Earth observation for decision-making

Earth observation data is a unique source of commensurable information. It can be combined with administrative, social and economic data at multiple scales for in-depth policy analysis.

The OECD is currently working with earth observation data providers and key partners to develop its geospatial data capacity.

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http://oe.cd/env-data

OECD
BETTER POLICIES FOR BETTER LIVES

March 2017

San Francisco Bay Area, Landsat-8, ESA.

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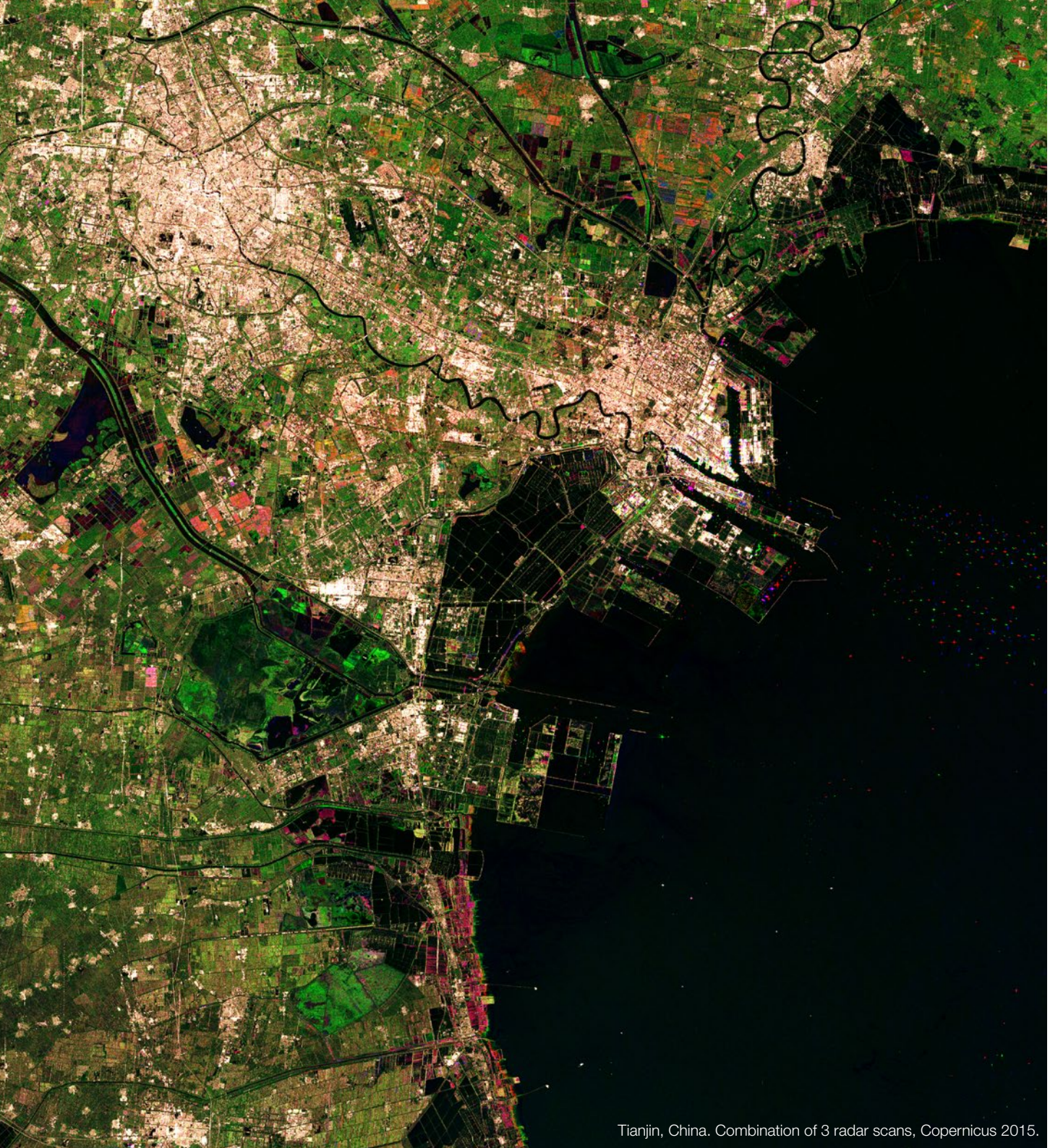
BETTER POLICIES FOR BETTER LIVES



Tianjin, China. Combination of 3 radar scans, Copernicus 2015.

Targeted and efficient environmental policies need a strong evidence base that accounts for the geographical distribution of environmental phenomena and economic activity. The existing evidence base of environmental policies has traditionally suffered from data gaps or incoherent time series.

Earth observation from satellites, aircrafts and drones, in-situ measurements or ground-based monitoring stations, can provide a unique and timely source of data that is commensurable across countries, regions and cities.

It can help harmonise international reporting on natural resources, ecosystems and environmental sinks.

It can be combined with other geo-referenced socio-demographic, economic and public administration data to make indicators and analysis more relevant and targeted.

Earth observation is not new, but it is only recently that investments in satellite capabilities, open and free access to data and tools, and advances in algorithms and data processing have started to enable the widespread use of this information at scale, and beyond the specialised scientific community. These developments offer opportunities for improving the range and robustness of environmental data and indicators.

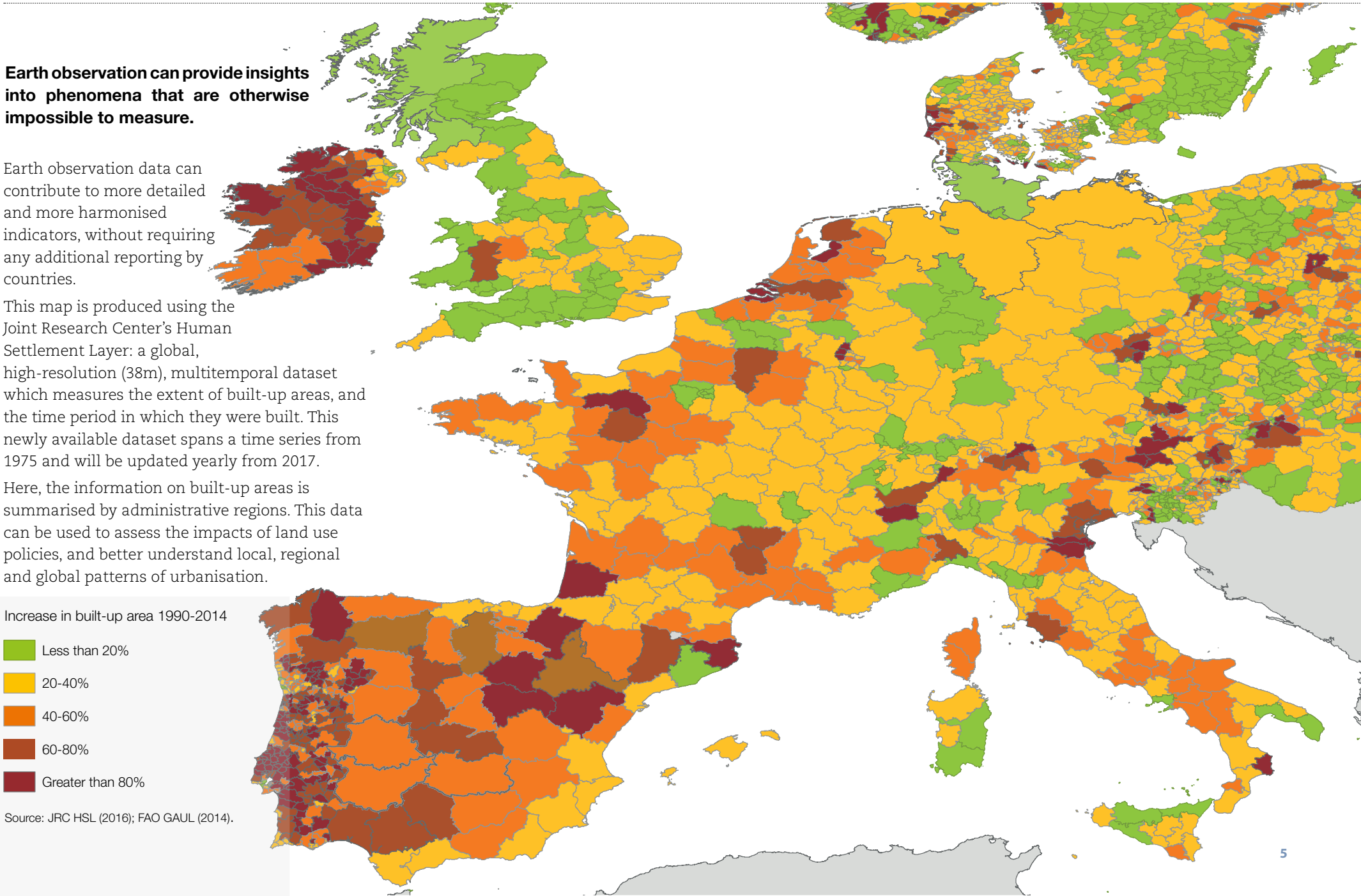
A unique source of information

Earth observation can provide insights into phenomena that are otherwise impossible to measure.

Earth observation data can contribute to more detailed and more harmonised indicators, without requiring any additional reporting by countries.

This map is produced using the Joint Research Center's Human Settlement Layer: a global, high-resolution (38m), multitemporal dataset which measures the extent of built-up areas, and the time period in which they were built. This newly available dataset spans a time series from 1975 and will be updated yearly from 2017.

Here, the information on built-up areas is summarised by administrative regions. This data can be used to assess the impacts of land use policies, and better understand local, regional and global patterns of urbanisation.



Source: JRC HSL (2016); FAO GAUL (2014).

Global insights

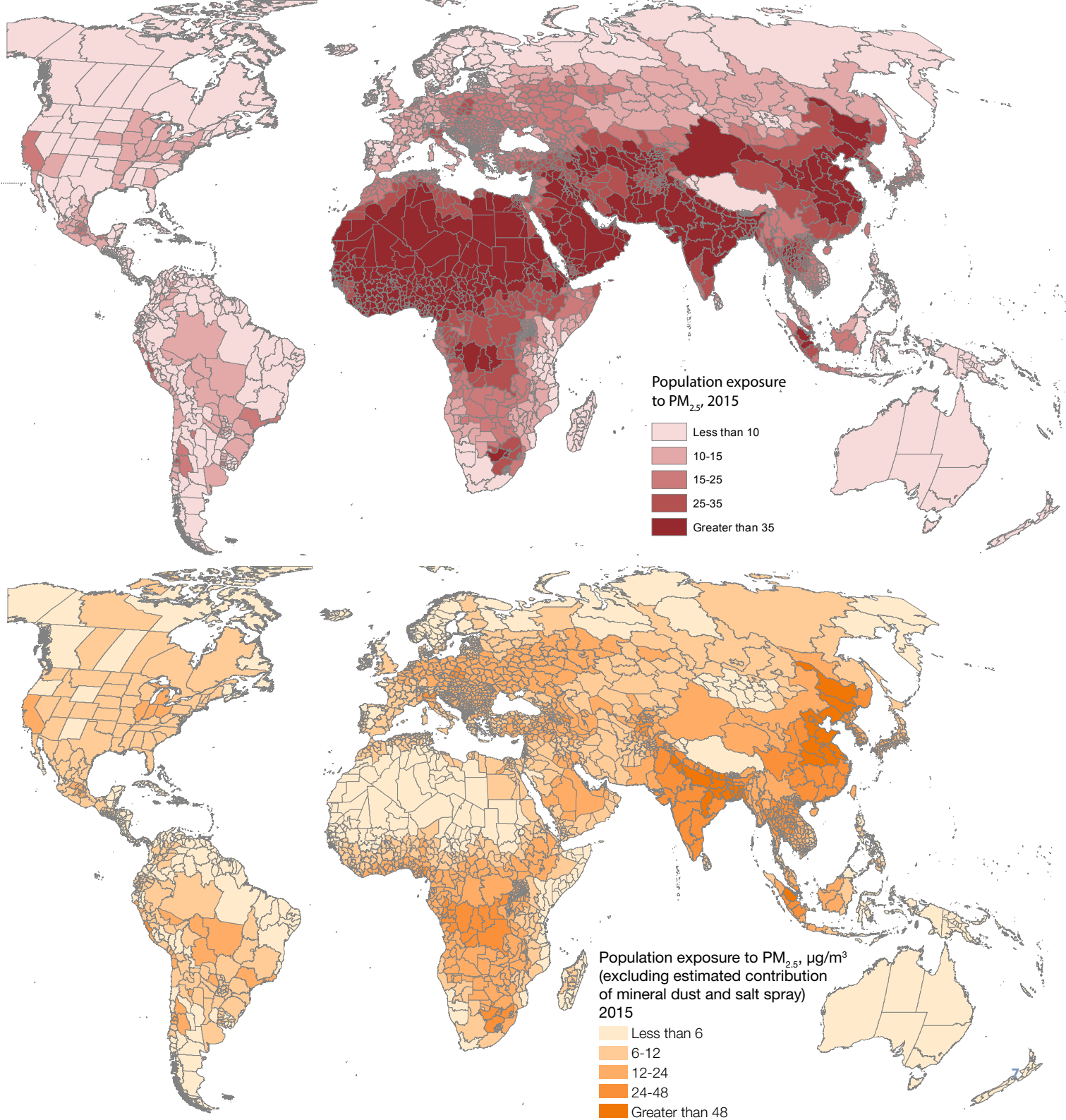
the example of air pollution

Information on population exposure to air pollution draws on merging satellite data, in-situ measurements and demographic data.

The measurement of population exposure to fine particulate matter ($PM_{2.5}$) can be harmonised across all countries.

Recent work used pollutant concentrations derived from satellite observations, ground monitoring stations and chemical transport models, and calculated exposure by weighting pollutant concentrations with populations in each grid cell of the underlying datasets. This method represents major progress compared to traditional data collection methods.

With this information, pollution abatement efforts can be focused on areas where exposure is highest.

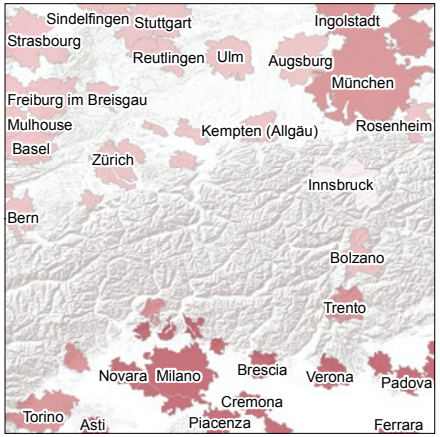


Estimates for chronic (annual average) outdoor exposure to $PM_{2.5}$ expressed in micrograms per cubic metre.
Top: total exposure to $PM_{2.5}$. This map takes into account all sources of $PM_{2.5}$, which is most relevant for assessing the health consequences of exposure.
Bottom: Exposure to $PM_{2.5}$ excluding the mineral dust (for example, sand in the deserts) and sea salt component. This map highlights more directly anthropogenic sources. However, human activity can also play a significant role in dust emissions (e.g. through agricultural practices).
Source: OECD Green Growth Indicators 2017 (forthcoming). FAO GAUL (2014).

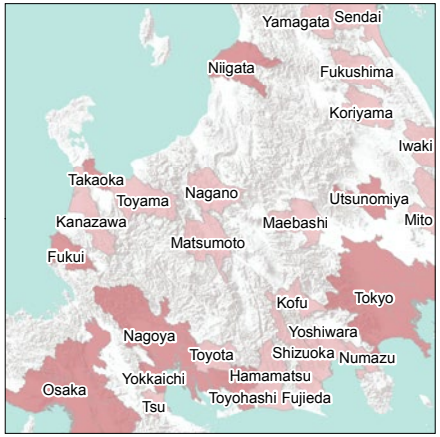
Sub-national focus

Concentration estimates can be overlaid with population density data to produce indicators at finer scales, such as at the level of urban areas.

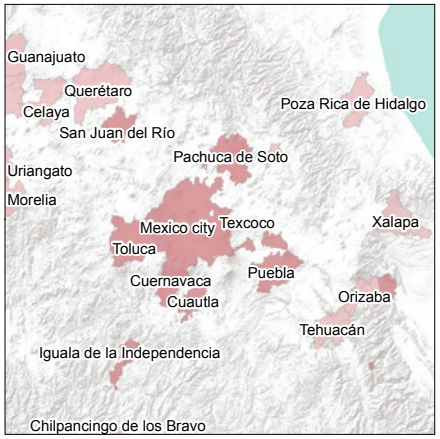
Eastern Alps, Europe



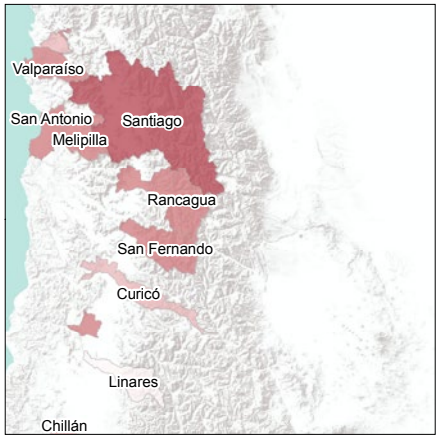
Japan



Mexico



Chile



Population Exposure to $PM_{2.5}$ 2015 (µg/m^3)

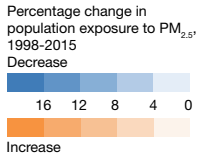
Less than 10 | 10-15 | 15-25 | 25-35 | Greater than 35

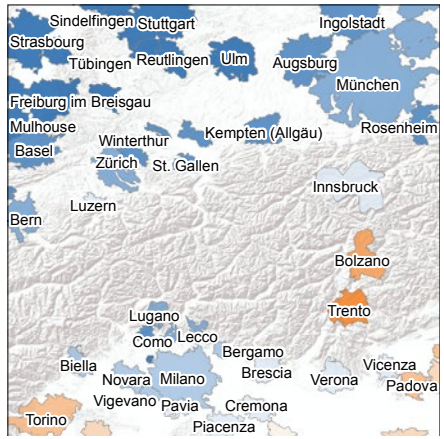
Sources. Donkelaar et al (2016); OECD FUA boundaries; ESRI, USGS, NOAA and FAO GAUL.

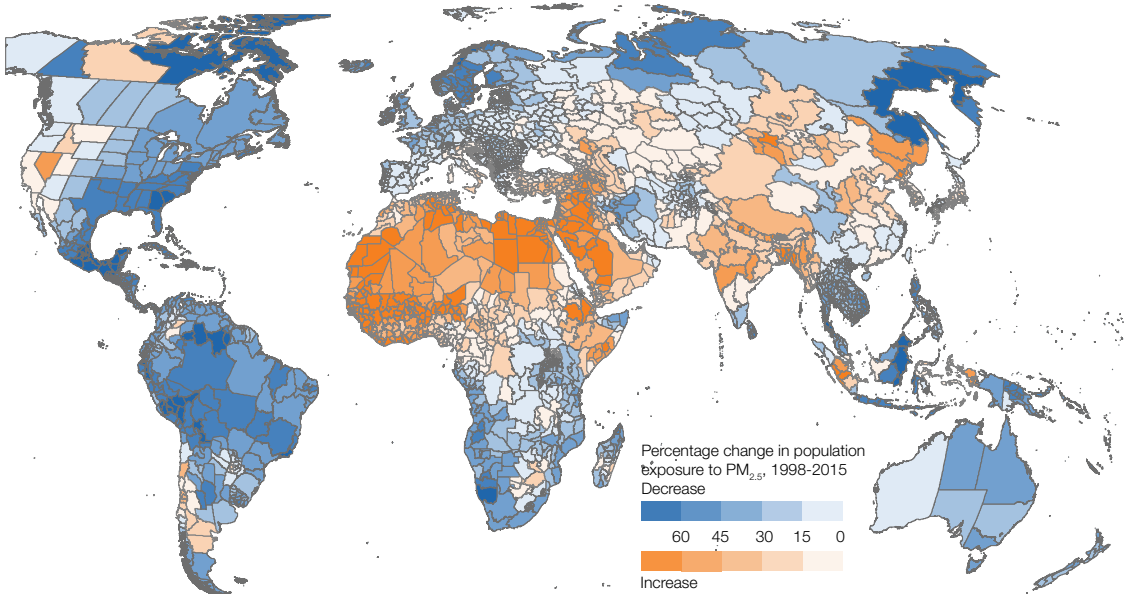
Time series

The same measurements are conducted at regular intervals, permitting consistent time series and analysis.

Traditional environmental data has long suffered from data breaks, due to changes in reporting methods, and from gaps (missing information). Earth observation provides consistent time series to compare different periods of time, and to derive trends.

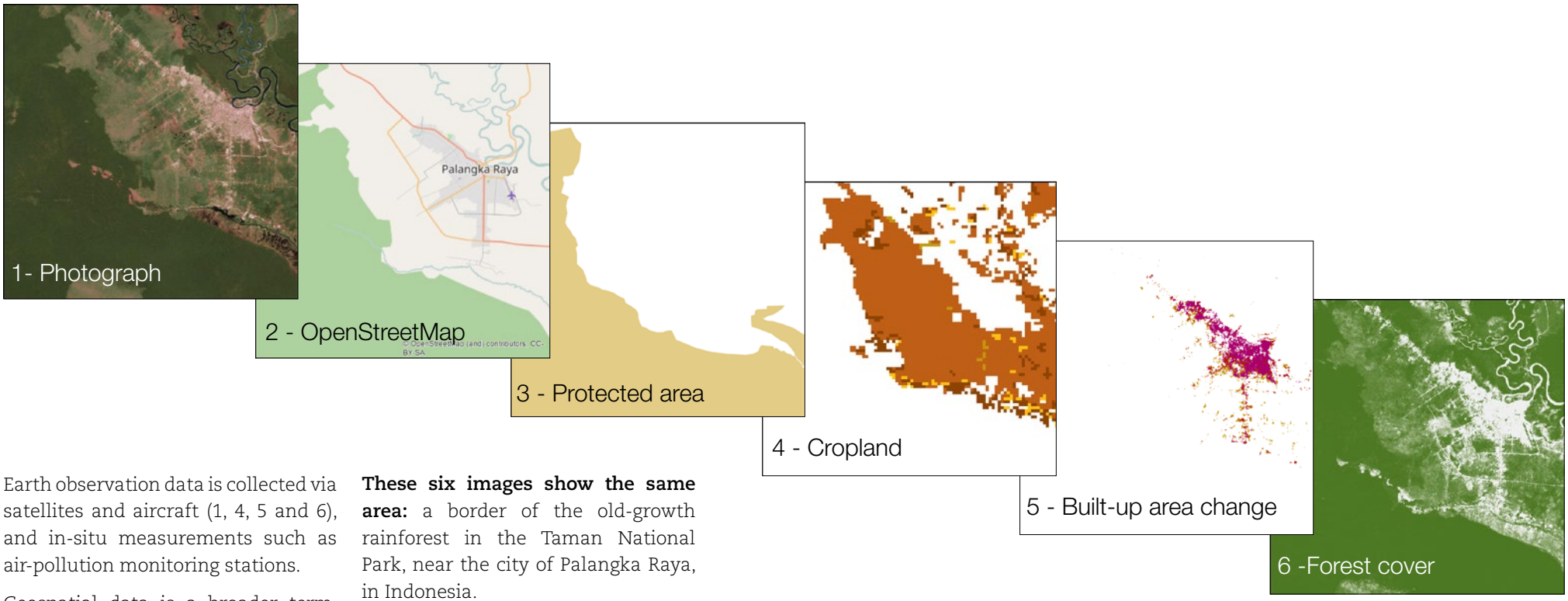






Combining earth observation data with other geospatial information

Earth observation data can be combined with geo-referenced public administration information, to improve the policy relevance of indicators.



Earth observation data is collected via satellites and aircraft (1, 4, 5 and 6), and in-situ measurements such as air-pollution monitoring stations.

Geospatial data is a broader term, typically used to include any data that is explicitly associated to a specific location, such as cadastral data or administrative boundaries (2 and 3).

There is a wealth of information to gain by combining high- and medium-resolution datasets from earth observation, with georeferenced administrative or census data.

These six images show the same area: a border of the old-growth rainforest in the Taman National Park, near the city of Palangka Raya, in Indonesia.

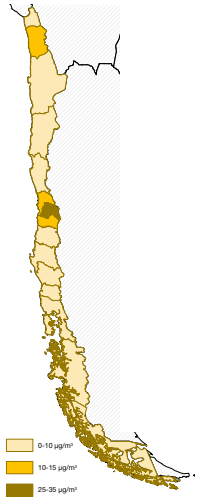
For example, the datasets shown can be used to quantify and identify patterns of agricultural land use (4), urbanisation (5) or forest change (6), within and around the boundary of the protected area (3). They can better characterise the effects of protected area designation or other land-use policies on ecosystems and local economies.

Sources: Hansen et al Global Forest Change (2013); JRC HSL (2016); ESA-CCI Land Cover 2015; UNEP; WCMC World Database of Protected Areas (2016) Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community OSM & Contributors 2017

Geospatial data in OECD work

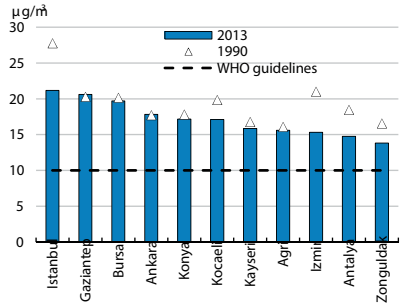
Earth observation data is now routinely used in country reviews and horizontal work. It also supports policy analysis.

COUNTRY REVIEWS



"Poor air quality remains a major public concern across Chile, particularly in large metropolitan areas, in the surroundings of large industrial and mining sites and in cities where wood burning prevails."

The 2016 *Environmental Performance Review of Chile* recommends implementing pollution prevention and decontamination plans in all areas that exceed air quality standards and improving air quality networks and access to air pollution information.

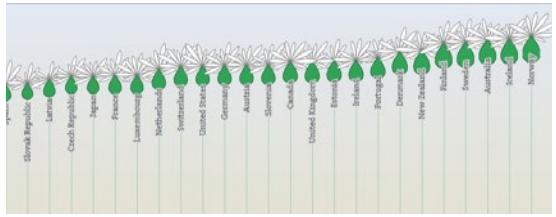


"Industrial regions display particularly high pollution levels and a particularly low improvement between 1990 and 2013. Similar to GHG emissions, a firmer mitigation effort is needed for fine particles. This would necessitate progress in the transparency of emission sources and formalisation would help."

OECD Economic Surveys: Turkey 2016

CROSS-CUTTING WORK

OECD Better Life Initiative



"The quality of our local living environment has a direct impact on our health and well-being." For this reason the OECD Better Life Index takes into account the share of the population exposed to concentrations above the World Health Organization limits of 10 micrograms of $PM_{2.5}$ per cubic meter of air.

The forthcoming ***Green Growth Indicators 2017*** use earth observation data analysis for indicators on population exposure to air pollution, the extent of natural vegetated land, protected areas, land use change, forest change, etc.

POLICY ANALYSIS

What is the impact of urban structure on the environment and on people's well-being? Spatial Planning INstruments and the Environment (or SPINE) is an OECD project to assess the environmental and economic effectiveness of spatial and land use planning instruments, as well as the potential gains from policy reforms.

Collaboration

The OECD is working closely with earth observation data providers and key partners to develop, combine and analyse geospatial data.

The OECD Space Forum was established to assist governments, space-related agencies and the private sector to investigate space infrastructure's economic significance, its role in innovation and potential impacts for the larger economy.

OECD analysts increasingly use earth observation data to support their policy recommendations. In 2015, the OECD joined the **Group on Earth Observations**, a partnership of more than 100 national governments and 100 participating organisations, as an observer.

The OECD is working closely with earth observation data providers and partners: **the United States NASA, the European Space Agency, the Global Observation of Forest and Land Cover Dynamics** (GOFC-GOLD), and the academic community in an effort to integrate results of frontier research into better policy guidance and provide feedback to the data providers to guide future investments.

The OECD Working Party on Environmental Information works with environment ministries, environment agencies and national statistical offices to develop internationally harmonised methodologies for new and improved indicators. Reliance on earth observation data has gained momentum. Population exposure to $PM_{2.5}$, based on geospatial data, has become a green growth headline indicator.

ESA's satellite Sentinel 3

Opportunities

There are key opportunities for the improvement of environmental information in two areas of particular importance:

- **Monitoring natural resources** such as land, soils and oceans **and environmental sinks,** including air and water pollution. Earth observation data can offer a wealth of information on water quality, soil carbon and soil moisture, and the oceans. The analysis currently applied to $PM_{2.5}$ pollution could be extended to many other pollutants.
- **Combining geospatial data with other datasets** to better assess environmental risks and the associated costs of exposure of humans, ecosystems, built property and economic activity to pollution, natural hazards and industrial risks. Earth observation data could be further combined with administrative and socio-economic data. For example, OECD teams have combined data on air pollution with household income.

Making best use of these opportunities will require voluntary contributions from countries to support specialised staff.