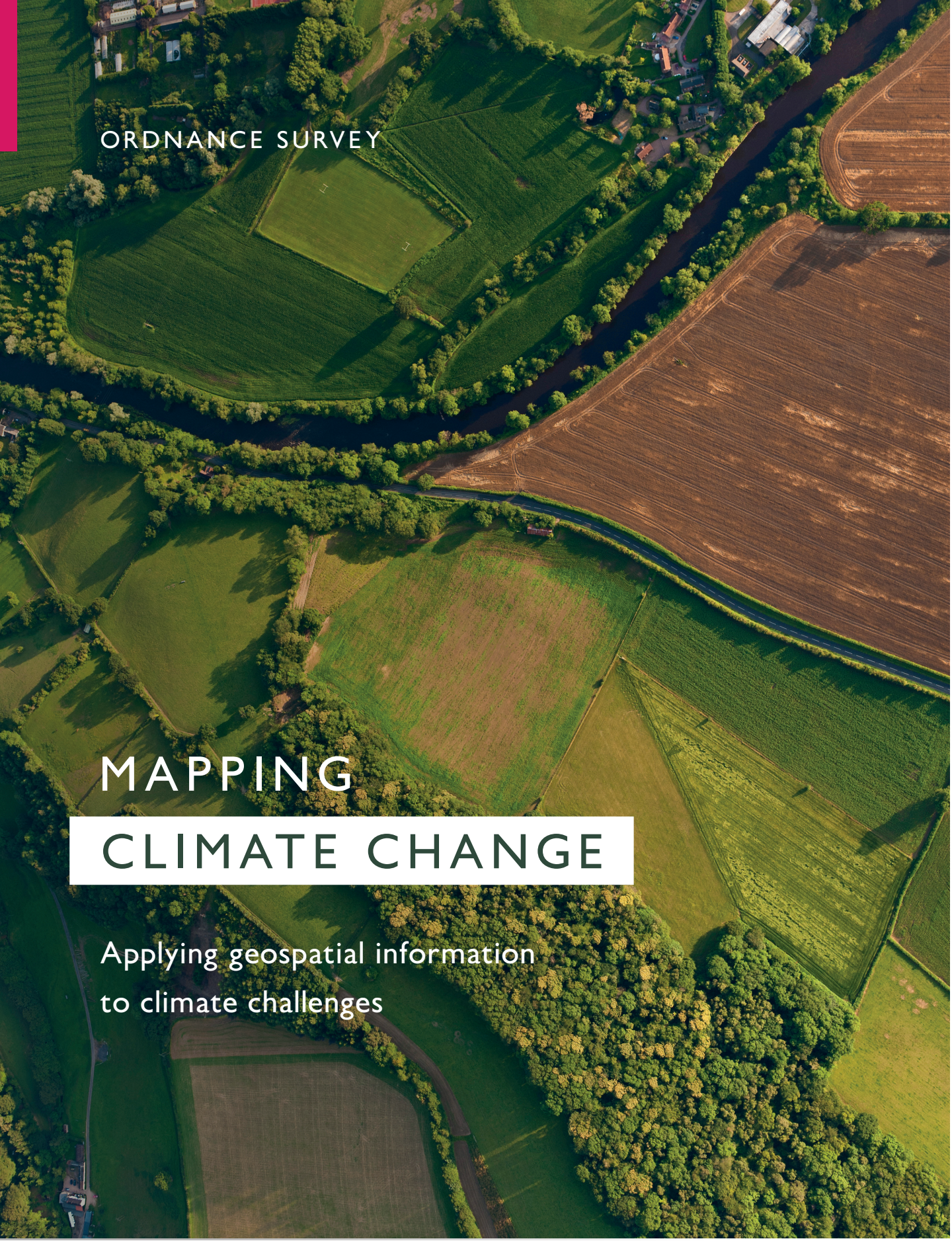

ORDNANCE SURVEY

MAPPING CLIMATE CHANGE

Applying geospatial information to climate challenges

Ordnance Survey

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WHERE TO BEGIN?

The effects of climate change are happening already, and a lot faster than scientists predicted. We must act fast and act together to ensure sustainable lives for people and our world.

Across the globe, billions of pounds are being invested into measures to tackle climate change. The UK alone will need as much as £20bn a year by 2050[1], and government authorities need data in order to make informed investments.

How can they identify high risk areas? How can they know that they are investing in right areas, and then measure the impact their investments have made?

We need to map and monitor our planet to enable the creation of innovative solutions for a sustainable world.

And it seems only fitting that geospatial (location-based) data can help decide where to start.

1. https://www.theguardian.com/environment/2019/sep/28/uk-needs-billions-a-year-to-meet-2050-climate-targets

OS data mapping greenspaces in London.

Sustainability through mapping

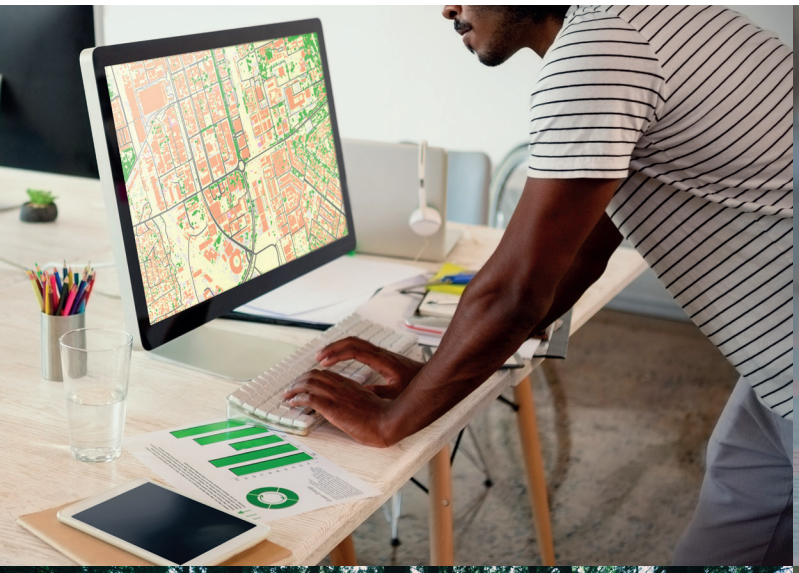
Geospatial technologies are an important tool, providing the ability to monitor and manage environmental changes, and provide insights and targets. Geospatial data can be used to:

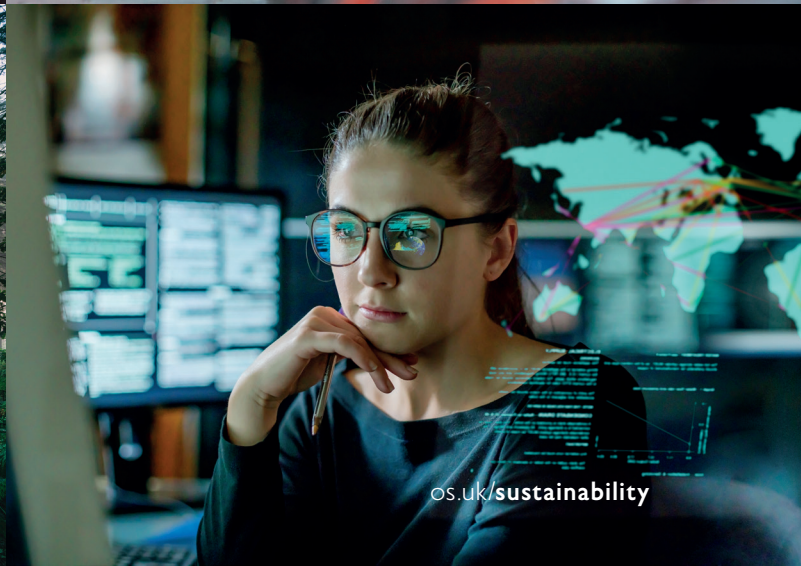
- gain insight
- track successful measures
- drive innovation
- support public services
- underpin decisions and investments

Usually, the way in which geospatial data is used follows this very system. It helps identify problems, monitor them, develop new concepts, and make decisions.

This report will explore the numerous and various examples which demonstrate the significance and capacity of geospatial data, and how – with the right idea, and application – it can deliver innovative and viable solutions.

Talk to us about sustainability ›





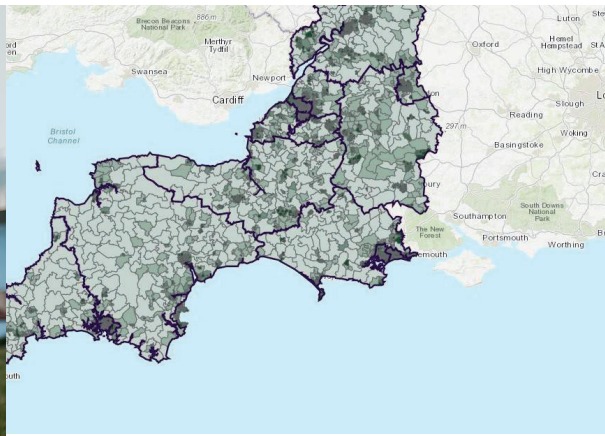
USING GEOSPATIAL DATA TO TRACK TRENDS

2

Before authorities and organisations can start to develop their solutions and make their investments, they need to know what issues need to be solved and where; and if possible, the severity of them to then prioritise accordingly.

Fortunately, maximising the use of geospatial data is not so different to how mapping is being used today. Maps are consistently used to show trends; from Covid-19 hotspots to discrepancies in house prices, and even visual maps combined with aerial imagery which demonstrate the effects of urbanisation.

Geospatial data can track, and then ultimately manage and measure, the effects of climate change.



For example, The Green Space Index (above) analyses provision of publicly accessible parks and greenspace.

Air pollution

Air quality is a significant concern for governments and has been for some time. The World Health Organisation (WHO) estimated in 2018 that nine out of ten people breathe air containing high levels of pollutants[2]. Now, with 91% of the world's population living with levels exceeding safe limits, and air pollution linked to 4.2 million deaths per year[3], improving air quality to protect our health is paramount.

However, air quality can be specific to a location, and it can differ dramatically within certain timeframes, or distance from both the source – i.e., roads and buildings – and green spaces. Geospatial information is a valuable tool in assessing air pollution and can help make better choices through hyper local air quality monitoring and real-time pollution maps.

Environmental Defence Fund Europe (EDFE) has partnered with the Mayor of London, to monitor the quality of air in London. It often exceeds safe limits but identifying pollution hotspots to implement measures will help to lower the pollution levels[4].

The problem can be difficult to visualise and subsequently hard to address through policy measures, but with geospatial data providing detailed, real-time data in a format that is easy to visualise, it presents a range of actions that city leaders could take immediately, with long-term benefits for the city.

2. https://www.who.int/westernpacific/health-topics/air-pollution
3. https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/ambient-air-pollution
4. Real-time pollution London - How pollution data can lead to cleaner air | Geospatial insights (ordnancesurvey.co.uk)

Environmental risk

The Covid-19 pandemic has led to an expansion of the rental market, as commercial buildings are being converted to residential use. However, with this property shift, local authorities, emergency services, and commercial organisations need a strong understanding of matters regarding individual properties, access, and purpose of use.

The land and property landscape is underpinned by growing political pressure to build the right houses in the right places. Therefore, to streamline the process of property planning and development, risk management organisation, Balkerne, has greatly benefitted from the OS data and OS Features APIs. They built their own SmartResilience platform.

As the effects of climate change continue, and extreme weather events become more frequent, Balkerene's risk management will be more beneficial; perhaps even a necessity.

Landscape changes

A coastal change planning tool has been developed for the Scottish government and local authorities, as well as communities and businesses to adapt to erosion.

The Dynamic Coast project[5] has developed this tool, using a new set of maps to build resilience and adapt to the pressures of climate change and sea levels rising.

An estimated £1.2 billion of Scotland's buildings, transport infrastructure, cultural, and natural heritage may be at risk of coastal erosion by 2050, according to new research. Phase 2 of the project adds a climate change layer to these projections producing a more realistic picture of our future coastline.

A change of investment

The Dynamic Coast project also helps to review previous, or existing solutions and investments. In the past, a common approach was to build seawalls. While in some locations this is necessary, doing so sacrifices the beach in front and the land adjacent to the seawall.

Construction and maintaining seawalls also result in ever-increasing repair costs.

Instead, climate leaders are realising it may be more sustainable to move assets out of harm's way, rather than interfere directly with the coast itself, and allow the beach to move inland.

The UK Environment Agency believes that adaptation is now just as vital as mitigation. Instead of altering the landscape, we need to become sea level wise, and we should use nature's defences better in the short term, and flexibly plan to adapt.

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5. Dynamic Coast project - Support to protect Scotland's coastlines - gov.scot (www.gov.scot) & Dynamic Coast

VALUABLE INSIGHT FROM MAPPING

3

Geospatial data is a versatile tool. It has been used to track the effects of climate change, and then monitor ongoing changes. It can also identify specific areas that require attention, such as green spaces, or locations at higher risk of pollution, or changes in temperature.

An inverted heatmap displaying the distribution of Peatlands.

For example, the OS MasterMap Greenspace dataset helped reveal that 60% of Edinburgh and Aberdeen are made up of green space. Greenspace Scotland identified these spaces as vital sources for clean energy production – places where low carbon heat can be harvested using ground source heat pumps to heat homes and businesses.

Elsewhere, the Milton Keynes: Smart Future Cities project is a large collaborative initiative, which helped to develop innovative solutions to support economic growth in Milton Keynes. Using various location-based datasets from OS, it became possible to analyse the suitability of residential and commercial gardens for ground source heat pumps (GSHP), which extract warmth from the ground to heat radiators and water in the home. It could also explore roof suitability for installing solar panels.

The Greenspace Scotland project, and the advancement of smart cities, both succinctly demonstrate how geospatial data can be used to map and monitor environments; it can also help towards building solutions to resolve issues, and in turn, monitor the effectiveness of those solutions.

OS MasterMap Greenspace dataset, analysing greenspace distribution across Aberdeen.

An ongoing solution

Space-enabled technological advances, using geospatial data, are being used for peatlands monitoring and climate action.

Peatlands are a type of wetlands that occur in almost every country on Earth, currently covering 3% of the global land surface, and 12% of the UK's land area. They preserve global biodiversity, provide safe drinking water, minimise flood risk, and help address climate change.

Critically, Peatlands are the largest natural carbon store on land. These 'Carbon Sinks' store more carbon than all other vegetation types in the world combined. Their preservation is essential.

However, 86% of the UKs peatlands have been degraded due to human activity, vastly decreasing their capacity for carbon storage, affecting biodiversity, and adding to greenhouse gas emissions.

Geospatial data is being used to monitor, protect, and preserve peatlands[6]. This will ensure these vital carbon stores continue to take in carbon dioxide and reduce the overall levels of greenhouse gases in our atmosphere.

6. https://www.ordnancesurvey.co.uk/business-government/environmental-sustainability/geospatial-sustainability-trends/preserve-carbon-sinks

Sustainable from the start

What if you wanted to ensure that a settlement is built in a sustainable way? Sustainable urbanisation is being helped by new and faster mapping techniques.

Implementing a sustainable infrastructure of roads, waste, water, and power, is possible with reliable geospatial data. OS has piloted the creation of an automated digital base map of Lusaka, Zambia[7].

The basemap provides the foundation for insight into informal settlements, the risk of flooding and climate impacts, and lack of infrastructure. OS provides the ability for authorities to mitigate against climate risk, create resilient cities, and ensure population have access to key resources such as health care.

An aerial image of Lusaka, Zambia (top) alongside the digital base map (bottom).

7. https://www.ordnancesurvey.co.uk/newsroom/news/using-ai-to-map-african-cities-to-improve-infrastructure-at-low-cost

What do you want to measure?

These valuable projects and innovative concepts are made possible with access to detailed, and accurate geospatial data. You can only manage what you can measure, and geospatial data provides a wide spectrum of measurable concepts:

Environmental changes

Satellite Earth Observation (EO) data has long been an important source of information for measuring and monitoring how the environment is changing. Having since integrated machine learning and artificial intelligence, EO data is now easier and quicker to use, helping governments monitor climate change more effectively.

Satellite view of farm production in Saudi Arabia

22

As of 2018, the 20 warmest years on record globally have been in the past 22 years.

4°C

The planet could warm by more than 4°C by 2100 with potentially drastic consequences.

Changes in temperature

As our planet continues to heat up, climate events will increase. Recent severe weather demonstrates climate change is happening faster than predicted.

Geospatial data is being used to monitor weather events, and map high risk areas.

OS has collaborated on a project[8] which uses satellite data to monitor and map heat in locations at greatest risk of climate change. The Earth observation data can indicate extreme events, and locations that may show greater risk to human health, such as cities where heat stress is a particular concern.

This will provide valuable insight into the impacts of climate change in hot spots across the UK and beyond, and governmental authorities will be able to tackle climate change more effectively.

8. https://www.ordnancesurvey.co.uk/newsroom/news/space-data-helping-earth-adapt-to-challenges-of-climate-change

High risk areas

'Heat Hazard Postcode' provides a map of 'at risk' areas to help manage the effects of extreme weather. Developed by 4 Earth Intelligence (4EI), satellite imagery and algorithms were used to create a free map that identifies literal 'hot spots' within urban areas where temperatures get higher.

London Borough of Lambeth intend to use the heat maps in conjunction with other data, such as indices of multiple deprivation, and flood mapping, to target the areas of greatest need.

This data and technology could be used to further develop climate monitoring and resilience products, to combine with other datasets such as flood risk and air pollution, and census outputs, to get an idea of how other issues are impacting the population.

OS worked with Environment Agency, Abu Dhabi (EAD) to help capture, maintain, and analyse environmental information to support their 2030 Vision, by monitoring and tracking the growth and health of important vegetation, such as mangroves and palm trees.

Satellite images and Earth observation data create heatmaps (above, left) which can indicate locations such as cities where heat stress is of particular concern.

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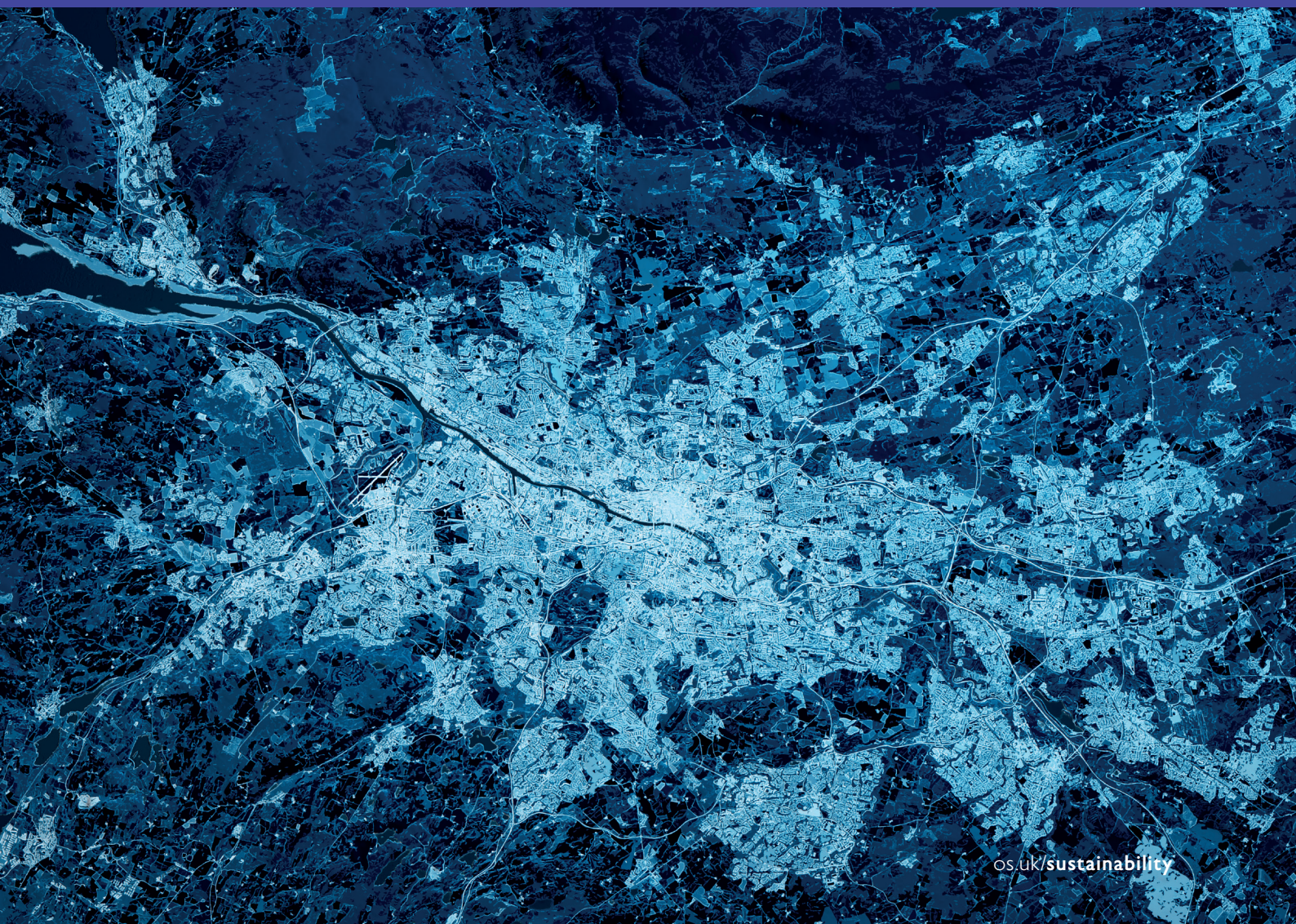
SUSTAINABILITY THROUGH MAPPING, ACROSS SECTORS AND INDUSTRIES

4



Climate change can disrupt different sectors, separately, and in various ways, but though these challenges differ between organisations, geospatial data can be a valuable asset to all of them.

For example, banks, property realtors, and government authorities use geospatial data to analyse environmental changes and assess risk in urban environments. This benefits the property sector, by better understanding existing buildings and communities.

But what about installing new infrastructure?

New behaviours require new infrastructure

The transition to electric vehicles (EVs) is a necessary change and will help improve air quality and reduce emissions.

To help plan EV infrastructure, the Department for Transport, and the University of Exeter, worked out which properties can accommodate private EV charge points via the household electricity supply.

As an added bonus, OS is supporting the energy and infrastructure sector to understand where renewable energy can plug into the grid and decide where electric car charging points can be implemented, to drive decarbonisation in the energy system. Renewable energy powering electric vehicles[9].

To first analyse off-street parking availability, the DfT used AddressBase Plus and combined datasets to classify residential dwellings as 'parking possible' or as 'no parking' (top).

9. https://www.ordnancesurvey.co.uk/newsroom/insights/mapping-the-uks-energy-network

The Africa Regional Data Cube

The Africa Regional Data Cube (ARDC) is a tool harnessing the latest Earth observation data and satellite technology to help Ghana, Kenya, Sierra Leone, Senegal, and Tanzania address various issues relating to agriculture, food security, deforestation, urbanisation, water access, and more.

Earth observation data and satellite imagery can promote food security to help end hunger. The ARDC can improve monitoring of vegetation cover, and can also detect change, comparing vegetation over time while balancing for seasonal variation.

The ARDC is an illustration of what is possible when partnerships, data, collaboration, and innovation are leveraged to power progress.

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COMBINING DATASETS AND OVERLAYING FOR THE 'BIGGER PICTURE'

5

Geospatial data is obtainable, accessible, easier to use, and capturing valuable insight; but what about combining datasets? Adding multiple views into one singular, highly visual system that can help map, monitor, and manage the effects of climate change, and the efforts to then overcome them.

Above is an example of the same location, displayed in layers from different datasets, which can be combined to enable more in-depth analysis.

(Clockwise from top left: OSMM Imagery, OSMM Highways, Vectormap local, and OSMM topography.)

In-depth analysis

Energy Networks Association (ENA) is working with Ordnance Survey (OS) and ISpatial to build a digital system map of the UK's energy system. Network data from all Britain's electricity and gas network operators will be pulled into an integrated, digital energy system map covering Great Britain. The map will provide customers with information about energy network assets, where those assets are located as well as who owns them, plus generators, and energy-intensive users.

This impressive undertaking and collaboration will help create a digital system map which energy networks operators can use to better serve their customers, and develop quicker, more efficient, and cheaper ways to deliver a cleaner energy system.

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Digital Twins

Geospatial data and innovative technology can be combined to create new ways of learning, reporting, and planning. A perfect example of this is the creation of a Digital Twin.

A Digital Twin is a digital model of an urban landscape – a town, or a city – that incorporates multiple datasets to create a single 3D visualisation of the chosen area. This can plot assets both under and above ground, including smaller details such as natural features, and even traffic lights. This method provides geospatial data with immense attention to detail, which helps organisations such as local government and councils to better plan largescale projects, and measure the impact before any changes are made, helping save money, time, and resources.

Digital Twins can be used with urban planning, not only for cost saving by using data to 'get it right first time,' but to help the construction industry keep up with the pace of emission reduction.

IMPROVING THE PRESENT AND PLANNING FOR THE FUTURE

6

Location data is not just about maps; it is a core capability to help solve climate change issues. With customers and new technologies requiring near real-time updates, we will continually invest in data capture and processing innovations, to enhance our mapping capabilities.

Mapping with artificial intelligence

Artificial intelligence has been a fundamental enabler for driving efficiency and by harnessing machine learning techniques, the process to deliver change detection effectively to customers is now automated, faster, and even more accurate.

These advancements have already delivered significant benefits to farmers across the nation, our AI-powered technology helped identify thousands of miles of hedgerows from aerial imagery allowing farmers to apply for subsidies and farm with precision to improve yields.

Predictive analysis

AI and predictive analytics could be used to scan location-based infrastructure data to predict and prevent system-wide vulnerabilities across the country.

Historically, resilience planning focuses on a reactive, not proactive, approach, such as preparing an emergency response to a flood or drought only after it has happened.

However, harnessing geospatial data and better understanding infrastructure system performance allows for the possibility of proactive resilience planning. Prevention and mitigation of natural disasters is more achievable before they occur, by way of simulation, and vulnerability reduction.

Proactive planning can also be applied elsewhere. Insights from data could be used to model potential future vulnerabilities in planned infrastructure. Everything, from new 5G pylons to electric vehicle charging grids, could be designed around preventing and mitigating them.

Geospatial data is not only helping monitor and improve change; it is actively driving it.

How geospatial data can benefit the customer

The examples shown in this report demonstrate how accurate, and up-to-date geospatial data can be used to:

- gain insight
- underpin decisions and investments
- drive innovation
- track successful measures
- support public services

It follows a gradual process, which any organisation or any government authority, in any country, can adopt. You can use geospatial data to track the development or changes of a location, gain insight which can help inform decisions and investments, build solutions, and make positive change against the effects of climate change.

And it doesn't have to be done individually. We encourage greater data sharing, and collaboration between organisations and sectors. The unity between governmental authorities, private organisations, charities and so on, as explored in this report, demonstrate what can be achievable when people work together.

Currently, utilities, telcos, local government, and many other sectors aren't able to maximise the benefits of the data they already hold. Resolving these issues and supporting data communities will greatly benefit in developing geospatial solutions and improve our shared arsenal in combating climate change.

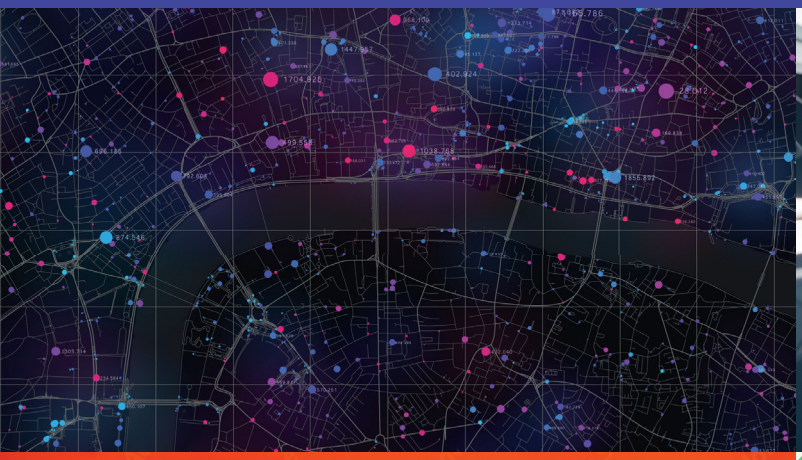
True success, however, will be measured in how quickly and evenly we adapt and mitigate against climate change.

When we look back in 10 years, we want to see that geospatial data brought clarity to our decisions, sped up our actions, and improved collaboration between governments and industry in preserving our fragile planet.

Talk to us about sustainability ›

This report has contained numerous examples of how OS data can be used to create new geospatial solutions – and it could just as easily help you and your organisations achieve your own sustainability goals.
We want to hear from you, and to help you as best we can.

Talk to us about sustainability >



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