Interoperability of IoT and satellite data for Earth observation supporting sustainable development

Session 1: International Research and Innovation Challenges and Opportunities

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ECMWF and European Commission DG-DEFIS Copernicus

ITU - 14 December 2021

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Europe's eyes on Earth

Space

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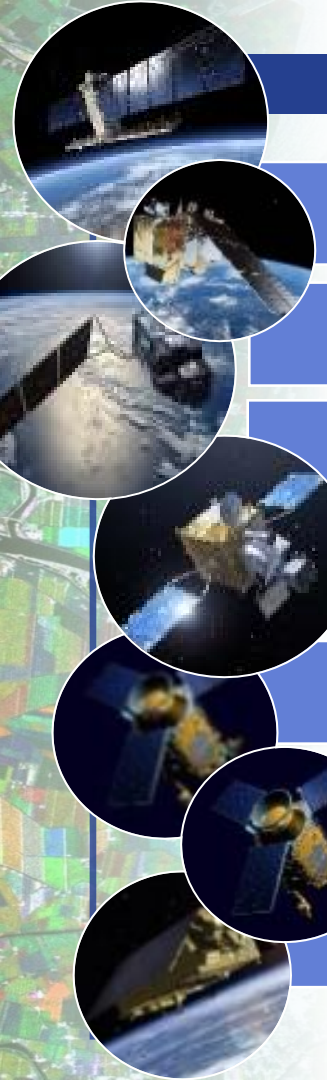

EU Earth Observation Satellites

Full, free and open data policy

Sentinel Mission and Status		Key Features
SENTINEL-1: 4-40m resolution, 3 day revisit at equator	*2 Sats in orbit*	Polar-orbiting, all-weather, day-and-night radar imaging
SENTINEL-2: 10-60m resolution, 5 days revisit time	*2 Sats in Orbit*	Polar-orbiting, multispectral optical, high-res imaging
SENTINEL-3: 300-1200m resolution, <2 days revisit	*2 Sats in Orbit*	Optical and altimeter mission monitoring sea and land parameters
SENTINEL-4: 8km resolution, 60 min revisit time	*1st Launch in 2022*	Payload for atmosphere chemistry monitoring on MTG-S
SENTINEL-5p: 7-68km resolution, 1 day revisit	*1 Sat in Orbit*	Mission to reduce data gaps between Envisat, and S-5
SENTINEL-5: 7.5-50km resolution, 1 day revisit	*1st Launch in 2022*	Payload for atmosphere chemistry monitoring on MetOp 2ndGen
SENTINEL-6: 10 day revisit time	*1 Sat in Orbit*	Radar altimeter to measure sea-surface height globally

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COPERNICUS ARCHITECTURE

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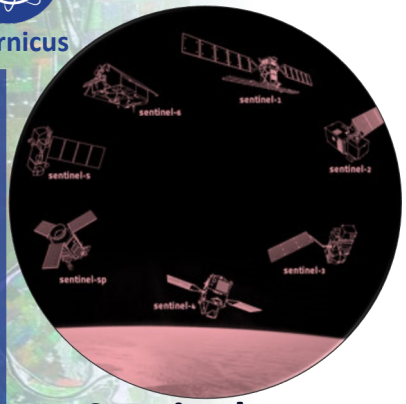
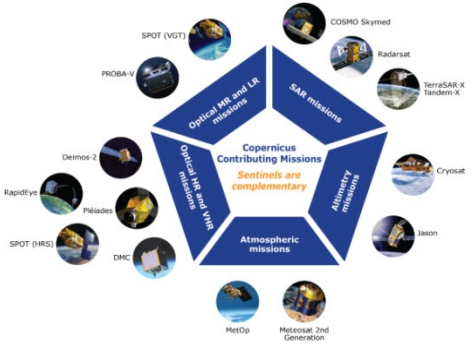
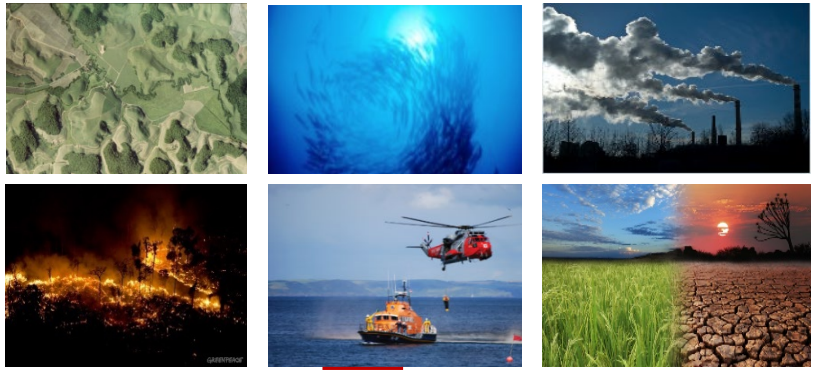


Sentinels

6 services use Earth Observation data to deliver



Contributing missions



In Situ

OPEN AND FREE DATA POLICY

added-value products

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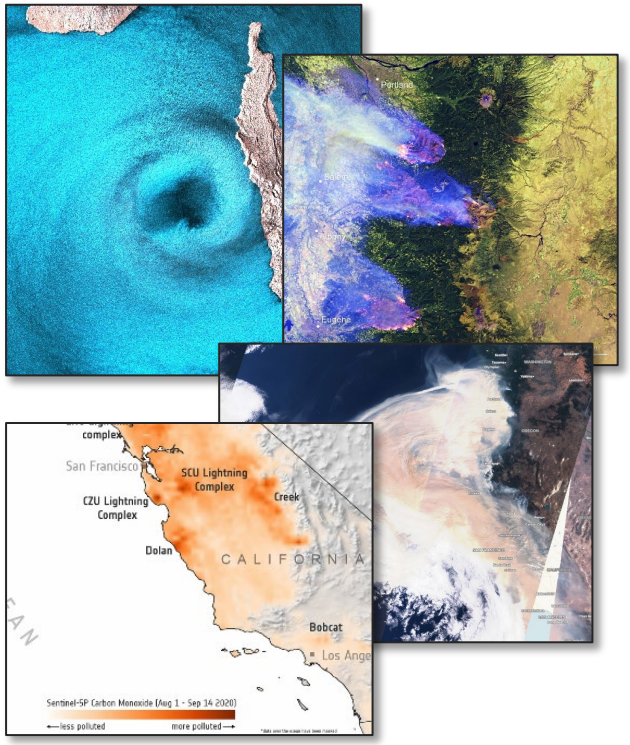
COPERNICUS IN BRIEF

- Copernicus, the Earth Observation programme of the European Union:
  - Monitors the Earth, its environment and ecosystems (climate, air quality, greenhouse gases)
  - Responds to EU's strategic goals (e.g. carbon emission targets) and policy objectives (such as the Green Deal)
  - Prepares for crises, security risks and natural or man-made disasters
- Adopts a full, free and open policy for data and information

AUTHORITATIVE DATA and QUALITY

- Copernicus has a reputation of high-quality data and services, enabled by
  - the excellence of the Sentinel sensors
  - algorithm performance and world-class modelling
  - comprehensive calibration and validation of data and products
  - ***Interoperability of the Sentinel data with other EO missions, while preserving European independence***



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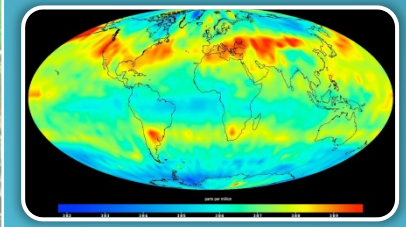
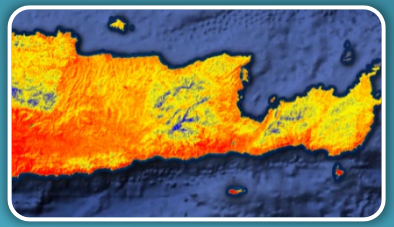
Copernicus Expansion Missions

6 priority challenges have been identified …

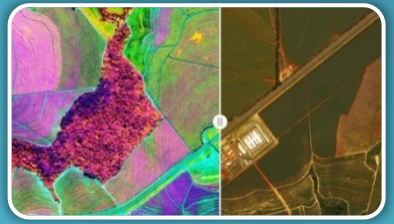


Emissions vs Climate Change

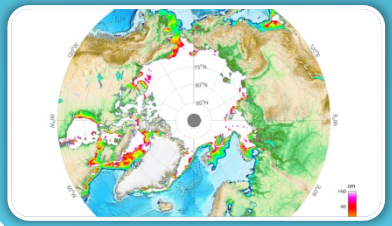


Agriculture & Urban Mgmt.

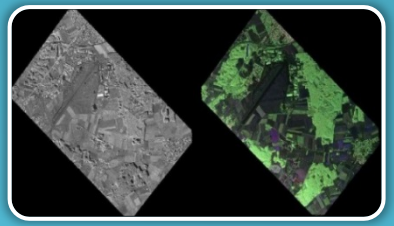
Effects Climate Change



Food Security, Soil & Minerals

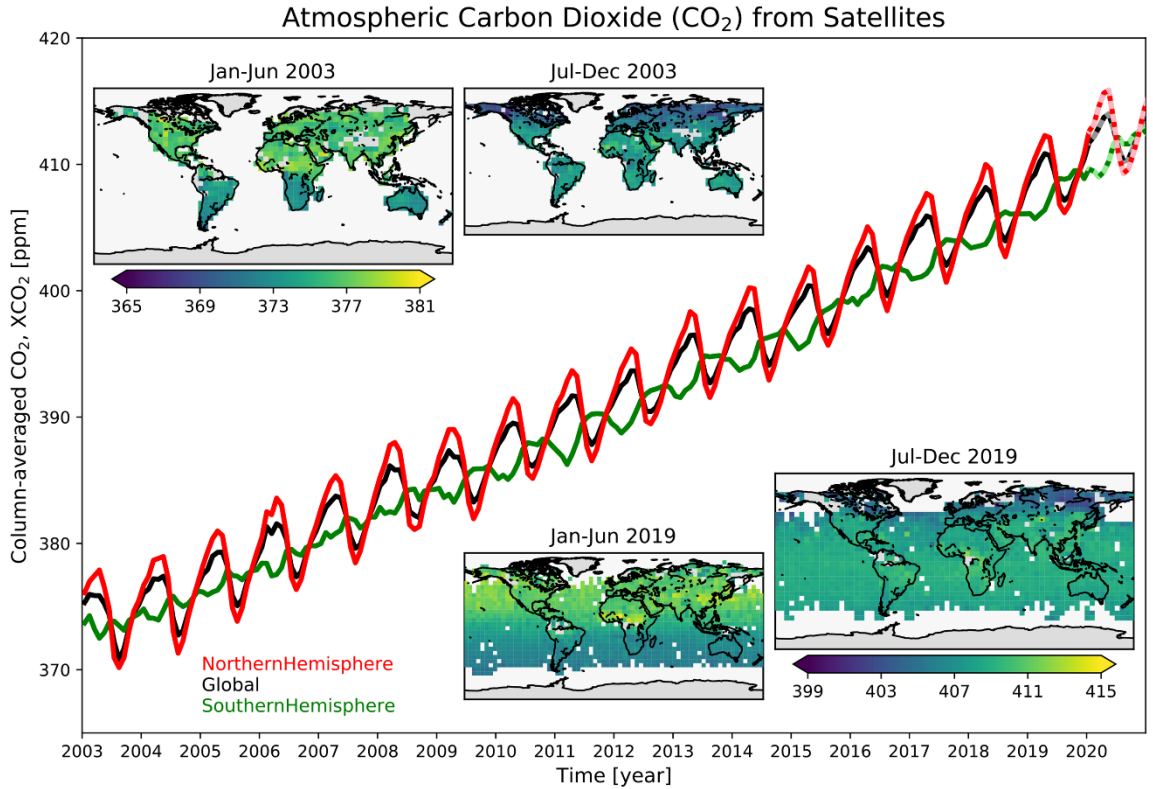


Sea Ice & Hydrology



Soil, Vegetation & Ground Motion

Global, continuous monitoring of CO2



Data:2003-2019:XCO2_OBS4MIPS(v4.2);2020:CAMS(NRT) - Satellites:SCIAMACHY/ENVISAT+GOSAT+OCO-2 - Credit:C3S/CCI/CAMS/Univ.Bremen/SRON

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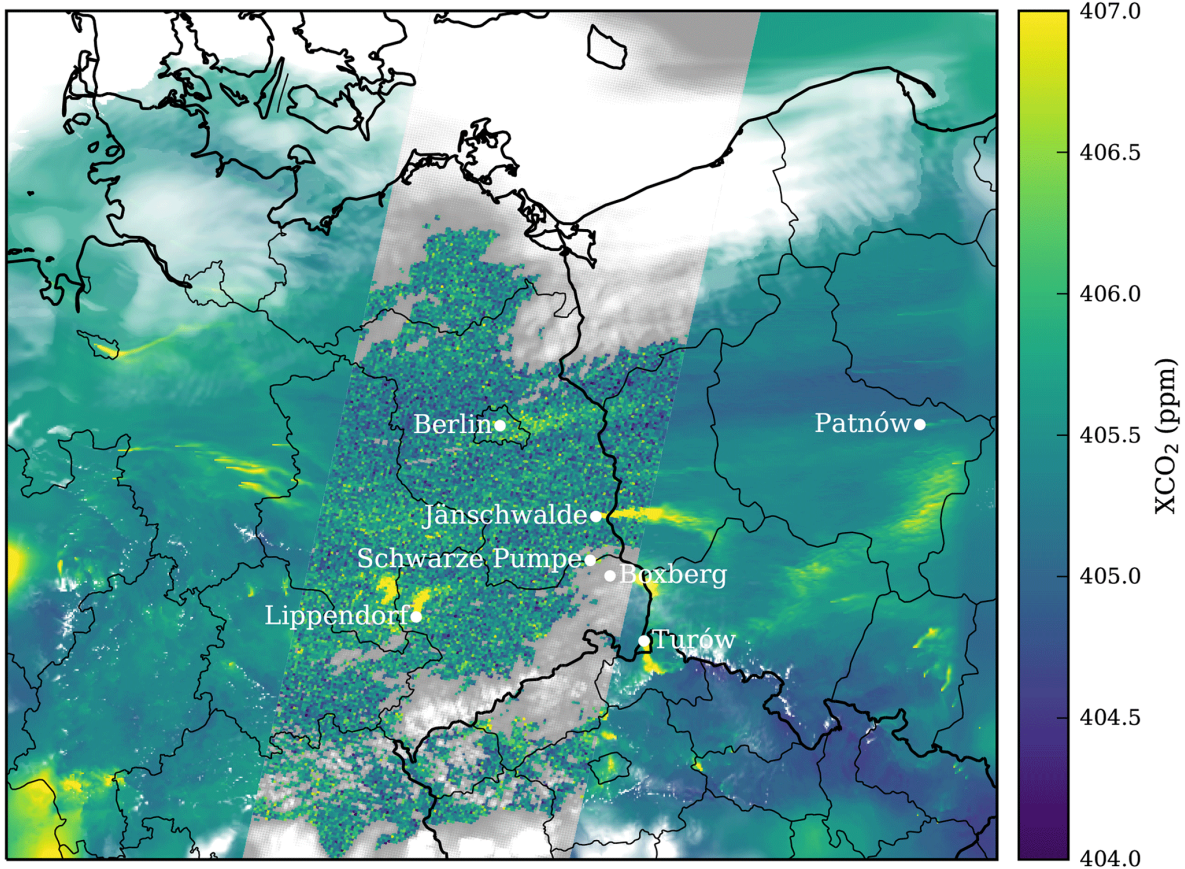
CO2plumes from cities and power plants



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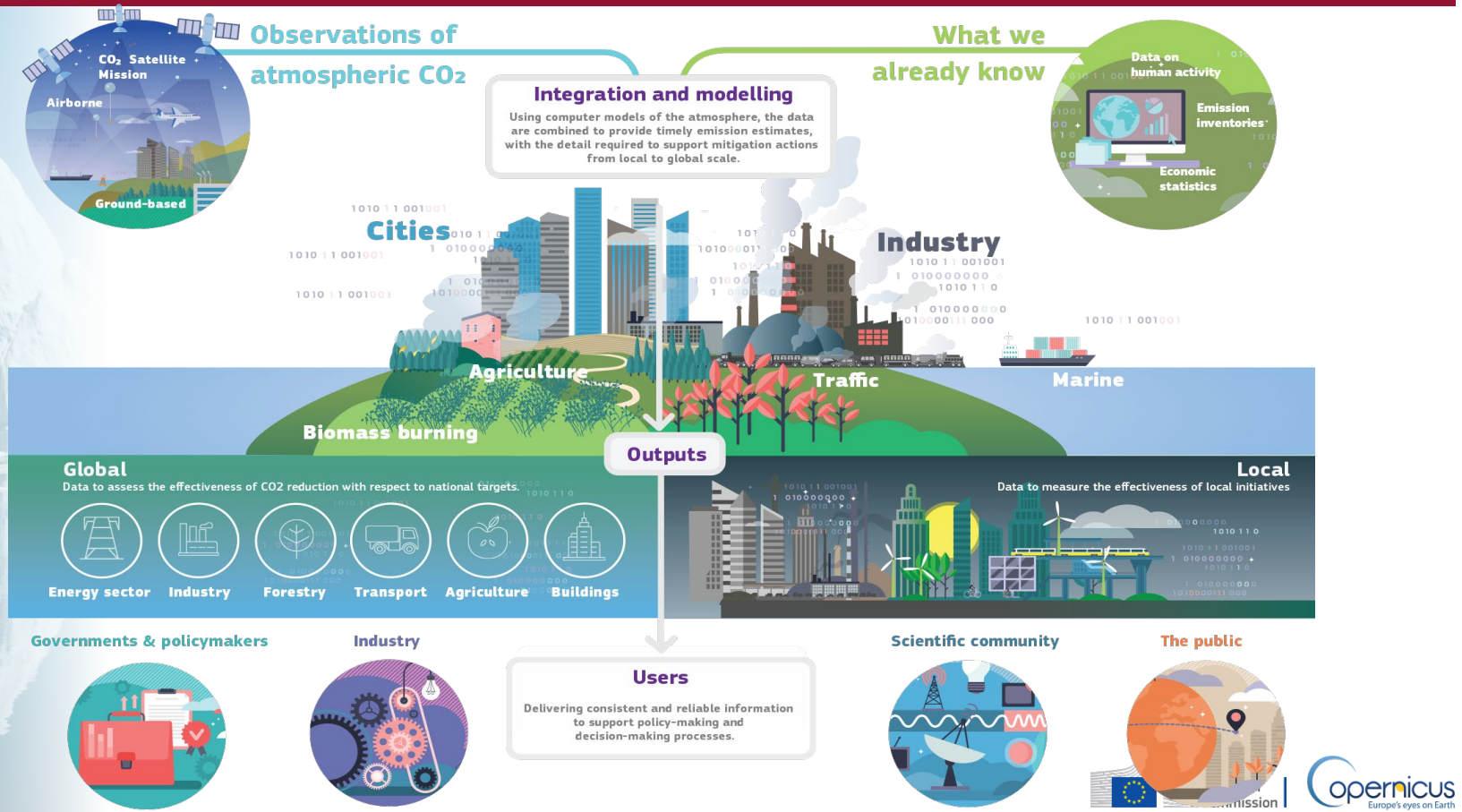
COPERNICUS CO2 EMISSIONS MONITORING & VERIFICATION SUPPORT CAPACITY

Climate Change



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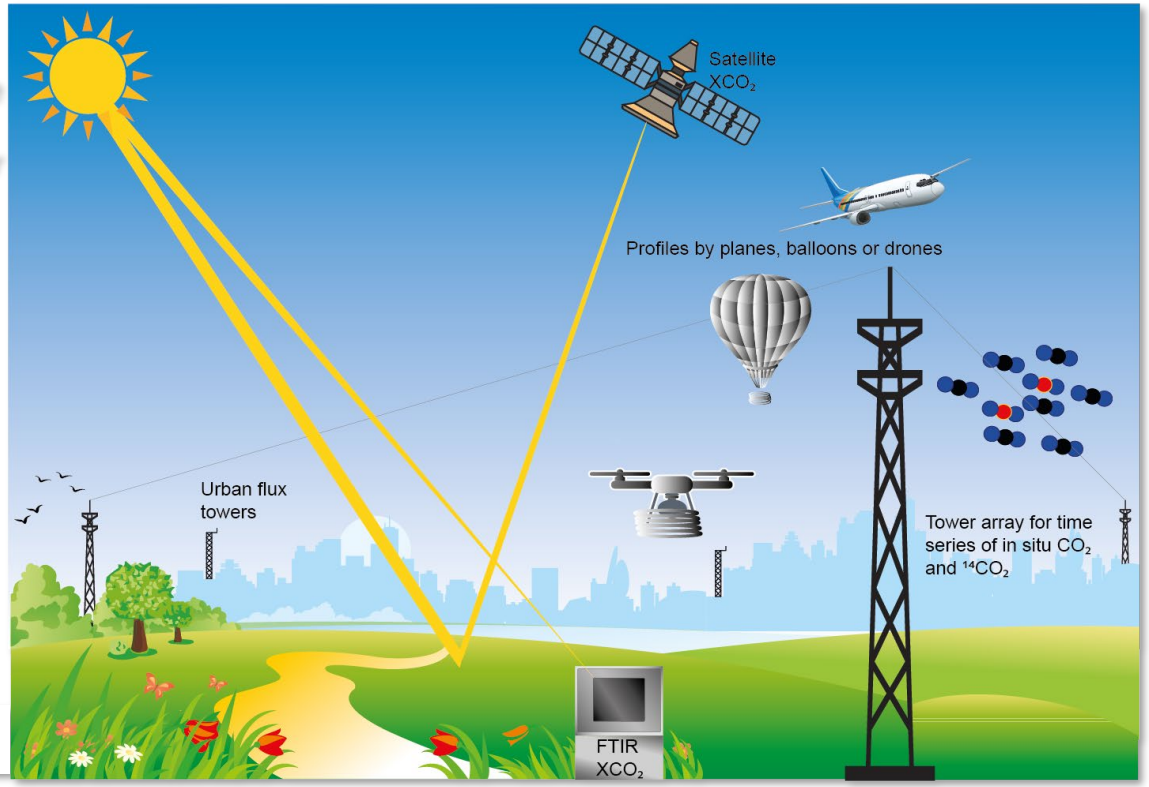
The urban CO2 observation networks

Outline for a comprehensive urban CO_2 observatory for fossil fuel emission detection.



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

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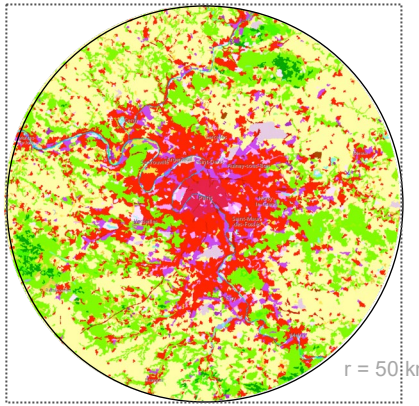
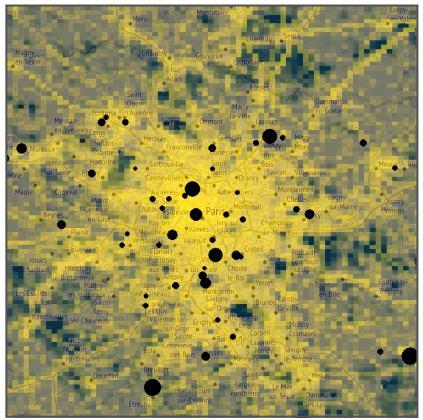
Paris

Metro 12.6 Mio Inh.
Urban 10.7 Mio Inh.

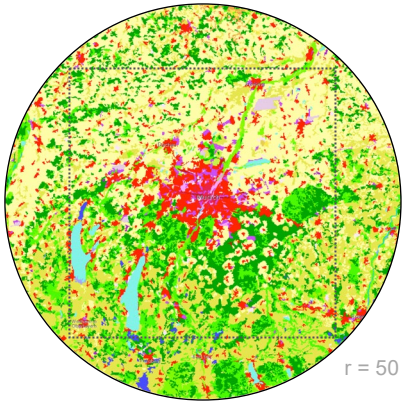


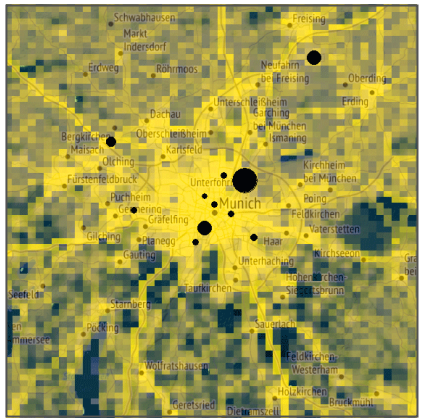


100 x 100 km

Munich

5.9 Mio Inh.
2.6 Mio Inh.

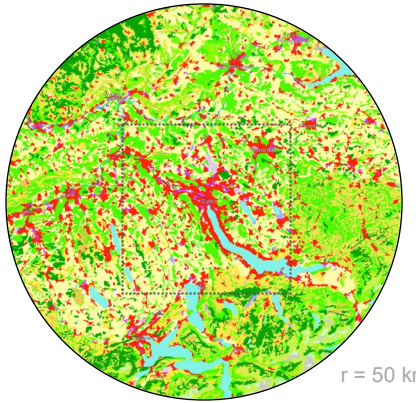


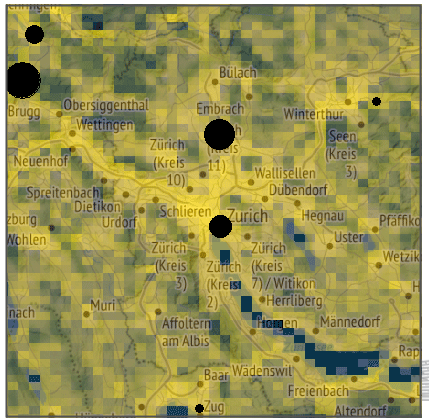


70 x 70 km

Zurich

1.6 Mio Inh.
0.4 Mio Inh.





45 x 45 km

Land cover

- Urban fabric
- Industrial / commercial
- Transportation
- Croplands
- Pastures
- Broad-leafed / mixed forest
- Coniferous forest
- Water bodies

$ffCO_2$ Emissions

kg yr^{-1} km^{-2}

1e+08
1e+06
1e+04
1e+02

$ffCO_2$ Point sources

kg yr^{-1}

1e+06
1e+07
1e+08
1e+09

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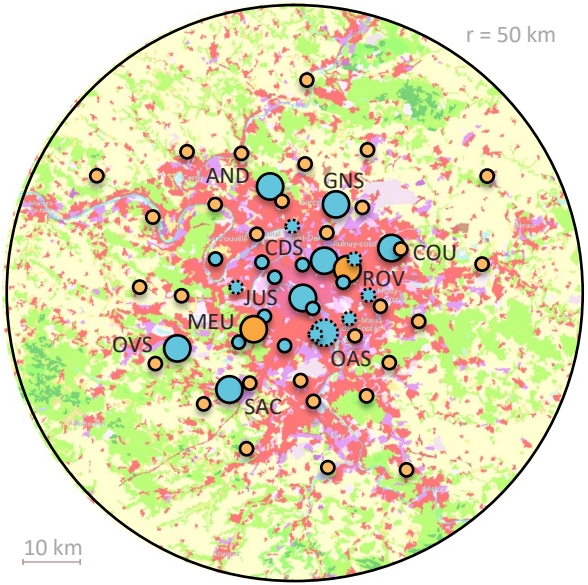
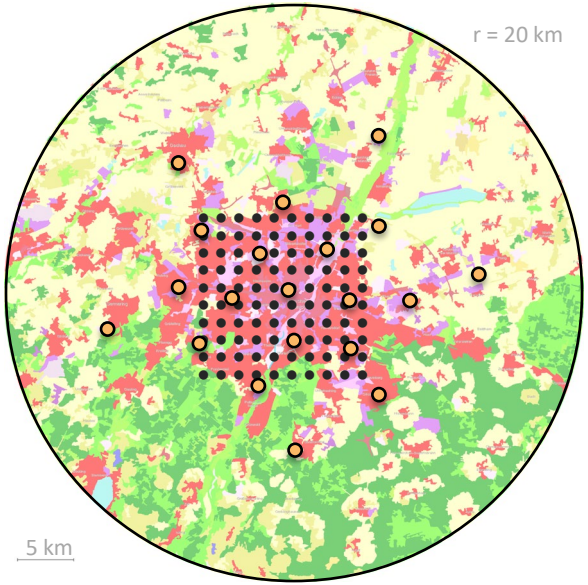
Paris

10 high-precision sites
30 roof-level sensors



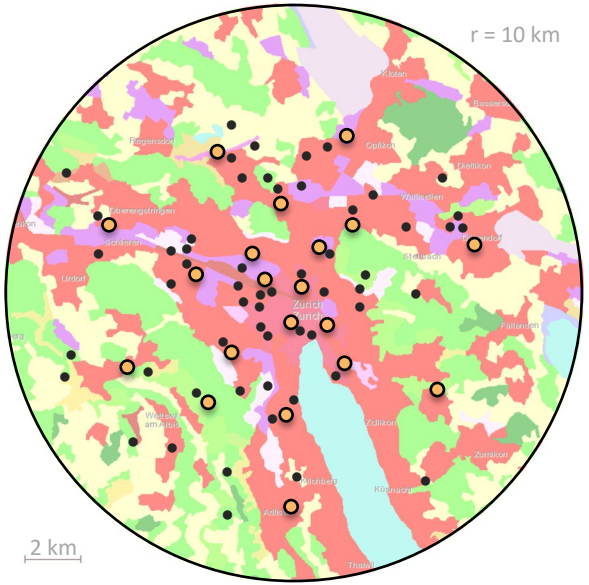
Munich

20 roof-level sensors
100 street-level sensors



Zurich

20 roof-level sensors
60 street-level sensors



Existing
Otherwise funded
New

Tall tower or elevated high-precision system (WP 3.1)

Roof-level sensor network sites (WP 3.2)

Street-level sensor network (WP 3.2)

(a) Atmospheric in-situ concentrations

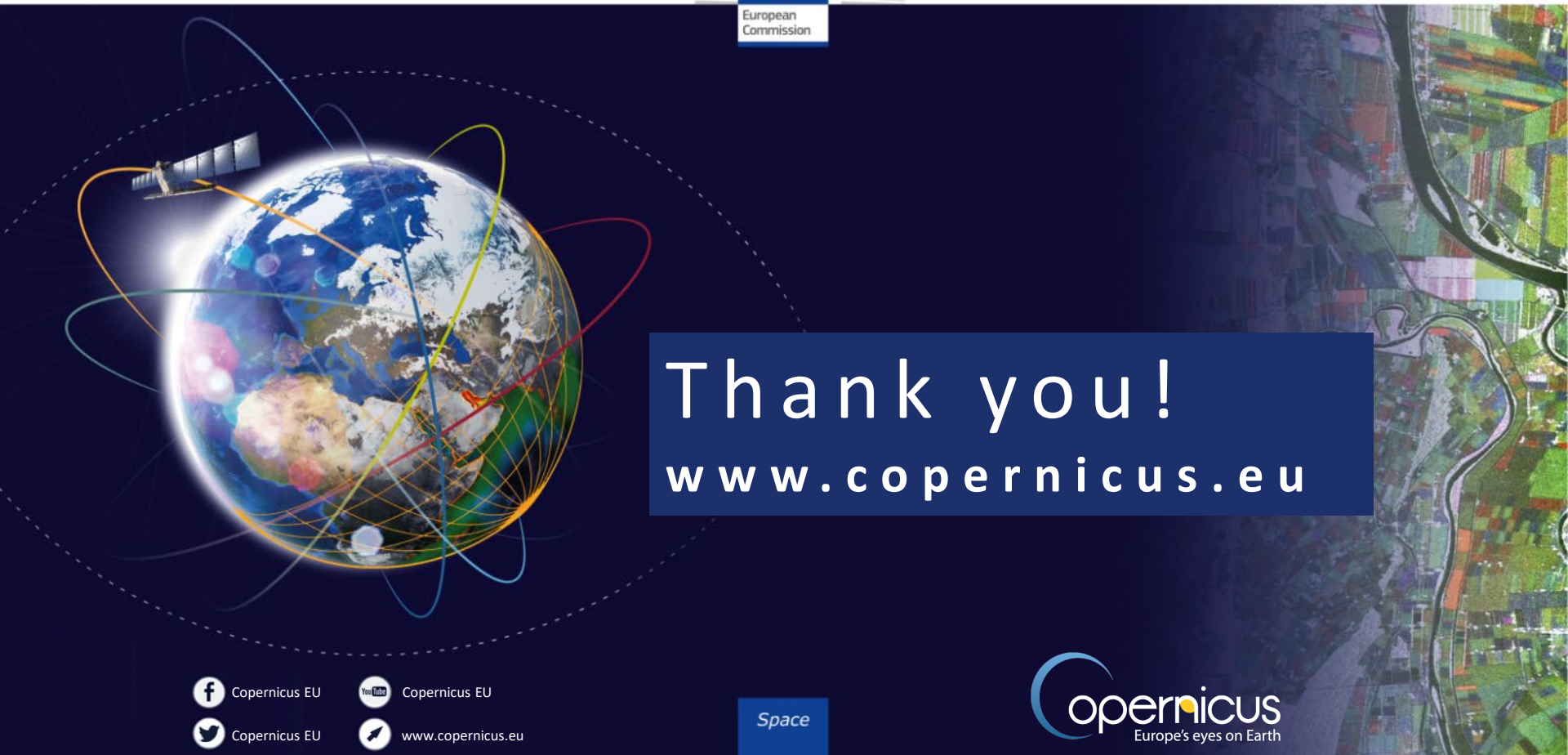
Observation Interoperability

Satellites provide the backbone

Information services require interoperability with ground-based observations because:

1. Local data in and around cities, and at power plants
2. Attribution to natural and anthropogenic sources
3. Real-time data assimilation in atmospheric models
4. Calibration and Validation

Rapid availability (hours), globally standardized (WMO), with documented accuracy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