Country Use Case of EO for SDG Indicator	
SDG Indicator/Sub-indicator	**Indicator 15.3.1:** Proportion of land that is degraded over total land area Sub-indicator: land cover. This EU indicator measures a soil sealing index as one component in the land cover sub-indicator.
Country or region	European Union
Status (please check)	X being used in official SDG Indicator reporting _ being verified or tested by country _ studying feasibility
Earth Observation Data Used and its links	Copernicus High Resolution Layer Imperviousness https://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness Imperviousness data is available for the reference years 2006, 2009, 2012 and 2015, and contains two types of products: 1. Status layers The percentage of sealed area is mapped for each status layer for any of the 4 reference years (e.g. degree of Imperviousness 2012). The status layers are available in the original 20m spatial resolution, and as aggregated 100m products. 2. Change layers Two types of change products are available for each of the 3-year periods between the 4 reference years (2006-2009, 2009-2012, 2012-2015), and in addition, for the period 2006-2012 (that is in line with the 6-year period between two Corine Land Cover products): a) A simple layer mapping the percentage of sealing increase or decrease for those pixels that show real sealing change in the period covered. This product is available in 20m and 100m pixel size. b) A classified change product that maps the most relevant categories of sealing change (unchanged no sealing, new cover, loss of cover, unchanged sealed, increased sealing, decreased sealing). This product is available in 20m pixel size only.
Additional/ Other Data Used and its links	NA
Description of data access, processing, and analysis, including methodology that was developed, associated tools or applications, and how these are applied to compute SDG Indicator	Data are available as open data, The imperviousness data capture the percentage and change of soil sealing. Sealed areas areas are characterised by the substitution of the original (semi-) natural land cover or water surface with an artificial, often impervious cover. These artificial surfaces are usually maintained over long periods of time. The imperviousness High Resolution Layer captures the spatial distribution of artificially sealed areas, including the percentage of sealing per spatial unit. The level of sealed soil (imperviousness degree 1-100%) is produced using a semi-automated classification, based on calibrated NDVI. Please find a more detailed product specification in the technical document. The indicator estimates the increase in sealed soil surfaces with impervious materials due to urban development and construction (e.g. buildings, constructions and laying of completely or partially impermeable artificial material, such as asphalt, metal, glass, plastic or concrete). This provides an indication of the rate of soil sealing, when areas change land use towards artificial and urban land use. The indicator builds on data from the imperviousness High Resolution Layer (a product of the Copernicus Land Monitoring Service). Imperviousness is mapped at 20m resolution and with a minimum mapping unit of 20m. This will improve to 10m in 2018 with repurcussions on comparability with earlier versions though. The indicator is presented in the following units: • Index 2006=100

- % of total surface
- total sealed surface in km2

Land cover classes classified as sealed include:

- Housing areas (even with scattered houses)
- Traffic areas (airports, harbours, railway yards, parking lots)
- Roads
- Railway tracks associated to other impervious surfaces (i.e. inside built-up area)
- Industrial, commercial areas, factories, energy production and distribution facilities
- Sealed surfaces, which are part of categories, such as e.g. allotment gardens, cemeteries, sport and recreation areas, camp sites, excluding green areas associated with them
- Artificial grass-covered sport pitches
- Construction sites with discernible evolving built-up structures.
- Single (farm) houses (where possible to identify from satellite imagery)
- Paved borders of water edges
- Greenhouses
- Permanent plastic covered soil
- Solar panel parks

Figure 15.3: Soil sealing index, EU-28, 2006–2015
(index 2006 = 100)

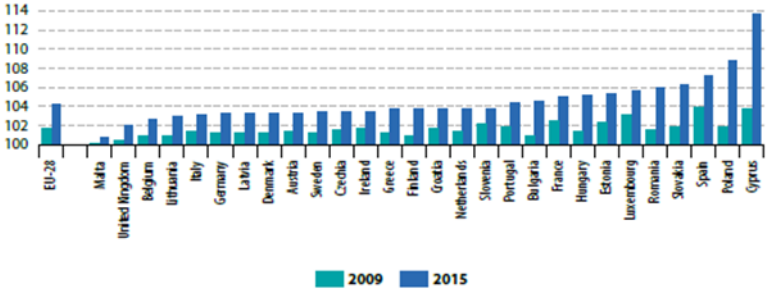
Source: EEA (Eurostat online data code: sdg_15_41)

Table 15.4: Compound annual growth rate (CAGR) of the soil-sealing index, EU

EU aggregate	Period	Growth rate
EU-28	2009–2015	0.4 % per year

Source: EEA (Eurostat online data code: sdg_15_41)

Figure 15.4: Soil sealing index, by country, 2009 and 2015
(index 2006 = 100)



Source: EEA (Eurostat online data code: sdg_15_41)

Work flow	**Production steps:** 1. Usage of a 100 x 100 km tiles based on the EEA reference grid as production units 2. Creation of three multi-seasonal image composites (spring-summer-autumn 2014-2016) per 100 x 100 km tile 3. Derivation of biophysical variables (NDVI) per input image 4. Mosaicking of single NDVI images to maximum NDVI mosaics per 100 x 100 km tile 5. Automated derivation of classification training samples from additional reference data (CLC, HR layers) 6. Automated supervised classification of built-up and non-built-up areas HRL Imperviousness Product Specifications Document Page 12 opernicus European Environment Agency 7. Combination of classification result with the built-up masks from the HRL Imperviousness 2012 and 2006 to determine built-up changes and possible omission and commission errors 8. Visual correction and supplementation of derived built-up change candidates 9. Absolute calibration of the maximum NDVI for calculating the degree of imperviousness based on the Reference Database for absolute Calibration.
Lessons learned, any gaps, key issues and recommendations	<u>EU monitoring</u> • Overall positive experience with the indicator and the use of EO data. • Purely EO based. Easy to explain and to get accepted as benefits of EO data are obvious. Acceptance helped by restricting the scope to one type of land cover that is easily understood (i.e. sealed surfaces) can be technically mastered and at the same time measures a relevant phenome (i.e. trends in urbanisation). Keeping indicators simple may be a good idea for promoting the use of EO data, even if they do not fully meet the requirements of the metadata. • Comparability over time remains an issue as sensors and quality of the data have been improving (2006-2012 pre-Sentinel 2, 2015 Sentinel 2.). Long term stability of methodology and comparability of indicators over time is vital for SDG monitoring, this must be addressed by the EO community for all EO based indicators before indicator production based on EO can become mainstream. • Frequency of three years for land cover changes ok, timeliness should be T+12 months, now sometimes >24 months which is too long. In the EU SDG indicator set, this land cover indicator is complemented by an indicator on land use in Goal 11 measuring settlement areas. This includes also non-natural green areas. <u>European coordination</u> The outcomes and findings of the coordinated analysis carried out on the SDG indicators by the 'UN-GGIM: Europe Working Group on Data Integration' according to the Work Plan 2017-2019 have allowed to agree on the following set of recommendations to enhance the contribution of geospatial data analysis and its integration with statistical data to address the SDG indicators: 1. Harmonize relevant geospatial data themes 2. Implement Cadastral and Land Cover data as key national authoritative data 3. Use geospatial layers generated from Earth Observation data 4. Create capacity building initiatives for NSI to take full advantage of EO based data

	5. Define and implement NSDIs having in mind the requirements for statistical production 6. Implement consistent and stable sub-national spatial units 7. Develop and use population grids and other grid-based statistics 8. Adopt harmonised and comparable concepts, definitions and classifications and build consensus among Geospatial Agencies and National Statistical Institutes 9. Ensure availability and accessibility of processing workflows, including open formats of programming codes 10. Develop initiatives that promote availability, accessibility and usability of geospatial data 11. Increase the collaboration with researchers and data providers 12. Increase cooperation between National Statistical Institutes and Geospatial Agencies
Supporting material about this use case. Include links, publications, etc.	<u>EU monitoring</u> Link to EU SDG monitoring landing page https://ec.europa.eu/eurostat/web/sdi/overview Link to the EU SDG monitoring report Link to overview page of goal 15 https://ec.europa.eu/eurostat/web/sdi/life-on-land Link to data table of EU SDG indicator 15_41 'Soil sealing index' https://ec.europa.eu/eurostat/databrowser/view/sdg_15_41/default/table?lang=en Link to European Environment Agency (EEA) interactive soil sealing viewer and data https://www.eea.europa.eu/data-and-maps/dashboards/imperviousness-in-europe <u>European coordination</u> Concerning the coordinated elaboration of the UN-GGIM: Europe Working Group on Data Integration a Final Report on 'The territorial dimension in SDG indicators: geospatial data analysis and its integration with statistical data' was published in July 2019 within the Work Plan 2017-2019. The report focuses on the contribution of geospatial data analysis and its integration with statistical data at a global, European and national perspective based on the analysis of four selected SDG indicators. Source: https://un-ggim-europe.org/wp-content/uploads/2019/05/UN_GGIM_08_05_2019-The-territorial-dimension-in-SDG-indicators-Final.pdf According to the Work Plan 2019-2022 the UN-GGIM: Europe Working Group on Data Integration has accepted new tasks to provide methodological, operational and technical guidance in the use of geospatial data and statistics to compute SDG indicators, with a European and national perspective, and reflecting on solutions which may contribute to reduce statistical burden and increase the level of detail of SDG indicators. The new tasks comprise (1) a benchmarking of pan-European data sources, i.e. comparative analysis between pan-European and national methodologies, data sources and results as well as (2) an integration of pan-European data sources with national data sources, i.e. analysis of the combination of pan-European with national data sources to extract new relevant information for indicators computation. The expected outputs will include: 1. The development of standard methodological/technical documents for each selected indicator compiling the solutions analysed and presenting normative methodological guidance on the use of EO for the computation of SDG indicators; and 2. The production of flyers/leaflets synthesising and illustrating the approaches analysed and the main results. Based on this, the work has started by taking the following indicators as a reference:

	3.6.1 | Death rate due to traffic injuries (tier I) 6.6.1 | Change in the extent of water-related ecosystems over time (tier I) 11.2.1 | Accessibility to public transports (tier II) 11.3.1 | Ratio of land consumption rate to population growth (tier II) 11.6.2 | Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (tier I) 11.7.1 | Access to public / green areas (proxy) (tier II) 14.5.1 | Coverage of protected areas in relation to marine areas (tier I) 15.1.1 | Forest area as a proportion of total land area (tier I) 15.3.1 | Proportion of land that is degraded over total land area (tier I) 15.4.1 | Coverage by protected areas of important sites for mountain biodiversity (tier I)
Collaboration with other agencies - agency names and activities	EU monitoring The EU SDG indicator was developed by the European Environment Agency EEA in Copenhagen that is responsible for the Copernicus Land Monitoring Services together with the SDG monitoring team in Eurostat, the statistical office of the EU. European coordination The selection and analysis of the SDG indicators should benefit from the different institutional background and technical expertise of members of the UN-GGIM: Europe Working Group on Data Integration. Additionally, this list should benefit from an articulation with the UNECE as well as the European Environment Agency (EEA) and Eurostat's SDG Working Group. Furthermore, the information exchange with the Inter- and Agency Expert Group on SDG Indicators – Working Group on Geospatial Information (IAEG SDG WG GI) will be continued. The same applies with the exchange and collaboration with the relevant global GEO initiatives and working groups, in particular, the EO4SDG initiative. On the European level, the exchange with the EuroGEO initiative has to be established as well.
Name(s) and email address of individual(s) involved in this effort. Please note the principal point(s) of contact (POCs).	EU monitoring ESTAT SDI EU2020 INDICATORS ESTAT-SDI-EU2020-INDICATORS@ec.europa.eu European coordination Pier-Giorgio Zaccheddu (Chair of the UN-GGIM: Europe Working Group on Data Integration), email: pier-giorgio.zaccheddu@bkg.bund.de Francisco Vala (Leader of the Subgroup I – SDG Analysis of the UN-GGIM: Europe Working Group on Data Integration), email: francisco.vala@ine.pt