Earth Observation Center

WELCOME AND OVERVIEW TO EOC

Prof. Christian Geiß
German Remote Sensing Data Center

October 13th 2025
60th meeting of CEOS Working Group on Information Systems and Services (WGISS)

DLR

A little bit of history – last WGISS meeting at DLR in 2018 (46th meeting of WGISS)

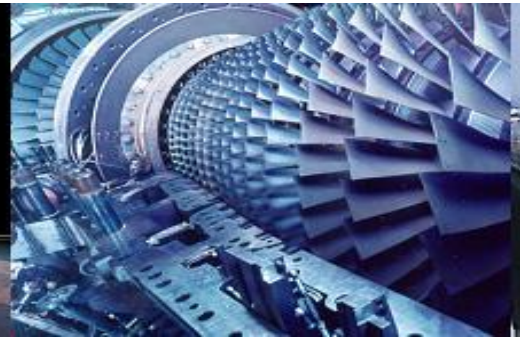
DLR – German Aerospace Center

- ***Research Center***
  - Aeronautics, Space, Energy, Transportation
  - Security
- ***Space Agency***
- ***Project Management Agency***

- Europe's largest research center for aeronautics and space
- Close cooperation with academia, research, and industry

54 Institutes
30 locations
~10.500 employees

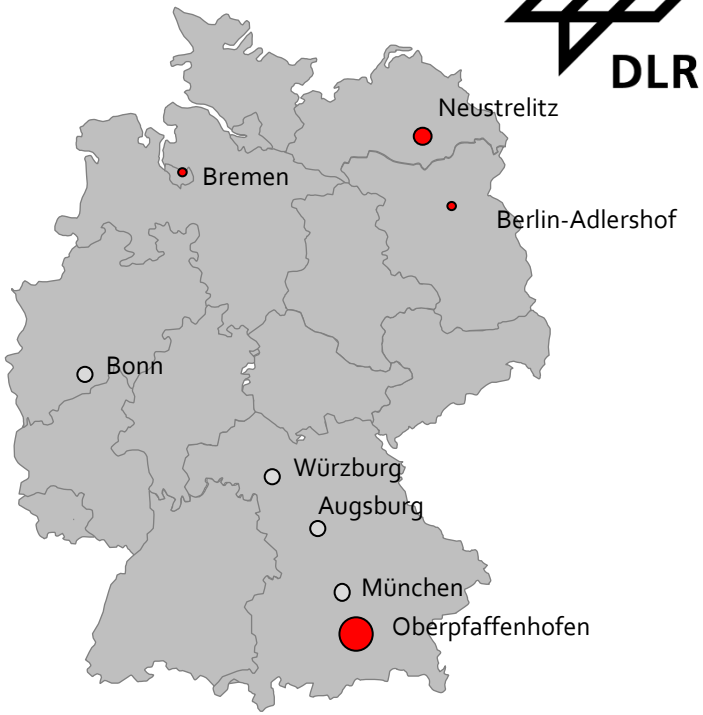




Earth Observation Center (EOC) – founded in 2000

German Remote Sensing Data Center (DFD)
Director: Prof. Dr. Stefan Dech

Remote Sensing Technology Institute (IMF)
Interim Director: Prof. Dr. Michael Eineder



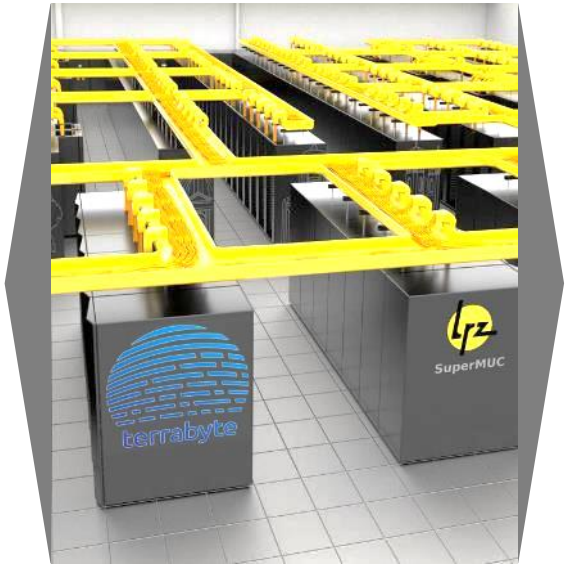
- ~ 400 staff at EOC
- ~ 40 staff at Universities (TU München, Univ. Würzburg, Augsburg, Bonn)
- ~ 280 scientists
- ~ 53 % third party funding

German Remote Sensing Data Center (DFD)
Founded at DLR in 1980

EO National Data Center

Space infrastructure

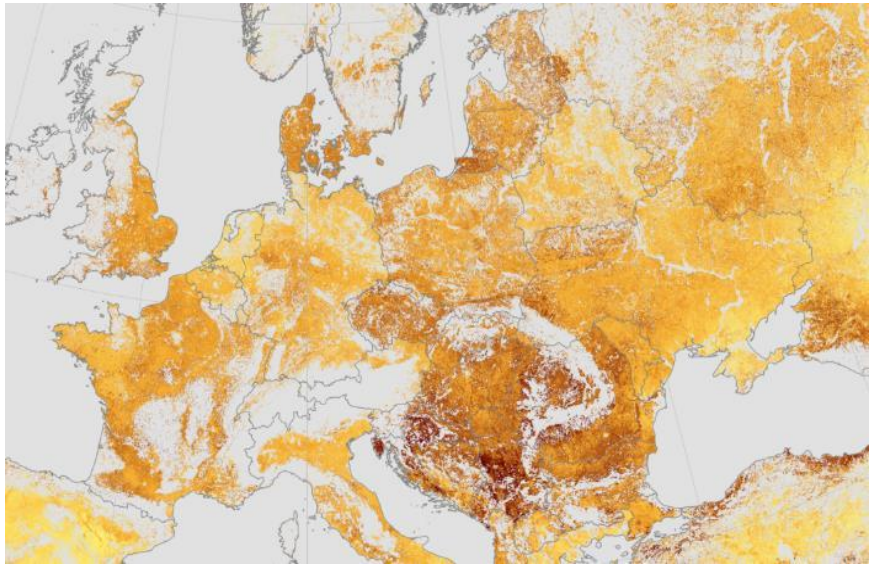
- Receiving station network
- Operational data processing systems
- German Satellite Data Archive (D-SDA)
- Contribution to European Missions
- Cooperation with Industry



Computing Infrastructure

- High Performance Data Analytics
- Scientific computing platform ***terrabyte***
- Time Series and AI
- Science Support

Applied EO Research



Global Change and Climate Change

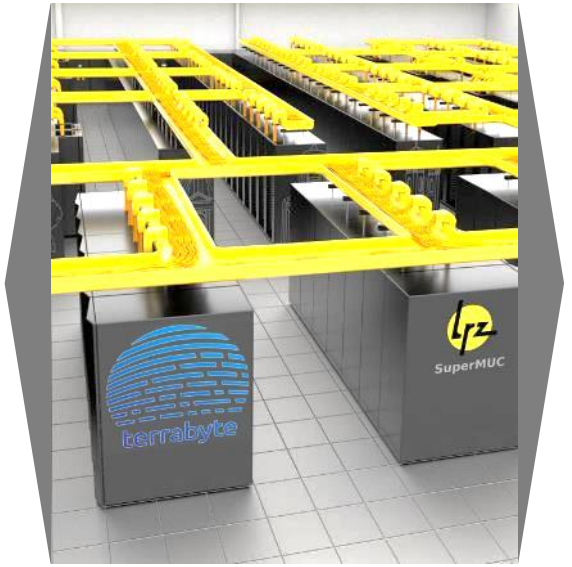
- Land cover dynamics
- Urban Areas
- Georisiks and Civil Security
- Atmosphere and Air quality
- Information and Early Warning Systems

German Remote Sensing Data Center (DFD)
Founded at DLR in 1980

EO National Data Center

Space infrastructure

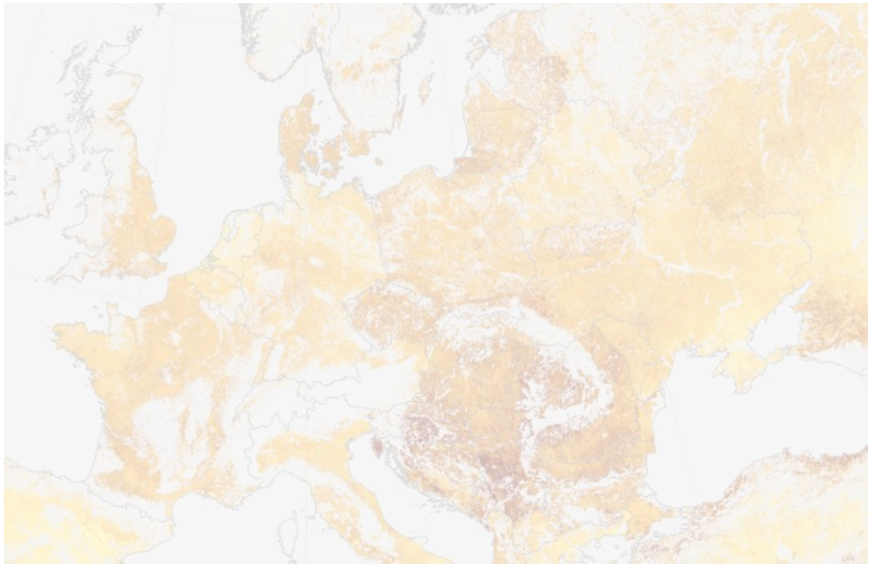
- Receiving station network
- Operational data processing systems
- German Satellite Data Archive (D-SDA)
- Contribution to European Missions
- Cooperation with Industry



Computing Infrastructure

- High Performance Data Analytics
- Scientific computing platform ***terrabyte***
- Time Series and AI
- Science Support

Applied EO Research

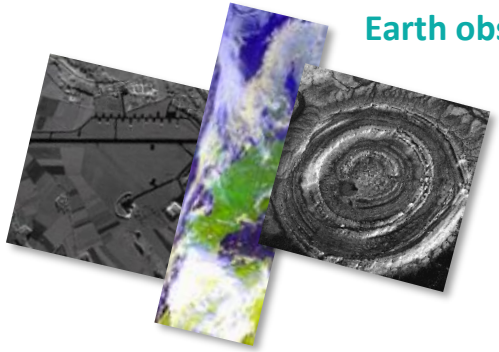


Global Change and Climate Change

- Land cover dynamics
- Urban Areas
- Georisiks and Civil Security
- Atmosphere and Air quality
- Information and Early Warning Systems

Big data management at the DLR Earth Observation Center

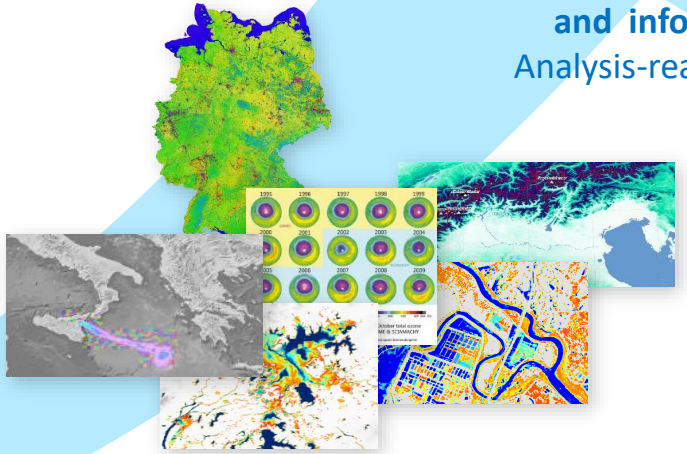
From Earth observation data reception to presenting actionable environmental information products



Earth observation data

High-performance exploitation platforms and information systems

Analysis-ready data, federation



Spatial information products

Fast, active archives

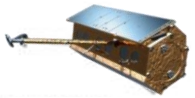
Secure data, geo-redundancy, capacity 150 petabytes

Interoperable catalog and data access

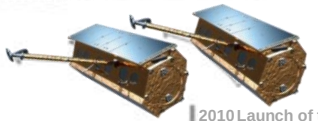
International station network

2000 Launch of the Earth observation mission SRTM

2002 Launch of the ESA environmental satellite ENVISAT



2010 Launch of the DLR-radar mission TerraSAR-X

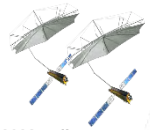


2010 Launch of the DLR-radar mission TanDEM-X

2014 Launch of Sentinel-1, first mission of the European Earth observation program Copernicus

2017 Launch of Sentinel-5p

2022 Launch of EnMAP



>2028 Follow-on national SAR mission

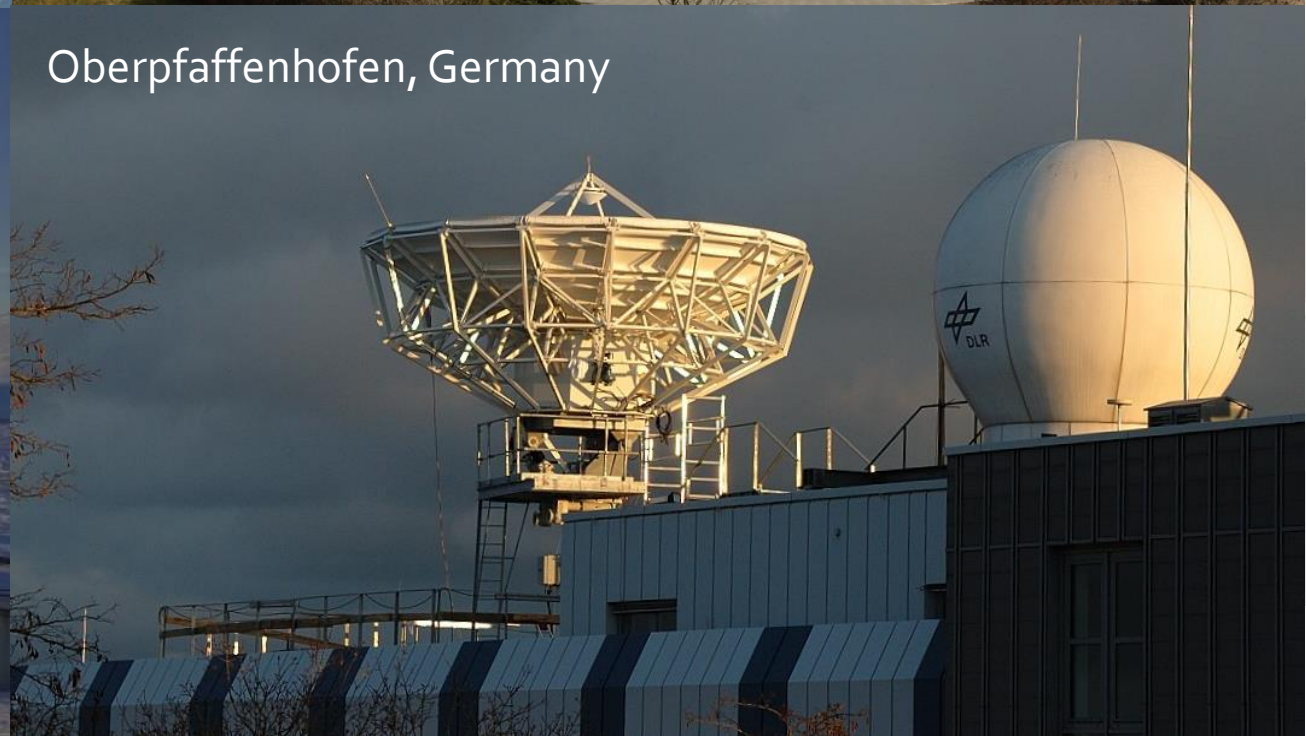
German Satellite Data Archive data volume in petabyte

30
25
20
15
10
5


Inuvik, Canada

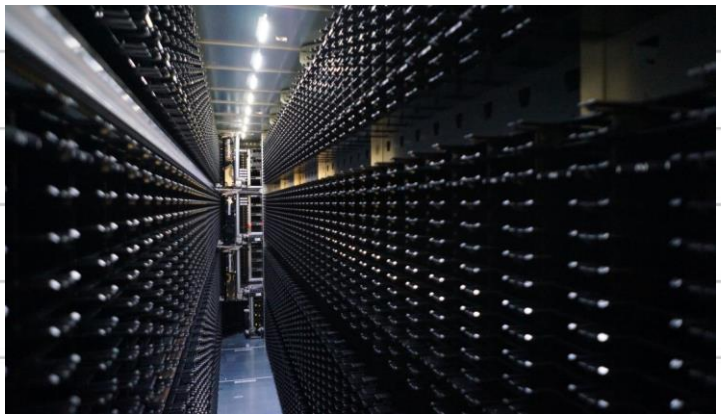

Neustrelitz, Germany


GARS O'Higgins, Antarctica


Oberpfaffenhofen, Germany

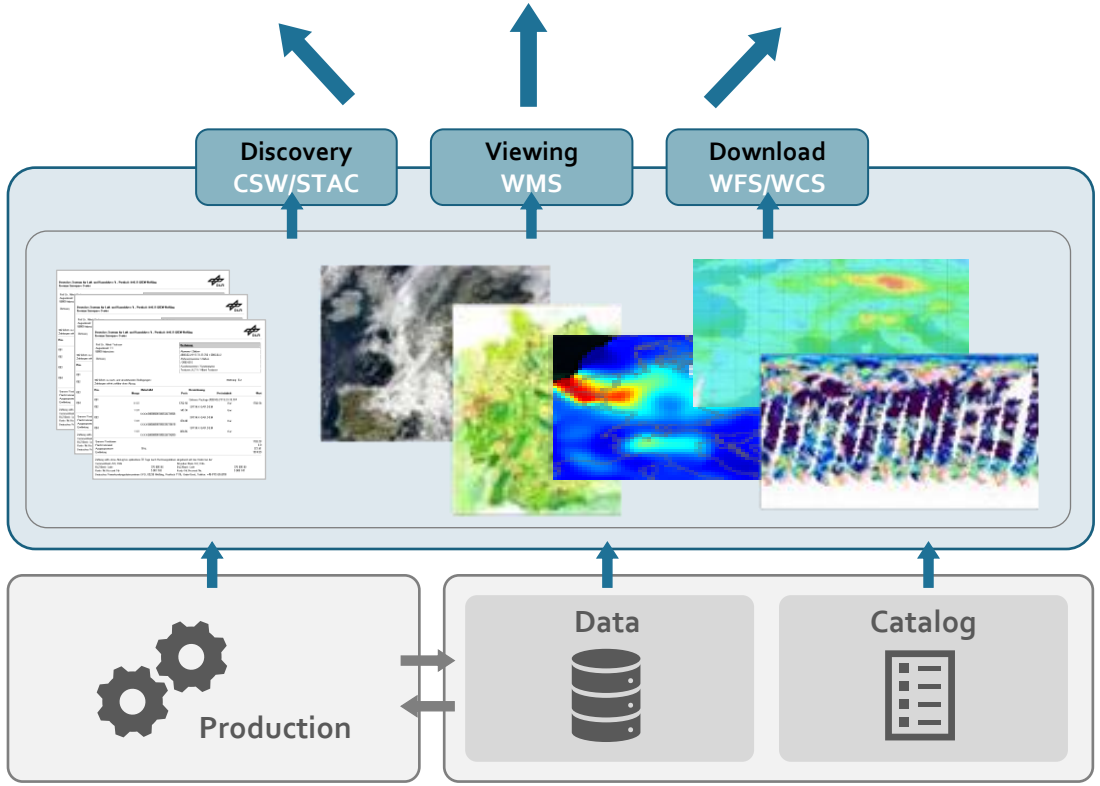
Data Volume in Petabyte in the German Remote Satellite Data Archive (D-SDA)

DFD Oberpfaffenhofen and Neustrelitz



EOC Geoservice
Data access for spatial information products

- Online data access platform
- Established geodata infrastructure according to FAIR principles
- Basic infrastructure for the integration of DLR/EOC data
- Standardized, interoperable system interfaces (OGC)



GeoFarm & HPDA
Processing systems

D-SDA
Long-term archive

eoc geoservice
Spatial Data Infrastructure

FAIR: Findable, Accessible, Interoperable, Reusable, OGC: Open Geospatial Consortium
CSW: Catalog Service Web, STAC: SpatialTemporal Asset Catalog,
WMS: Web Mapping Service, WFS/WCS: Web Feature/Coverage Service, WPS: Web Processing Service, DAPA: Data Access & Processing API

terrabyte
EO Exploitation & High Performance Data Analytics Platform

DLR

terrabyte

55 PB storage
44.000 vCPUs
188 GPUs
330 TB RAM

High-Performance-Computing

jupyter · xarray · DASK · OPEN DATA CUBE · OPEN OnDemand · slurm workload manager

Cloud Services

Open Geospatial Consortium · STAC · kubernetes · docker

terrabyte

EO Data Management Data Ingestion & Archiving

lrz

Long-term archive

DSDA
German Satellite Data Archive

External data sources

esa · USGS science for a changing world · NASA

Federated EO data and platforms

- Distributed infrastructures and federated platforms
- Interoperable OGC interfaces for data access
- Identity and access management
- LTA interface for mass data transfer in the target cloud

Portals and Applications

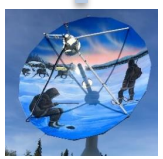
OGC

eoc geo service

terrabyte

eoc Cloud
Earth Observation Center
GeoFarm & IDA

DSDA
German Satellite Data Archive



OGC

IAM

LTA

External federated platforms

CODE DE

EOlab

gaia-x

copernicus
Europe's eyes on Earth
Data Space

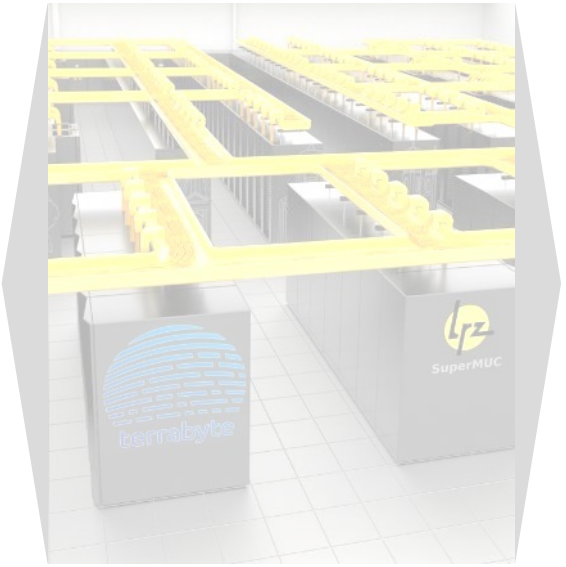
OGC: Open Geospatial Consortium
IAM: Identity and Access Management
LTA: Long Term Archive

German Remote Sensing Data Center (DFD)
Founded at DLR in 1980

EO National Data Center

Space infrastructure

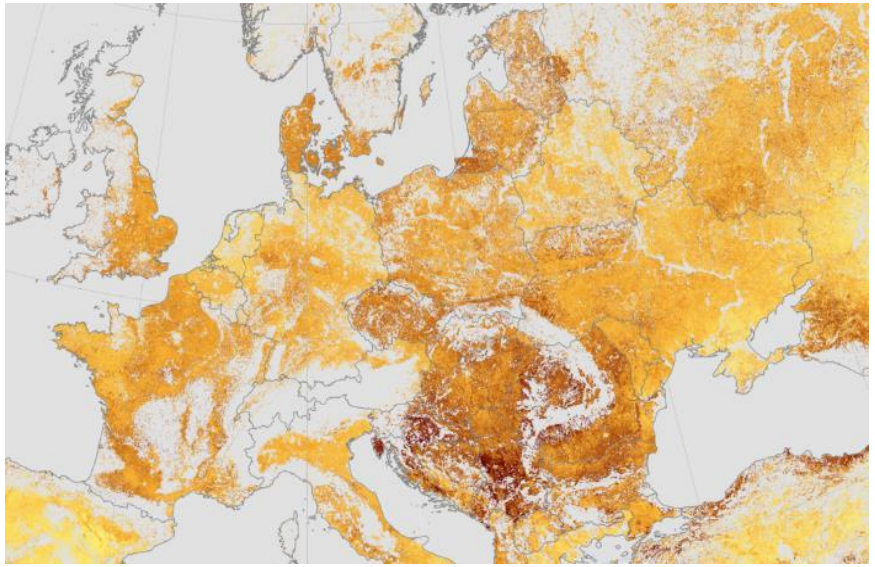
- Receiving station network
- Operational data processing systems
- German Satellite Data Archive (D-SDA)
- Contribution to European Missions
- Cooperation with Industry



Computing Infrastructure

- High Performance Data Analytics
- Scientific computing platform ***terabyte***
- Time Series and AI
- Science Support

Applied EO Research



Global Change and Climate Change

- Land cover dynamics
- Urban Areas
- Georisiks and Civil Security
- Atmosphere and Air quality
- Information and Early Warning Systems

World Settlement Footprint

DLR

Urbanization monitoring – Shanghai 1985

Urbanization monitoring – Shanghai 1990

Urbanization monitoring – Shanghai 1995

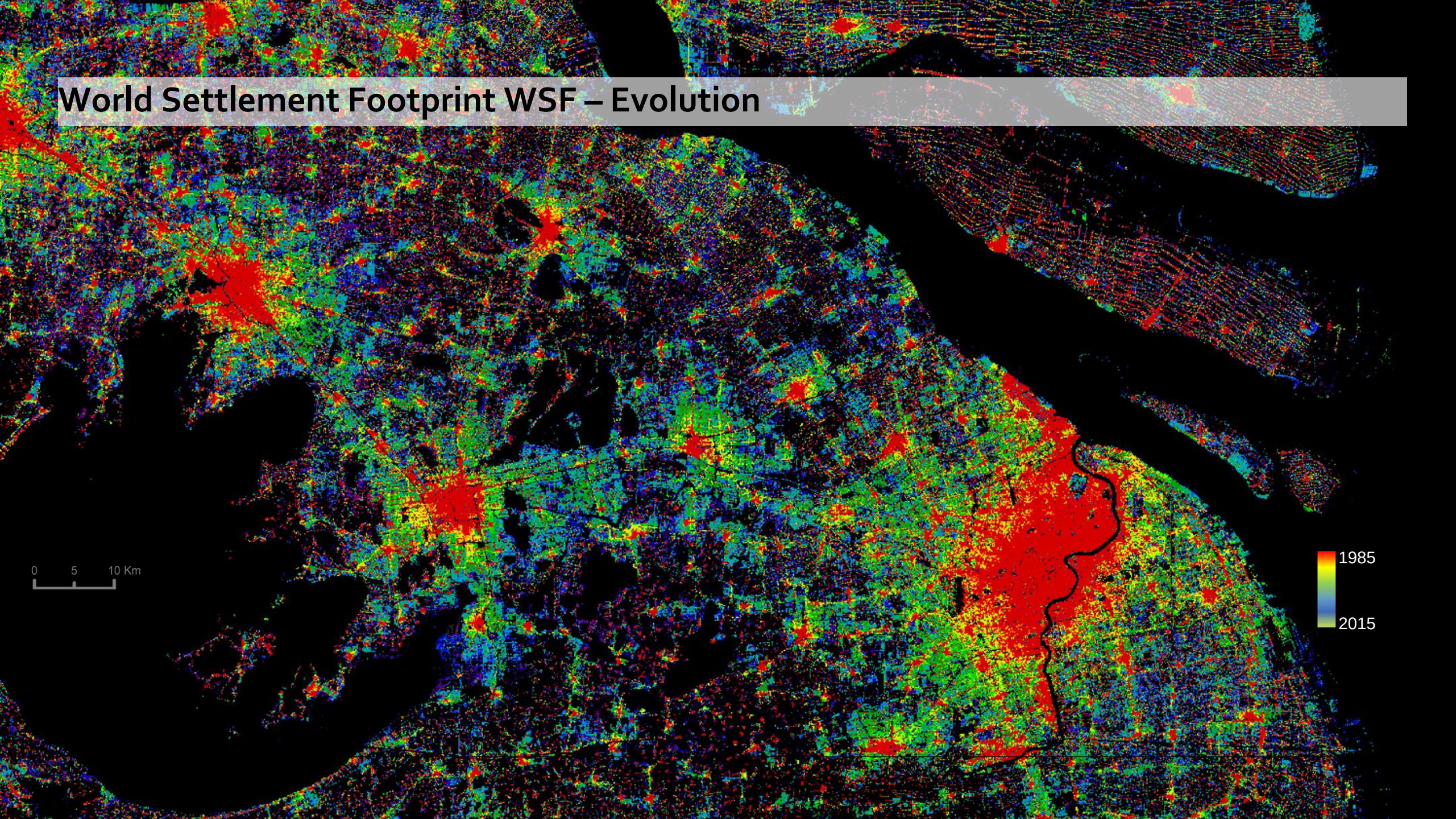
Urbanization monitoring – Shanghai 2000

Urbanization monitoring – Shanghai 2005

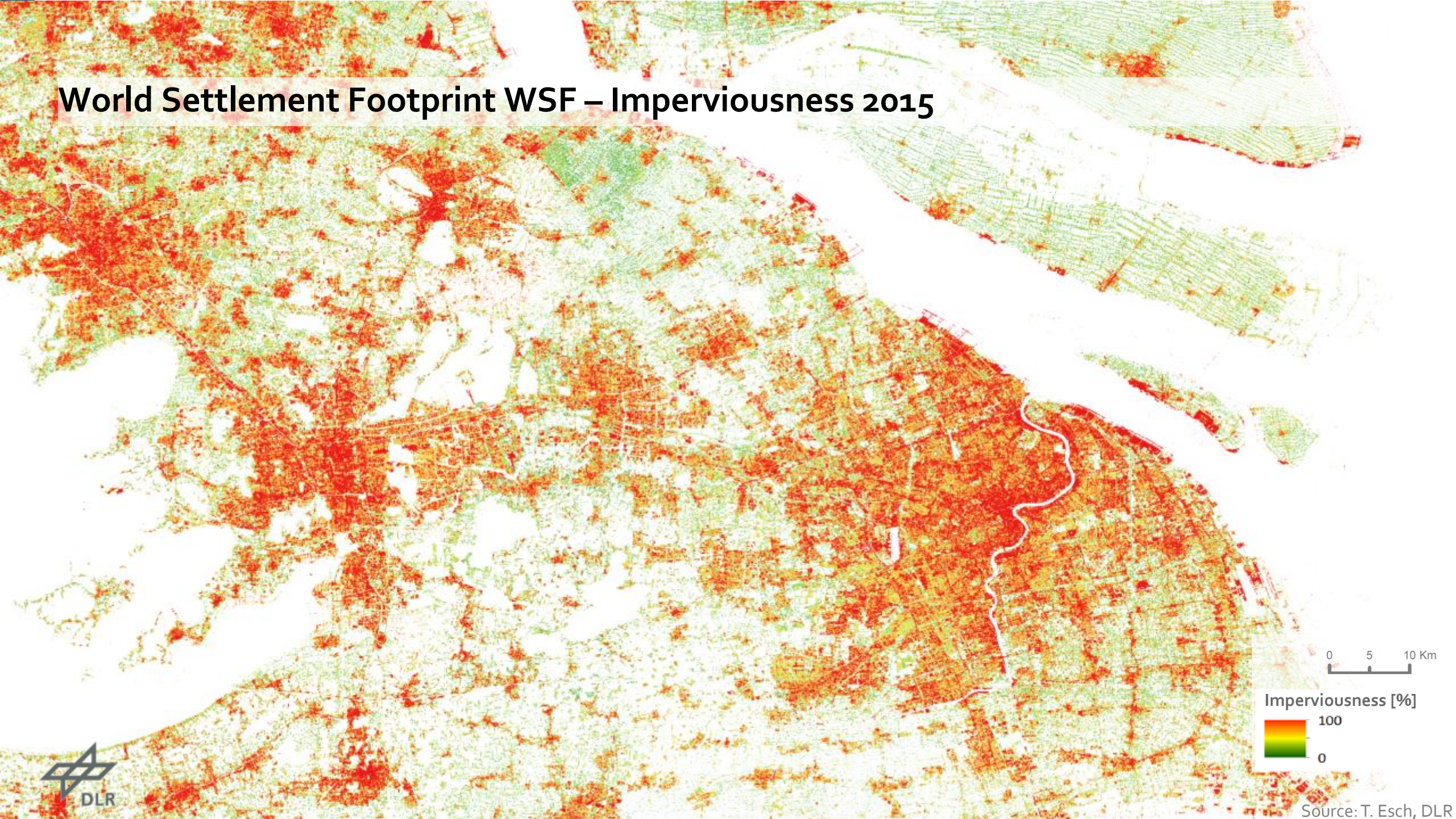
Urbanization monitoring – Shanghai 2010

Urbanization monitoring – Shanghai 2015

World Settlement Footprint WSF – Evolution



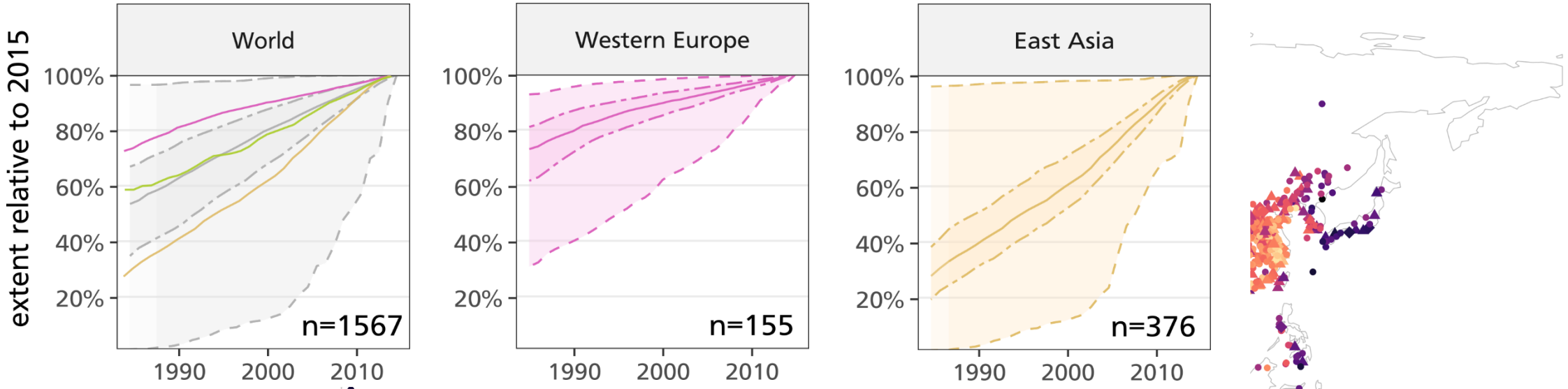
World Settlement Footprint WSF – Imperviousness 2015



Source: T. Esch, DLR

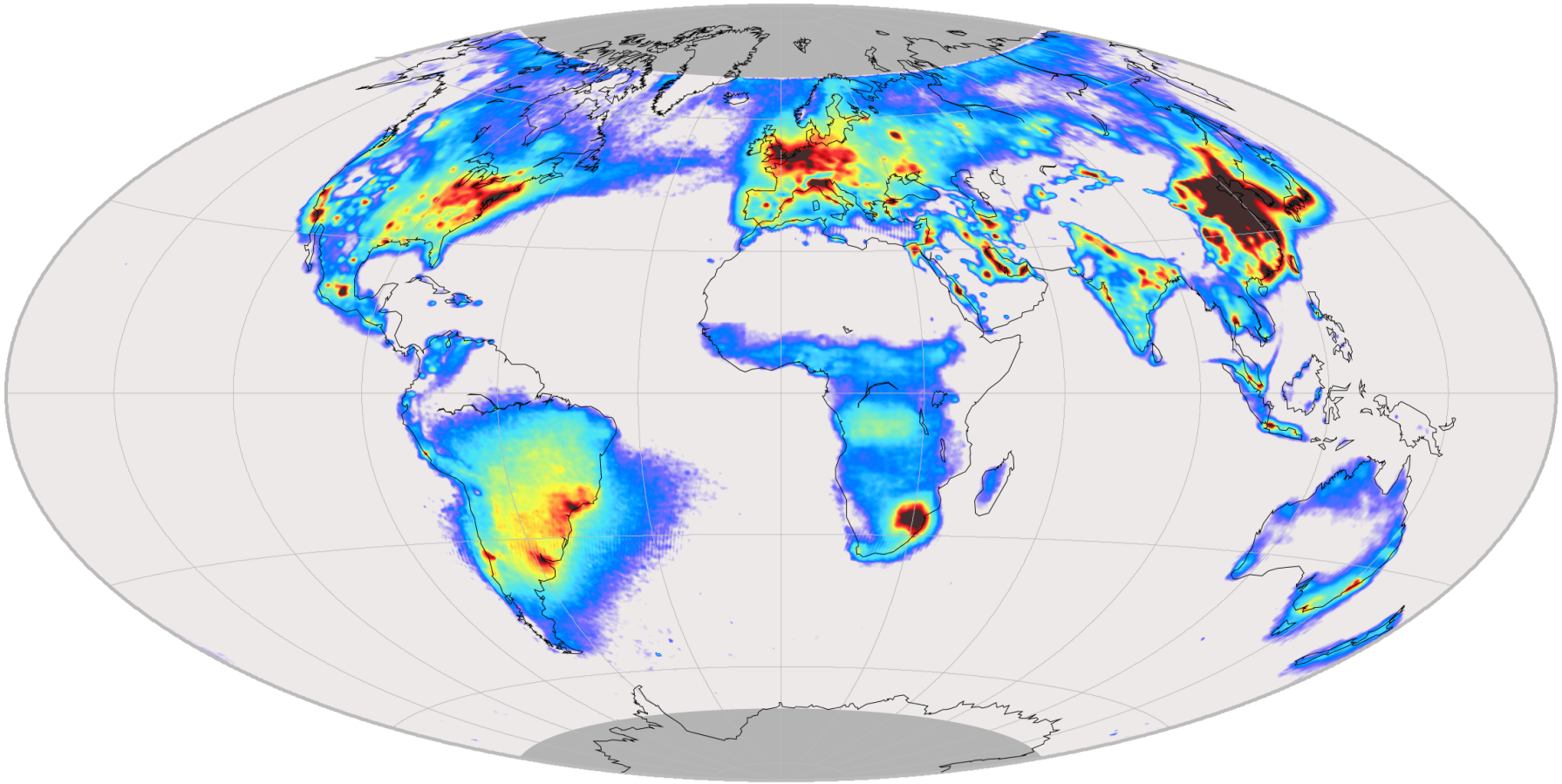
Global differences in urbanization dynamics

1985 to 2015



- **Highest urban growth rates** in East Asia and South-East Asia
- **Lowest urban growth rates** in Europe and Pacific OECD countries

Air Quality – Nitrogen Dioxide NO_2

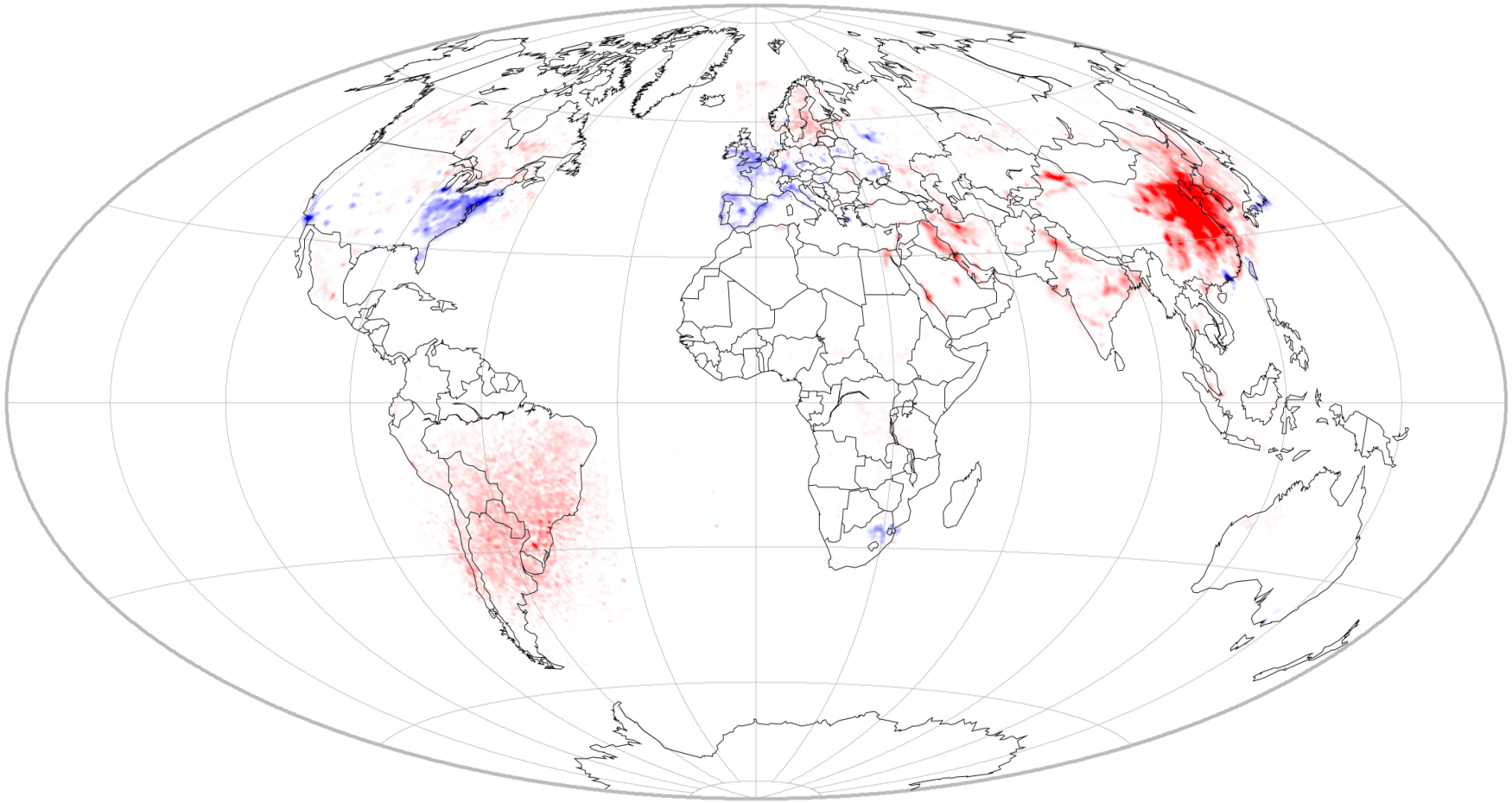


NO_2 [10^{15} Moleküle/cm²]

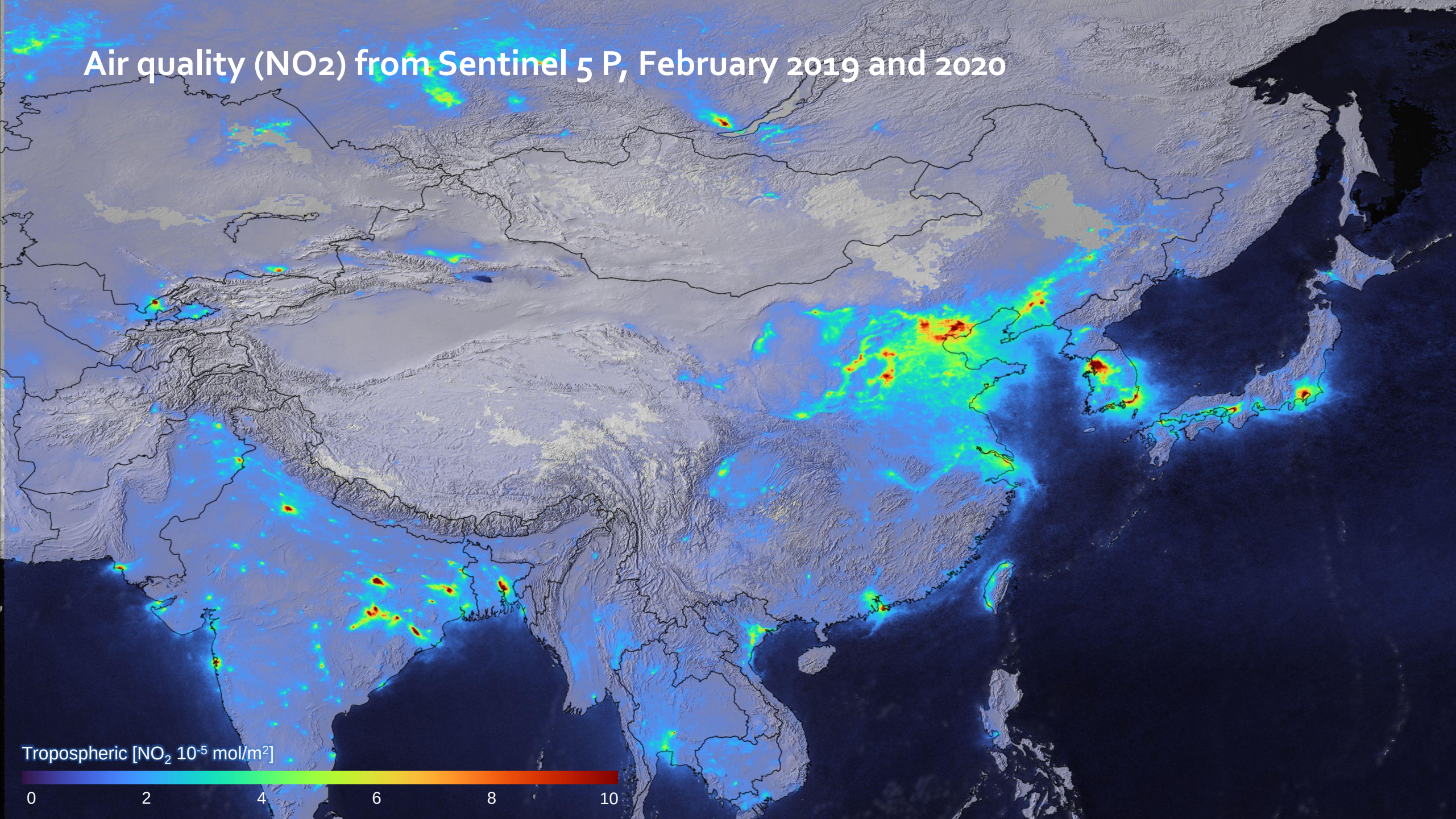
1 2 3 4 5

MetOp/GOME-2
Long-term mean
2007 -2019

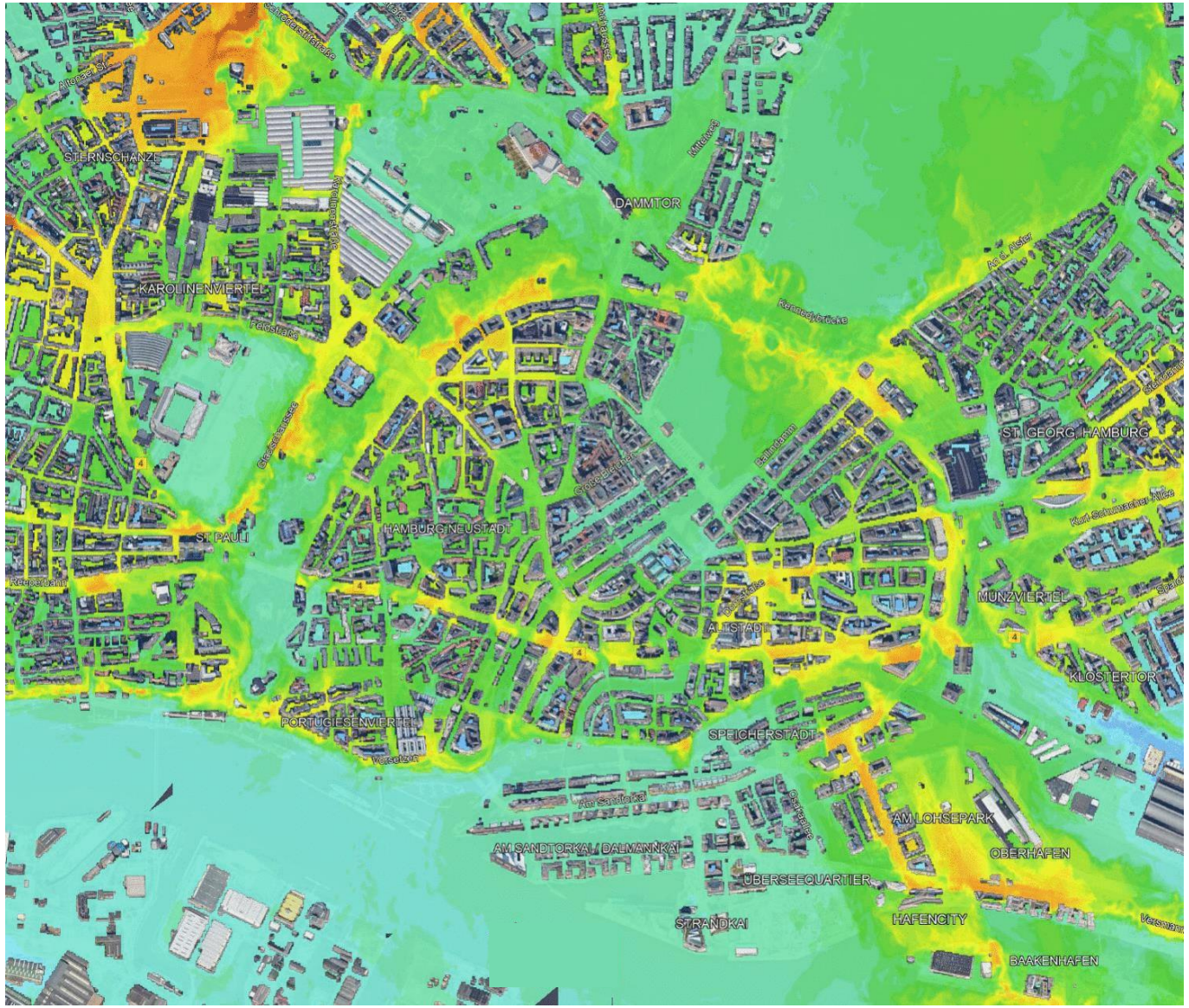
Air Quality – Change in Nitrogen Dioxide NO_2 2007 - 2019



MetOp/GOME-2

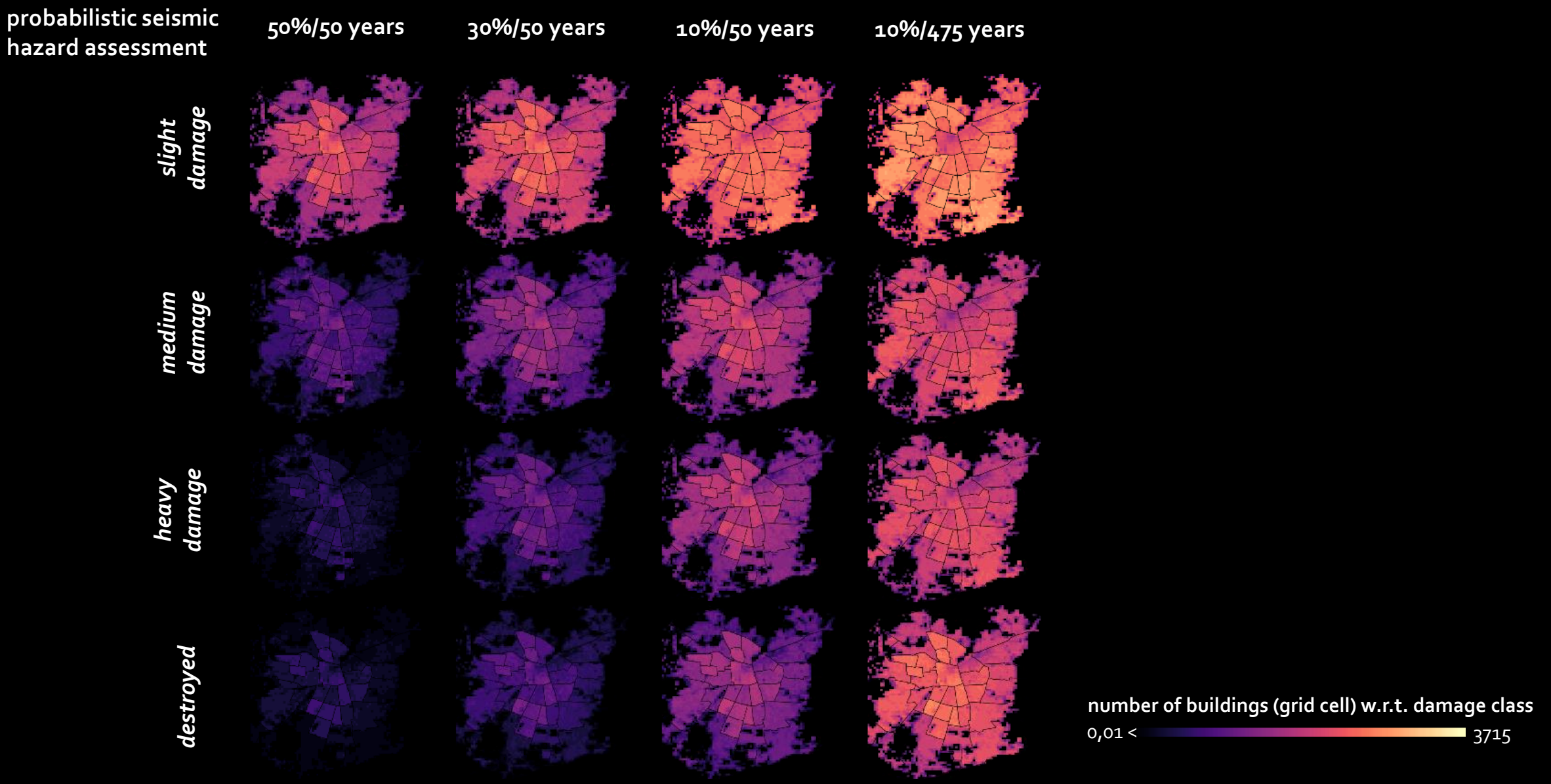

Air quality (NO2) from Sentinel 5 P, February 2019 and 2020
Tropospheric [NO2 10-5 mol/m2]
0
2
4
6
8
10

Air Quality – Simulation down to street level



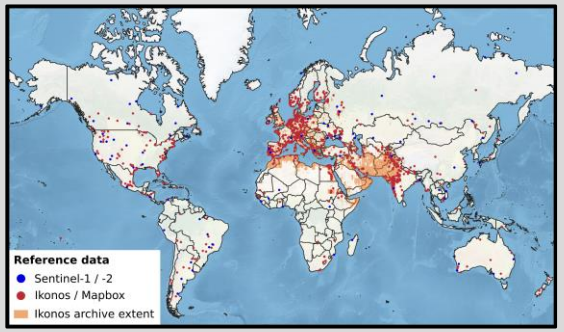
Hamburg
15. March 2022, 7 – 9 a.m.
5 m x 5 m spatial resolution

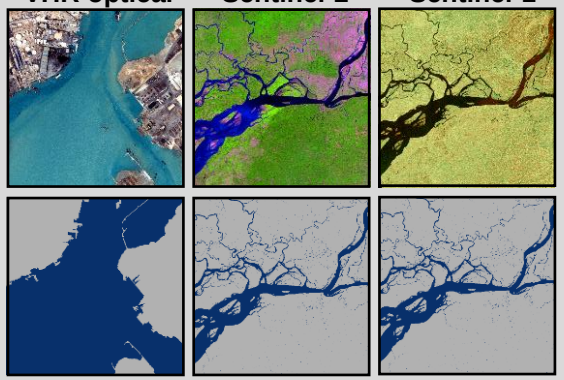
Urban climate model PALM-4U


probabilistic seismic hazard assessment
50%/50 years
30%/50 years
10%/50 years
10%/475 years
slight damage
medium damage
heavy damage
destroyed
number of buildings (grid cell) w.r.t. damage class
0,01 <
3715

AI 4 Natural Hazard Mapping and Characterization

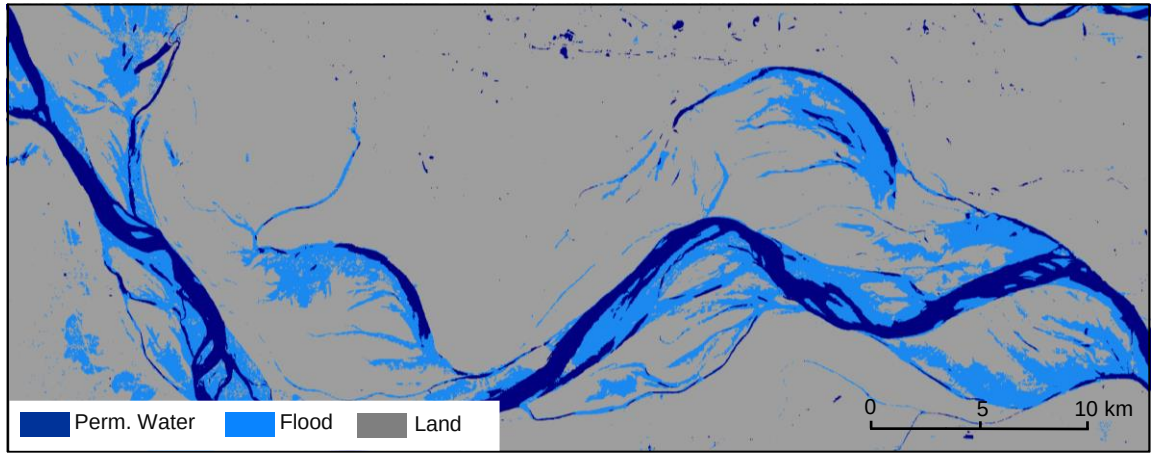
Flood extent mapping

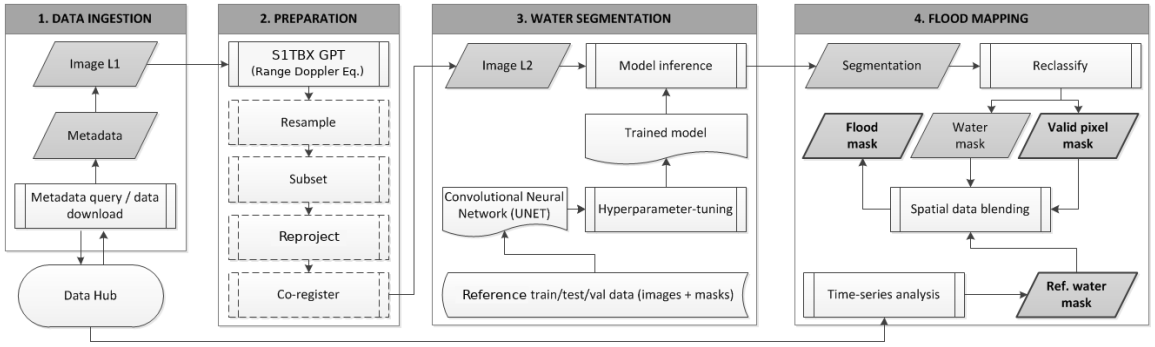


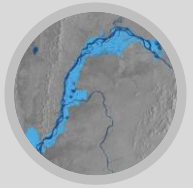


1.200+ scenes, 3 sensors, 270.000+ tiles

	Rule-based	ML
IOU	0.52	0.79
Precision	0.78	0.91
Recall	0.60	0.85





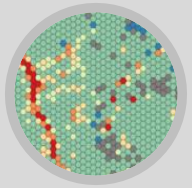


Flood rapid mapping

Mapping of reference water bodies

Flood duration, spatio-temporal dynamics

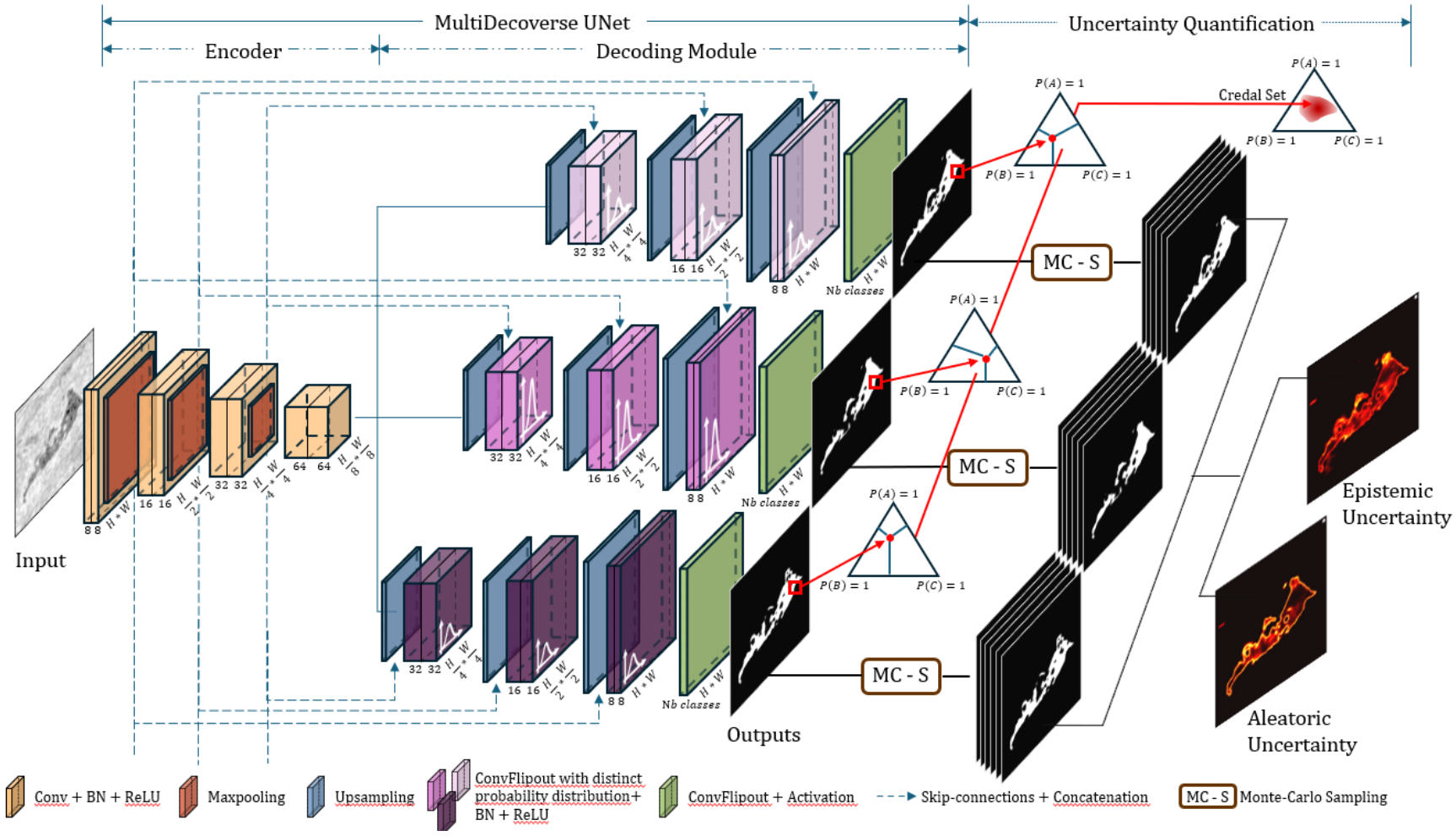
Anomaly-detection and alerting



Mapping of hydrological drought

AI 4 Natural Hazard Mapping and Characterization

Uncertainty quantification

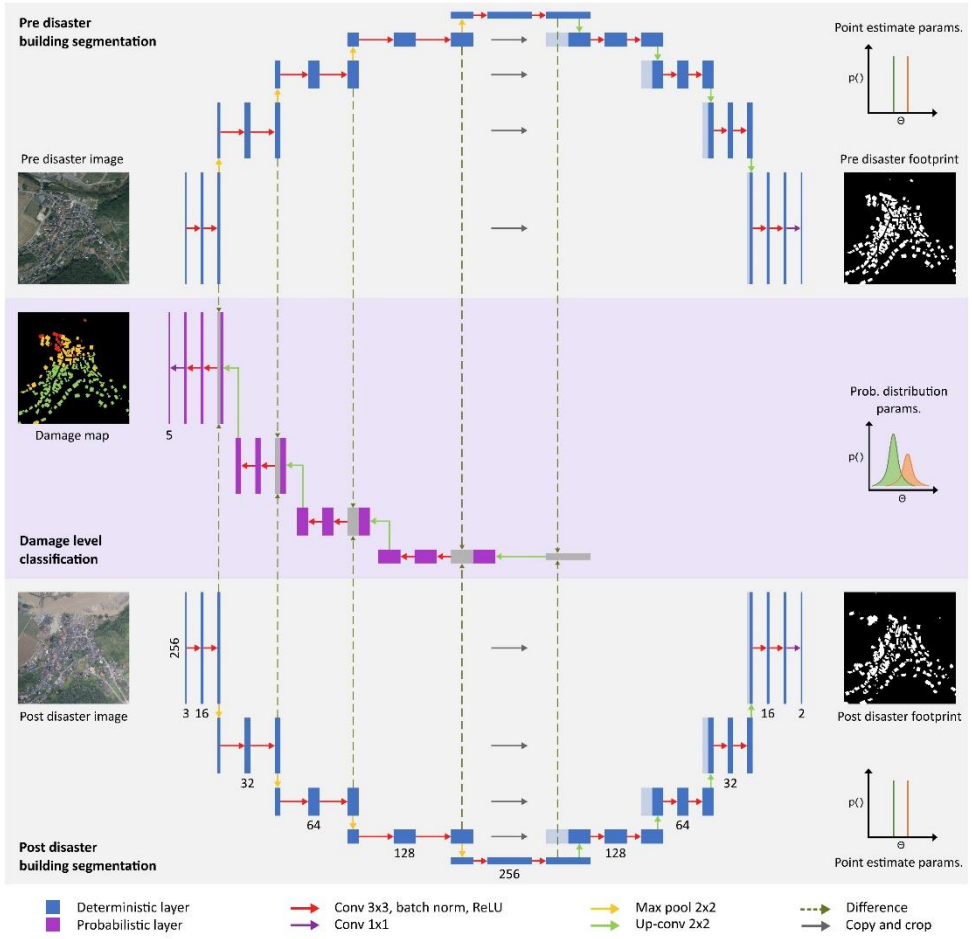


AI 4 Natural Hazard Damage Assessment

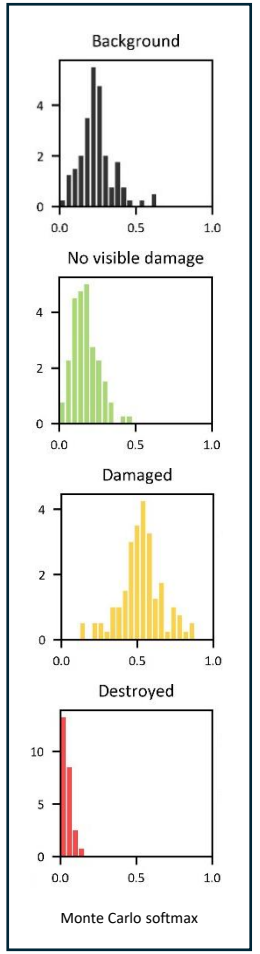
AI 4 Natural Hazard Damage Assessment

Uncertainty-aware models with domain adaptation capability

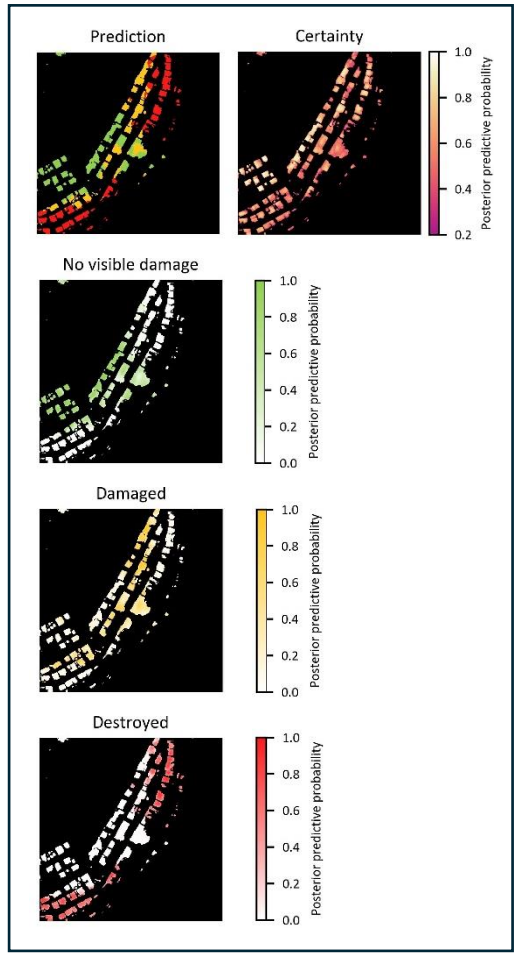
Bayesian model



Monte Carlo sampling



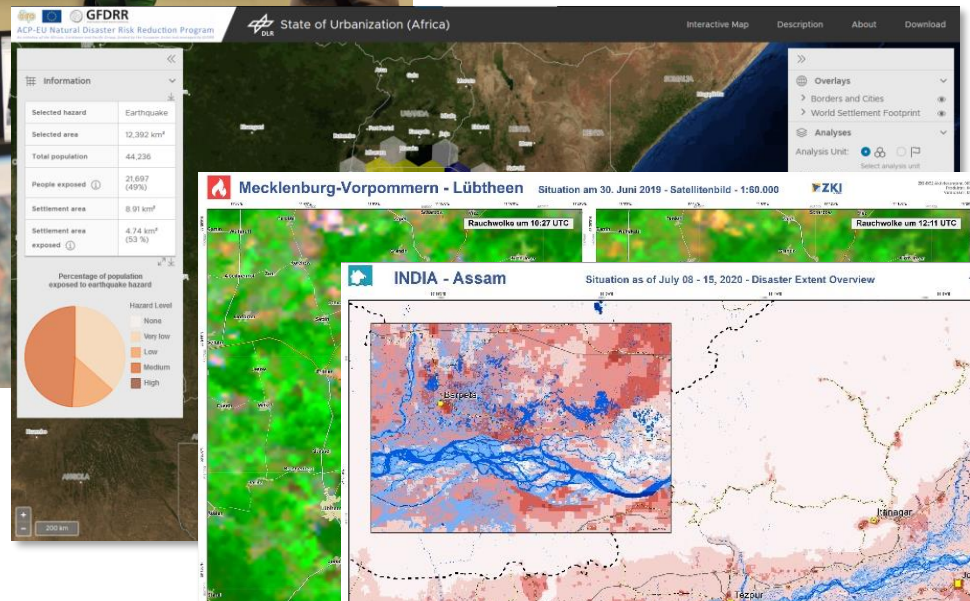
Uncertainty-aware prediction



Transfer of Remote Sensing solutions to federal authorities

ZKI

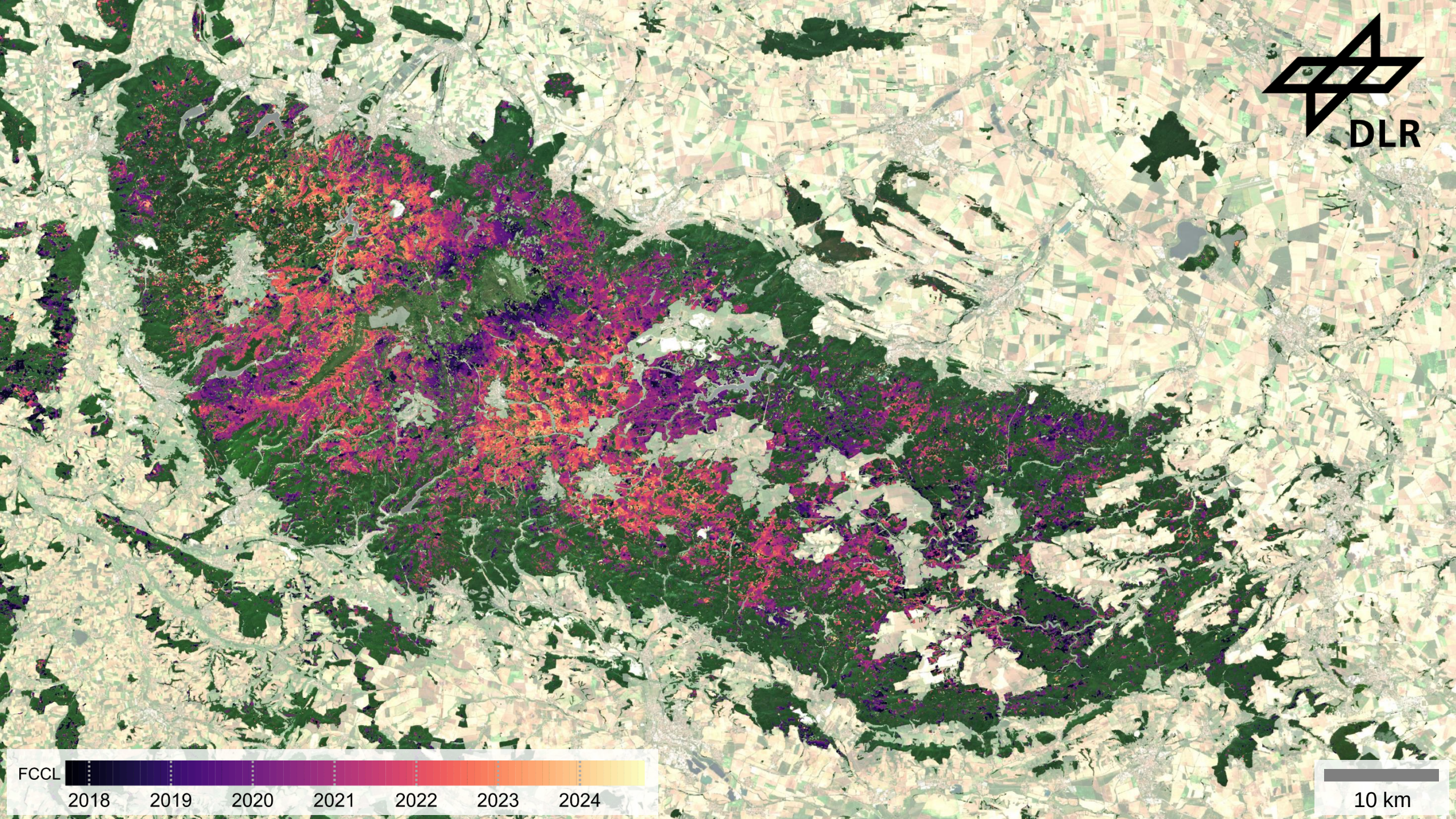
Center for Satellite Based Crisis Information

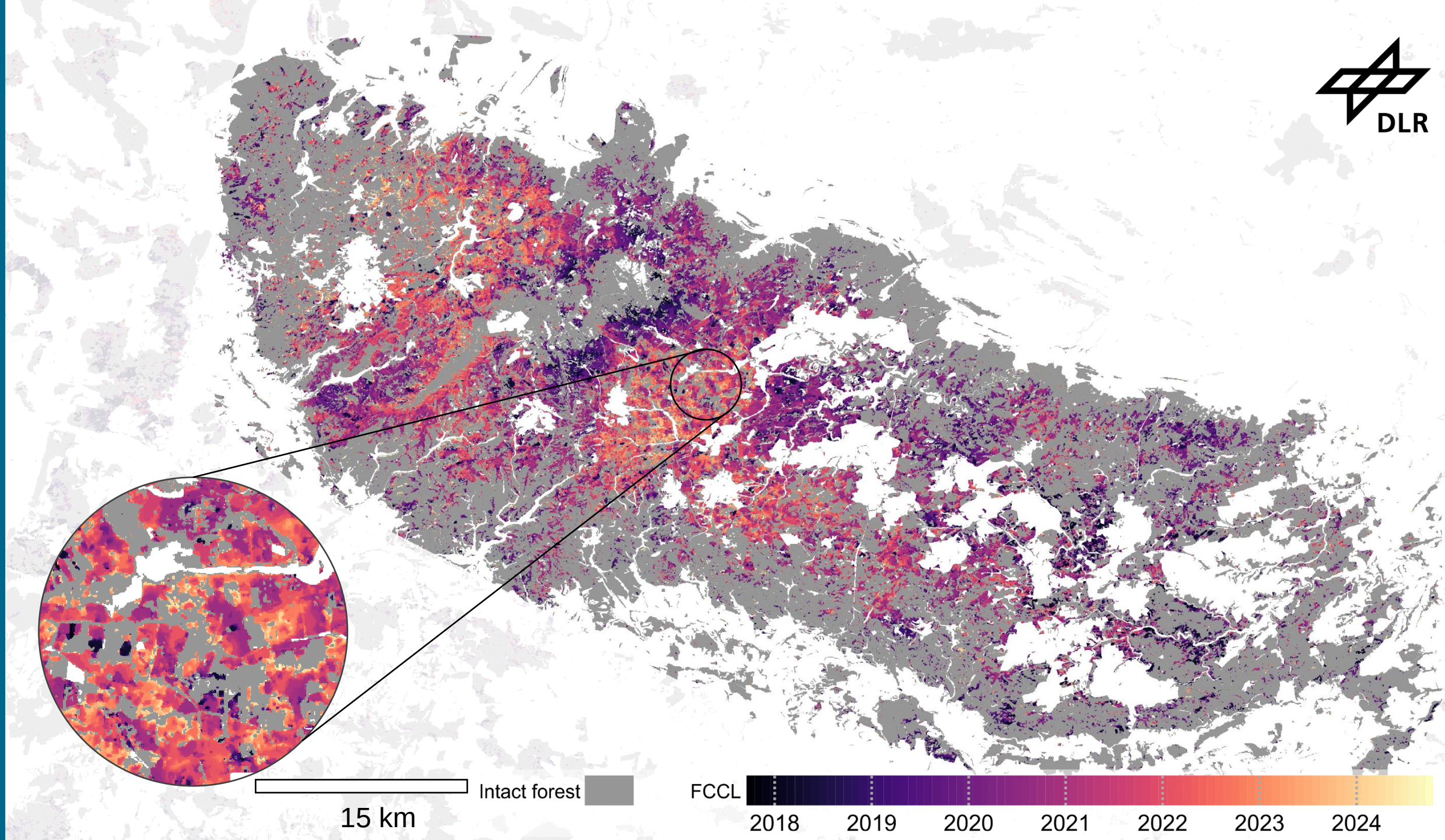



DLR
2018
10 km


DLR
2022
10 km

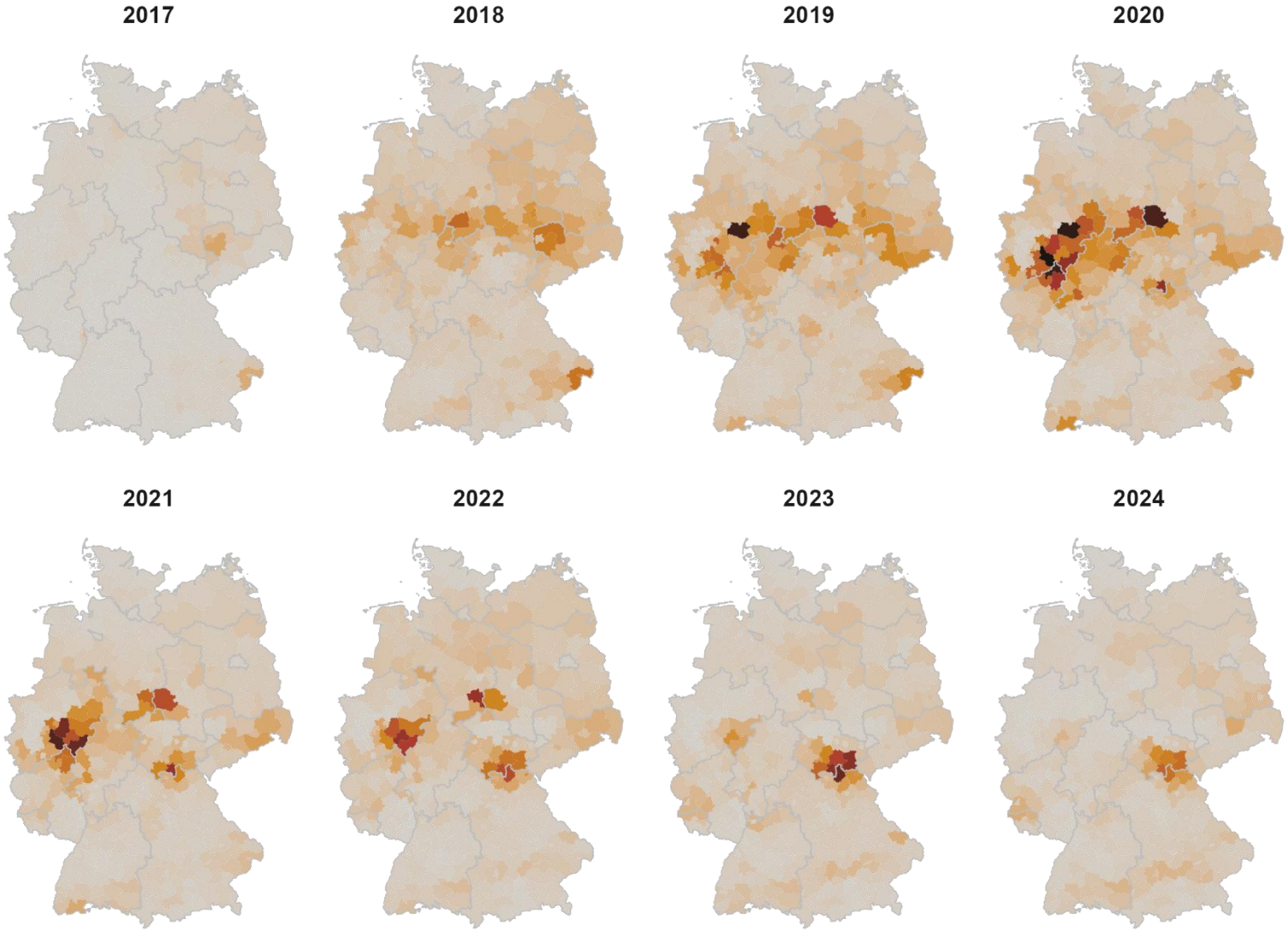

DLR
2025
10 km

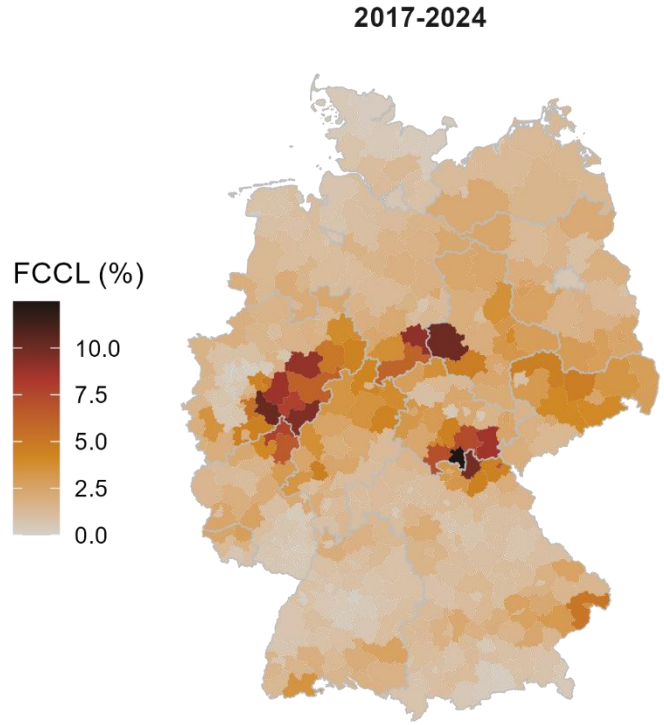

DLR
FCCL
2018
2019
2020
2021
2022
2023
2024
10 km


DLR
15 km
Intact forest
FCCL
2018
2019
2020
2021
2022
2023
2024

Forest Canopy Cover Loss Sep 2017 – Sep 2024

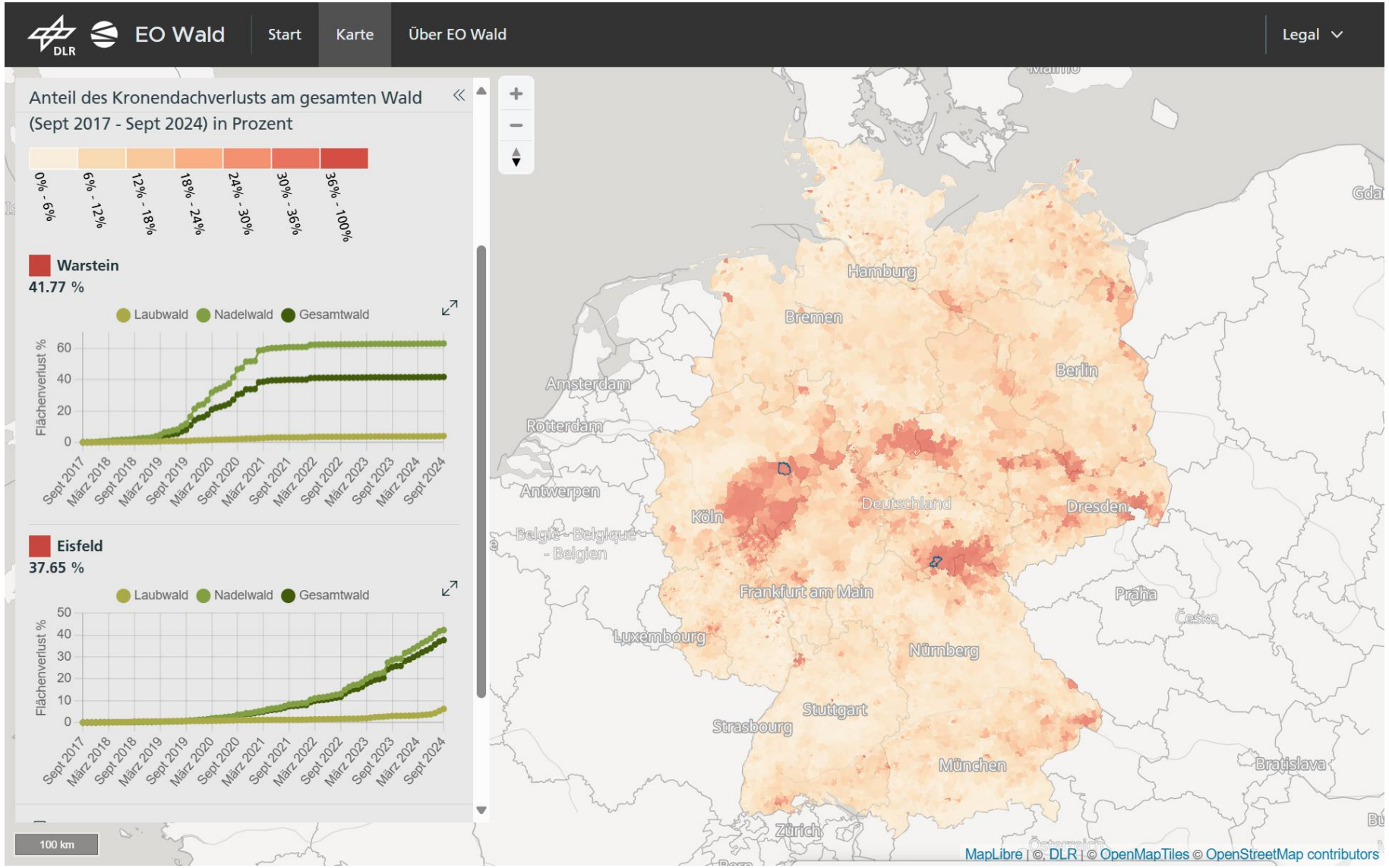
All forest types, district level



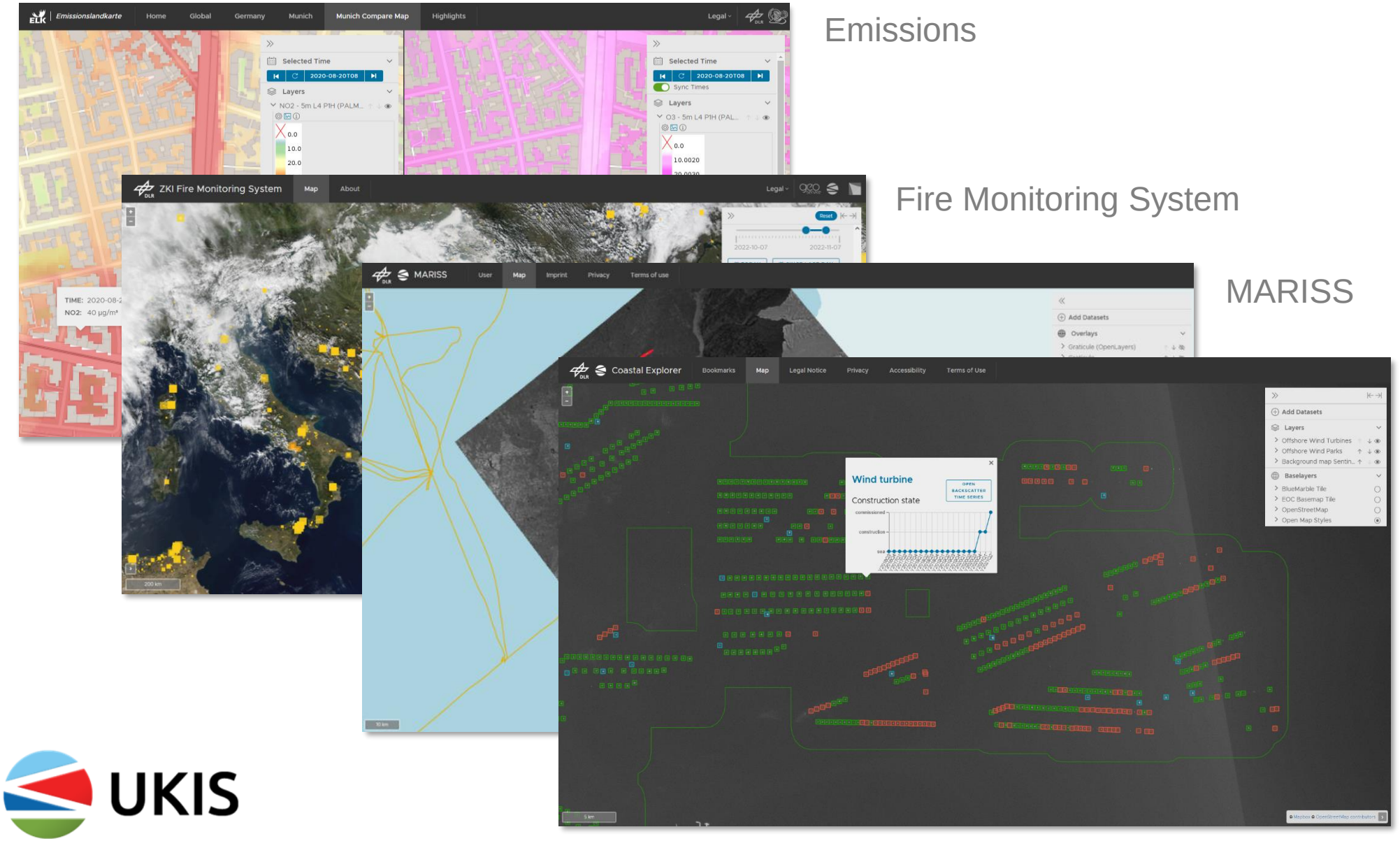


Thonfeld et al. (in prep.)

EO Wald


EO Wald
Start
Karte
Über EO Wald
Legal
Anteil des Kronendachverlusts am gesamten Wald
(Sept 2017 - Sept 2024) in Prozent
0% - 6%
6% - 12%
12% - 18%
18% - 24%
24% - 30%
30% - 36%
36% - 100%
Warstein
41.77 %
Laubwald
Nadelwald
Gesamtwald
Flächenverlust %
Eisfeld
37.65 %
Hamburg
Bremen
Berlin
Amsterdam
Rotterdam
Antwerpen
Köln
Deutschland
Dresden
Frankfurt am Main
Praha
Česko
Luxemburg
Nürnberg
Stuttgart
Strasbourg
München
Bratislava
Zürich
100 km
MapLibre | ©, DLR | © OpenMapTiles © OpenStreetMap contributors

Environmental and Crisis Information Systems



Emissions

Fire Monitoring System

MARISS

Coastal Explorer

Earth Observation Center

WELCOME AND OVERVIEW TO EOC

Prof. Christian Geiß
German Remote Sensing Data Center

October 13th 2025
60th meeting of CEOS Working Group on Information Systems and Services (WGISS)

DLR