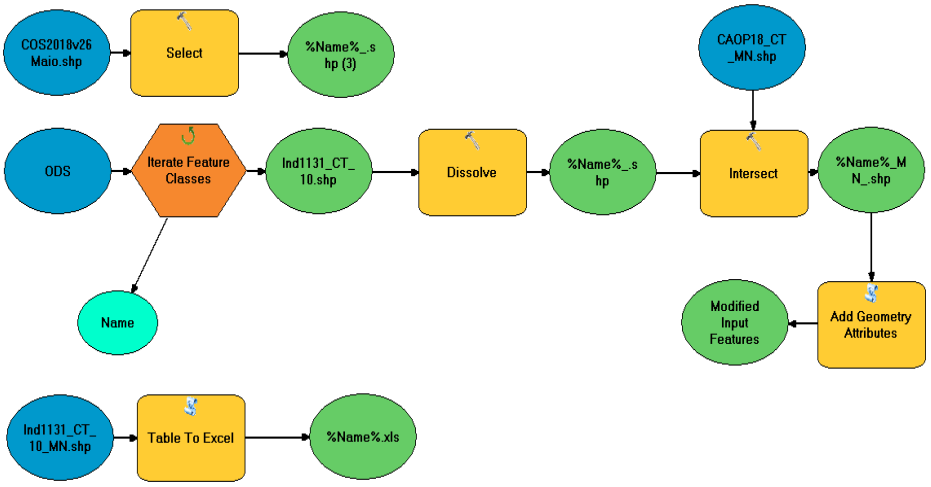
Country Use Case of EO for SDG Indicator	
SDG Indicator/Sub-indicator	**11.3.1** Ratio of land consumption rate to population growth rate Proxy indicator based on JRC Land Use Efficiency Formula (Corbane et al., 2017) - Efficiency evaluation of the artificial land by inhabitant
Country or region	Portugal Indicator calculated up to municipality level
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	Land Use and Land Cover (COS) Map produced by the Directorate-General for Territory (DGT) - http://www.dgterritorio.pt/dados_abertos/cos/ The latest COS Map refers to 2018 and compatible versions for COS 2015 and COS 2010 have also been produced.
Additional/ Other Data Used and its links	Data on population estimates are also used for the same reference years of the Land Use and Land Cover Map (2010, 2015 and 2018). Resident population (No.) by Place of residence (NUTS - 2013), Sex and Age group; Annual Source: Statistics Portugal, Annual estimates of resident population Data on territorial administrative boundaries area used for the most recent reference year of COS - Official Administrative Map of Portugal (CAOP 2018) http://www.dgterritorio.pt/cartografia_e_geodesia/cartografia/carta_administrativa_oficial_de_portugal_caop/caop__download_/ Source: Directorate-General for Territory (DGT).
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	COS is a thematic cartography that divides surface area of Mainland Portugal into landscape units, that share the concepts of land use and land cover. The cartography is obtained by visual image interpretation of ortho-rectified aerial photographs, with a spatial resolution of ≤ 50 cm and four spectral bands (blue, green, red and infrared). The unit of land use/land cover represents any area of land greater than or equal to the minimum mapping unit (UMC) of 1 ha, with a distance between rows of 20 m or more and where a given land use/land cover class has a percentage greater than or equal to 75% of the total delimited area. The production of COS 2018 is based on visual interpretation of orthophotos and assisted and complemented with novel methods of image analysis. First, a change detection method based on inter-annual time series of Landsat 8 data was applied. This method adopts thresholding and k-means clustering on image differencing of NDVI data of 2015-2018 for detecting changes in forest and shrublands. Then, a classification method based on intra-annual Sentinel-2 data was considered for annual croplands. This method uses expert knowledge and statistics extracted from the intraannual time series to distinguish between Autumn/Winter crops and Spring/Summer crops. The satellite data overcomes the temporal limitation of the orthophotos, making it possible to map two classes with otherwise insufficient accuracy. For a more detailed description of COS production see Costa et al, 2020. The nomenclature of COS 2018 consists of four levels of detail that can be

	grouped into 9 classes of first level of detail: 1 - Artificial land; 2 - Cropland area; 3 - Grassland area; 4 – Agro-forestry areas; 5 - Forest area; 6 - Shrubland area; 7 - Open spaces or sparce vegetated areas; 8 - Wetlands; 9 - Surface water bodies. Based on COS2018 there is a common subset of 83 land use and land cover classes (DGT, 2019). Definition: The indicator considers COS first level class 'artificial land', excluding the 'areas under construction, which includes excavation areas, shipyards, public and industrial facilities, road or rail network infrastructures, dams and dykes since they are under construction. This exclusion is related to the potential of these areas to revert to non-artificial occupations at the end of the construction. The calculation of this indicator also benefits from the annual estimates of the resident population, at municipality level, produced by Statistics Portugal. Areas extraction: The extraction of the area occupied by artificial land results from the intersection of two consecutive versions of the COS (from years n and n-x) with the version of the CAOP for the last reference period of the COS (year n), thus ensuring geographical consistency. This process results in two products, on which a polygon geometry is calculated in order to determine the area occupied by artificial land, at both times, using the same geographical basis. Calculation formula: The indicator is calculated based on the Land Use Efficiency formula as proposed by the Joint Research Centre (Corbane et al., 2017) up to municipality level for Mainland Portugal: [((TA_n/ Pop_n) - (TA_ n+x/ Pop_ n+x))/ (TA_n / Pop_n) x 100)] x(10/N); Where: TA_n = artificial land in moment (n); Pop_n = resident population in artificial land in moment (n); TA_n+x = artificial land in moment (n+x); Pop_n+x = resident population in artificial land in moment (n+x); N = years between observations
Work flow	ArcGIS Model builder workflow for indicator calculation



The next steps of indicator calculation are carried out using Excel, where input data on “Artificial land” and “Population” for the reference years (2010, 2015, and 2018) is systematised up to municipality level for Mainland Portugal and the calculation formula is applied.

Lessons learned, any gaps, key issues and recommendations

<u>National monitoring</u>

- This indicator benefits from a close articulation between Statistics Portugal and the Directorate-General for Territory, which has shown to be fundamental in order to increase the scope of statistical indicators to monitor the progress of SDG indicators at national level.
- The indicator is part of a set of Land Use and Land Cover Statistics (LCLUStats) disseminated by Statistics Portugal based on the Land Use and Land Cover (COS) Map. The LCLUStats was the first statistical operation disseminated by Statistics Portugal based on EO derived data and on its integration with statistical data, which comprised several challenges on meeting the requirements of the standard statistical methodological document describing the methodological procedures, concepts and classifications associated with a statistical operation.
- The frequency of dissemination is irregular and depends on production cycle of COS, which periodicity is not defined. However, the practice of producing new editions of the COS, taking into account recent history, has varied between three and five years.

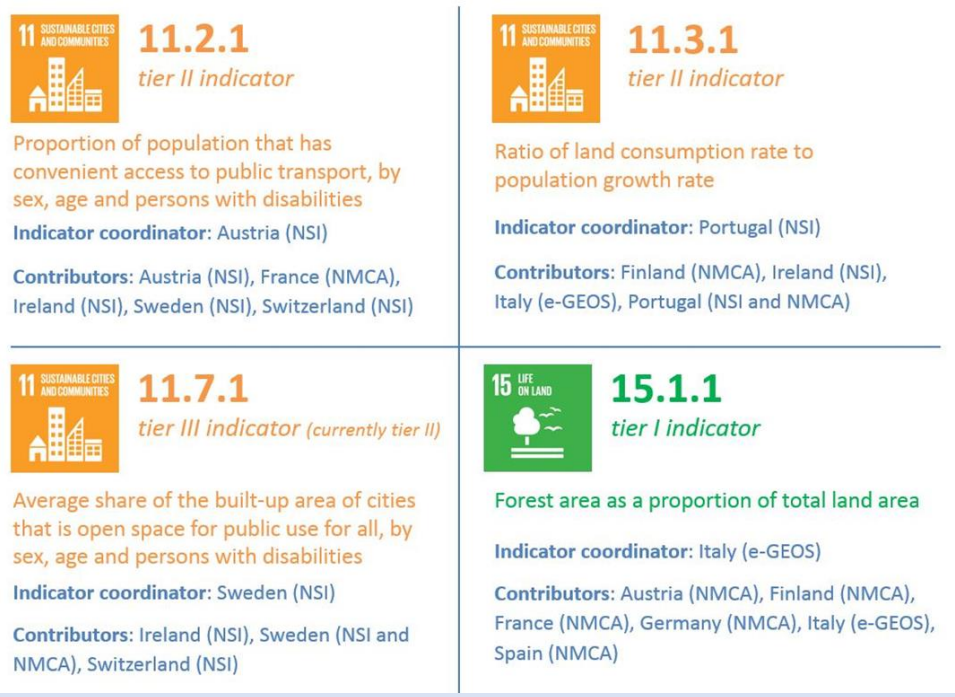
<u>European coordination</u>

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

Lessons learned, gaps and key issues on (1) 'concepts', (2) 'data sources', (3) 'computation and algorithm' and (4) 'challenges regarding the use of geospatial data' have been compiled for four specific SDG indicators (11.2.1, 11.3.1, 11.7.1 and 15.1.1).



Supporting material about this use case. Include links, publications, etc.

National monitoring

Data on this indicator is published in Statistics Portugal website within the dedicated section on SDG indicators.

Efficiency evaluation of the artificial land by inhabitant (%) by Geographic localization (NUTS - 2013); Irregular

An analysis of this indicator is available on Statistics Portugal publication on SDGs. The latest edition - Sustainable Development Goals - Agenda 2030. Indicators for Portugal- 2010/2019

European coordination

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	<u>National monitoring</u> For the purpose of this indicator Statistics Portugal collaborated closely with the Portuguese NMCA – Directorate-General for Territory. Statistics Portugal and the Directorate-General for Territory have been closely cooperating under the scope of a Memorandum of Understanding since 2015 and

	the areas of cooperation between the two institutions have been focusing on bridging statistical and geospatial information promoting data integration, which, amongst other achievements, has resulted in the operationalization of SDG indicators under the scope of the statistical operation on Land Use and Land Cover Statistics (LCLUStats). 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).	National monitoring From Statistics Portugal: - Cátia Nunes, catia.nunes@ine.pt - Inês Fontes, ines.fontes@ine.pt - Francisco Vala, francisco.vala@ine.pt From the Directorate-General for Territory: - Mário Caetano, mario.caetano@dgterritorio.pt - Filipe Marcelino, fmarcelino@dgterritorio.pt - Nuno David, ndavid@dgterritorio.pt 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