.the environmentalist

environmentalistonline.com

December 2014

Rr 27 ⁷/₉

KILOWATTHOURS

S ● CL200 240V 3W●TYPE J5S 30TA 7.2Kh ●
F
5C74734
TC-35
401-50300-9
*IFS09S274734EH *
98 274 734
60Hz

Energy savings
Preparing for ESOS

iema
Institute of Environmental
Management & Assessment

The view from above

Lucie Ponting discovers how satellites and remote-sensing technologies are aiding companies like Drax and Ecover

Landscape intelligence is how earth observation data specialist Rezatec describes its use of satellite and other remote-sensing technologies to help businesses manage their land-based assets and respond to environmental changes.

Since its formation two years ago, the company, which originated at University College London (UCL), has used earth observation (EO) techniques on projects ranging from measuring carbon stock to mapping Mallorca's bio-economy. Partners include organisations as diverse as the European Space Agency (ESA), green cleaning products manufacturer Ecover, British Sugar and power generator Drax.

"Threats to food and water security and pressure to find new sources of renewable energy are placing ever-increasing demands on our land and its use," says Philip Briscoe, Rezatec's marketing director. "Landscape intelligence, which involves collecting and scientifically analysing satellite and other EO data, can help us map, measure and monitor land so organisations can optimise use, mitigate risks and meet legislative requirements."

Satellite and other aerial observations have long been used to forecast weather, monitor climate change, identify natural hazards and track biodiversity trends. But Rezatec, which is based at Innovate UK's (formerly the Technology Strategy Board) Satellite Applications Catapult within the Harwell Space Cluster, has developed an innovative software platform that is cutting the cost of incorporating sophisticated satellite and other aerial and ground-based data into business decision-making.

Innovate UK, a non-profit research organisation, set up the Satellite Applications Catapult – one of seven catapult centres serving different sectors – to help businesses take new ideas connected with space and satellite technology, and develop them into commercial applications. "Being here in this building is extremely useful because it puts us at the centre of UK space technology," emphasises Briscoe.

Leaf area index

Rezatec – which employs staff with backgrounds in software development, EO tools, and forest and agricultural management – was set up to calculate carbon stock in agricultural land and forests, and build a global database. "At UCL," says Briscoe, "they saw an opportunity to derive carbon stock from above-ground biomass, providing a more cost-effective and scalable way of estimating the amount of carbon residing in a particular area.

"Traditional methods are ground-based and expensive. You can't do it very frequently and you can't really scale them. So we took well-established data available from NASA's MODIS satellite and from there derived a leaf area index that identifies how much of an area is leaf." Rezatec then incorporated other landscape intelligence on issues such as slope, elevation and soil type to estimate how much carbon was in a particular section of forest, given the leaf area index. "From that – using modelling and regression analysis – we derived a carbon number per kilometre squared," says Briscoe.

Earth observation

Earth observation (EO) uses remote sensing technologies such as satellites and aerial sensors, supplemented by ground-based observation, to gather information about the earth's physical, chemical and biological systems. Data gathering techniques include:

- satellite – multispectral data can be used to monitor and detect changes in vegetation health and synthetic aperture radar (SAR) data to measure soil moisture and topography;
- aerial and unmanned aerial vehicles (UAVs) – UAVs can help measure a crop through its growing cycle; and
- ground observations – smartphone applications can collect and upload field data to verify remote sensing information, such as evidence of illegal logging.

Given the lack of stability in the carbon market, the company decided to look at where it could apply the technology it had used in carbon modelling to other commercial activities. "We took the idea of landscape intelligence – understanding the land and using whatever type of EO data and techniques we need to do that – and focused on key areas such as food, water and energy," says Briscoe.

The decision to concentrate on these areas was triggered by higher-level global requirements. "Water security, for example, is always a huge issue," Briscoe says. "And not just for drinking water but also for agricultural use; how do you manage that?" On the energy side, the search for renewable sources is intensifying as oil and gas reserves run out. "If we look at biofuel and biomass, we can use EO techniques to help demonstrate compliance with sustainable forestry management and biomass production to fulfil EU and UK legislation." In the agricultural sector, EO techniques can tackle food security issues – helping food manufacturers and suppliers ensure security of supply sustainably. "Brand protection and reputation are critical," says Briscoe. "The last thing a brand wants is to be involved with a supplier causing deforestation or biodiversity loss, and organisations can't transfer responsibility to the farmers or other suppliers."

Rezatec's concept of landscape intelligence is based on the belief that all these issues are ultimately linked. "It's about understanding the best way to use land and EO gives you a way of doing that," explains Briscoe, "which perhaps wasn't possible in the past, and certainly not in any scalable way."

Map, measure, monitor

Rezatec maps, measures and monitors data available from an array of sources. "This might sound a bit simplistic," says Briscoe. "But you need to map and understand what you've got, then be able to measure and analyse it, and then, because it's not a one-off process – some investments in different practices take years before they produce results – you need to monitor those changes."

A biomass blueprint

In August this year, a business-led consortium involving Rezatec, power generator Drax, consulting firm E4tech and the University of Edinburgh announced a nine-month project to develop a service providing biomass and bioenergy firms with more accurate data to certify the origin and sustainability of wood biomass.

The project will assess the environmental impact of Drax's wood pellet production from forest feedstock in north America using Rezatec's methodology for extracting carbon estimates from earth observation (EO) data. Dr Ausilio Bauen, director of E4tech, said his company had initiated the project because it believed EO information would be important in determining and monitoring the sustainability of biomass for energy.

Nigel Burdett, head of environment for Drax Power, emphasised that Drax would purchase only biomass that could be proven to have been produced in line with the company's sustainability policy and exceeded thresholds set by Ofgem for subsidy support. "We're aiming to be the benchmark for knowledge around determining the temporal carbon flow consequences of biomass for energy," he added.

Rezatec chief executive Patrick Newton said he hoped the project would overcome the challenges of obtaining cost-effective and accurate datasets to support sustainability obligations and serve as a "blueprint for sustainable biomass production".

The process starts with gathering data if necessary and available, or commissioning research for new data, from disparate sources such as satellites, unmanned aerial vehicles (UAVs), otherwise known as drones, or ground-based options such as smartphones and tablets. "For some of the work we've done with peat monitoring in south-east Asia, we've developed apps for mobile phones or tablets," says Briscoe. "People can go out to the fields, make observations and do things such as measure peat depth. This information is then sent dynamically to a central system, so it automatically updates."

As the data is collected, experts from a range of disciplines apply scientific modelling and analyses to take measurements and monitor change based on organisations' individual requirements. Relevant data and analyses are displayed using a secure, customised platform interface. The Satellite Applications Catapult provides additional support by helping to store and manage project data at its climate, environment and monitoring-from-space facility.

"Within the business, we've got commercial people, EO scientists who can use the tools and understand the environmental context, and software engineers who can develop new tools to bring together data, analyse it and present it," says Briscoe. "But while we've got a peat expert and a carbon expert, we won't necessarily have someone who knows about specific crop modelling, so we will then work with a university or a specialist consulting organisation."

Waste and pollution

One of Rezatec's recent collaborations was with Ecover on its "Glocal" project in Mallorca alongside Forum for the Future, the sustainability think tank. "We worked with Ecover on a pilot looking at the feasibility of mapping natural resources on the island and then using waste products from crops and farming – seeing which of those waste streams could be turned into cleaning products," says Briscoe. "The idea was to create a new kind of circular bio-economy, providing an economic boost for different clusters on the island."

Using EO data, Rezatec mapped the location of crops, which included olives, citrus fruit, vines and carob. "Using the dashboard for this project, we could drill down and look at the different layers of information to show where the crop is grown, its density and type, and the amount of crop waste," says Briscoe. This data then provided the starting point for the University of Barcelona to analyse the different waste products and look at which of these could be turned into something useful.

"It was a theoretical project to learn about the potential of the bio-economy," says Briscoe. But he believes the approach could benefit larger ecosystems, and even be applicable to a whole country. "Our techniques help us understand agricultural waste streams, which can help identify where waste can be transformed and used to create new products, with potential benefits to whole industries, livelihoods and wider economies."

Another area in which Rezatec has been working is catchment management. "We've been helping water companies in the UK manage water quality by looking at agricultural land use and related sources of diffuse

pollution," says Briscoe. "If there is a particular crop or perhaps cows grazing adjacent to a river, we can map that using EO and analyse the risk of diffuse pollution." The water companies and landowners can then work with agronomists to decide on mitigating action, such as buffer strips or altered farming practices.

Initially the risk map offers a coarse-level view of a catchment by bringing together publicly available datasets. From this, it is possible to identify likely risky areas to investigate at a much finer level. "If the coarse-level data triggers a risk indicator, we can then commission UAV or buy commercial data to identify the precise pollution sources," says Briscoe.

Because many water companies do not own the land, the catchment management approach relies on the wider involvement and cooperation of farmers and landowners upstream. Farmers can have a unique view of their farming practices from the EO data, and help provide real-time ground-data collection, for example by flagging via apps for tablets and smartphones when particular fertilisers are applied to specific fields.

Peat spotting

Rezatec's project with ESA involved developing a "peat spotter" data service that offered a cost-effective and accurate way to identify peatlands and their integrity over large areas. "We've worked in south-east Asia on tropical peatlands as well as on temperate peatlands in the UK," says Briscoe. The aim was to better understand the structure and integrity of the peat – its extent, depth and state of degradation, as well as the associated vegetation types, soil moisture and degree of anthropogenic disturbances. "This information means you can calculate things like its carbon volume and decide where to apply restoration and conservation efforts," he says.

Peat sequesters more than twice the carbon stock of forests worldwide, and is also an important source of drinking water and habitat for plants and animals. But both tropical and temperate zone peatlands face significant threats. "So much of it has been dried out and degraded for all sorts of reasons," says Briscoe, "whether it's been burnt or reused for farming."

As with the catchment management work, the first stage is a coarse assessment to identify high-risk areas and prioritise where restoration work is likely to be most effective. "An area of less degraded, deep peat will give you a much better return in terms of carbon storage or ability to store water," explains Briscoe, "as opposed to a degraded, shallow area. Of course, ideally you'd want to do it all, but that's not realistic."

In future, he hopes it will be possible to do further work with plantation owners in south-east Asia to improve the quality of their peat and, for those who want to change land use, help them identify the most valuable peat areas and work with them to find alternatives.

Crop yield optimisation

Crop yield optimisation is another area where EO techniques can offer organisations a broader perspective. In a project funded by Innovate UK, Rezatec has been working with British Sugar and agribusiness consultancy Rectory Farmhouse to examine how to increase sugar beet yields by analysing the plant through the growing cycle via satellite, UAV and ground-based observations. The idea is to help UK growers make the most of local environmental conditions to increase annual yield and for British Sugar to have more transparency in its supply chains.

In this case, the Rezatec dashboard includes embedded data about each field and grower, as well as the status of the plants (how many and when they were planted). "Essentially what we're measuring here is the space between plants – the amount of soil you can see – which provides the indicator of how large the plant has grown," says Briscoe. This is then compared with the industry-growing model, ABSugar BEETGRO. "At each point, from when the seeds emerge, through the growing season to harvest, we're taking observations and calibrating them," he adds. "We can then work out the health of the plants and allow the farmer to take mitigating action." If plants are stressed, they might need more water or spraying, for example.

For British Sugar, which is the sole beet buyer in the UK, the EO data can help it to understand its supply chain and better estimate what volume of beet is coming into its production facilities and when. "They know that if the plant is x cm across at a certain point, it is, say, 10 days from that point to harvest," says Briscoe. "So they know a particular field or farmer will harvest on a particular day and a certain volume is coming in to them.

"You can apply this approach to any crop and any geography," he adds. And there are even wider implications associated with improved prediction of supply and prices. "On a commodity trading level," he suggests, "if you have insight into perhaps what the wheat harvest in Ukraine is likely to be, this could invaluable."

Future proofing

Briscoe acknowledges that, although the technologies Rezatec uses are "exciting and different", organisations also need to understand how these bring benefit to their bottom line. "It is not just about seeing things they would not otherwise be able to see, but also about risk and reputation management, optimising land-based resources and managing compliance."

With technologies developing all the time, and the costs coming down, the potential benefits are only likely to grow. "We are particularly interested in the new nanosats [very small satellites of 1-10kg] that are increasingly going up," says Briscoe. The other big development is the ESA/EU Copernicus programme and its sentinel satellites. Sentinel-1A is now up and operational. "This will be SAR [synthetic aperture radar] data, which is very good for looking at things like soil moisture and will help a lot of the things we do," he says.

"Issues such as climate change and food and water scarcity are massive global challenges but, at an individual level, all organisations are going to have to adapt in some way," Briscoe adds. "They have to be realistic; they have to look ahead and EO analysis allows them to do that and be more intelligent with the resources they have."

Lucie Ponting is a health, safety and environment journalist.