

11 – Sustainable Cities and Communities



Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable



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Goal: Make cities and human settlements inclusive, safe, resilient and sustainable.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.

"Currently, an estimated 1.6 billion people live in inadequate housing globally, of which 1 billion live in slums and informal settlements". The rapid urban growth of recent decades has led to an increase of slums and informal settlements, as well as air pollution and inadequate basic services and infrastructure. The lack of proper urban planning and management can bring tenure insecurity, increase poverty, pollution, health risks, as well as a higher vulnerability and exposure to natural and technological hazards. To make urban spaces more inclusive, safe, resilient and sustainable the development, monitoring and management of better forms of urban plans are urgently needed. Many local governments ignore the extent of slums. "Slums disappear not through being removed, but by being transformed", and in order to carry out this transformation the extent, the physical characteristics as well as the dynamics of slums, such as their densification and expansion, need to be understood and monitored. EO can help both understanding and monitoring slums, but can also link their morphology with socio-economic data, as well as help to identify hazardous areas where many of these settlements are located. An increased number of studies in the last 15 years have been published on the use of EO to understand geography and dynamics of slums, thanks to the availability of very-high-resolution (VHR) data and the advances in the methodologies to analyse them. The use of EO can support monitoring of slums and informal settlements growth, thanks to their frequent coverage of large areas, for which it would be difficult to regularly undertake on the ground household surveys. By knowing the dynamics and the extent of slums, sustainable urban plans and slum improvement policies can be developed and monitored, including the improvement of the building structures, access to water, electricity and other basic needs. VHR images are also increasingly used by slum communities and NGOs as a basis for mapping and enumeration, who then use the data to negotiate for recognition and their right to the city and its services.

(eo services based on [Understand and monitor slums & informal settlements. Indicator 11.1.1: Informal settlements](#))

Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

EO data can inform the production of efficient and effective plans for road infrastructures and shipping routes (although, the global coverage of remote sensing images allows the identification of areas currently lacking infrastructures for transportation. This data can be combined with census data to provide more detailed information on public transport that cannot be measured through EO (e.g. railways and subways), as well as data on vulnerable people. EO data has been widely used to extract infrastructures such as urban areas, roads and dams using data at different spatial resolution (e.g. rural roads can be detected just with high resolution images) and different techniques (e.g. supervised and unsupervised classification, neural networks, and mathematical morphology). Research is also currently focused on using high resolution or radar data to monitor the status of infrastructures, particularly in areas prone to natural disasters, such as flooding, but also in areas affected by conflicts (Roberts et al., 2006). The need to plan for regional and trans-border infrastructure is also well served by EO since it is technology that crosses borders and is not limited by a single country's or region's national data collection systems. In theory, open access EO data should help countries collaborate on shared infrastructure projects.

(eo services based on [Assess production & efficiency for road infrastructures & shipping routes](#))

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Urban areas are rapidly expanding to accommodate the growing number of people moving to cities. "From 2000 to 2015, in all regions of the world, the expansion of urban land outpaced the growth of urban populations". An uncontrolled urban sprawl can lead to the increase of carbon emissions, poverty, health and safety risks, social inequalities, and vulnerability to natural disasters. The achievement of this target will ensure that land is used efficiently, allowing sustainability and inclusiveness, but it also provides the foundation for attaining other sustainable development goals related to health, food security, energy, safety and poverty. Urban growth needs to be monitored and managed to ensure the sustainable use of land. The improvement of EO technology and the availability of high temporal and spatial resolution images, as well as the advancement in the methodologies proposed to identify built up areas from satellite images, have created a good opportunity to plan and monitor urban development. EO has been used for the direct monitoring and dynamic simulation of urban expansion since the '60s and new models and methods are continually being proposed and tested. Remote sensing data can support the generation of country specific urban expansion models and inform the development of sustainable urban plans. In particular, they can inform the development of urban plans that include the increase of green spaces where these are lacking, identify where these spaces have the capacity to mitigate natural hazard such as floods, and therefore should be prioritise for protection, which are the most vulnerable areas to disaster, as well as to enhance infrastructures such as roads or access to energy, in poorer areas of the city, to include its inclusiveness. The effectiveness of these plans can then be regularly monitored and adapted through EO.

(eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption)

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

This target seeks to reduce the adverse effects of natural disasters. It recognises the growing impact of natural disasters around the world and the heightened risk, especially to vulnerable populations, e.g. in unplanned urban settlements without adequate protection or planning. It targets both slow-onset, climate related disasters such as sea level rise and extreme weather events. Human loss is the main focus of the target, both in terms of mortality and injury, and negative economic impacts of disasters. This target also relates to targets 1.3, 1.5, 3.6, 3.9, 15.3, 12.1 and 14.2 as well as related targets in the Sendai Framework for Disaster Risk Reduction 2015-2030. EO can play a role in both planning and achievement of this target. For planning purposes, EO can map both the areas that are vulnerable to disasters, e.g. coastal, low-lying areas or areas of deforested, steep slope, susceptible to landslides as well as to map vulnerable populations, e.g. through informal urban settlement mapping. EO also has a role to play in planning for natural disasters by the provision of early warnings systems where flooding, fires and landslides pose a risk to people and their material goods. In order to achieve the target EO can be used to assess the overlap or proximity between vulnerable population and areas prone to disaster and the extent of change in this overlap area in order to ascertain if the human related loss is increasing or decreasing over time. Although not EO-derived, globally gridded GDP data can contribute to the achievement of this target by mapping the geographic location of the poor (see indicators 1.2.2 and 1.2.1).

(eo services based on Mapping of vulnerable disaster areas & early warning systems)

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Minimising the per capita environmental impact of cities is challenged by traffic congestion, lack of funds to provide basic services, a shortage of adequate housing, declining infrastructure and rising air pollution within cities. This target covers aspects of waste generated by cities and aims to reduce the amount of solid waste generated and air polluted, while encouraging better waste management. Therefore EO can be used in three major aspects of this target – the spatial mapping of cities and the sources of pollution, the identification and treatment of waste in and around cities and in planning better waste management for per capita pollution reduction.

Firstly, satellite observations of human settlement are increasingly more sophisticated allowing the impact of cities to be assessed based on their spatial extent and density. EO-derived maps of cities allow the size, shape and other metrics of urban setting (e.g. monitored from which likely environmental impact could be inferred. Within cities there are identifiable sources of aerosol emissions such as power plants and various industrial processes. urban population) to be These sources generate significant amounts of particulates, e.g. fine particulate matter (PM_{2.5}), which can have adverse effects on human health. Remote sensing of dry PM_{2.5} mass concentration near the ground is now feasible. In addition to particulates, trace gases that affect air quality are now routinely monitored over large urban areas.

In addition to air pollution, solid waste management can be supported in cities by using EO as a tool to evaluate the impact of different phases of the waste cycle. In particular, very high resolution EO has been shown to be effective in the detection of illegal waste disposal sites through visual image interpretation and classification as well as the monitoring of the spread of municipal landfill sites using multi-temporal thermal Landsat imagery.

(eo services based on Spatial mapping of cities & waste management. Indicator 11.6.2: Urban air quality)

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

Green and public spaces in cities are important for human well-being and economic development and should be sustainable spaces for all to use equally. Increasingly there are inadequate, poorly designed, or privatized public spaces in cities that generate exclusion and marginalization for inhabitants, especially those who are vulnerable.

This target addresses the drastic reduction in the quality of green and public space in cities and seeks to make them safe and inclusive for all regardless of gender, age or level of mobility. Public space is made of streets and green and open spaces in public use. EO can help countries to achieve this target because it is a useful tool to establish the extent of urban areas as well as to do an inventory of open space in cities, especially green open space. The challenge in using EO to complete the target will be in discerning what private and public space is as they will have the same spatial characteristics from an EO point of view. Furthermore the notion of access is complicated as it implies freedom of movement and this not a practically measurable quantity from EO. Therefore while certain aspects of the target can be planned for using EO, much will depend on other in situ data sources or local ancillary data such as cadastral records, land use or basic topography.

(eo services based on Mapping extend of urban areas)

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