutions from 43 countries
  - Science, public sector, NGOs
  - 99% of all GUF requests were granted a license

Global Urban Footprint: Accuracy Assessment (first results)

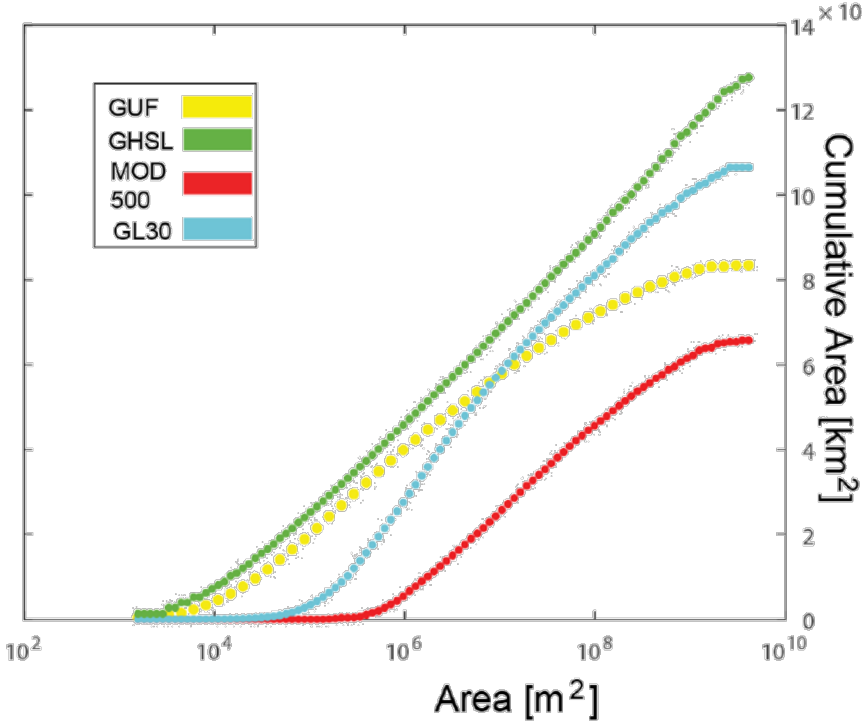
Study Area	GUF		GHSL		GL30		MOD500	
	OA	Kappa	OA	Kappa	OA	Kappa	OA	Kappa
Addis Ababa	84.87	0.695	78.41	0.524	81.66	0.630	69.29	0.369
Athens	85.42	0.672	86.67	0.703	82.98	0.624	78.27	0.475
Beijing	87.35	0.682	84.02	0.613	83.32	0.569	73.39	0.275
Dar Er Salaam	85.01	0.689	77.66	0.550	80.99	0.598	66.10	0.207
Kampala	84.95	0.690	76.13	0.521	79.99	0.559	71.56	0.321
Kigali	82.60	0.623	75.60	0.459	78.94	0.463	72.45	0.212
Lagos	84.49	0.688	92.15	0.843	79.14	0.580	63.28	0.257
Mexico City	89.40	0.786	82.30	0.641	84.30	0.683	68.60	0.347
Milan	89.33	0.784	88.28	0.763	84.23	0.680	69.35	0.365
Nairobi	85.01	0.688	69.22	0.326	81.44	0.616	67.86	0.262
New York	74.28	0.480	84.43	0.710	79.04	0.585	72.20	0.446
Perth	87.75	0.753	91.45	0.829	88.20	0.761	77.30	0.538
Mean	85.04	0.686	82.28	0.623	82.02	0.612	70.80	0.340
Standard Deviation	3.96	0.080	7.00	0.155	2.75	0.075	4.33	0.105

Global Urban Footprint: Accuracy Assessment (first results)

Cumulative distribution function of settlement objects



Cumulative area of all settlements



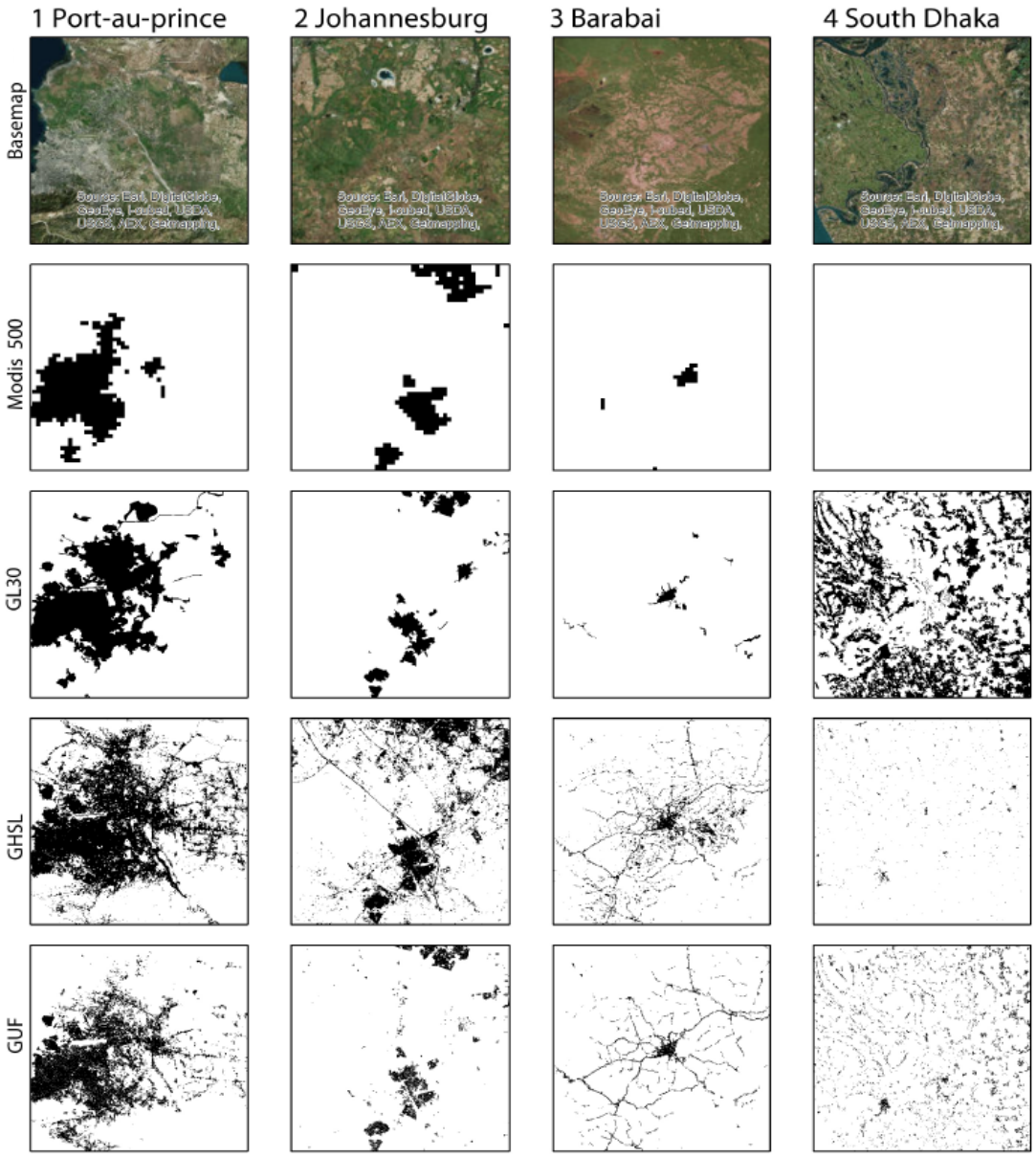
GUF : 834,260 km²

GHSL: 1,289,506 km²

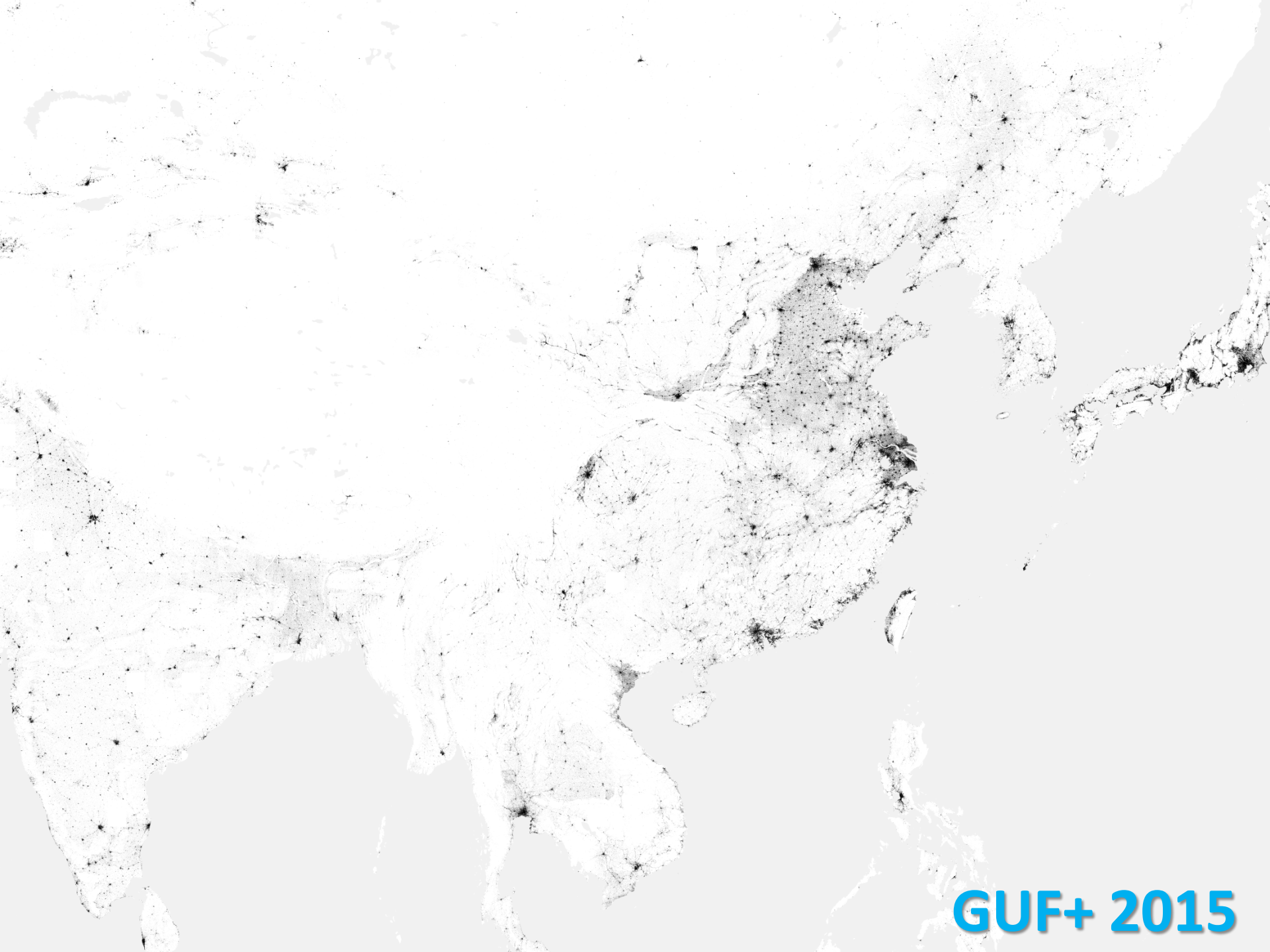
GL30: 1,064,940 km²

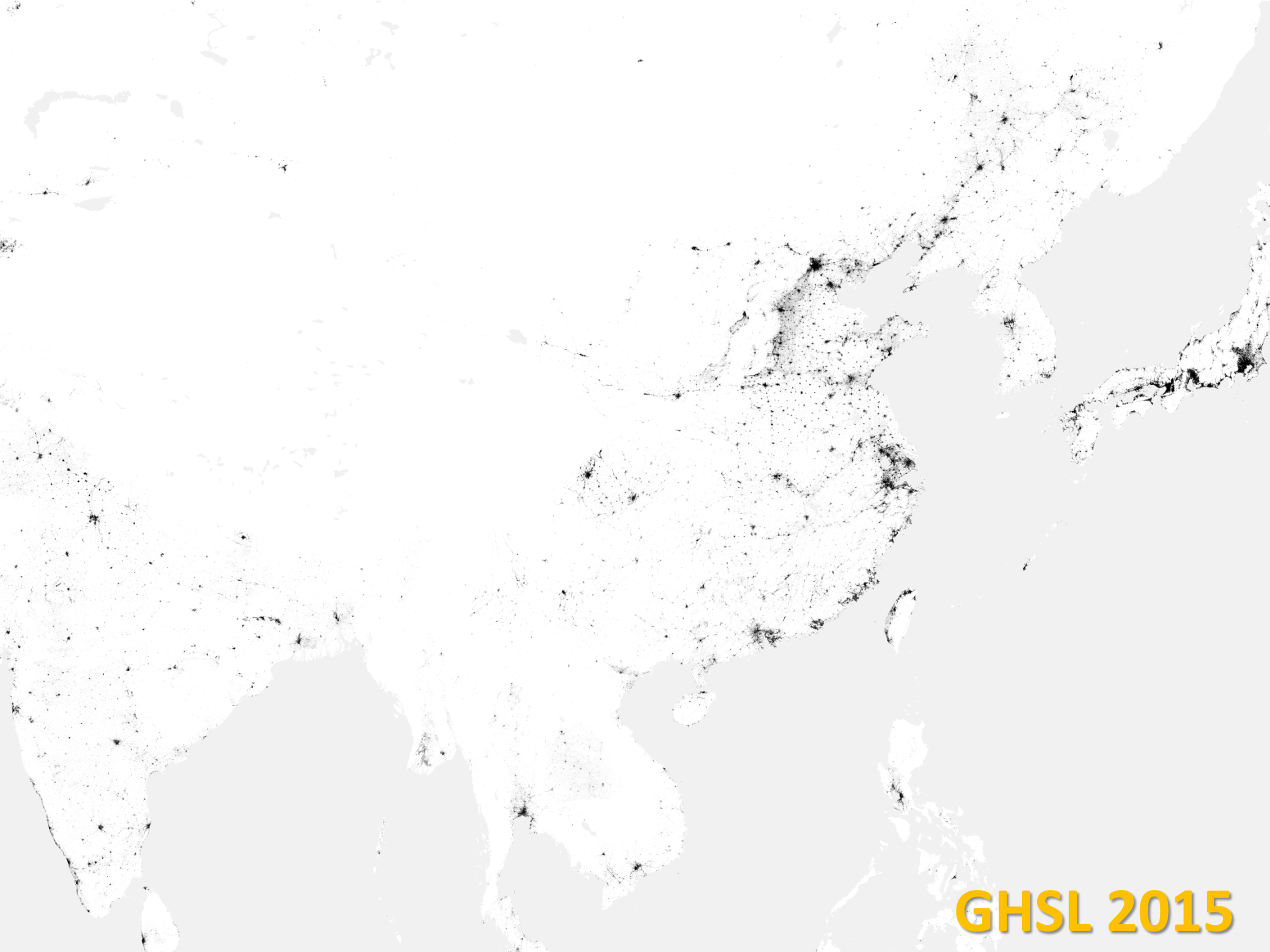
M500: 657,384 km²

Global Urban Footprint: Accuracy Assessment (first results)



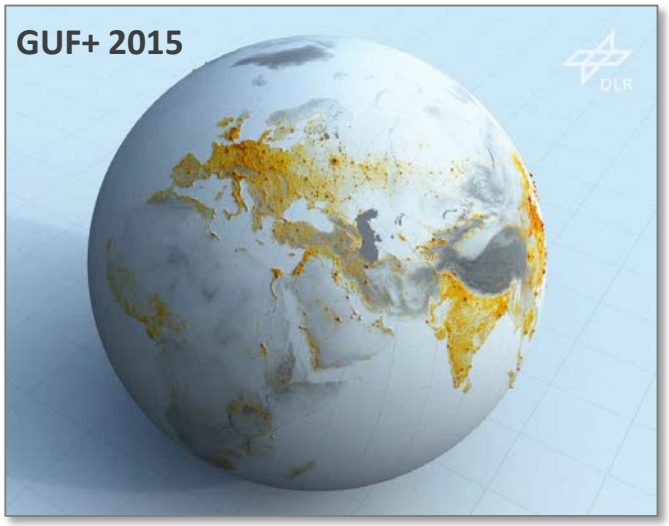
Spatial accordance of layers frequently < 60%


GUF+ 2015


GHSL 2015

Global Urban Footprint +

- ***Key objectives***
  - Continuity, sustainability
  - Full open and free access to products
  - Robustness: repeatability, consistency
  - Applicability: product suite, data analytics tools
- ***Methodology***
  - Use of free and open data and software
  - Multi-sensor (Sentinel-1, Landsat/Sentinel-2)
  - Multi-date (use of all scenes acquired)
  - Multi-facility (i.a. U-TEP, GEE)
- ***Product portfolio***
  - GUF+ 2015 (binary settlement mask)
  - GUF+ 2015 Density (% imperviousness)
  - GUF+ Evolution (1984-2015)
  - GUF+ Network (settlement properties/pattern)
  - GUF+ 3D (average building volume)

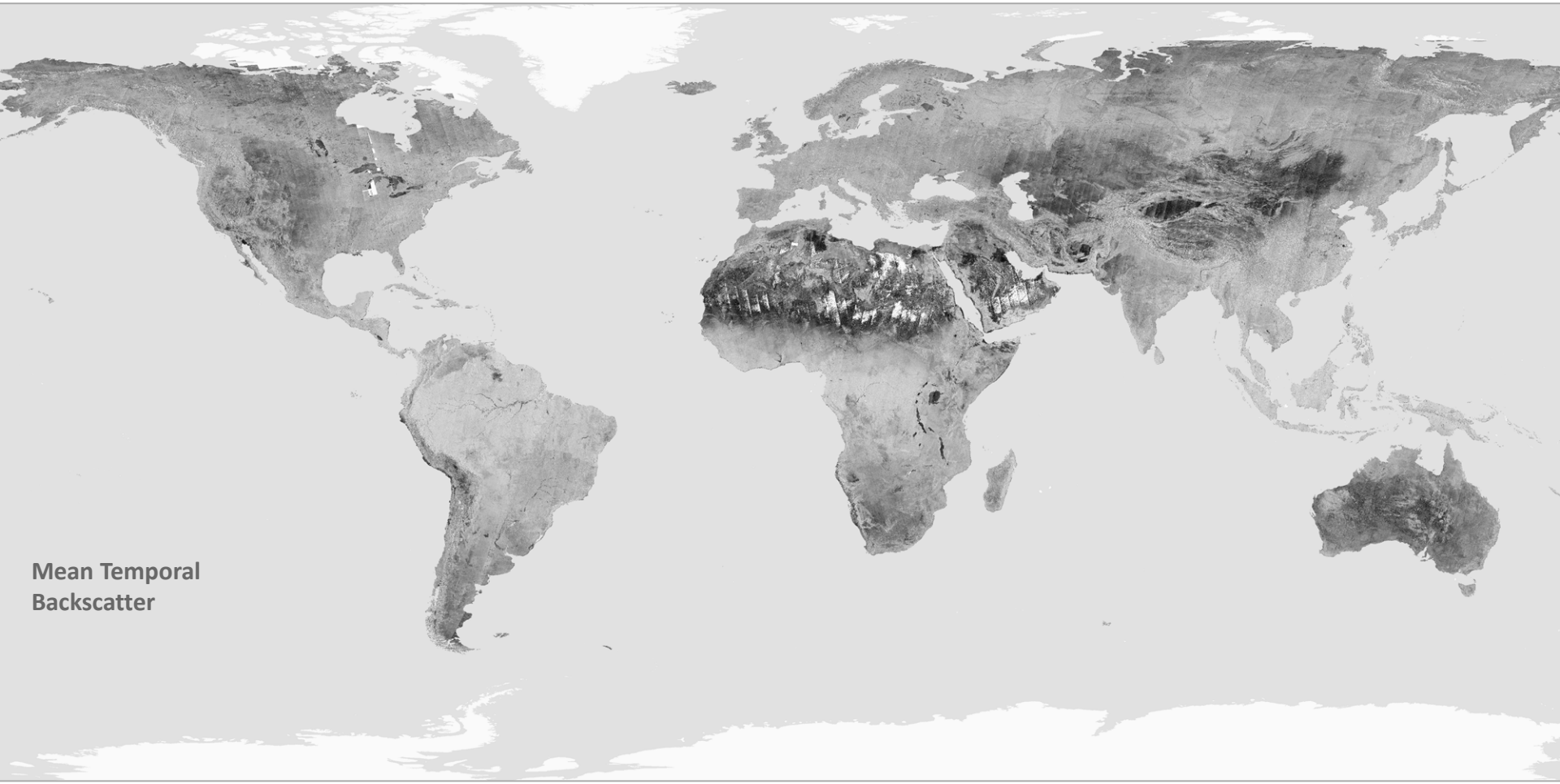


Global Urban Footprint +

GUF+ 2015

(Binary settlement mask – 10m)

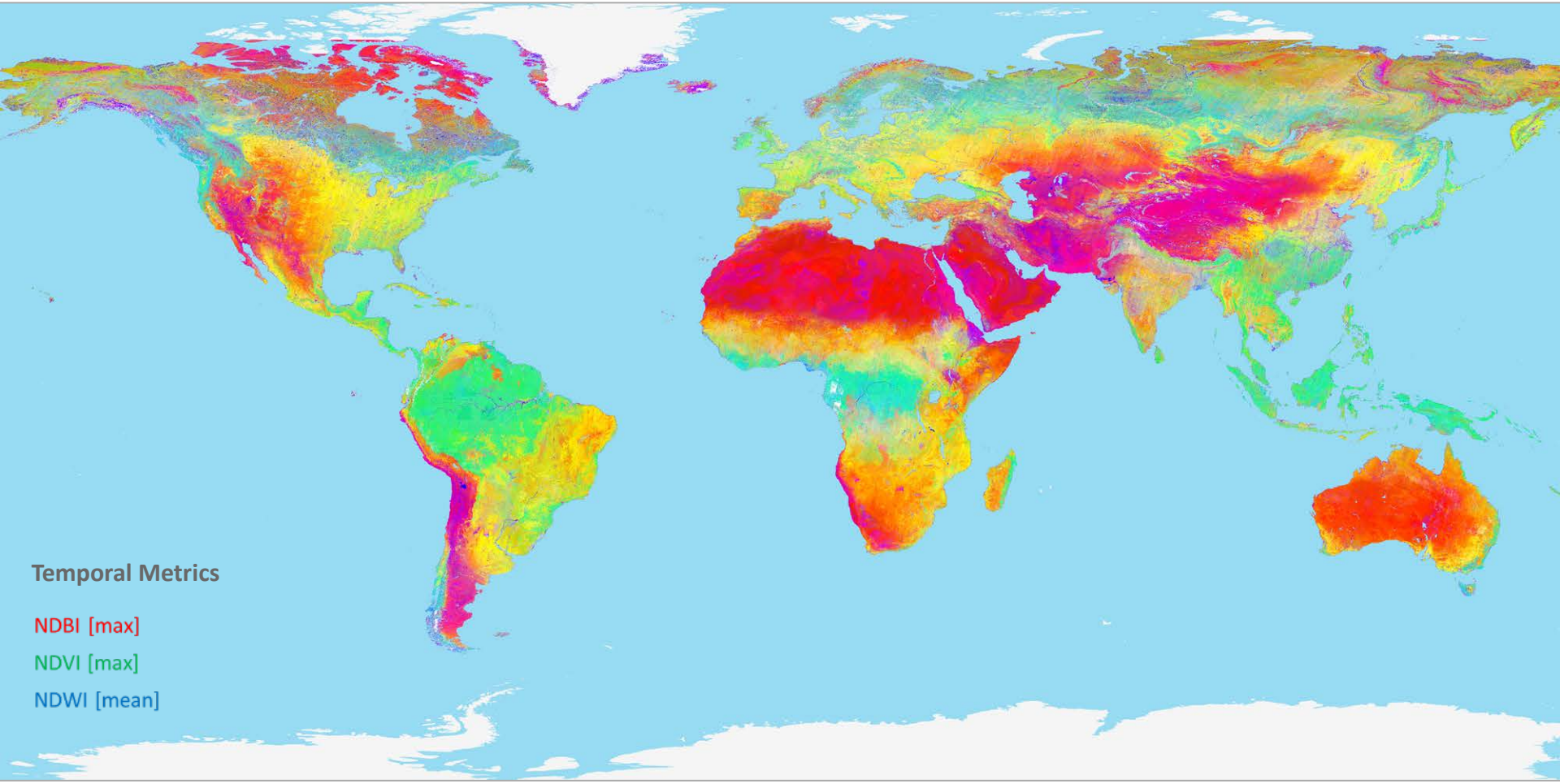
Global Urban Footprint + TimeScan Sentinel-1 2015



TimeScan layer derived from 245.535 Sentinel-1 images collected in 2014-2015 (>1.1 PB; final product: 60TB)

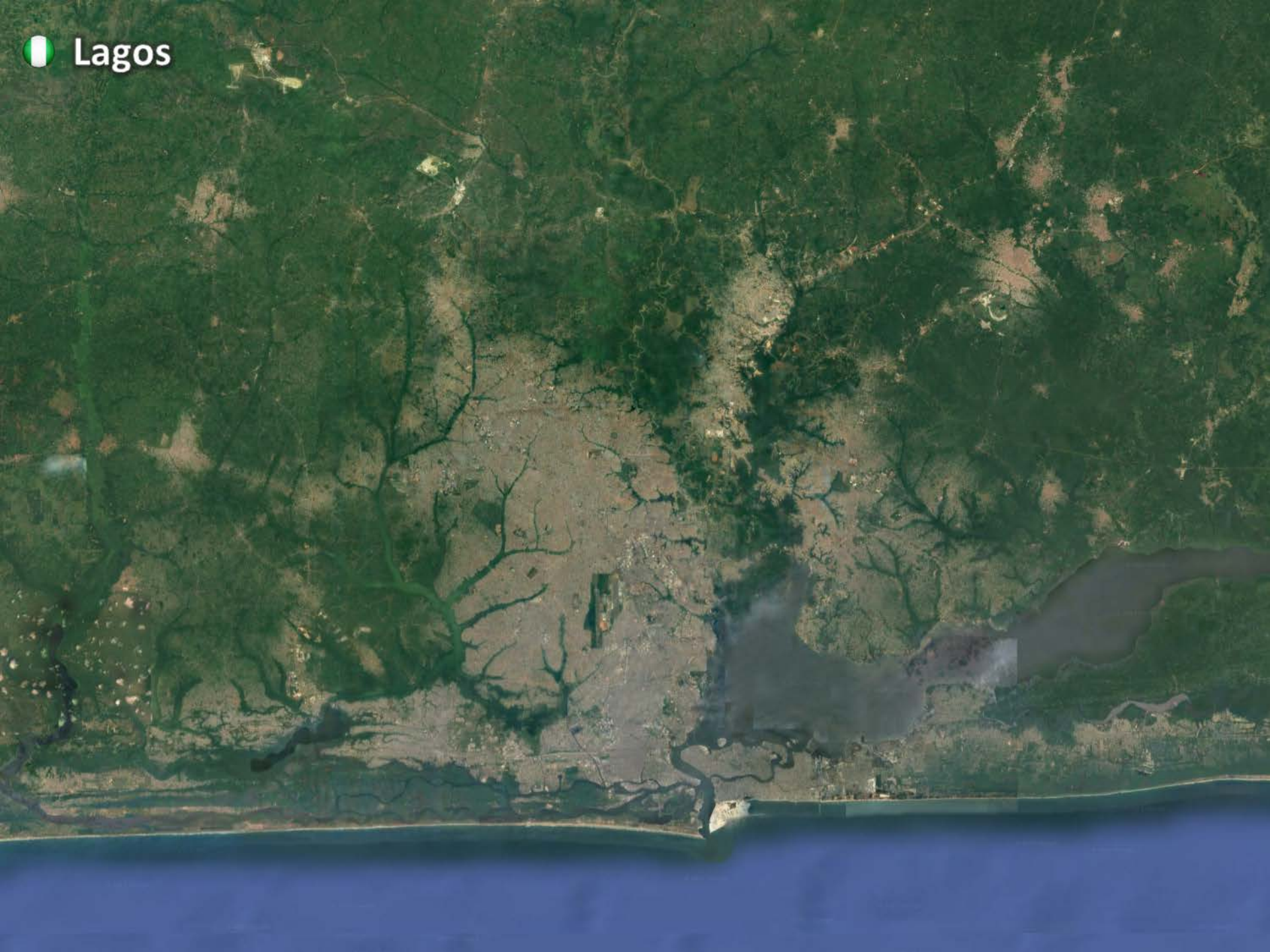
DLR

GUF+ 2015: TimeScan Landsat 2015

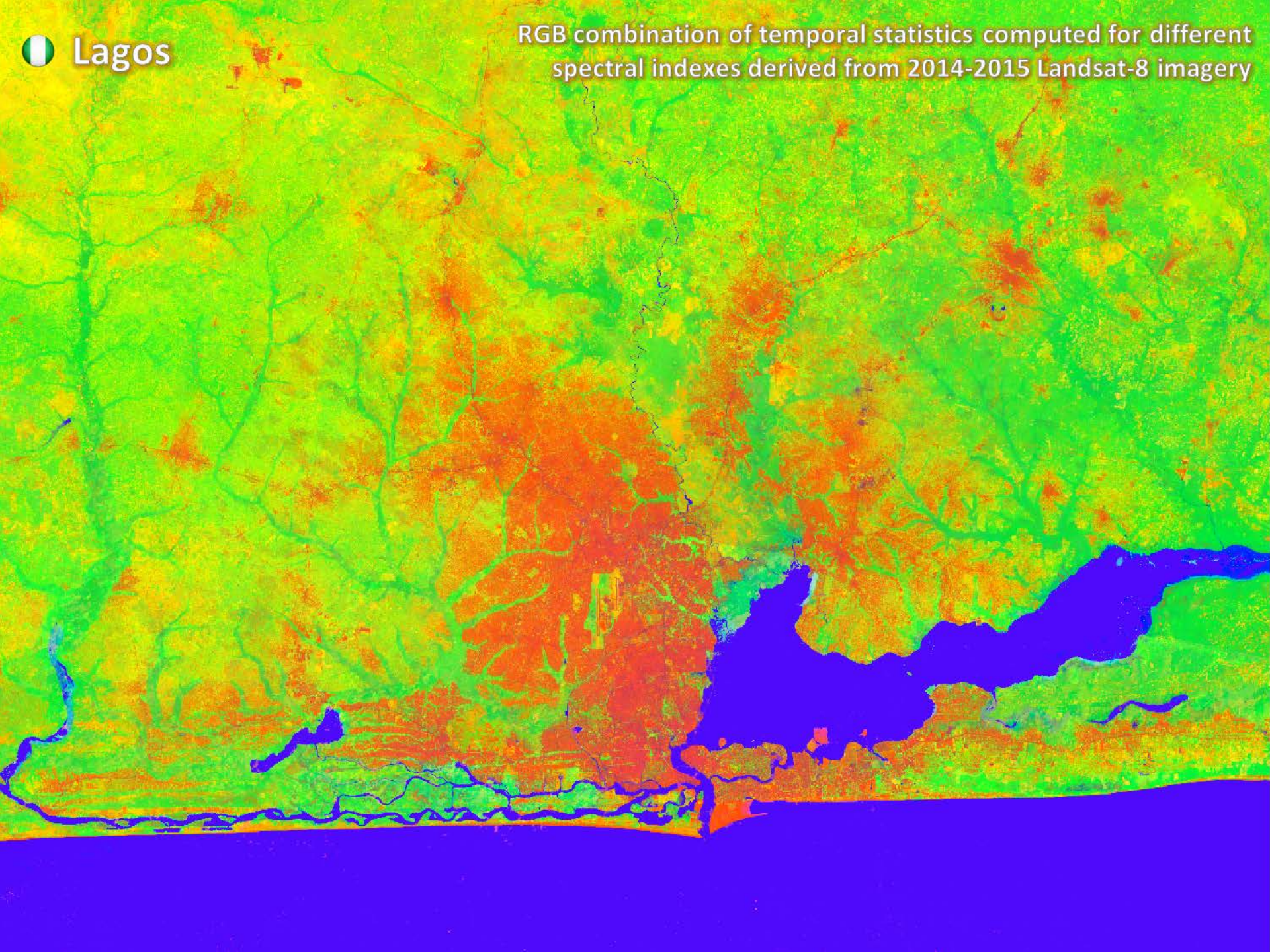


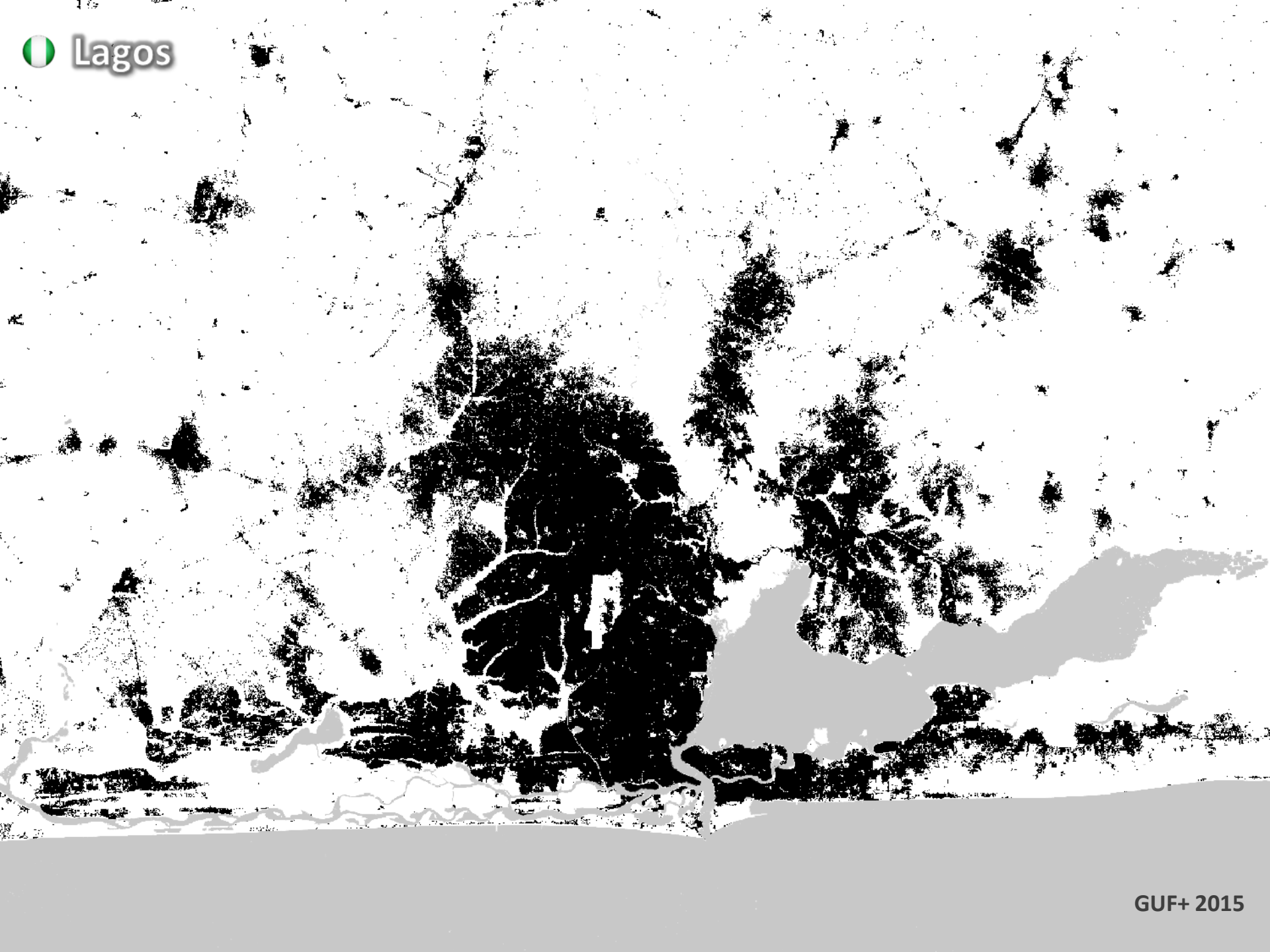
TimeScan layer derived from 452,799 Landsat images collected in 2013-2015 (>1.5 PB; final product: 25TB)

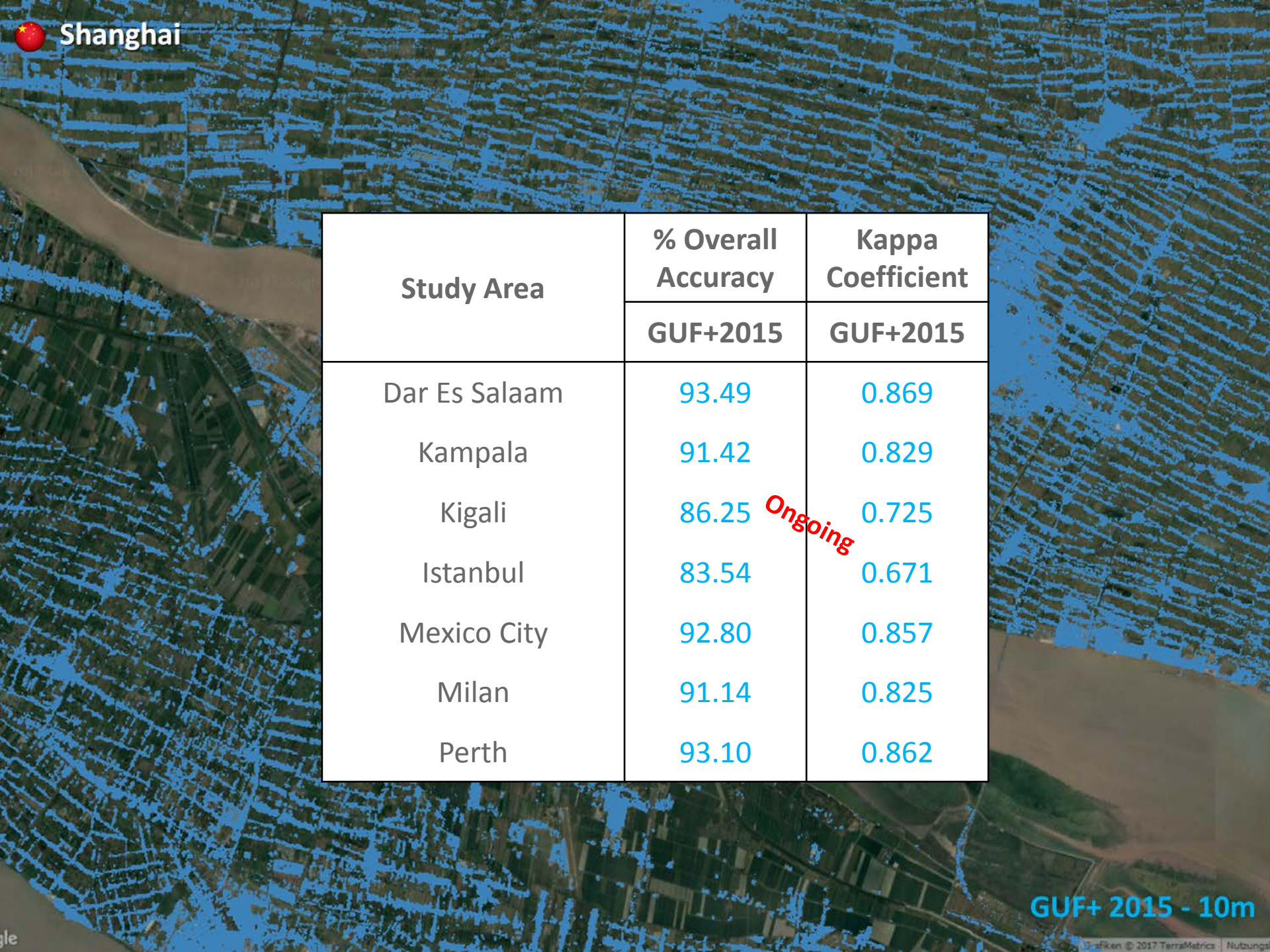
DLR


Lagos

Lagos
2014-2015 S1A IW GRDH backscattering temporal mean
Ascending Pass – VV Polarization


Lagos
RGB combination of temporal statistics computed for different
spectral indexes derived from 2014-2015 Landsat-8 imagery


Lagos
GUF+ 2015



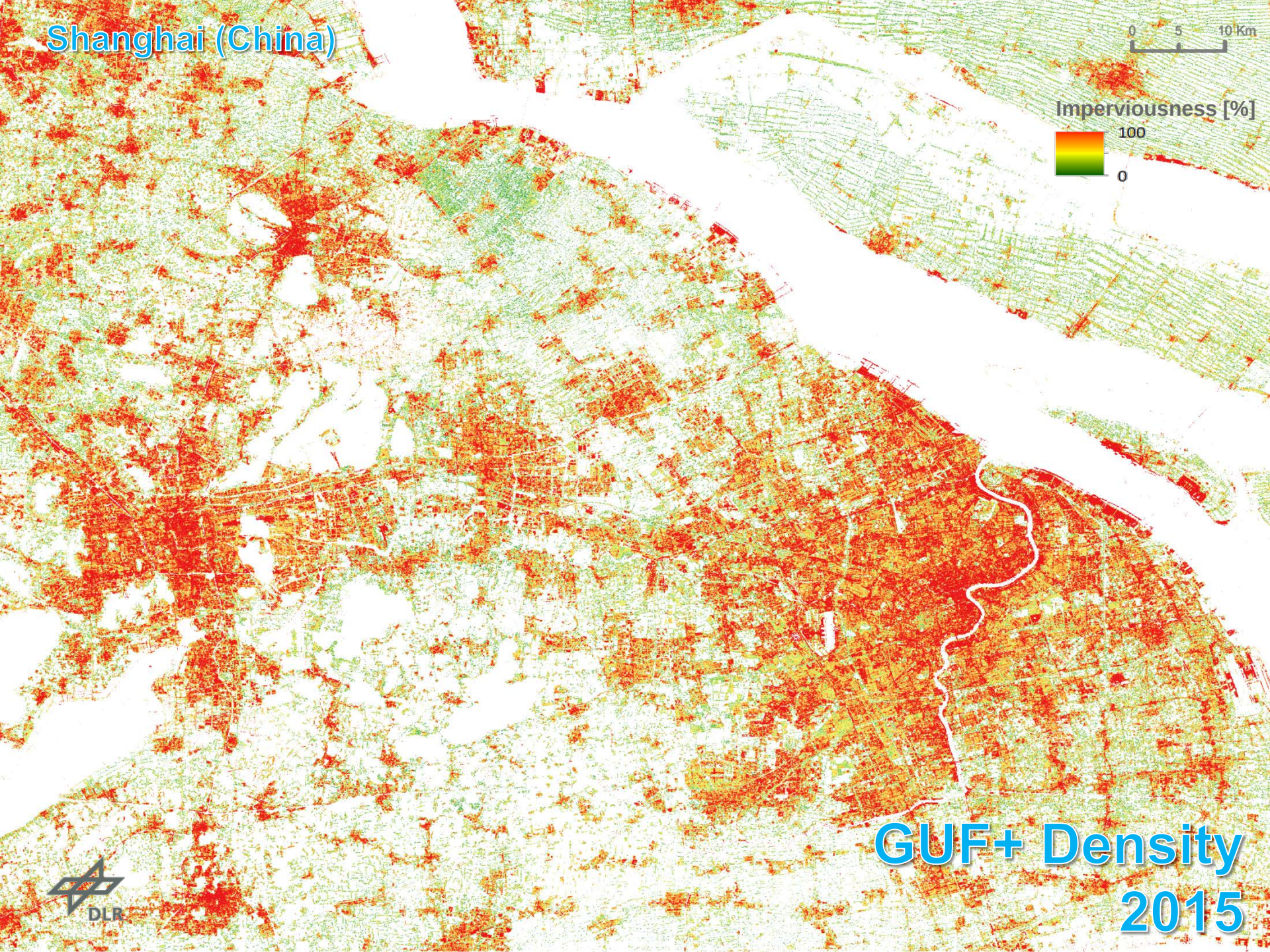
Study Area	% Overall Accuracy	Kappa Coefficient
	GUF+2015	GUF+2015
Dar Es Salaam	93.49	0.869
Kampala	91.42	0.829
Kigali	86.25	0.725
Istanbul	83.54	0.671
Mexico City	92.80	0.857
Milan	91.14	0.825
Perth	93.10	0.862

Ongoing

Global Urban Footprint +

DenS 2015

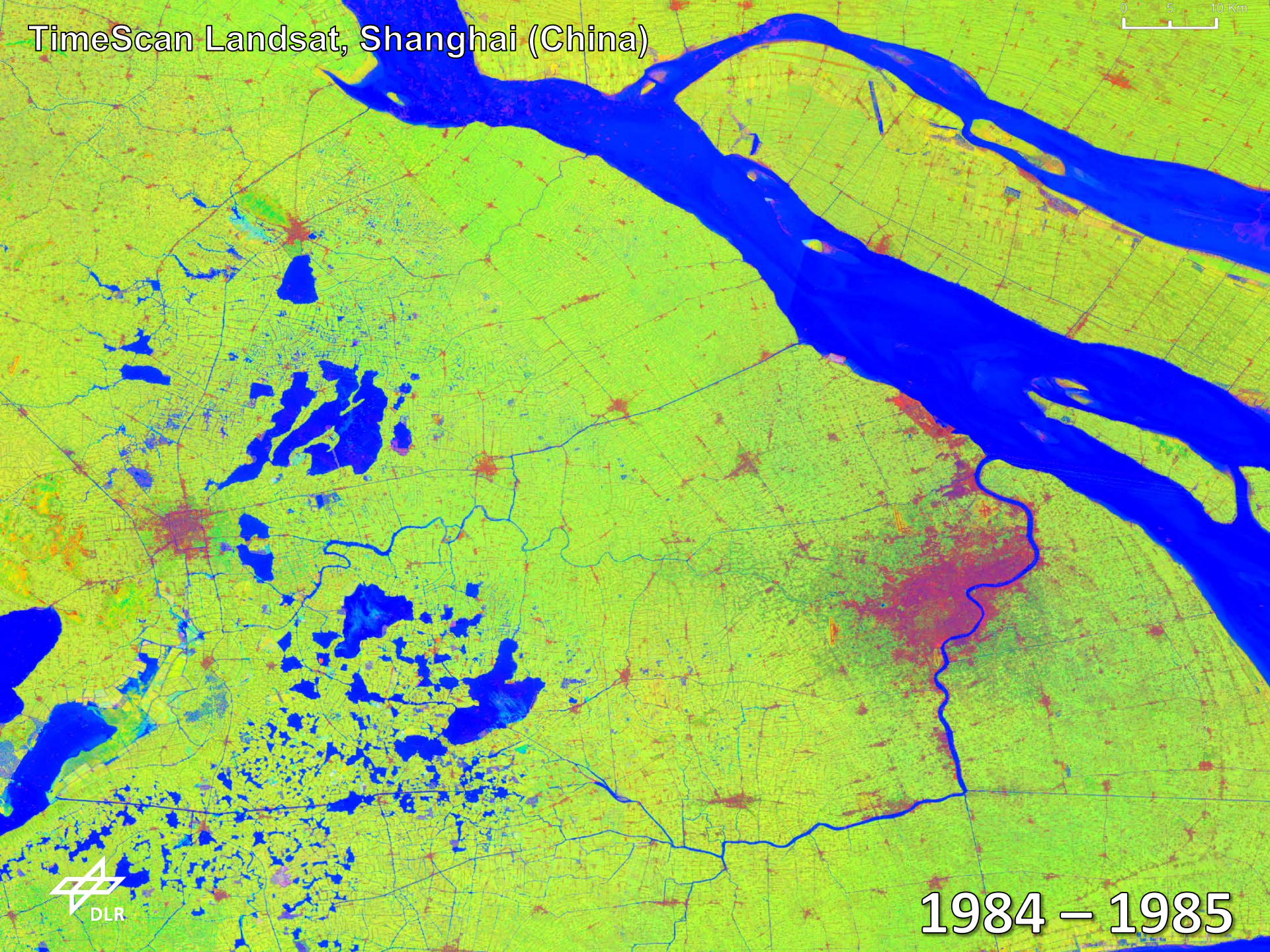
(Percent imperviousness, 30m)

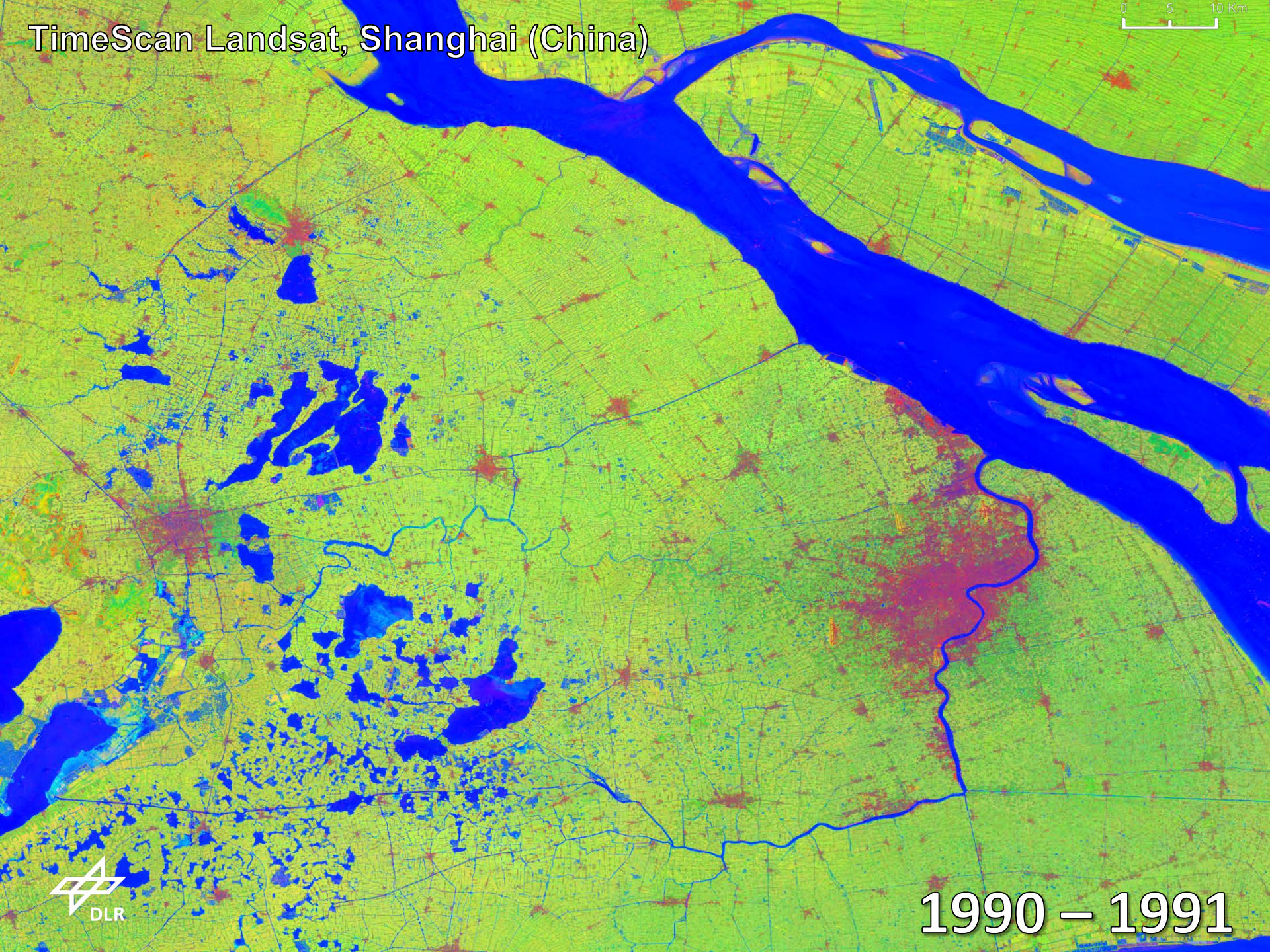

Shanghai (China)
0 5 10 Km
Imperviousness [%]
100
0
GUF+ Density
2015
DLR

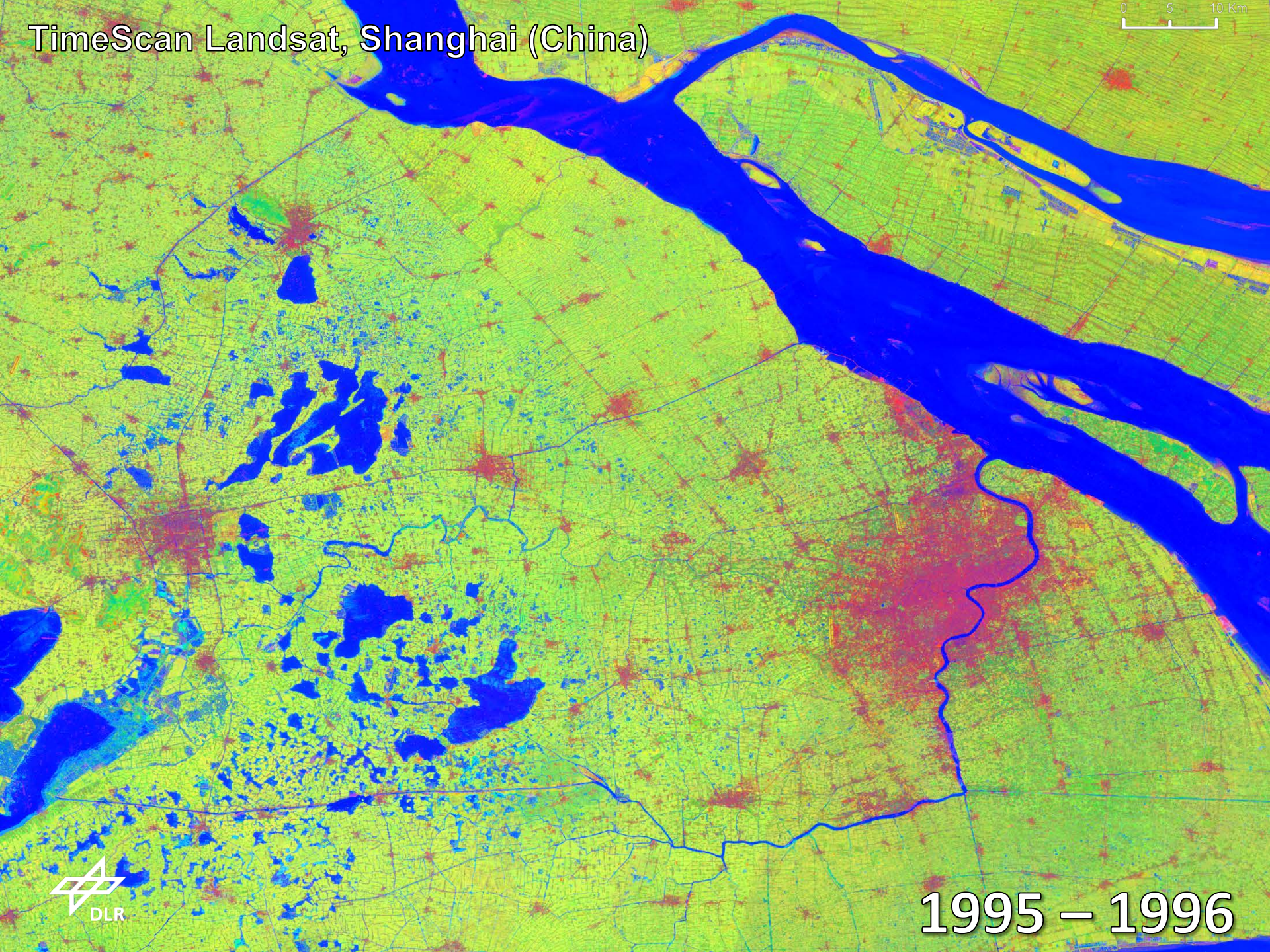
Global Urban Footprint +

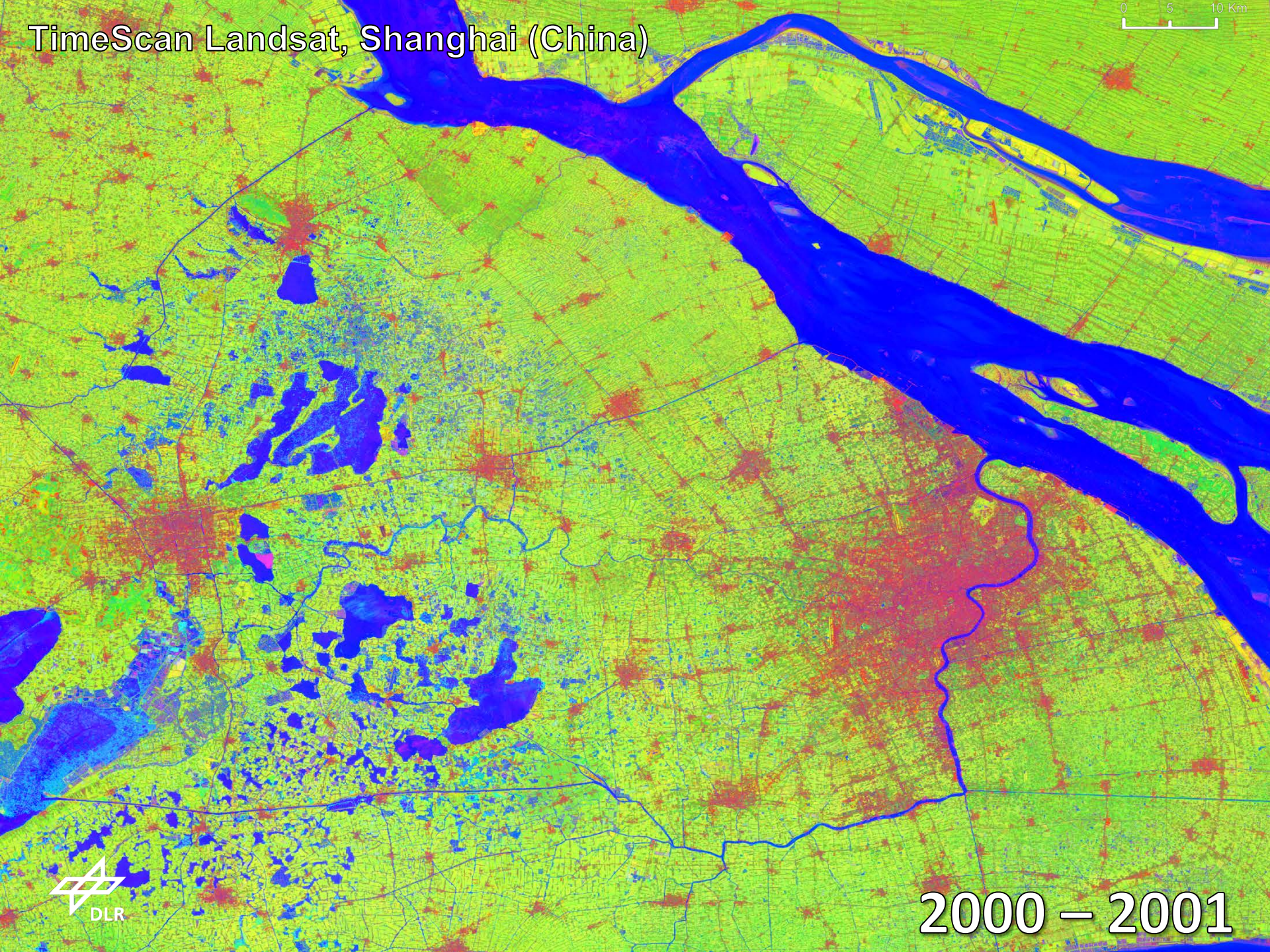
Evolution

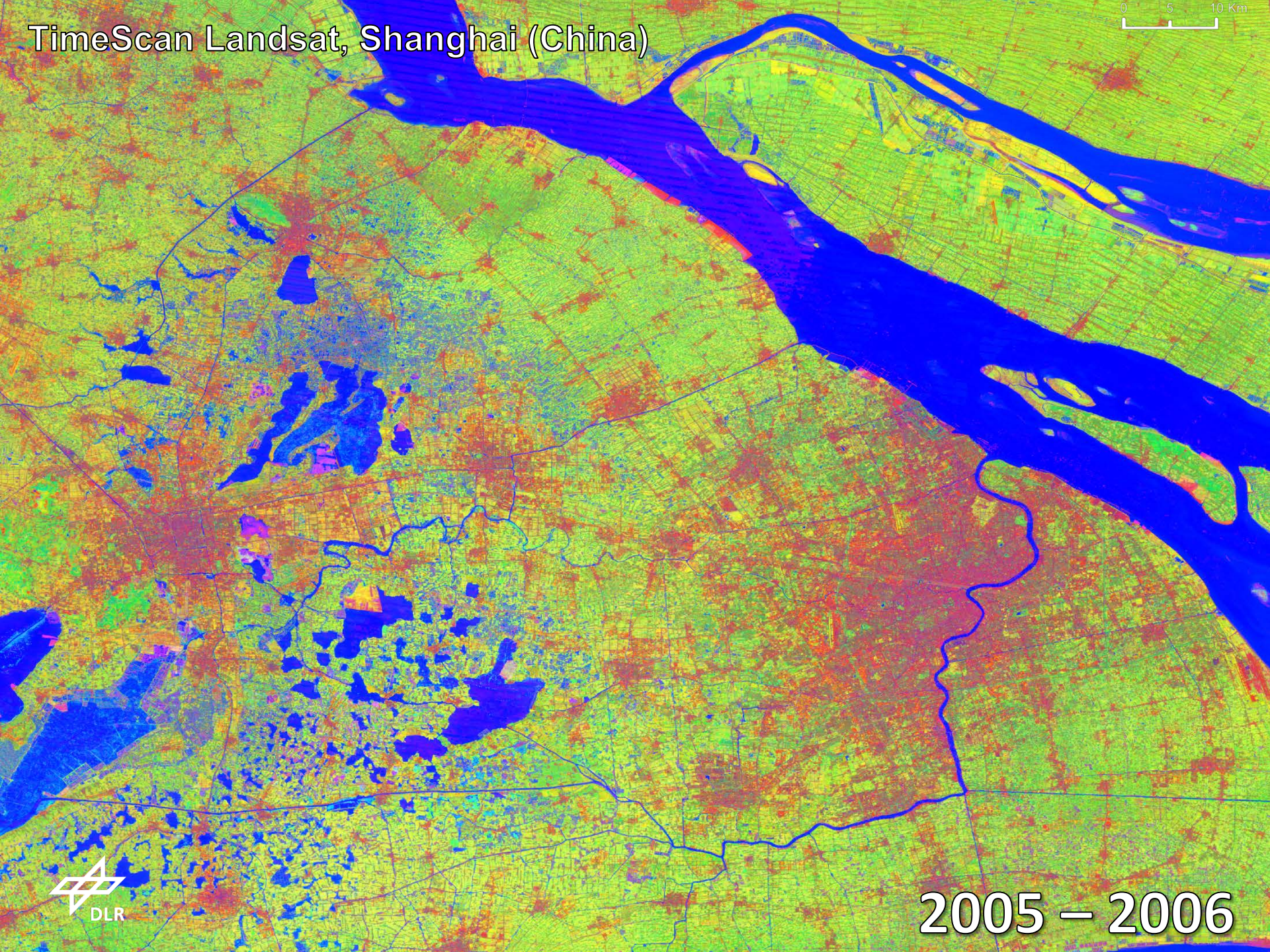
(1984 – 2015, 30m)

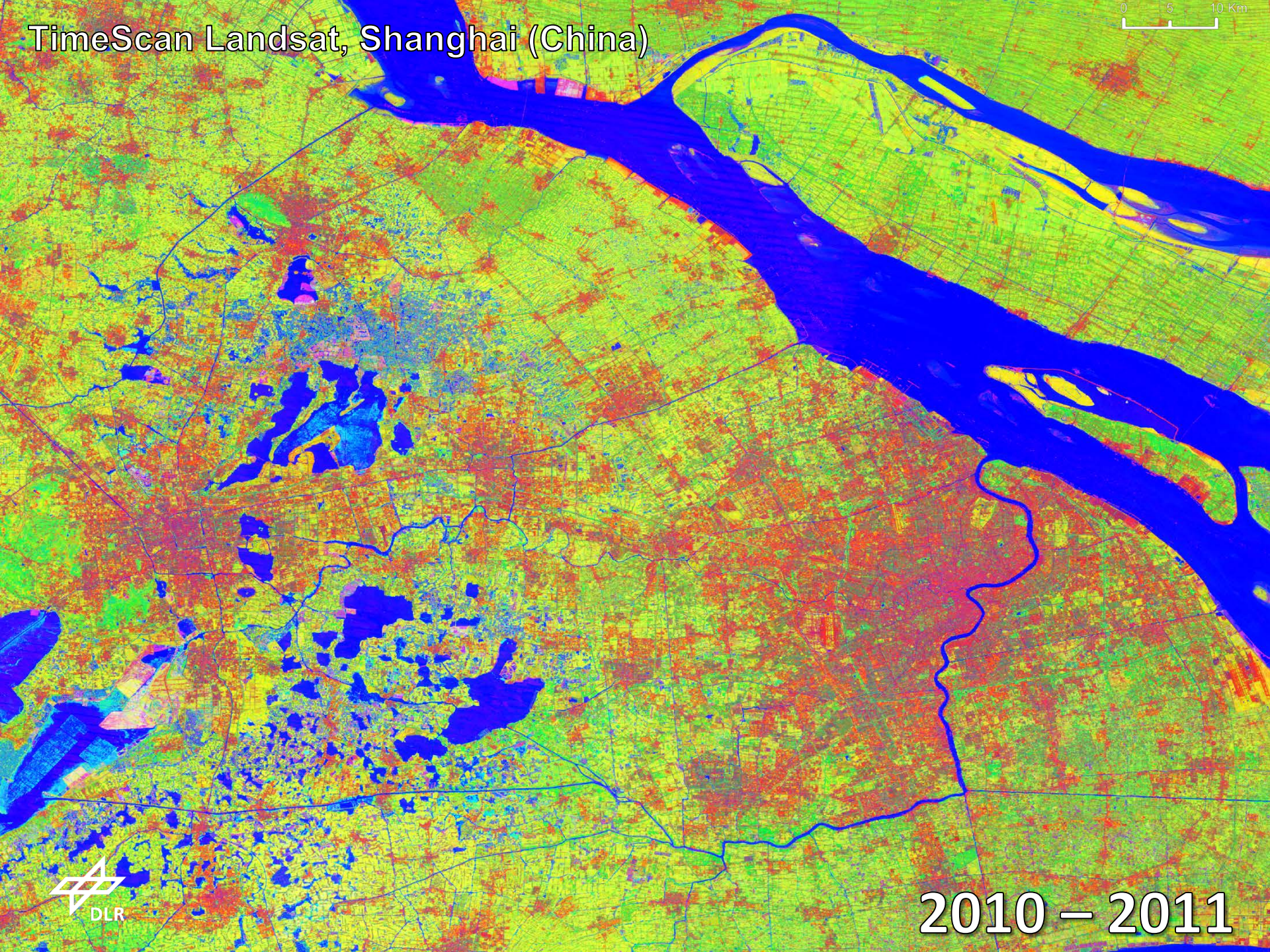

TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
1984 – 1985

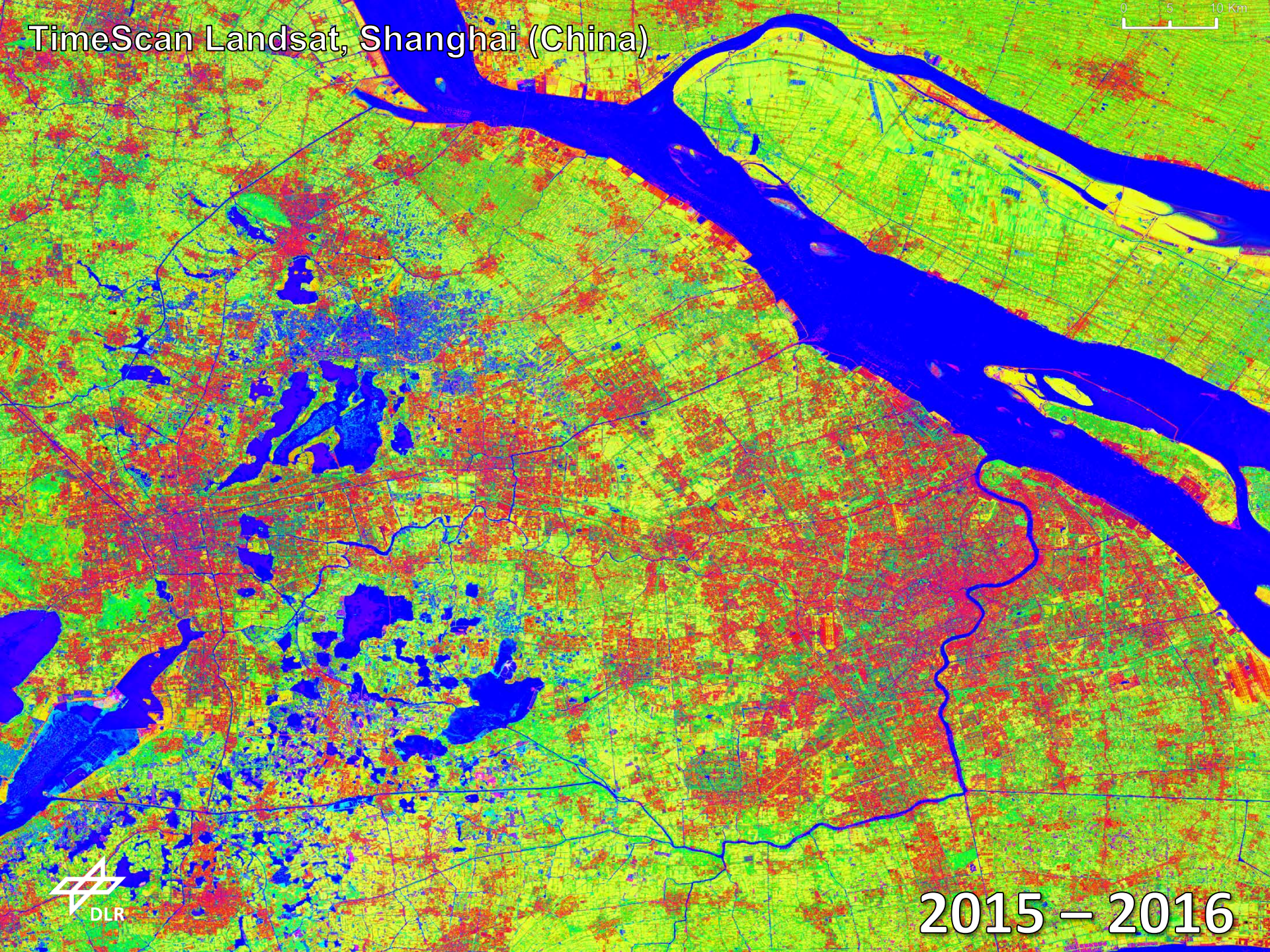

TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
1990 – 1991

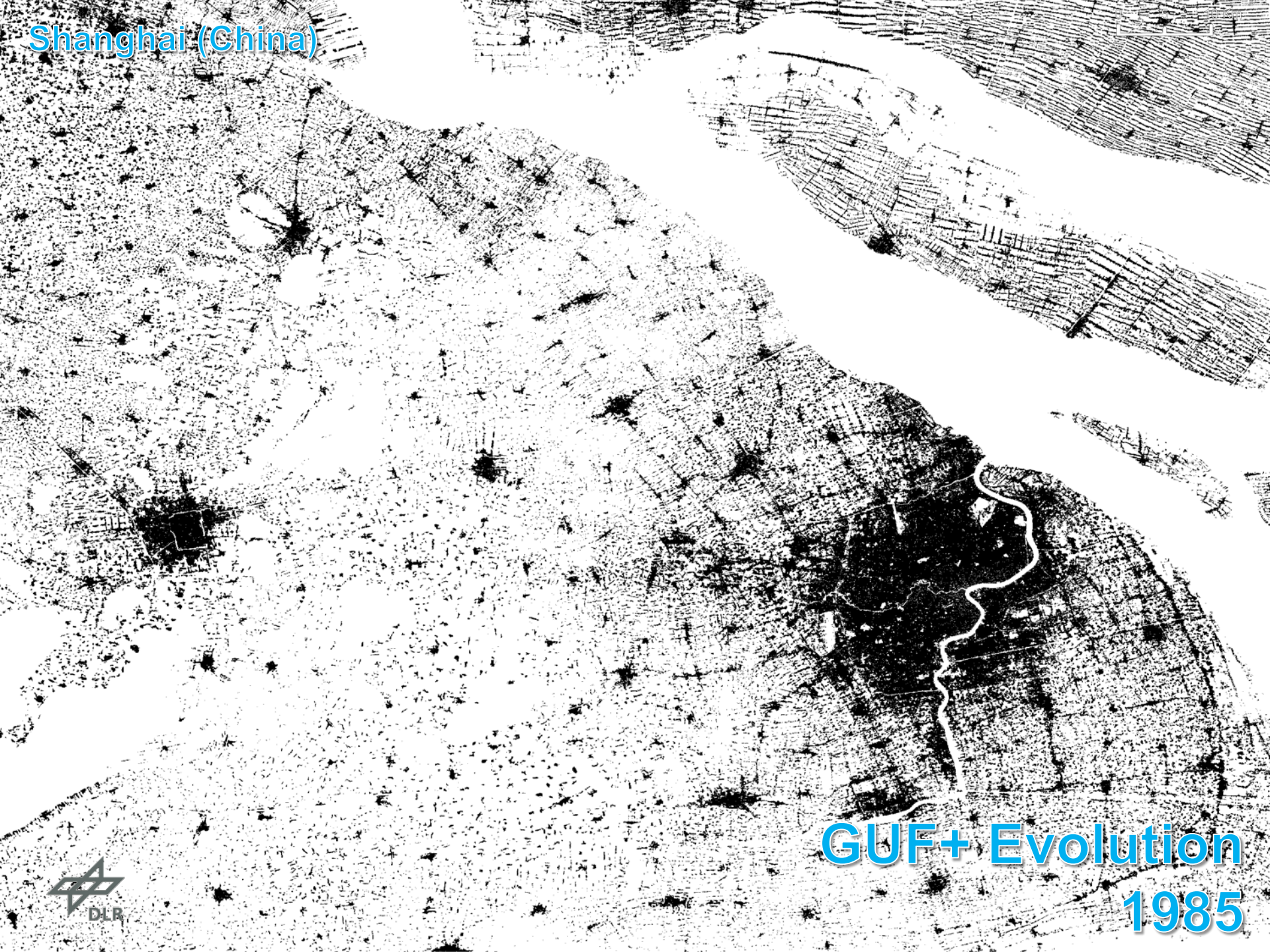

TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
1995 – 1996

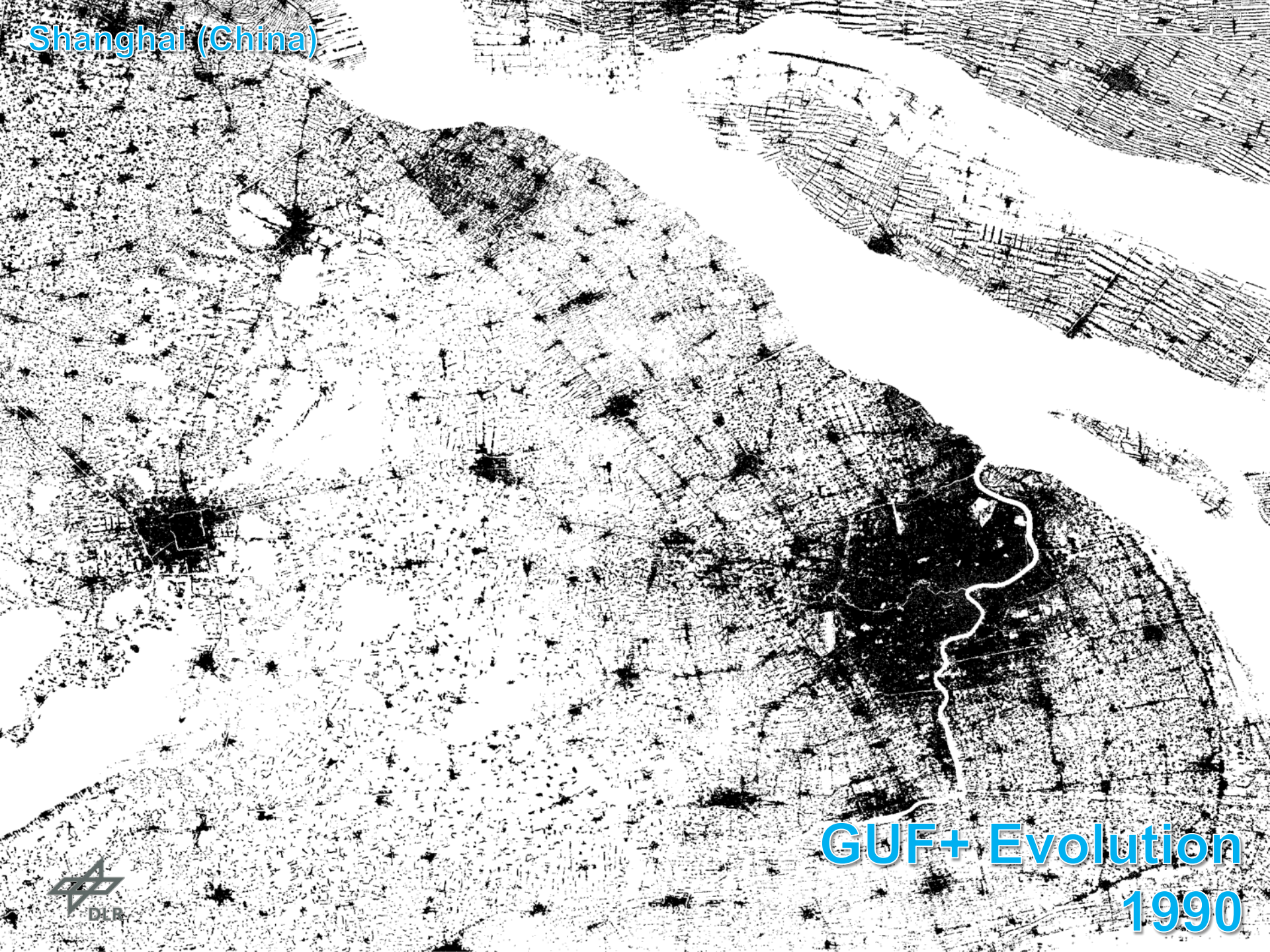

TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
2000 – 2001

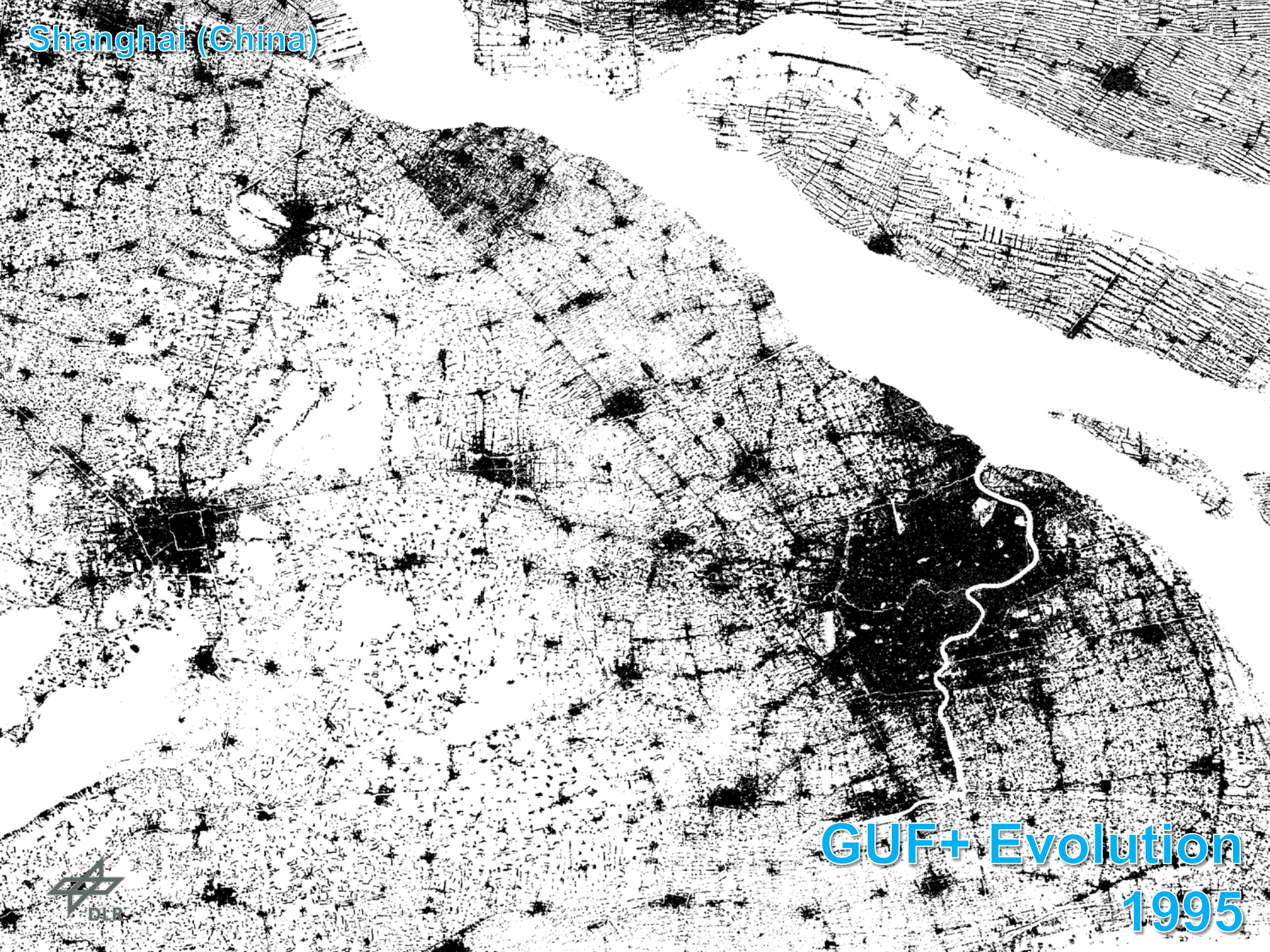

TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
2005 – 2006


TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
2010 – 2011


TimeScan Landsat, Shanghai (China)
0 5 10 Km
DLR
2015 – 2016

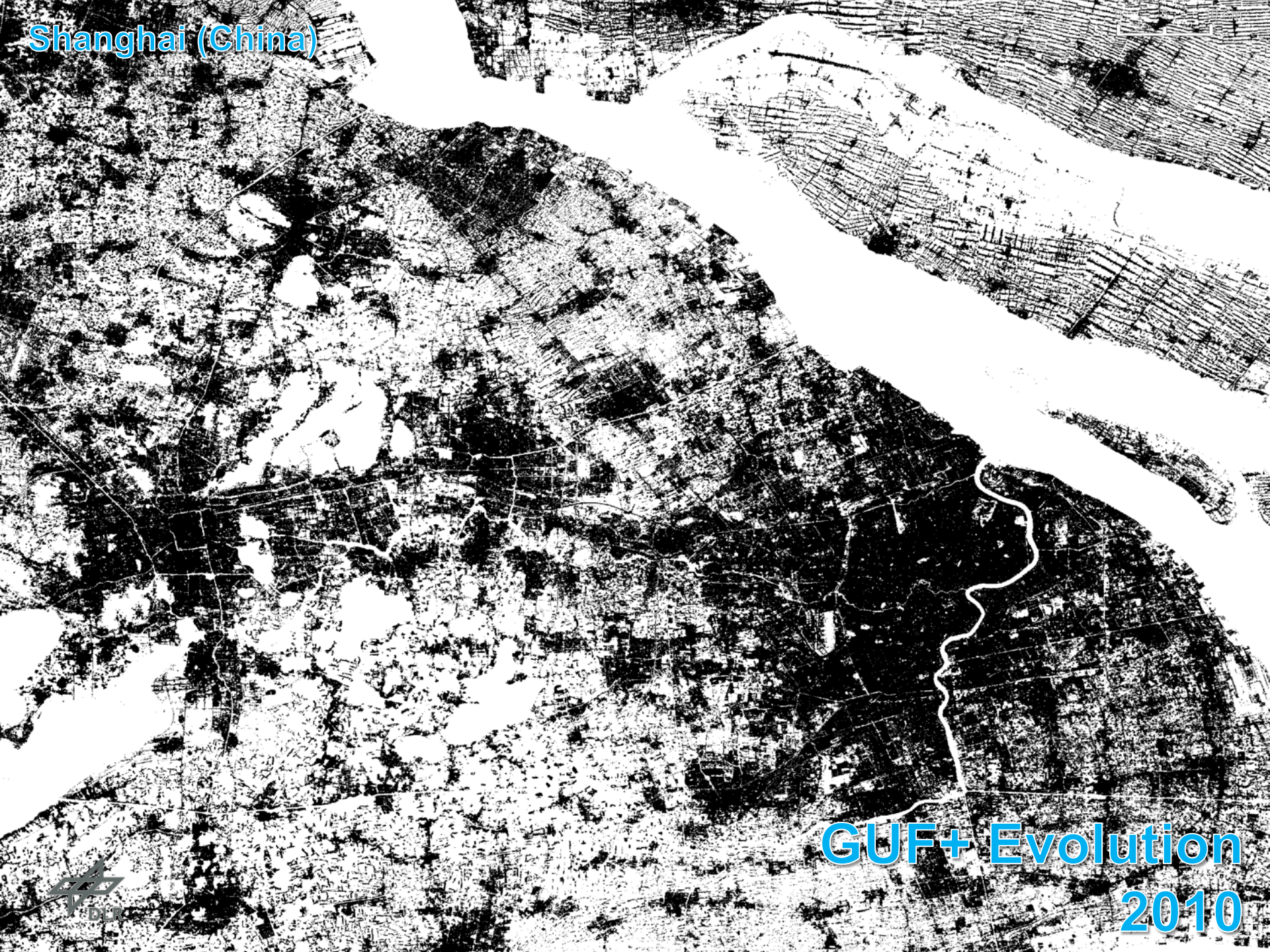

Shanghai (China)
GUF+ Evolution
1985
DLR

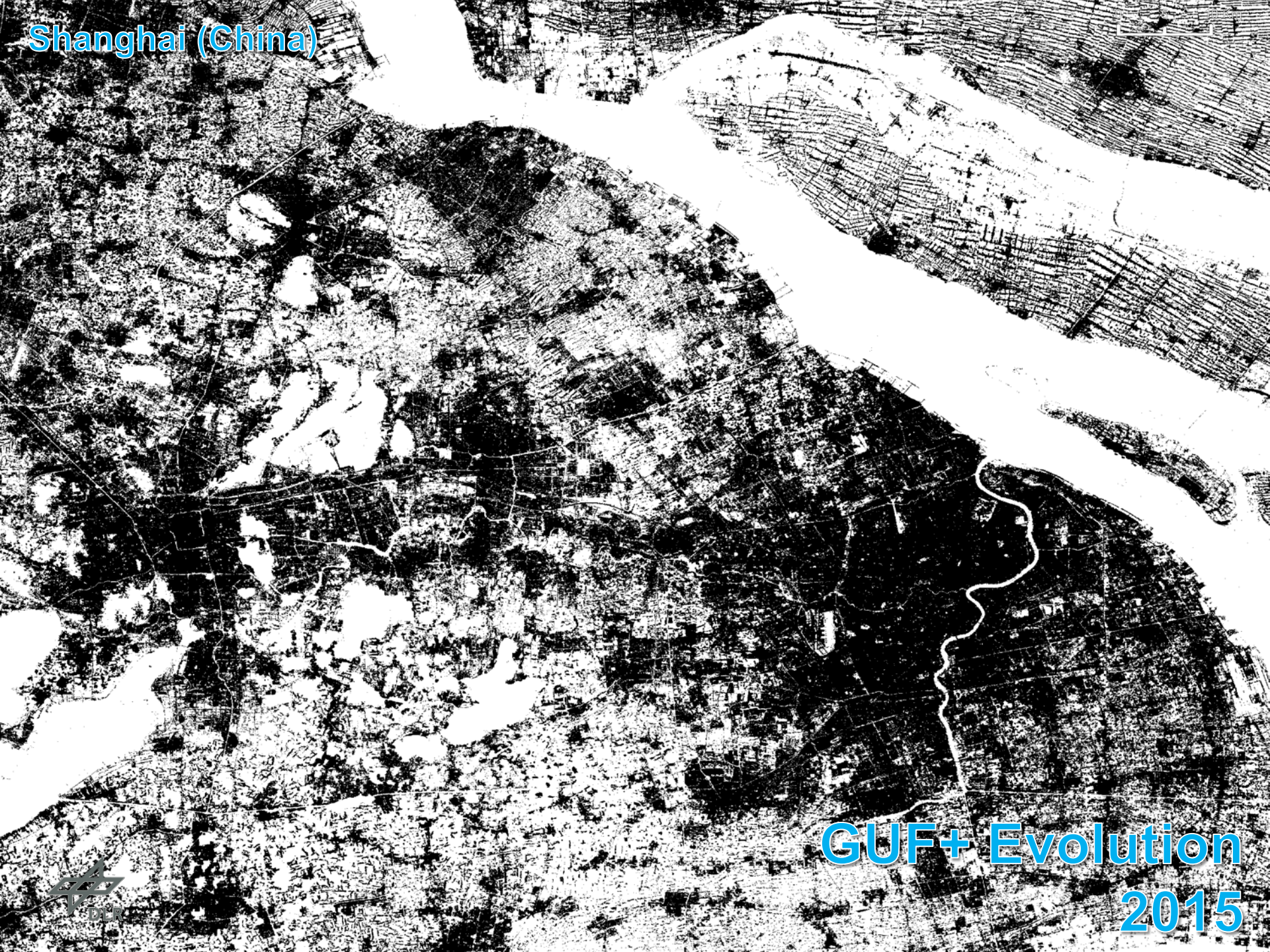

Shanghai (China)
GUF+ Evolution
1990
DLR


Shanghai (China)
GUF+ Evolution
1995
DLR

Shanghai (China)
GUF+ Evolution
2000
DLR

Shanghai (China)
GUF+ Evolution
2005
DLR

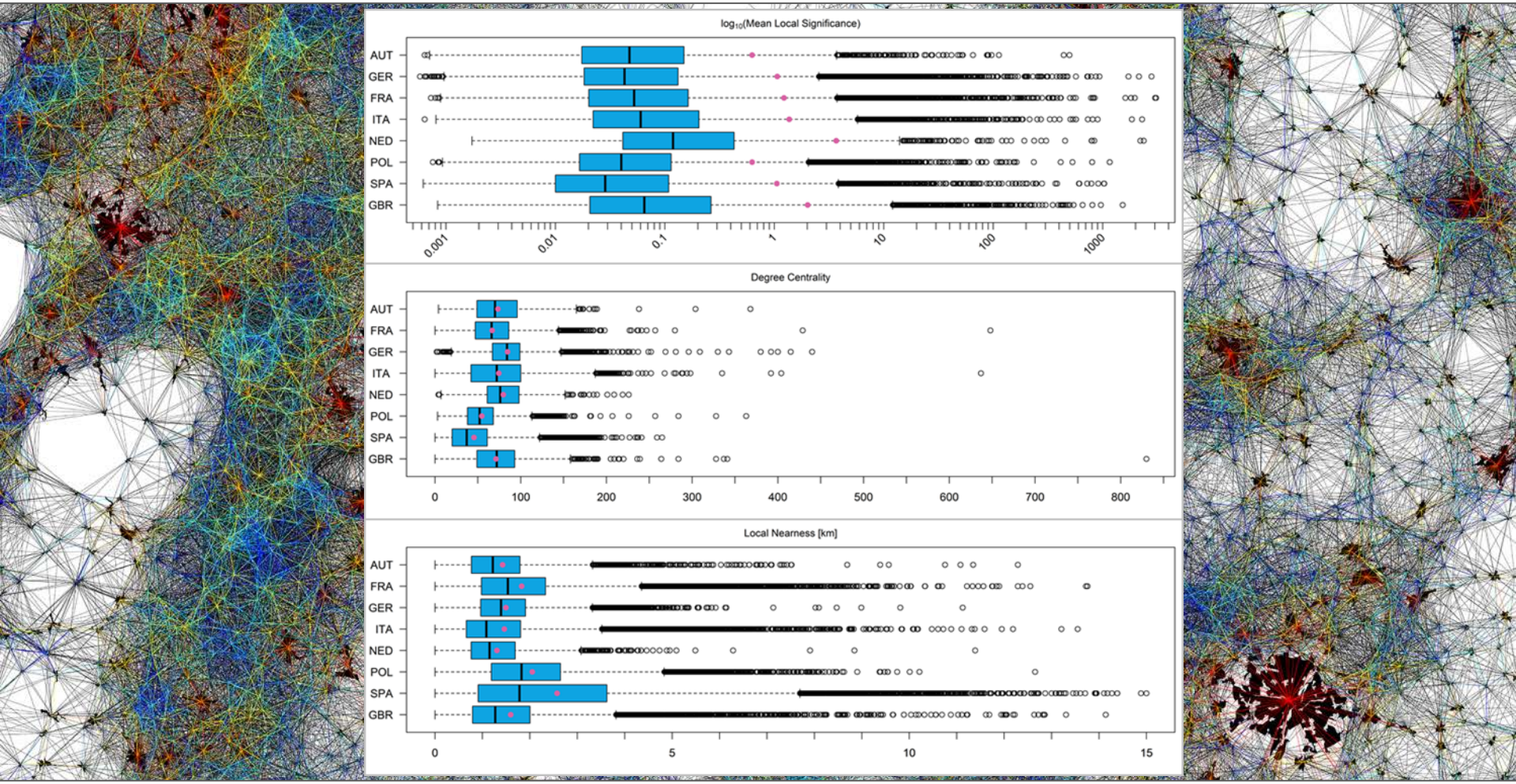

Shanghai (China)
GUF+ Evolution
2010
DLR


Shanghai (China)
GUF+ Evolution
2015
DLR

Global Urban Footprint + NetS

(Settlement properties and pattern, vector data)

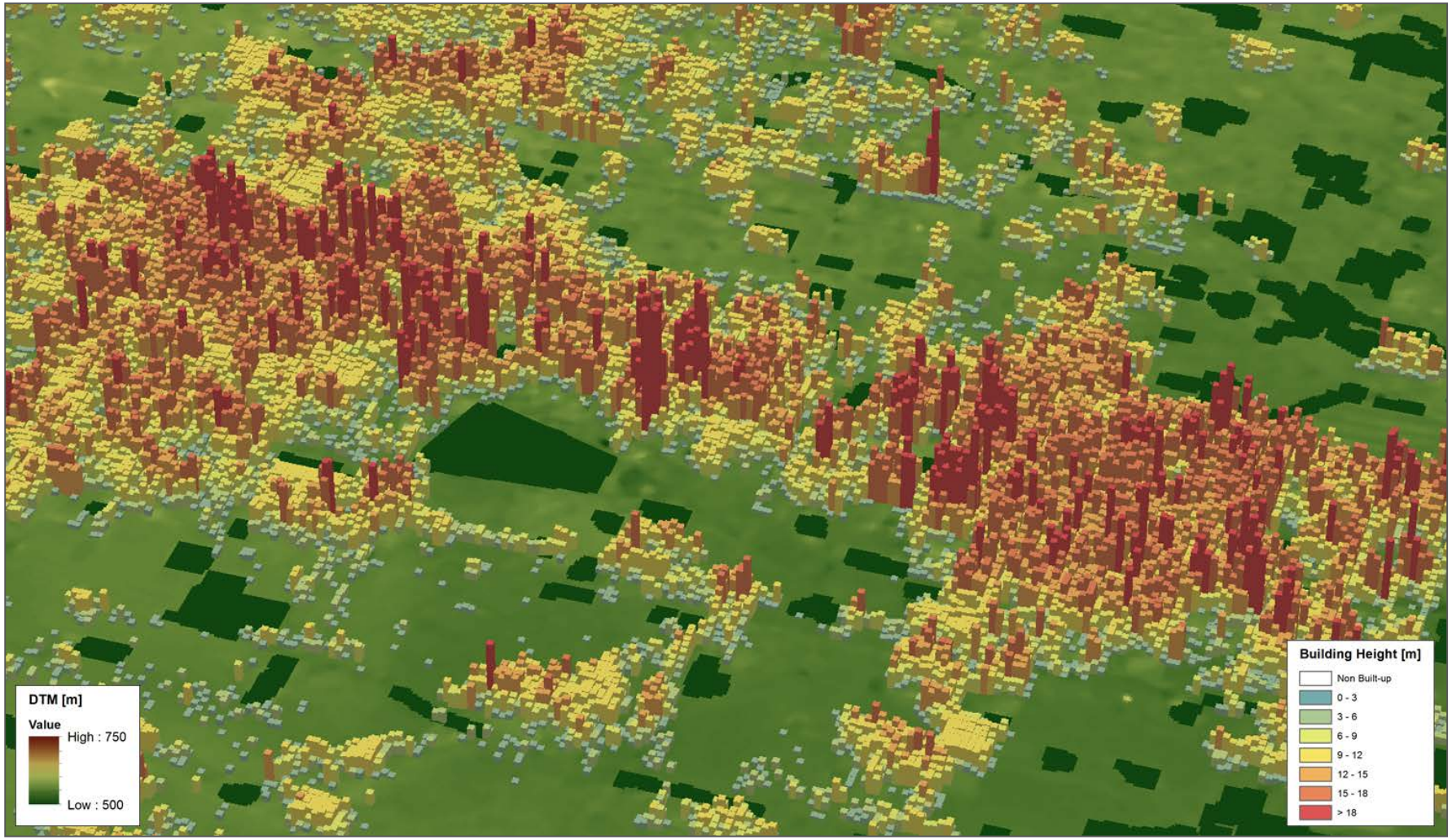
Global Urban Footprint + GUF-NetS



Characterizing the local relevance of settlements using spatial network analysis

DLR

Global Urban Footprint + GUF-3D



Average building height (120x120m) derived from TanDEM-X IDEM for Dongying, China

DLR

Urban Exploitation Platform (U-TEP)

urban tep

DLR

Brockmann Consult

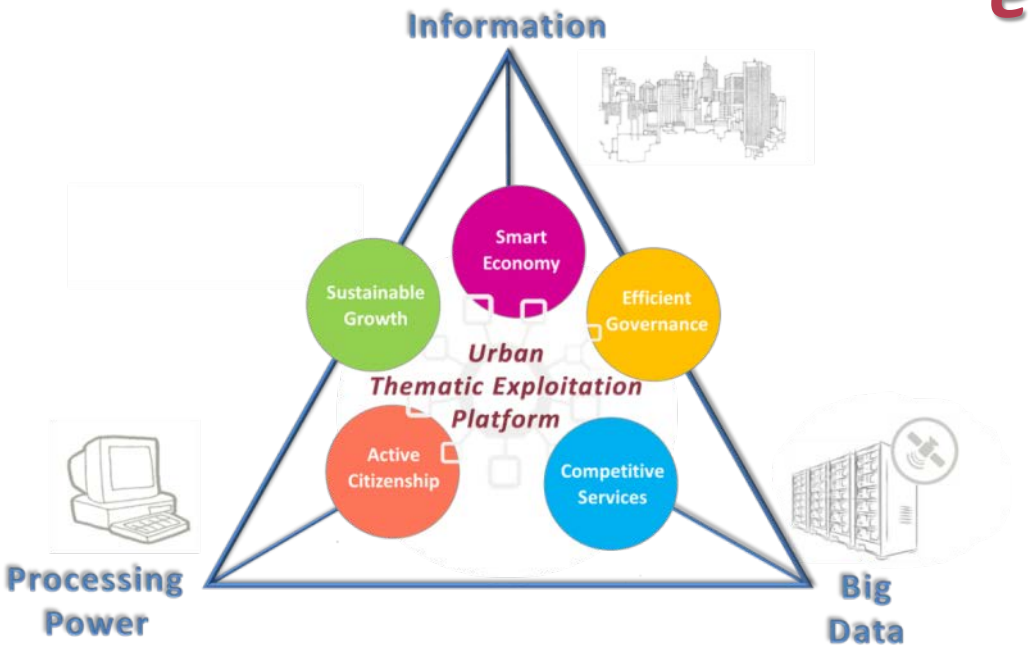
terradue 2.0

gisat

IT4I

U-TEP at a Glance: Scope and Objective

Development of a *platform* providing *end-to-end solutions*…



…for a broad *spectrum of users* (experts and non-experts)…

…to extract *unique information/indicators* required for *urban management* and *sustainability*.

U-TEP Version 1.0: All-in-One Solution

Web-portal

(entry point)

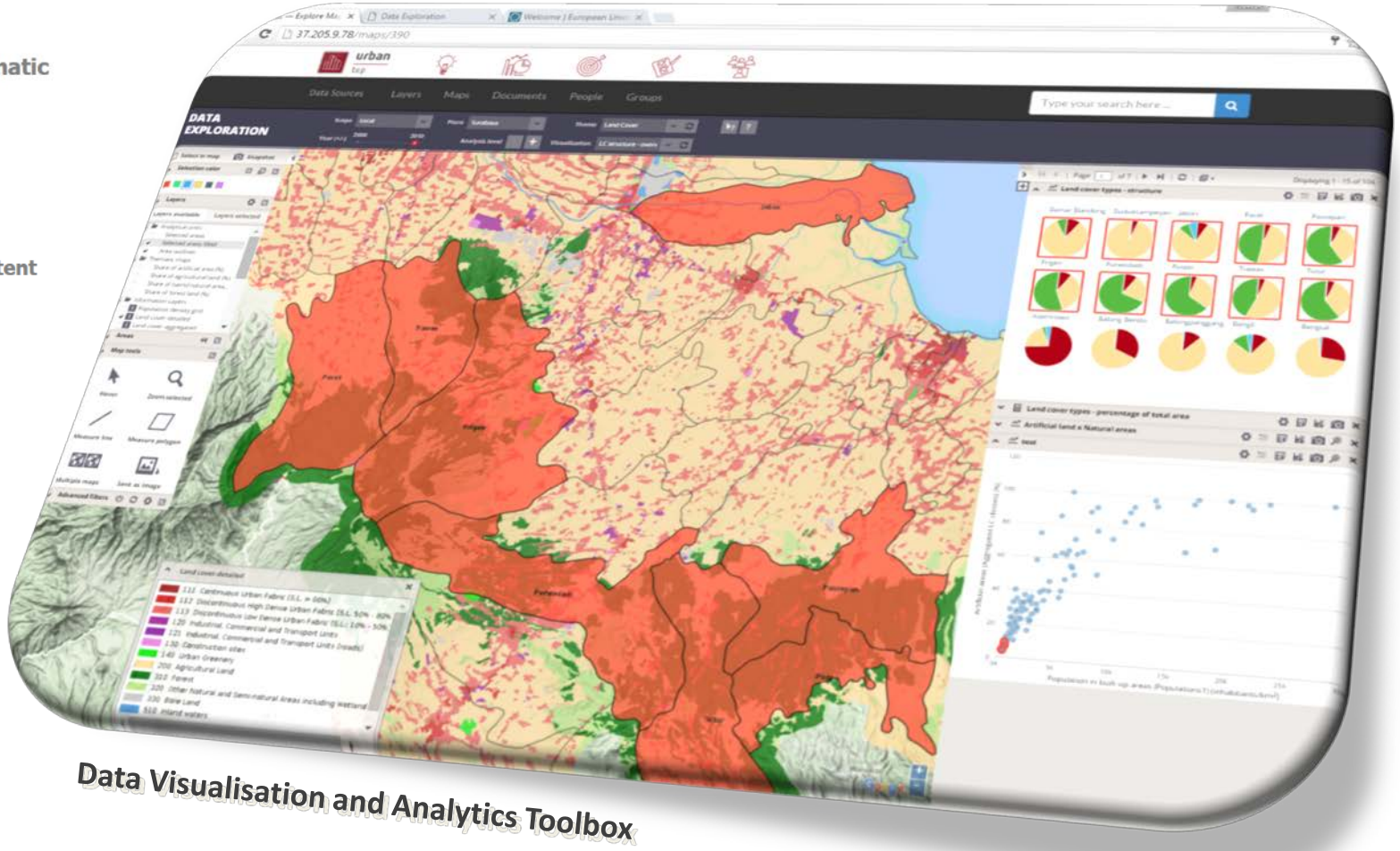
U-TEP Version 1.0: All-in-One Solution

Explore or task thematic applications

U-TEP Version 1.0: All-in-One Solution

Explore or task thematic applications

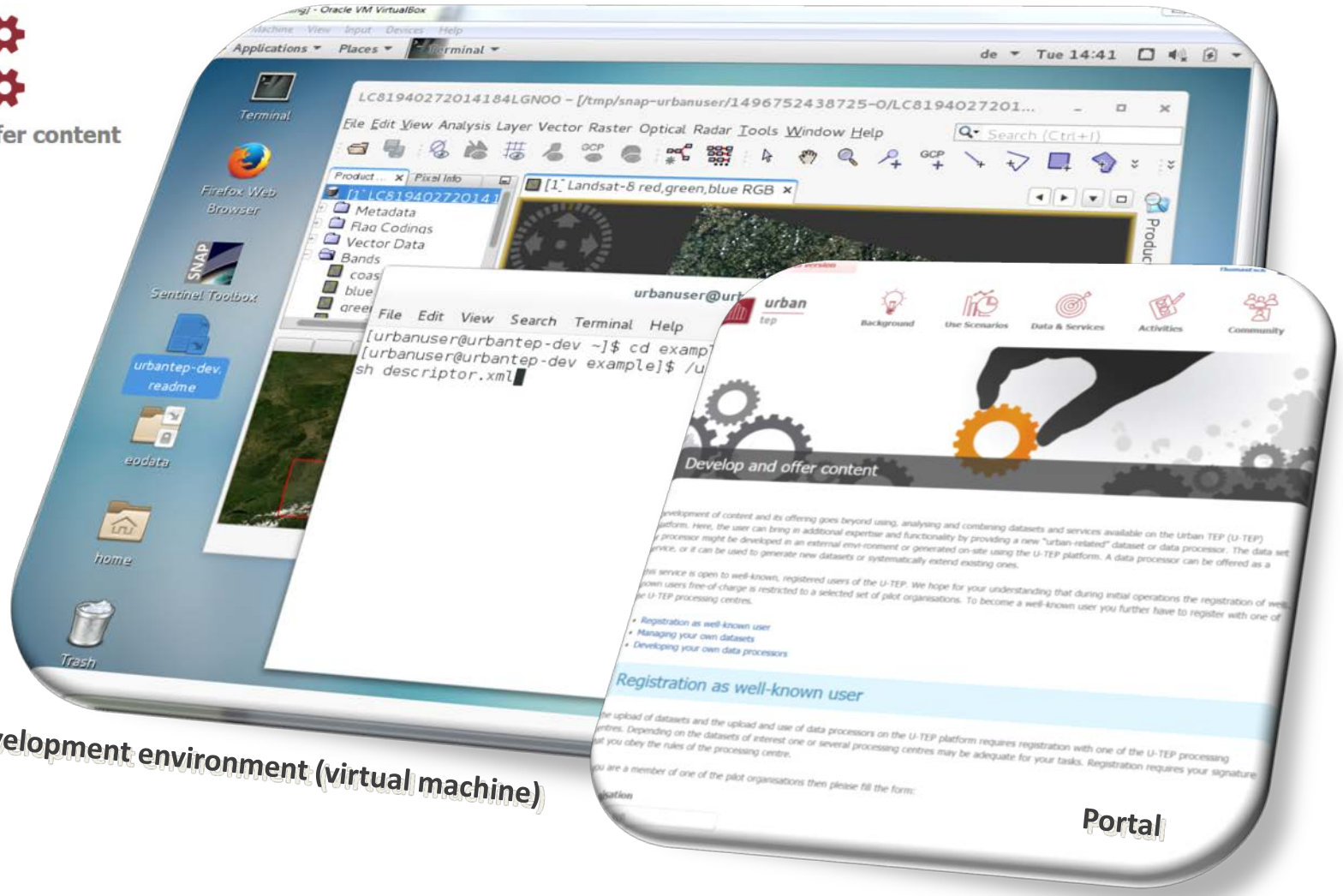
Develop and offer content



Data Visualisation and Analytics Toolbox

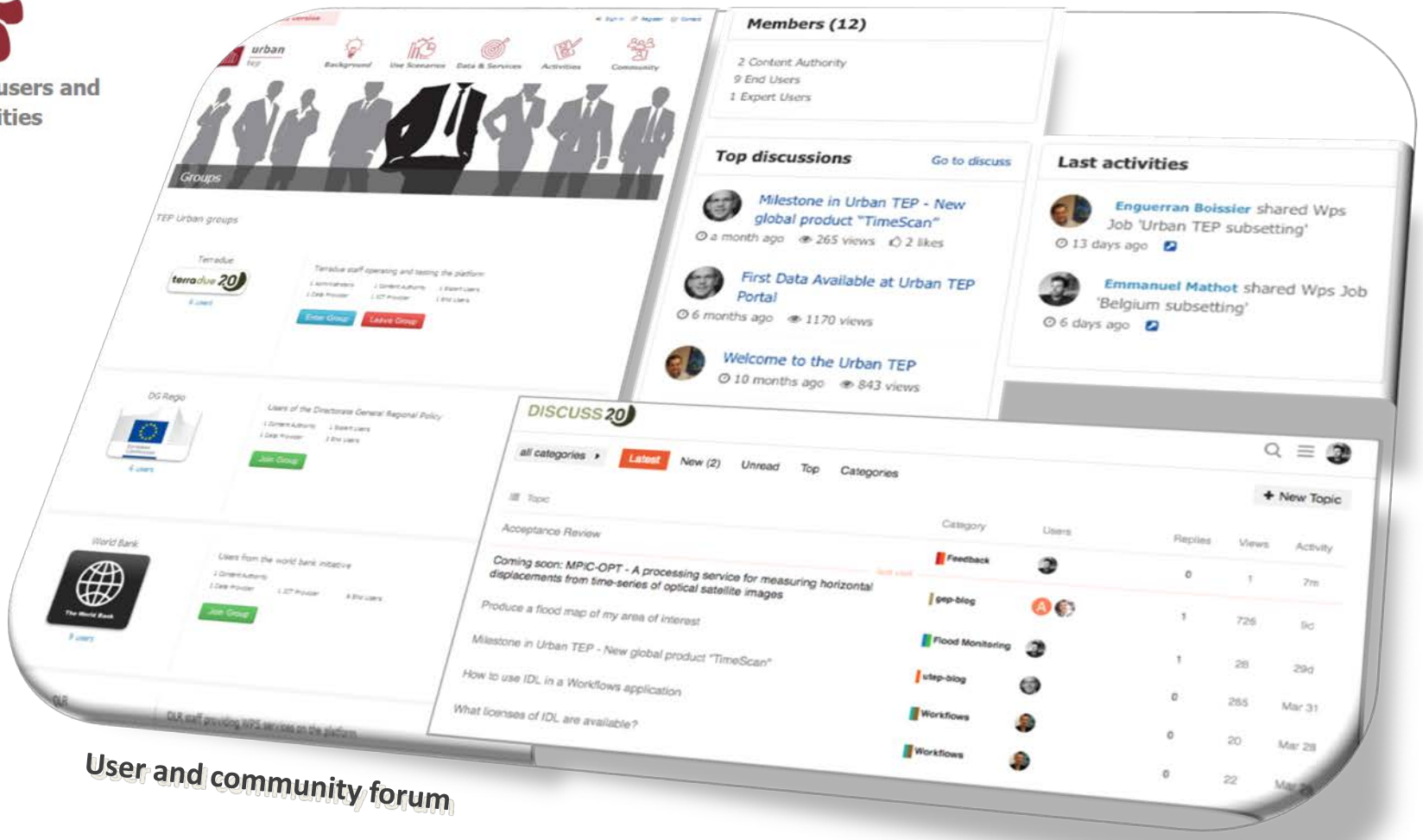
U-TEP Version 1.0: All-in-One Solution

Develop and offer content



U-TEP Version 1.0: All-in-One Solution

Connect with users and communities



User and community forum

Wrap-up

Contributions to Human Planet Initiative

Next Steps

- ***Provision of GUF/GUF+ data***
  - For GUF 2012: send order/license form to guf@dlr.de (download: www.dlr.de/guf)
  - GUF+ 2015, GUF+ 2015 Density and GUF+ Evolution ready by Oct-Nov 2017
  - Beta-version(s) will be provided already on request (email to guf@dlr.de)
  - Open and free release (i.a. via U-TEP portal) as soon as full validation/quality assurance are completed (early 2018)
- ***Global validation and cross-comparison***
  - Development of sound understanding of product characteristics
  - Baseline for HPI's future strategy regarding production/monitoring/analysis
  - Managing expectations of user communities
- ***U-TEP***
  - Innovative all-in-one and end-to-end solution
  - Matchlessness portfolio of products, service and enabling technologies
    - Multi-mission, multi-source data access (efficiency, handiness).
    - Remote high-performance processing (timeliness, efficiency).
    - Data visualization and analytics toolbox (value-adding).
    - Data and technology sharing (innovation, societal benefit).
    - Participatory, collaborative user forum (benchmarking, outreach)

Thank you for your attention!

Dr. Thomas Esch

Telephone: +49 8153 28-3721 | Email: thomas.esch@dlr.de

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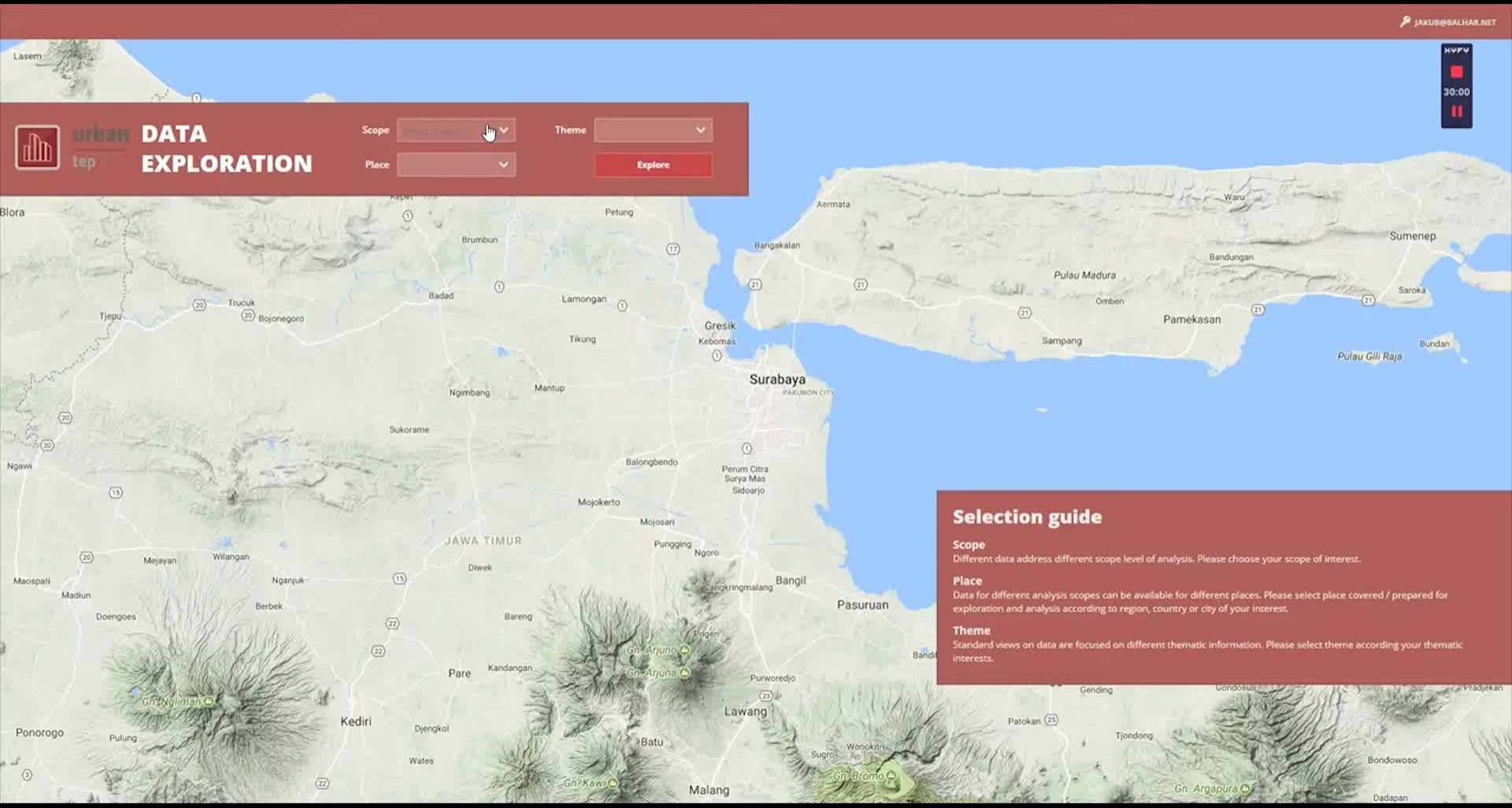
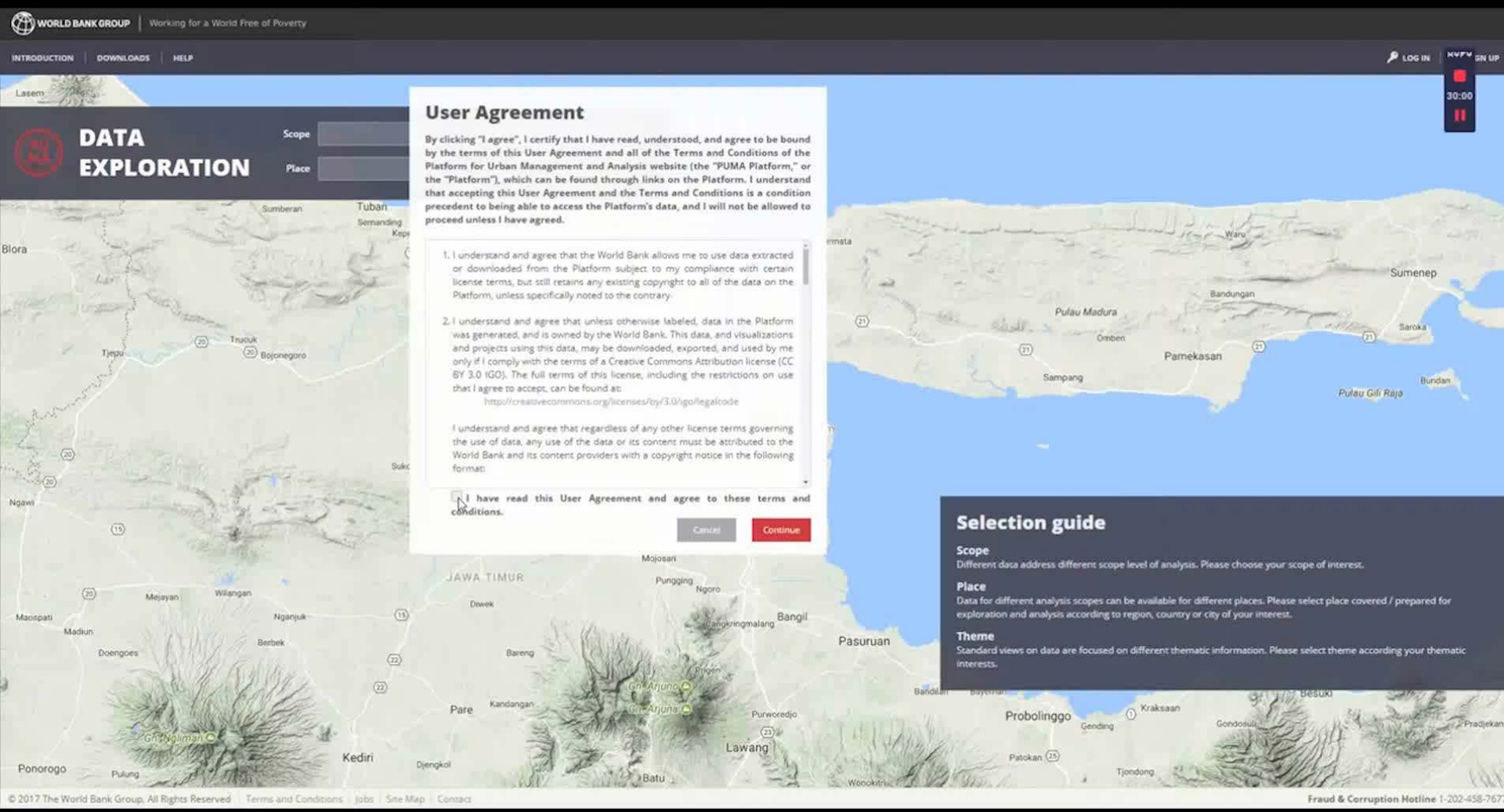
U-TEP Version 1.0: All-in-One Solution



U-TEP Version 1.0: All-in-One Solution