

# TEP Urban

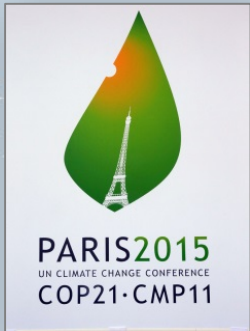
## The Urban TEP – Joint Analysis of Multi-Source Data for Innovative Monitoring

Felix Bachofer

Felix Bachofer, Thomas Esch, Hubert Asamer, Jakub Balhar, Martin Boettcher, Enguerran Boissier, Andreas Hirner, Emmanuel Mathot, Mattia Marconcini, Annekatrin Metz-Marconcini, Fabrizio Pacini, Hans Permana, Tomas Soukup, Vaclav Svaton, Soner Uereyen, Julian Zeidler



# Motivation



## Urban challenges

- Water
- Energy
- Waste
- Food
- Risk adaptation and mitigation
- Growth management
- Living conditions
- Basic services
- Transportation
- ...

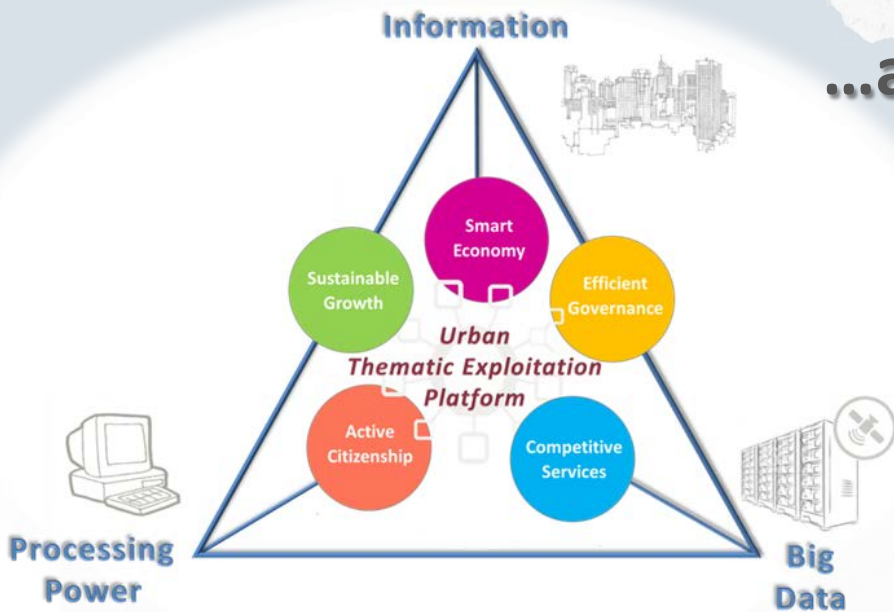
# Portfolio

Data provision  
Data processing  
Analysis & Visualization  
Knowledge exchange

...all **data** and **tools** needed...

...available in **one place!**

**end-to-end solutions ready to use**



# User community



## Application Providers

Processing

Number of users: > 380  
Number of organisations: 42

Key users:

- World Bank Group
- United Nations
- OECD
- World Food Programme
- Bill & Melinda Gates Found.
- Group on Earth Observation (GEO)
- WorldPop
- Columbia University (CIE)
- MININFRA Rwanda
- ....

Analysts

Scientists

User  
Groups

Analysis &  
Visualization

Spatial  
Planners

Policy- /  
Decision  
Makers

Key Messages

Information Consumers

# Outlook

- Kick-Off for the next funding phase took place two weeks ago
- Streamlining of operations, design and functions (until March 2019)
- Release of more functions and datasets to the urban community (e.g. processing services, WSF products)
- Striving for sustainability during next phase

Esch, T., Asamer, H., Bachofer, F., Balhar, J., Böttcher, M., .... et. all (Accepted 2018): **Digital World Meets Urban Planet - New Prospects For Evidence-based Urban Studies Arising From Joint Exploitation Of Big Data, Modern Information Technology And Open Knowledge**. Accepted: [International Journal Of Digital Earth](#).

# Platform

The screenshot shows the Urban TEP platform interface. At the top left is the 'urban tep' logo. A navigation bar contains icons for 'Background', 'Use Scenarios', 'Data & S...', and 'Partners'. A grey box with a white arrow points from the URL [urban-tep.eo.esa.int](http://urban-tep.eo.esa.int) to [urban-tep.eu](http://urban-tep.eu). Below this is a featured article titled 'Global Urban Footprint (GUF) layer now available' with a 'Browse GUF' button. At the bottom, three main features are listed: 'Explore or task thematic applications' (with a magnifying glass icon), 'Connect with users and communities' (with a group of people icon), and 'Develop and offer content' (with a gears icon).

Urban Thematic Exploitation Platform (U-TEP)

# Live Demo

## Portal

<https://urban-tep.eo.esa.int/#!>

## Geobrowser

<https://urban-tep.eo.esa.int/geobrowser/?id=portfolio#!&context=GUF%2FGUF2012-12m>

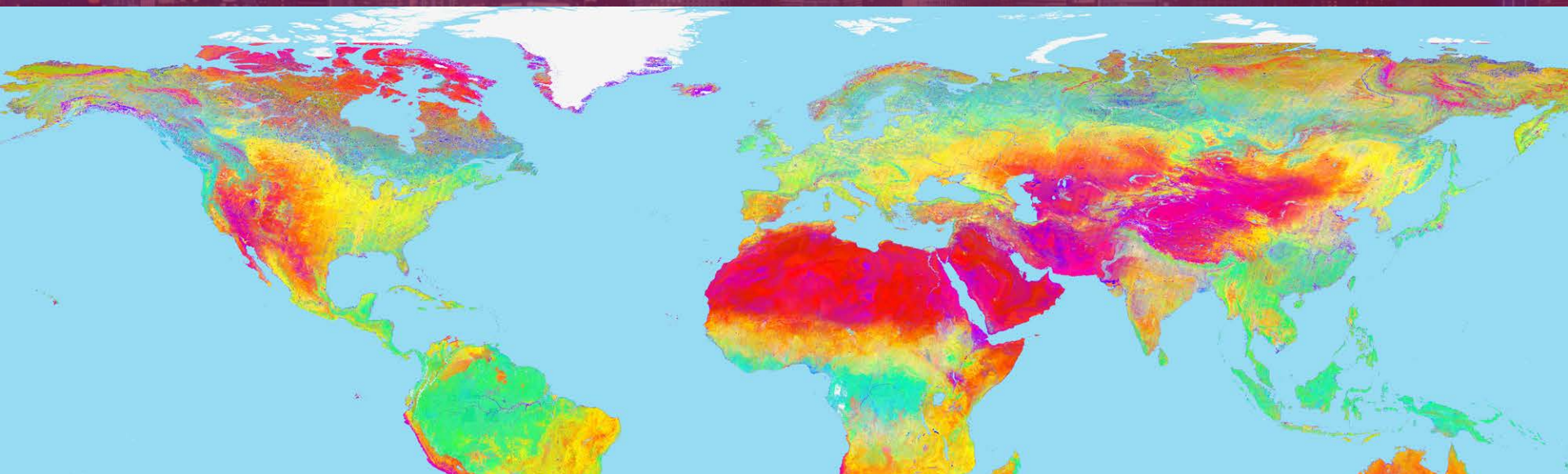
## TimeScan-Processing

<https://urban-tep.eo.esa.int/geobrowser/?id=timescandev#!>

## Thematic Application

<https://urban-tep.eo.esa.int/puma/tool/?id=78554&lang=en&needLogin=true>

# TimeScan Landsat 2015



NDBI [max]  
NDVI [max]  
NDWI [mean]

Esch, T., S. Üreyen, J. Zeidler, A. Metz–Marconcini, A. Hirner, H. Asamer, M. Tum, M. Böttcher, S. Kuchar, V. Svaton and M. Marconcini (2018). "Exploiting big earth data from space – first experiences with the timescan processing chain." Big Earth Data: 1-20.

**~460.000**

Landsat-8 scenes  
collected in **2014-2015**

**6** spectral  
indices  
**5** temporal  
statistics

**30m**  
spatial  
resolution

**> 1.5 PB**  
intermediate products  
**25 TB**  
final product





[urban-tep.eo.esa.int](http://urban-tep.eo.esa.int)

[urban-tep.eu](http://urban-tep.eu) (From 01.12.2018)

[contact@urban-tep.eu](mailto:contact@urban-tep.eu)



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# Live Demo

## 1) Portal

- Develop offer content
- Tutorials & Videos
- Connect with user communities

## 2) Product Portfolio

- GUF /WSF
- Nightlights
- Geotagged Tweets

## 3) Time Scan on Demand

- Information Aggregation

## 4) VISAT (predefined Thematic Applications)

- WSF Evolution
- Zoom to Hanoi
- Single date / multivariate
- Tilt view / DGM
- Bar Chart (population / settlement)
- Scatterplot (population / settlement)
- Table SDG 11.3.1: Area change normalized with population change
- Polar table (Area change / pop change/ Gross national income (\$ / capita)
- If time available: Land-use



# Back-up Slides

# Platform

<https://urban-tep.eo.esa.int>

**urban tep**

Background Use Scenarios Data & Services Quick Start Activities Partners

**Global Urban Footprint (GUF) layer now available**  
 Discover DLR's new Global Urban Footprint (GUF) data at the Urban TEP platform and inspect the urban and rural human settlements pattern in a so far unique precision and consistency

Browse GUF

Explore or task thematic applications

Connect with users and communities

Develop and offer content

Urban Thematic Exploitation Platform (U-TEP)

# User Communities

## • Platform Portal

The screenshot displays the Urban TEP Platform Portal interface. At the top right, there are links for 'Sign in', 'Register', and 'Contact'. The main content area is divided into several sections:

- Members (12):** Lists 3 Content Authority, 9 End Users, and 1 Expert Users.
- Top discussions:**
  - Milestone in Urban TEP - New global product "TimeScan" (a month ago, 265 views, 2 likes)
  - First Data Available at Urban TEP Portal (6 months ago, 1170 views)
  - Welcome to the Urban TEP (10 months ago, 843 views)
- Last activities:**
  - Enguerran Boissier shared Wps Job "Urban TEP subsetting" (13 days ago)
  - Emmanuel Mathot shared Wps Job "Belgium subsetting" (6 days ago)
- Groups:**
  - Terradue 20:** Terradue staff operating and testing the platform. 6 users.
  - DC Rango:** Users of the Directorate General Regional Policy. 6 users.
  - World Bank:** Users from the world bank initiative. 9 users.
- DISCUSS 20:** A forum section with categories like 'Feedback', 'pdp-blog', 'Flood Monitoring', 'step-blog', 'Workflows', and 'Workflows'. It includes a table with columns for Topic, Category, Users, Replies, Views, and Activity.

Below the screenshot, there is a text block: "Another tutorial video, this one is for... https://www.youtube.com/watch?v=wenI\_MRINuM&feature=youtu.be @ 5 months ago".

Below that, there is a section titled "Tutorial Video of Development Environment" with the text: "Hi all, Here is a tutorial video on how to use Urban TEP development environment. https://www.youtube.com/watch?v=E1djhMte\_s\_Hans @ 6 months ago".

To the right of the screenshot, there is a red gear icon and the text "and offer content".

At the bottom right of the screenshot area, there is a blue circular logo and the text: "ISOCARP @ISOCARP Register soon! The 55th @IMLconference in @OttawaCity takes place May 14-18 on the theme... https://t.co/Ge0Du1qyx @ 8 hours ago".

Connect with users and communities

# User Support – Ticketing System

urban tep

Logged in as Thomas Esch My account Sign out

Search U-TEP Early Adopters

Overview Activity **Issues** Gantt Calendar News Documents Wiki Files Settings

Issues New issue

Filters: Status open Add filter

Apply Clear Save

#	Tracker	Status	Priority	Subject	Assignee	Updated
195	Support	Resolved	Normal	Re: U-TEP	Jean-Louis Weber	01/25/2018 09:00 AM
178	Support	In Progress	Normal	Population exposure to natural hazards	Thomas Esch	01/25/2018 09:01 AM
177	Support	In Progress	Normal	Sultan Qaboos University	Andy Kwarteng	03/28/2018 06:02 AM
176	Support	In Progress	Normal	DroneMapping Use Case	Thomas Esch	01/25/2018 08:57 AM
175	Support	New	Normal	Urban Growth Modelling	Jakub Balhar	01/25/2018 08:55 AM

(1-5/5)

Also available in: Atom | CSV | PDF

User support functionalities

**Tutorial video of On-demand Processing Services**  
 Another tutorial video, this one is for On-demand processing services:  
[https://www.youtube.com/watch?v=wenI\\_MRINuM&feature=youtu.be](https://www.youtube.com/watch?v=wenI_MRINuM&feature=youtu.be)  
 5 months ago

**Pierre Laconte** @LacontePierre  
 "World of Cities" - Géopolitique de l'énergie - Prof. S. Furfari 23/4 + autres débats ...  
<https://t.co/87VVeJLCuq>  
 an hour ago

**Tutorial Video of Development Environment**  
 Hi all, Here is a tutorial video on how to use Urban TEP development environment.  
[https://www.youtube.com/watch?v=E1djhBMie\\_s\\_Hans](https://www.youtube.com/watch?v=E1djhBMie_s_Hans)  
 6 months ago

**ISOCARP** @ISOCARP  
 Register soon! The 55th @IMCLconference in @OttawaCity takes place May 14-18 on the theme...  
<https://t.co/Ge0Du1qyqx>  
 8 hours ago

# System Design

APIs of U-TEP's integrated software components are based on open standard specifications such as Open Cloud Computing Interface (OCCI) and Open Geospatial Consortium (OGC).

- i) a web portal (geobrowser), interacting with an
- ii) EO data catalogue (and associated data storage; based on Apache Lucene) and various internal and external Web Processing Services (WPS)
- iii) a Visualisation and Analytics Toolbox (VISAT)



GitHub (<https://github.com/urban-tep>)

# Deployment of Processors

## Development and Deployment of Processors

Processing Centers:

Salomon HPC cluster  
(Landsat data)

Calvalus cluster  
(Sentinel-2)

Geofarm (Sentinel-1)

Copernicus Data and Information Access Service (DIAS)





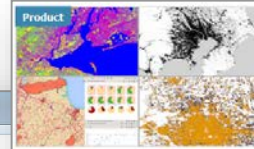
# Product Portfolio

# Geobrowser Product Portfolio



Explore or task thematic applications

## • Product and Service Portfolio



### U-TEP Product Portfolio

by U-TEP

This application allows to visualise and inspect all U-TEP products and data from external sources in the geobrowser.

May 16th 2015

### Services

- TimeScan Landsat on-demand
- TimeScan Sentinel-2 on-demand
- Functional Urban Area Definition
- Visualisation and Analytics Toolbox

The screenshot displays the U-TEP Geobrowser interface. At the top, there are browser tabs for 'ESA Urban TEP' and 'U-TEP Product Portfolio'. The address bar shows the URL: <https://urban-tep.eo.esa.int/geobrowser/?id=portfolio#1&context=GUF%2FGUF2012-12m>. The interface includes a navigation menu with options like 'Sign in', 'Register', 'Contact', 'GUF', 'Time Scan', and 'HAPS'. A search bar is present with the text 'EO Free Text Search'. The main area features a world map with a timeline slider at the bottom, ranging from '1990-01-01' to '2016-12-31'. Below the map, there is a search result section showing 'Query results for series guf201212m' with 'Total results 1' and a result titled 'Global Urban Footprint 2012 (12m)'. The 'urban tep' logo is visible in the top left corner of the interface.

# Tracing Global Urbanization: New Data from Space

## ▪ *Global Urban Footprint (GUF)*

- Data base: 182,249 TerraSAR-X/TanDEM-X images (3m) collected in 2012 (308 TB)
- Spatial resolution: 12 m (scientific use), 84m (non-profit use)
- Release: November 2016
- Users: >300 institutions from 43 countries

## ▪ *World Settlement Footprint (WSF)*

- Use of free and open data
- Multi-sensor (Sentinel-1, Landsat/Sentinel-2)
- Multi-date (use of all scenes available)
- Multi-facility (DLR, U-TEP, GEE)

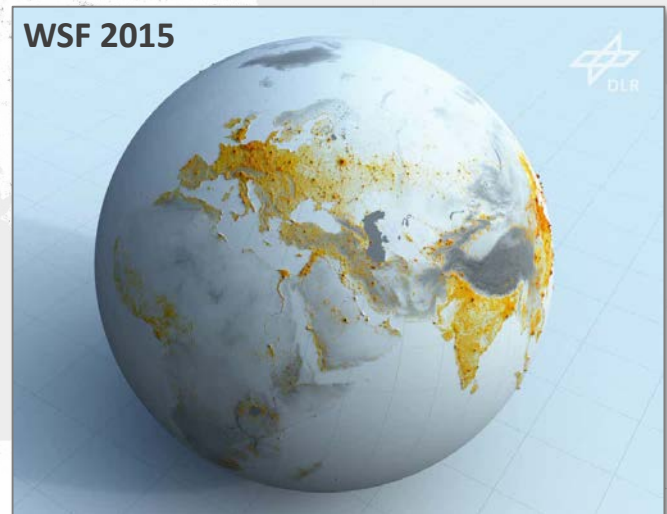
### Product portfolio

- WSF 2015 (10m, binary mask)
- WSF 2015 Density (30m, imperviousness)
- WSF 2015 Network (settlement pattern)
- WSF Evolution (30m, 1984-2015)
- WSF/GUF 3D (average building volume)

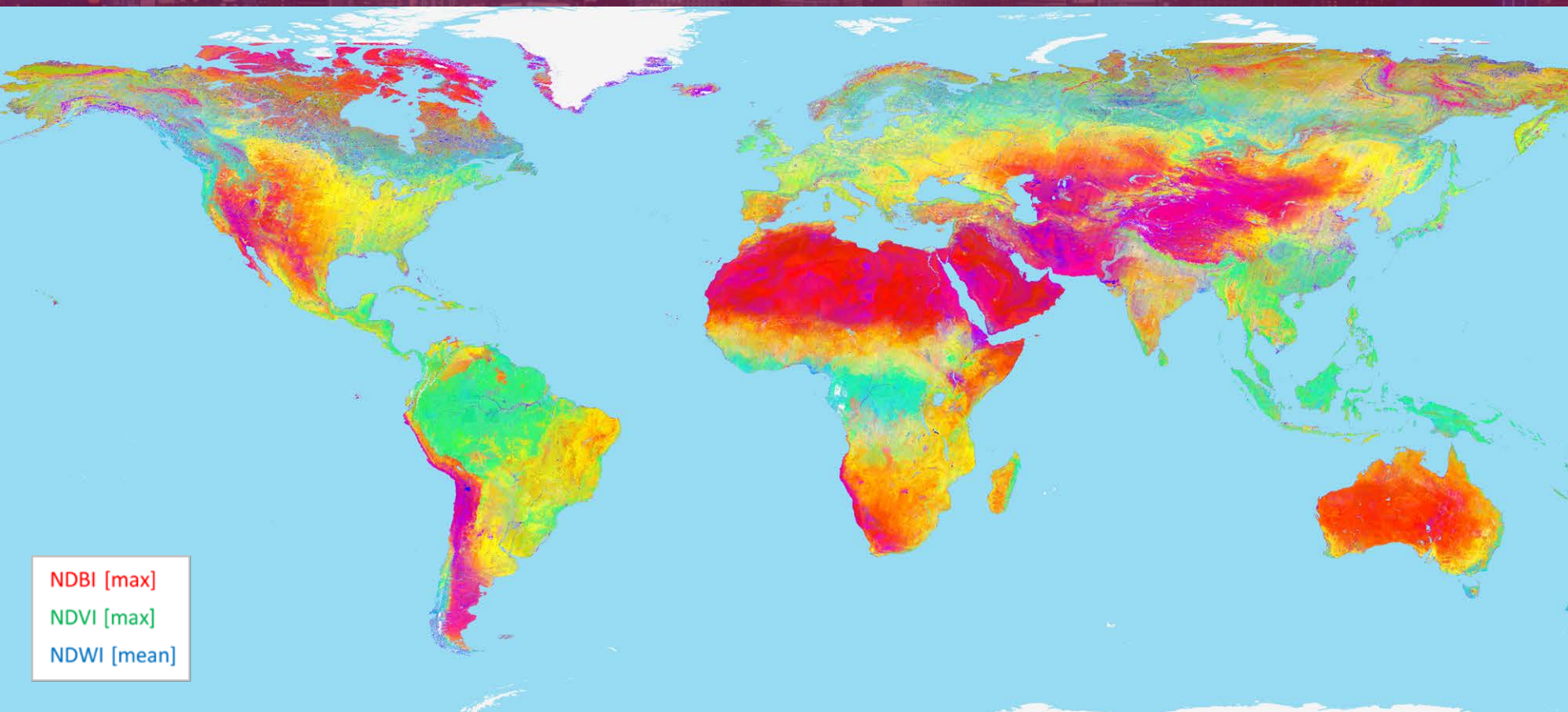
GUF 2012



WSF 2015



# World Settlement Footprint: TimeScan Landsat 2015



NDBI [max]  
 NDVI [max]  
 NDWI [mean]

**~460.000**

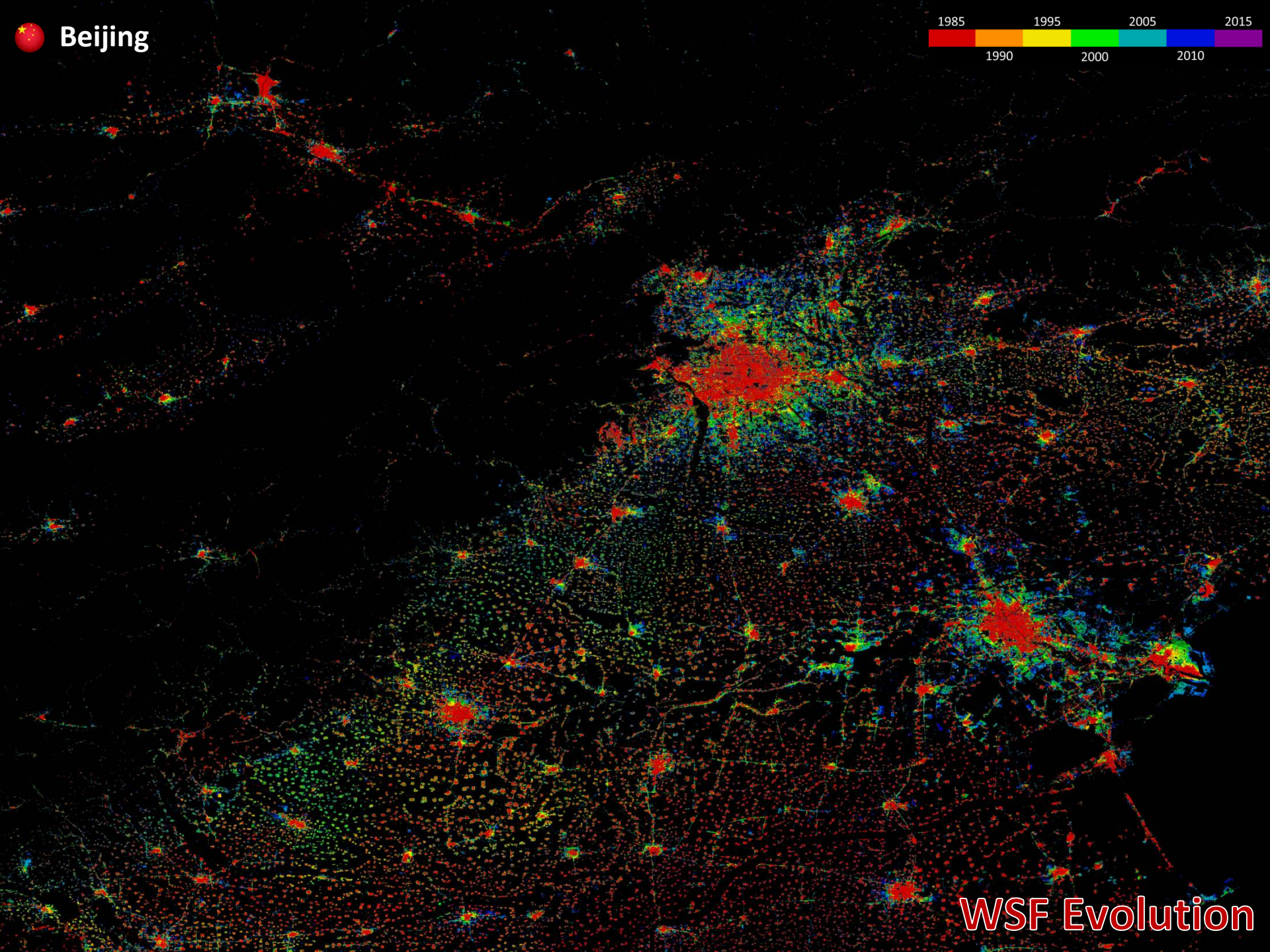
Landsat-8 scenes  
 collected in **2014-2015**

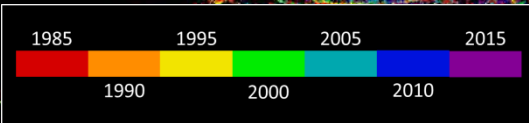
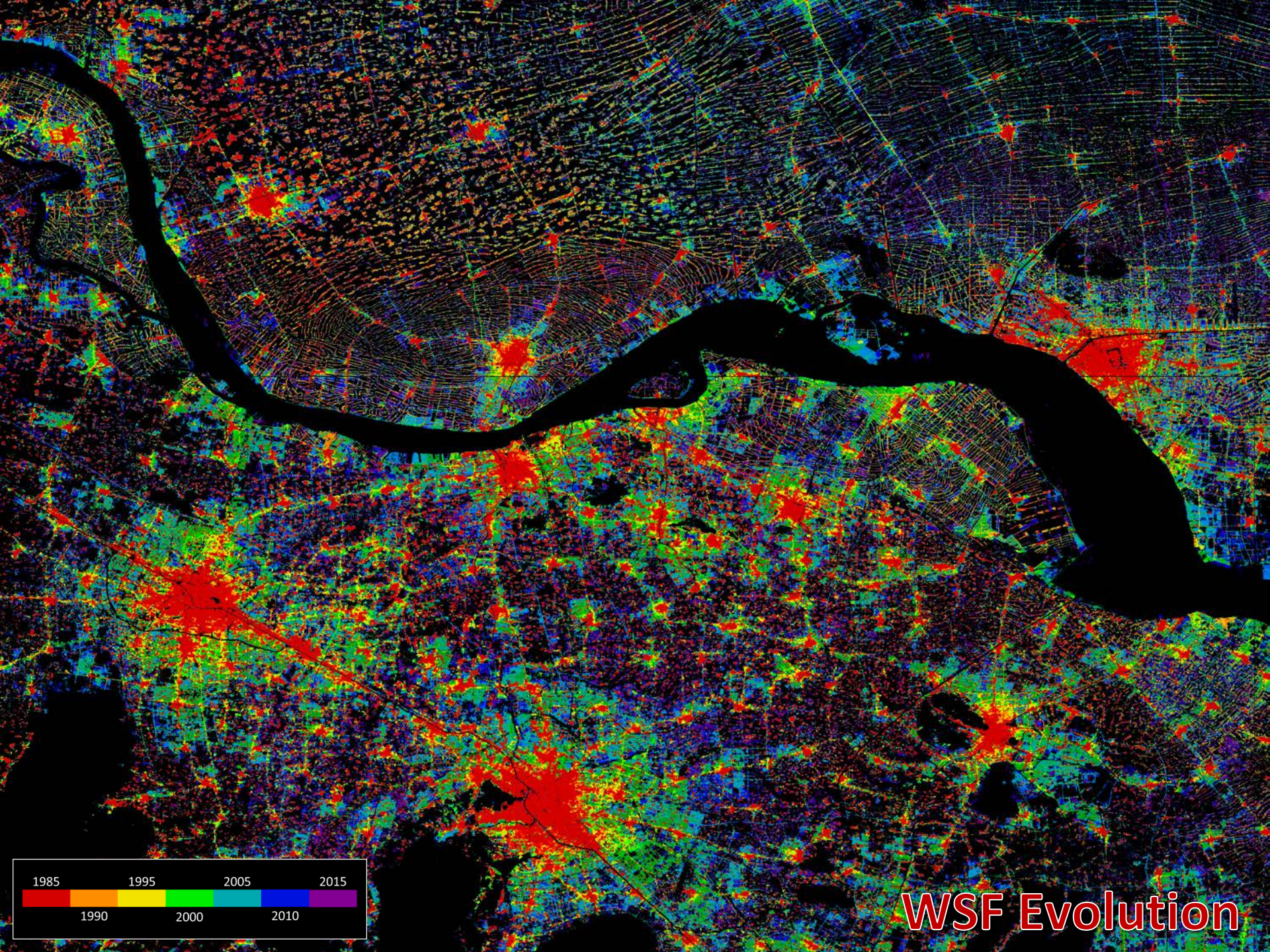
**6** spectral  
 indices  
**5** temporal  
 statistics

**30m**  
 spatial  
 resolution

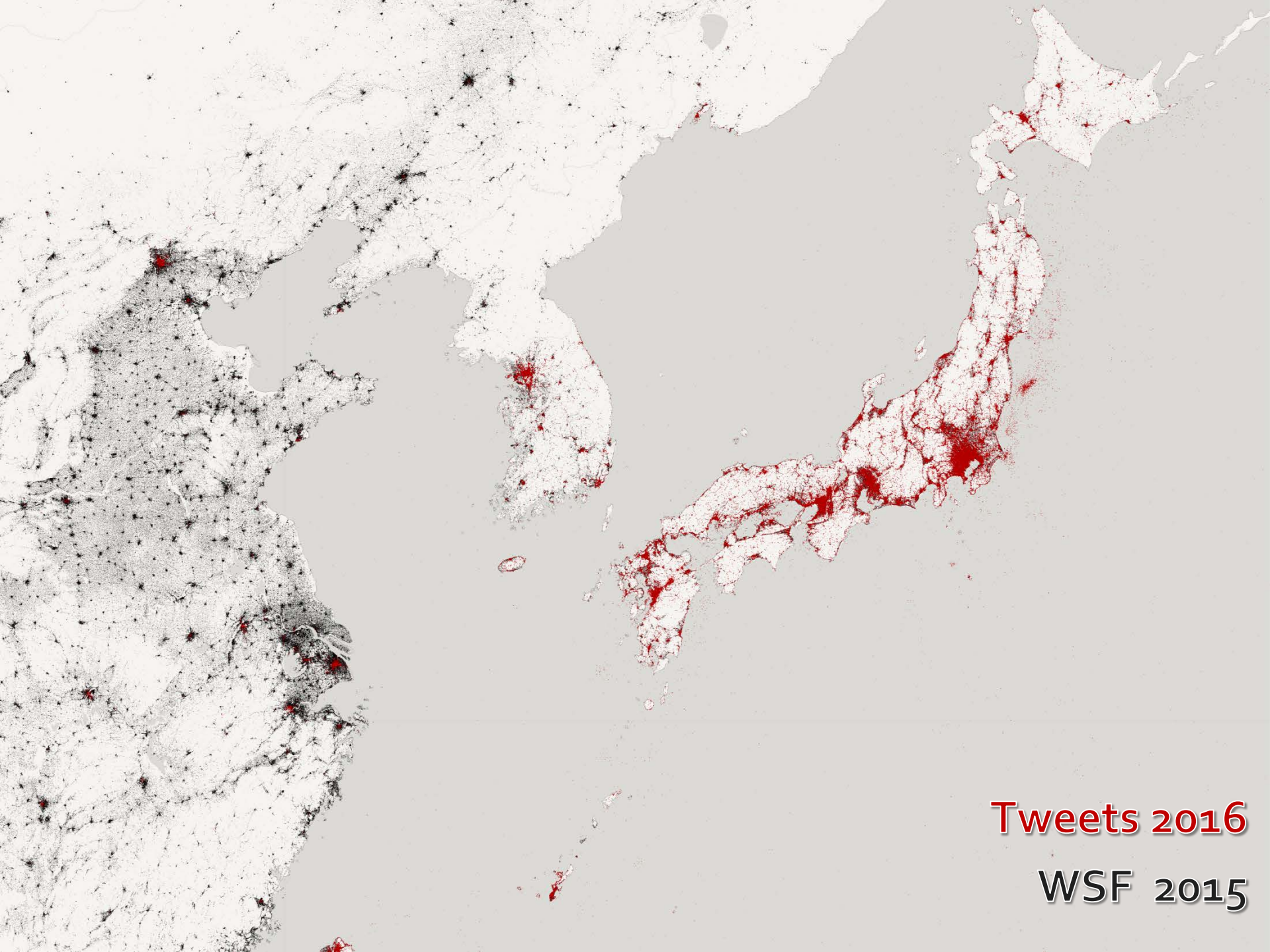
**> 1.5 PB**  
 intermediate products  
**25 TB**  
 final product







**WSF Evolution**



Tweets 2016

WSF 2015



# High Resolution / Local Level

**E.g. Pilot User: World Bank**

Use case: *UAV Mapping Service*

Motivation: Demonstration of an approach for UAV mass data processing to orthomosaic and DTM (test area: Dar es Salaam, Tanzania, ~100 sqkm, 11832 images).

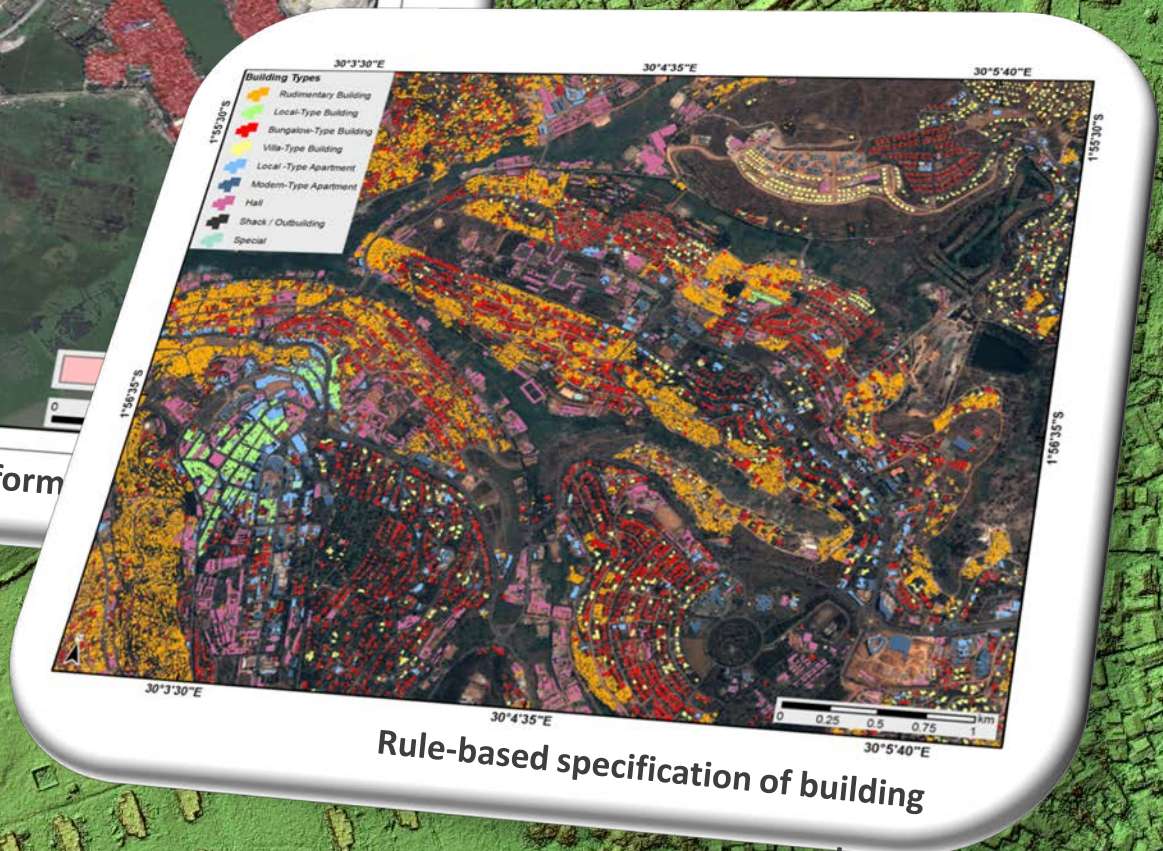
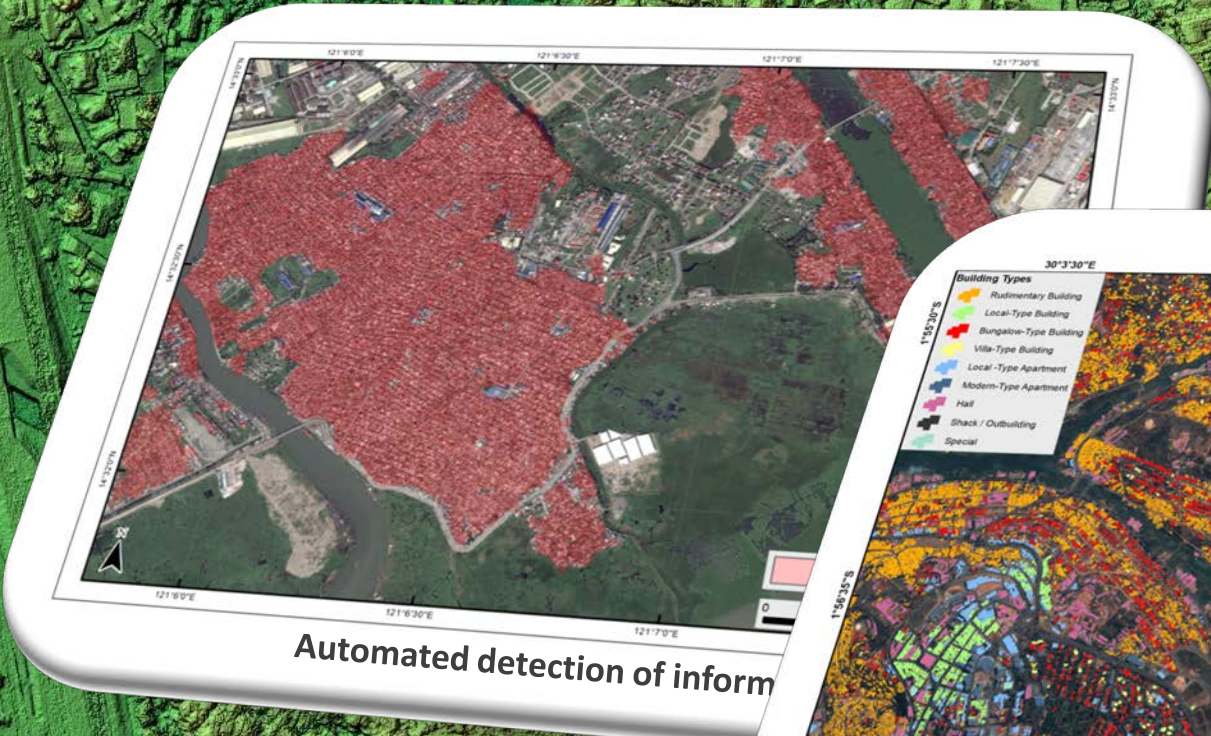
Methods: Orientation, matching, DTM processing, orthoprojection and mosaicing.

Results: 5cm resolution orthomosaic and 20cm DSM delivered to World Bank.



# High Resolution / Local Level

Derived Digital Surface Model



# Thematic Applications

A world map with a light blue background and white landmasses, centered on the Atlantic Ocean. The map is slightly faded and serves as a background for the main title.

## Visualisation and Synergistic Data Analysis

# Thematic Applications

Sign in Register Contact

Log in Sign up

About

World

City Level Analysis SE Asia

Built-up, Population per Countries

Population distribution and density SE Asia

EOWorld2 City Analysis

Built-up, Population SE Asia

Explore External Data Layers

Settlements Analysis EU

Functional Urban Areas

## ESA Urban TEP

**urban tep**

The main goal of the Urban Thematic Exploitation Platform (TEP) is the implementation of an instrument that helps addressing key research questions and societal challenges arising from the phenomenon of global urbanization.

Therefore, the Urban TEP represents a web-based platform that allows users to effectively utilize Earth Observation (EO) imagery and existing auxiliary data (e.g., geo-data, statistics) to measure and assess key properties of the urban environment and monitor the past and future spatiotemporal development of settlements.

Key elements of the Urban TEP are the provision of easy and high performance

1 2 Next

**gisat**

Open App

so far

**DLR**

Open App

**Product**

### Global Urban Footprint Plus (GUF+)

by **DLR**

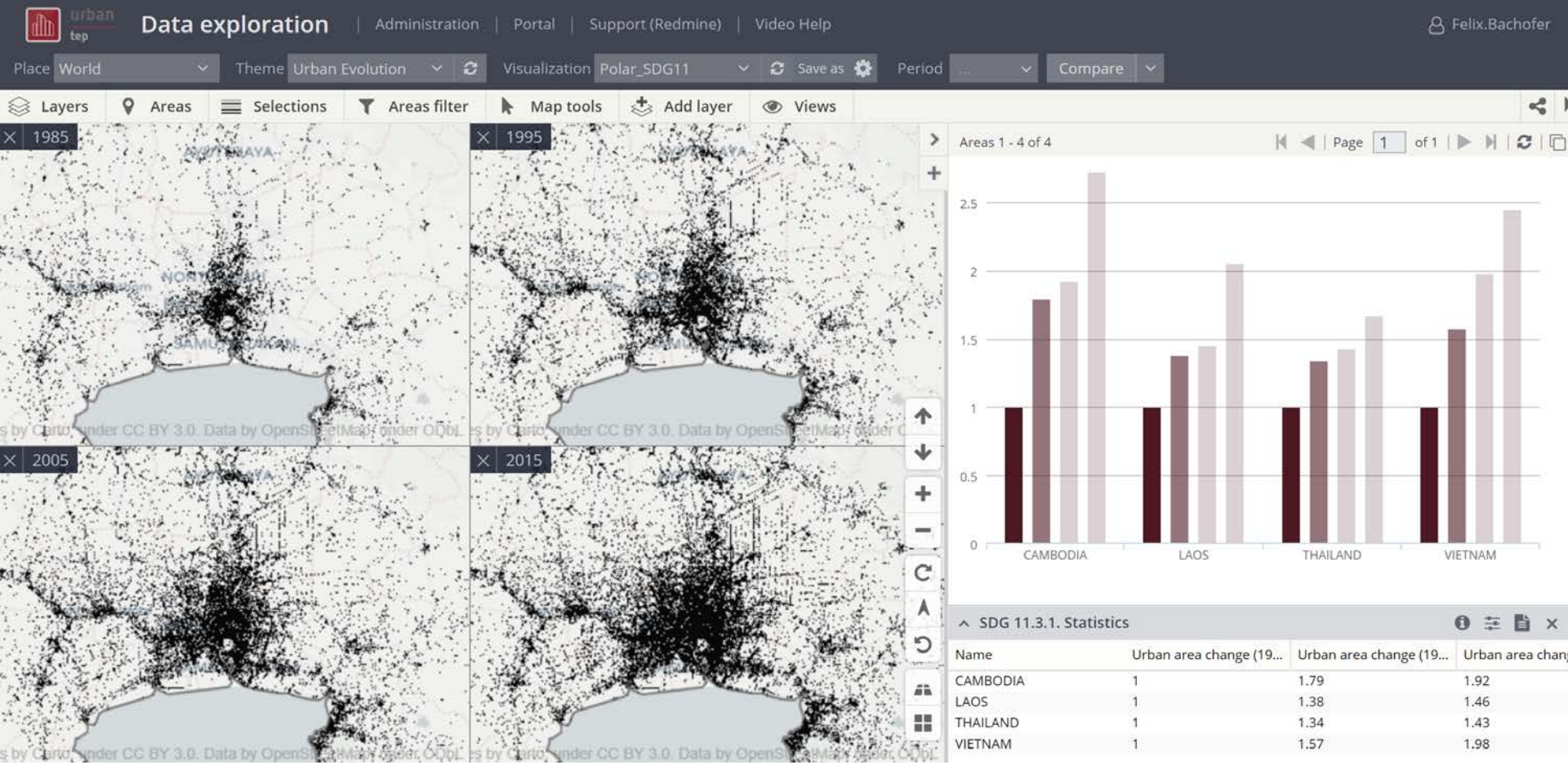
The Global Urban Footprint + Evolution (GUF+ Evo) collection shows the status of the urban extent for the years 2015-2010-2000-1990. The GUF+ Evo...

May 16th 2015

**DLR**

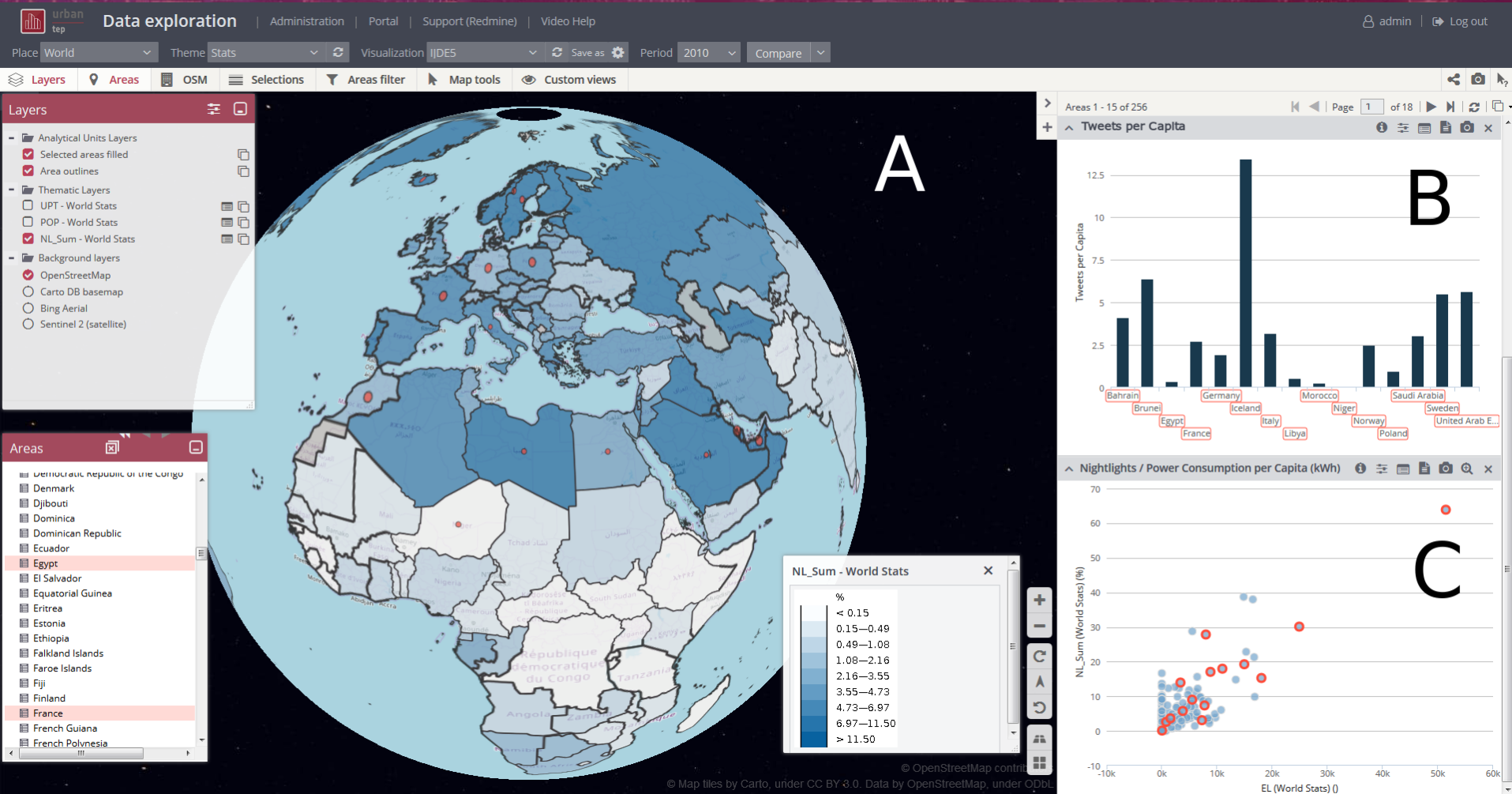
Open App

## Visualisation and Analytics Toolbox



Map: WSF Bangkok 1985, 1995, 2005 and 2015. Bar Chart & Table: SDG 11.3.1 Indicator: Population Change normalized by Settlement Area Change. The higher the ratio the more unbalanced the development between population and settlement area.

# Thematic Applications

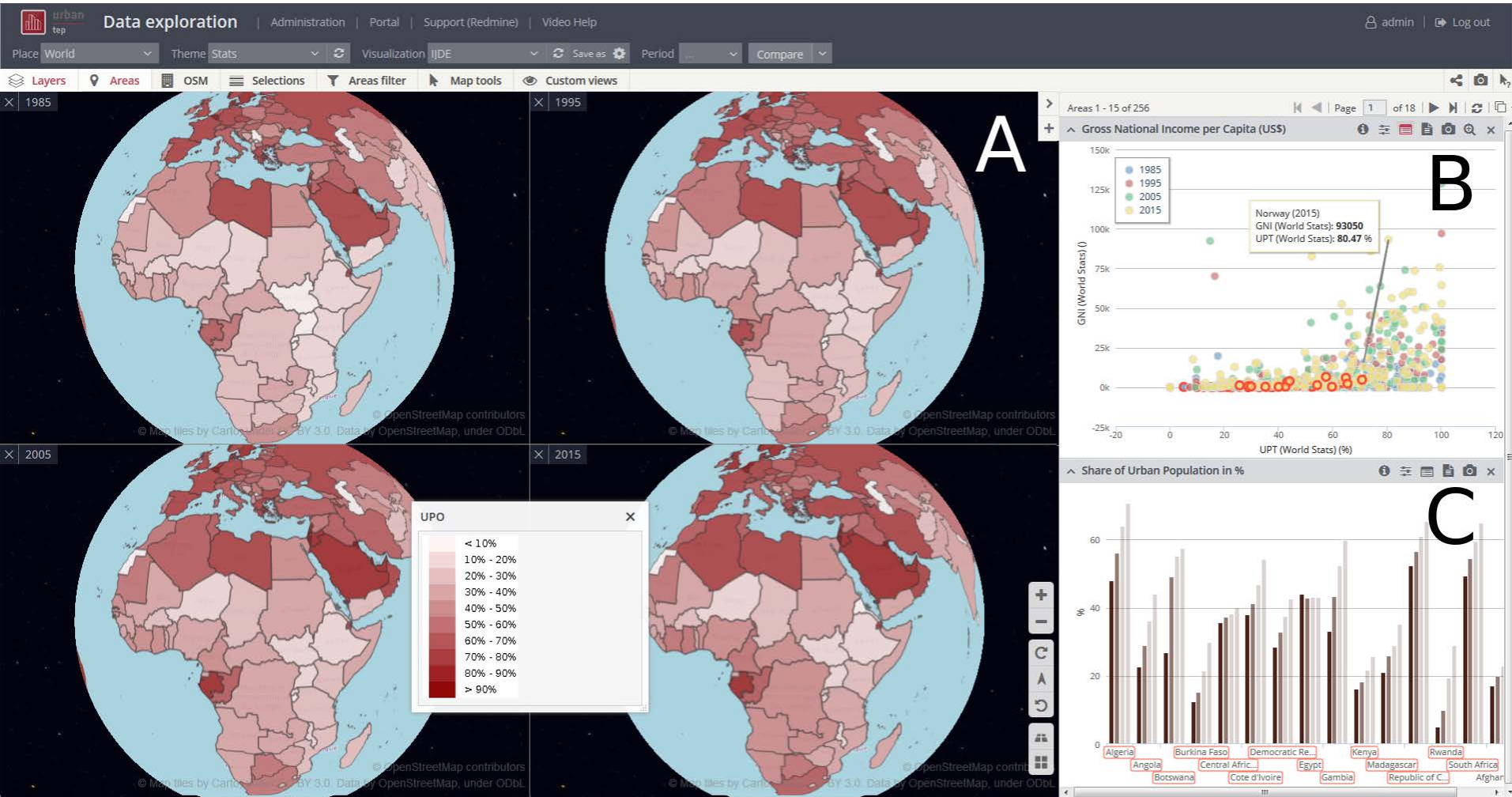


**A:** Accumulated nightlights intensity of 2015 in relation to the total population of a country in 2015

**B:** Number of geotagged tweets per capita 2016

**C:** Accumulated nightlights intensity of 2015 in relation to the electric power consumption per capita [kWh]

# Thematic Applications



**A:** Urban population in % of total population (1985 – 2015)

**B:** Gross national Income per capita (US\$) (Development 1985 – 2015)

**C:** Urban population in % of total population (1985 – 2015)

# Thematic Applications

