

## Welcome

In this bumper edition of Sphere we are focusing on our Environment Systems Data Services which has been operating for the last two and a half years. As well as providing third parties with a rich vein of analysis-ready satellite data this availability is also having a considerable impact on our own and other collaborative projects. The prospects are very exciting. This issue also marks the launch of 'eSphere' which is delivered by email; read on to find out more. [editor@envsys.co.uk](mailto:editor@envsys.co.uk)

### BS8555



Environment Systems has an Environment Management System (EMS) which is accredited to BS8555:2003 Phase 2. An EMS serves as a tool to improve our environmental performance, quite important for our credibility as an environment and agricultural data consultancy! The EMS provides a framework for how our performance can be monitored, controlled and improved. We have just passed our annual inspection. Over the years we have faced environmental challenges as the Company has grown and moved into larger premises. We are constantly alive to the challenges we face in improving our performance. During 2017- 18 we have:

- Reduced the amount of waste generated per person by 17%
- Reduced the amount of waste that went into landfill by 13%
- Recycled 3.4 times the amount of waste going into landfill
- Achieved a ratio of nearly 1:6 between waste going to landfill, and waste being composted

### eSphere



We send out this newsletter by post four times a year and have done since 2011. We've always wanted to reach a wider audience but been wary of adding yet another newsletter to our clients' and contacts' inboxes. That said a number of people have asked if Sphere was available by email or online. Sphere has always been available online as a viewable and downloadable PDF ([envsys.co.uk/about-us/#sphere](http://envsys.co.uk/about-us/#sphere)) but we thought it might be time to make an email version. Our compliance with GDPR means that we will only send to those who want to receive it or who have signed up to receive news from us. If you want to change your subscription to receive eSphere please email: [editor@envsys.co.uk](mailto:editor@envsys.co.uk)

### EXPO AGROFUTURO 2018

In August we travelled as part of a delegation from the Department of International Trade to showcase British companies, on the British Embassy stand at Agrofuturo 2018 which took place in Bogotá, Colombia in August. This well-attended event focuses on the agriculture sector and is considered to be the leading business and knowledge event for the Agro industry in Latin America. On the stand we presented our Data Services products and SENCE natural capital solutions.

Our Senior EO & Business Consultant, Pascale Bodevin, featured in a promotional video ([youtu.be/NMd3PRu16hk](https://youtu.be/NMd3PRu16hk)) for the event explaining how Environment Systems was using EO in the EO4cultivar project.

The EO4cultivar project that Environment Systems is leading in Peru and Colombia provides for three fully funded PhD studentships in the UK. One of these, Christian Silva, presented a paper at the recent International Geoscience and Remote Sensing Symposium (IGARSS 2018), which took place in Valencia, Spain in July. Christian's paper covered the use of Sentinel 1 'polarimetry' (PolSAR) data and its role in improving the monitoring of agricultural fields, identification of specific crop conditions, growth stage and change detection. Polarimetry deals with the way that radar 'backscatter' is related to geophysical properties on the ground.



### Ecosystems In A Changing World

Katie Medcalf, our Environment Director, together with Natural Resources Wales (NRW) will be presenting at the ESP (Ecosystem Services Partnership) Conference being held in San Sebastian, Spain in October ([esconference.org/eu2018/](http://esconference.org/eu2018/)). The Conference is organised under the theme: 'Ecosystem services in a changing world: moving from theory to practice'.

The conference is considering how ecosystems are essential to human wellbeing and will bring together practitioners to grow understanding of ecosystem functions and services to meet the demand from both policy makers and practitioners for guidance on how to implement ecosystem services.



In the joint presentation 'Mapping ecosystem services in Wales for health, well-being and environmental resilience at a local to country scale' we will focus on our work in the mapping and modelling of ecosystem services in Wales. Identifying areas with opportunities to enhance ecosystem services where there is a high demand. This data is a key information source to underpin the work of NRW to meet the Welsh Environment Act (2016). The talk will conclude by demonstrating how the maps are being used in practice at a local level with communities and stakeholder groups.

### Rob Rokosz



Rob joined us this summer as a software developer, adding expertise and experience to our growing software team. Previously Rob has worked as a software engineer in the retail sector and more recently at DVLA in Swansea. He has a degree in Computer Science from the University of Wales, Swansea. Rob is working within our Data Services team splitting his time between software development and project based software support.

# Data Services Focus

There has been huge growth in the availability of satellite data in recent years. In most instances the data remains expensive and in the hands of the specialists. The Copernicus Sentinel program has opened up many opportunities to bring Earth Observation (EO) data into the mainstream. We have taken advantage of this open data source and for the past two and a half years made some of it available via Environment Systems Data Services. Our Data Services remove the hassle of managing and processing terabytes of data; users simply choose a product, an area of interest, a chosen point in time or time series and download the data in a ready-to-use format. Analysis-ready-data means that organisations can start to benefit from the insights any analysis delivers immediately, without any of the up front heavy lifting. Making this data readily available via an API also means that organisations with their own applications or platforms can simply plug themselves in and automatically ingest data directly and in high volumes. We are also providing consultancy and bespoke product development to help our customers make the most of the opportunities this rich new source of data offers.

## Satellites in Agriculture

Satellites in Agriculture (SIA) is a collaborative R&D project undertaken by Ecometrica, Environment Systems and Rothamsted Research. With funding from Innovate UK, the project has developed wall-to-wall applications of Sentinel EO derived information products for environmental compliance and productivity monitoring in agriculture.

Within the agricultural sector as a whole, there are a number of potential EO applications, including:

- Broad-scale monitoring of changes to agricultural production and land use
- Information about the interface between agriculture and natural ecosystems
- Commercial data about crops and varieties, leading to production estimates
- Risk, suitability and change information
- Precise, timely information for agri-businesses to inform on water and agrochemical requirements, and the optimal timing of operations

The current market for EO derived information products in agriculture is growing fast. Leveraging the increased availability of data and cloud computing capacity presents an exciting opportunity to bring these data products into the mainstream.



Estimated crop cover of potato fields in July and September. Red is bare soil, Dark green full cover and shades between indicating more/less crop cover, important for evaluating harvest timing and planning for desiccant application.

The result of our work on this project so far is a fully automated API-driven processing chain which delivers data products routinely for Rothamsted through EOLab, Ecometrica's web based application platform. An API means that other application platforms can access our data products too. Having developed the highly scalable workflow the project then went onto to deliver ready to use data products that include:

### Production intelligence

Large scale agri-businesses which have large growing or purchasing operations spread geographically over multiple locations face many challenges. These include monitoring of within season performance between different sites and aggregating that data for effective decision making. Automated processes within our Data Services enable us to tailor the products to deliver precisely the information required and at the right time. Potatoes, for example, are grown both directly by the business and under contract by independent farmers. Businesses that subscribe to our data product feeds can verify planted area, monitor crop establishment and field-scale performance throughout the season. They can also identify problems within fields, predict harvest timing and estimate yield. Within season satellite indicators can be used to provide consistent data across the whole business, improve risk management and reduce monitoring costs.

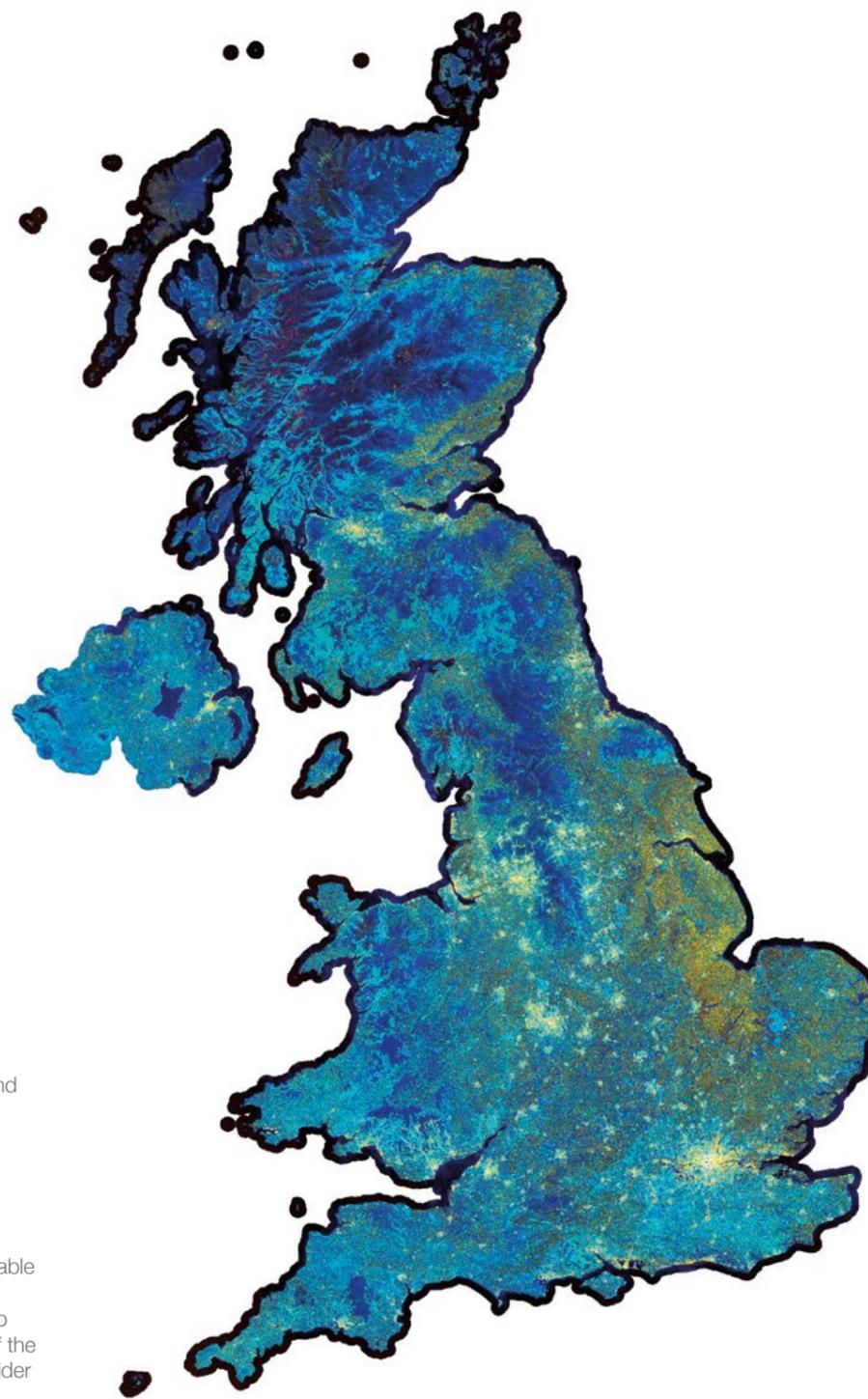
provides valuable insights for large-scale agri-businesses and government agencies. Crop type mapping can range from consistent mapping of all crops grown within the year, to mapping of specific crops of interest at key decision times.

We tailor the delivery of information from our Data Services for agri-businesses that need up-to-date intelligence on crop production to inform their planning and management. Vegetable growing businesses in the UK can adapt their planting and harvesting schedules in response to market forces reacting to the state of competitors' crops. We program weekly maps of the extent and estimated growth stage of vegetables across a wider region enabling more informed commercial decisions.

Government organisations that have a regulatory role in monitoring crop types annually, and report on crop presence, diversification and ecological compliance are already using Environment Systems Data Services to support their work. Data that is more scalable and responsive underpins monitoring and policy development.

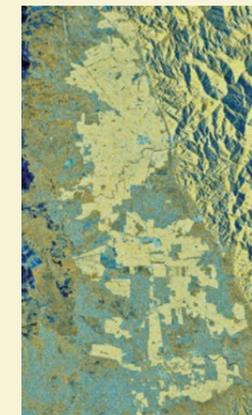
### Regional crop mapping

Within season mapping of crop type at a regional scale



UK - February 2018 - Sentinel-1 composite image - light blue colour is grassland and forests, dark blue less productive upland vegetation, orange denotes cropland and bright yellow, urban areas. Monthly composites like this can underpin regional monitoring, revealing changes to vegetation across the year.

## Improving agricultural practice



Banana crop clearly visible from radar image - Zona Bananera, Magdalena region on the Caribbean coast of Colombia

In this IPP UK Space Agency funded project Environment Systems is working with a number of commercial and government stakeholders in the high value agricultural sectors in Peru and Colombia. We have now developed a range of analysis ready data products specifically aimed at regular monitoring of the crops that dominate in these countries of Latin America.

EO4cultivar is changing decision making in the agricultural sector that is helping bring about improved agricultural practice. It is doing this by establishing partnerships, developing data products that provide new knowledge about crops and land management, then transferring that knowledge to change and improve decision making and practice at regional and field level.

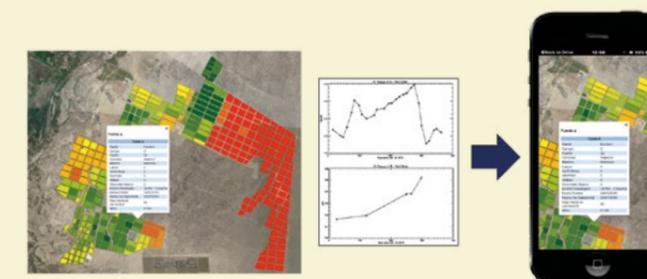
Copernicus Sentinel 1 and 2 satellite data are at the core of these product developments. A time series of radar data enables us to identify key growth stages in crops, which helps growers plan agronomic activities and prepare for harvest. Sentinel 2 optical satellite data delivers a number of vegetation indices that detect signs of stress in crops, ahead of when they may be visible to the human eye.

Environment Systems Data Services enables agri-businesses to receive up-to-date crop monitoring information in a format they are familiar with (data, alerts, maps) and compatible with their own crop management systems, putting these ready to use data products directly into the hands of their growers.

Agri-businesses and regional advisory services are now using these products directly themselves and to dispense advice, observations and insights to smallholders and others in supply chains for these export crops.

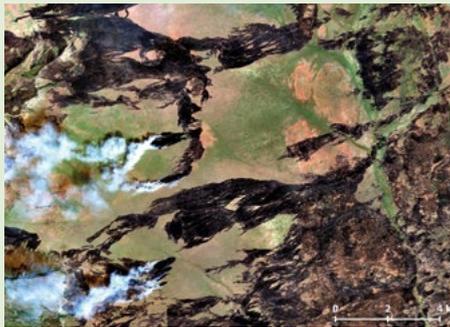
At the time of going to press we are working on automating the routine production of data products for a number of crops including asparagus, grapes, bananas and potatoes. In each case all the data processing will happen within Environment Systems Data Services.

- Field-level production status: for yield estimates, growth stage, harvest timing
- Field-level leaf stress estimates
- Field-level metrics aggregated to farm/regional scale
- Field-level crop maps with inter-seasonal change
- Regional maps of grape field types (Pisco v Table)
- Regional cropped area maps
- Crop specific estimates of area and yield



Putting stats and insights directly into the hands of the growers

## Monitoring on a national scale



Burn areas in the Karamoja region of Uganda

The DFMS (Drought and Flood Mitigation Service) project is based in Uganda and is an IPP UK Space Agency funded project. The extreme conditions caused by droughts and floods demand high quality information to direct mitigating action on the ground. The project aims to provide timely and improved meteorological, hydrological, and EO satellite information in the form of current observations, forecasts and historical data. A kind of 'early warning system' to provide decision makers with practical information that will improve knowledge and help mitigate against droughts and floods.

On this project, Environment Systems Data Services is providing analysis-ready Sentinel-1 and Sentinel-2 data for the whole of Uganda. The data are ingested by the DFMS platform and used to automatically produce a range of products including monthly Sentinel-2 derived NDVI composites. Sentinel-2 passes over Uganda in three paths, or swaths, every 5 days. The images from these swaths are combined to produce aggregate NDVI maps. Using these maps, decision makers can monitor the state of green vegetation throughout Uganda; growers can see the progress of crops, the impact of drought and much more. The resolution is sufficient to provide regional analysis and even down to a field level. Kakira Sugar, one of the project partners, is using these composites to monitor their sugar cane estates.

The data are also being used in the Karamoja region where burning prior to the wet season is a common agricultural practice to encourage fresh growth of grazing pastures. However, the extent of burning, and its impact on the environment, is unknown. Consequently, Sentinel-2 images are being processed to produce a 'Burn Area Index' that is sensitive to the charcoal signature that exists following a fire. As a result, large areas can be analysed and the location and extent of burning quantified.

## Habitat Mapping for Onshore Wind Farms



Satellite data helped to reduce the cost of habitat mapping by 50%

Onshore wind farm developments face considerable challenges not least the planning process which rightly scrutinises prospective sites and their environmental impact.

Environment Systems is a long-established provider of services to developers which include Phase 1 habitat surveys and protected species surveys that inform site design and mitigation measures required during construction.

Recently our team has been using Environment Systems Data Services to validate existing but out of date Phase 1 Habitat surveys. A site of 1,300 hectares (13 sq km) was simply too big to re-survey cost effectively so we used Sentinel 2 multispectral imagery together with the existing survey to carry out the habitat segmentation. This highlighted the areas of change across the entire site. Of course the sophisticated techniques we use in the office need some validation and standard NVC (National Vegetation Classification) surveys were carried out on the areas highlighted by the updated habitat map. In most instances these areas consisted of clear-fell within plantation forests and some areas where improved drainage had led to the introduction of grazing or further woodland planting. The time saved by using satellite imagery also delivered a 50% cost saving.

## Potato Crop Identification



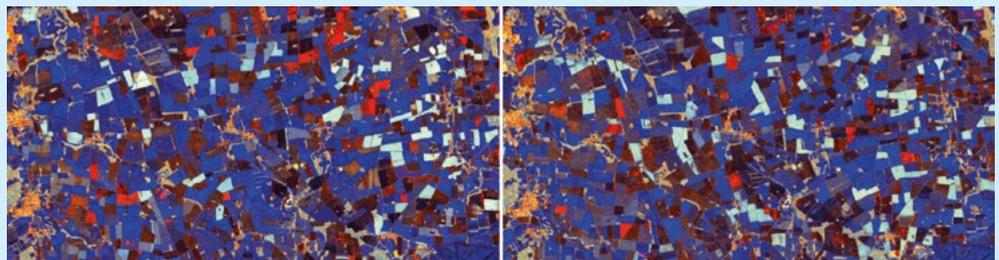
In the UK levies are paid to farmers growing potatoes by the Agriculture and Horticulture Development Board (ADHB). This covers all varieties of potato grown within a season. ADHB are investigating a monitoring program which utilises satellite remote sensing to validate grower declared fields. A pilot project carried out by Environment Systems this summer considered a range of optical and Synthetic Aperture Radar (SAR) satellite data to demonstrate their potential for detecting potato fields.

Four locations in potato growing areas were used to demonstrate the quality and scalability of the process. Time series Sentinel 1 and Sentinel 2 data were downloaded from Environment Systems Data Services. The data was combined and a potato crop detection algorithm was applied based on the crop's known phenological characteristics. The exercise was a success and demonstrated that the detection algorithm was able to delineate potatoes from surrounding crops at a national scale.

## More Automation Better Interpretation

One of the benefits that the Sentinel satellites deliver is regular coverage. That means the data can be reliably used for change detection. The Sentinel 1 radar satellites are particularly useful as they are not affected by cloud cover. We now have a mature, fully automated processing workflow for Sentinel 1 SAR data which removes some of the 'speckle' noise and makes the imagery more interpretable. As a result we can now deliver monthly composite maps that are useful in

the interpretation of biomass, particularly crops. Automation not only delivers a better more consistent image layer but also reduces the cost of production. This means less time spent processing and preparing data and more time on the interpretation, statistical analysis and algorithm development. The more our customers can understand about their crops the better the evidence base will be for making land management, commercial or policy decisions.



These two Sentinel 1 images were taken a year apart and clearly show the Oil Seed Rape (light blue) rotation