



SMARTER FARMING

A NEW PROJECT HOPES TO OFFER GERMAN FARMERS THE BENEFITS OF THE LATEST ADVANCES IN SATELLITE IMAGERY. KNUIT HARTMANN REPORTS

For about 45 years, various earth observation satellites have been orbiting the Earth. These provide spatial, up-to-date and historical information about the condition of and changes in our environment.

In Germany, agriculture is by far the largest user of land. Approximately half the total area is owned about 285,000 farms. Farmers already widely use GPS, communication and other satellite data in their day-to-day work, but a gap exists between the potential of information derived from satellite imagery and its application in practice.

Information derived from satellite images can provide valuable information for crop management and precision farming. It also offers a perfect overview of field developments and high and low yielding zones. However, until now, this information was mostly available only to experts, since the collection and analysis of data were costly and complicated.

AGRO-DE aims to overcome existing barriers and bridge the gap between satellite data processing and storage, and integrate them into farmers' practice. The objective is to showcase the benefits of up-to-date, spatial information derived from satellite imagery and improve farming efficiency and sustainability.

New regulations such as capped nitrogen fertilisation in Germany and the EU concept of 'greening' for diversification of crops and maintenance of permanent grasslands are among the many items that farmers need to consider. In this, they can be significantly supported by satellite-based services.

In April 2015, the European Space Agency (ESA) started to launch a new satellite fleet which provides image data tailored to support agricultural applications. The European Copernicus programme, under which Sentinel Earth observation satellites are being launched, provides operational satellite data in unprecedented quantity, temporal resolution and technical excellence. For Germany, the new

Sentinel-1A/B satellite acquires information about the development of vegetation, using cloud-penetrating radar technology every two to three days; every three to four days, the multispectral Sentinel-2 systems will cover entire Germany, increasing significantly the chances of obtaining a cloud-free image. In contrast to most existing remote sensing missions, the raw data from Sentinel is available for free. The high temporal, spatial (10-20m) and spectral resolutions will enable completely new data products that are also very interesting for small-scale and organic farms.

"Farmers can benefit from the new era of earth observation satellite data by accessing ready-to-use data, which will be supplied via web-interfaces. Data will be user-ready for farmer's decision making. With ESA's new satellite missions, fantastic datasets will become available that were not accessible before," says Dr Holger Lilienthal, a scientist at Julius Kühn Institute and project coordinator of AGRO-DE.

The project consortium consists of the Julius Kühn-Institut, the German Aerospace Center (DLR), EOMAP GmbH & Co. KG and Hanse-Agro GmbH. The core of the development is embedded in DLR's processing environment, which provides an efficient infrastructure to access, process, deliver and archive satellite image data and derived products. Given the vast amount of data that needs to be processed and delivered in a timely manner, intelligent and robust concepts and algorithms will be developed as part of AGRO-DE. Furthermore, a high level of automation is required to deliver precise and detailed information for large areas such as Germany and beyond.

AGRO-DE enables farmers, agricultural consultants, contractors and service providers to use preprocessed satellite information layers in a timely manner and to integrate them into their operations. Data layers currently provided to the public include the most up-to-date high resolution satellite imagery, relative and absolute crop parameters,

and yield predictions. But more than one dozen data product layers are currently being designed, with some of them being incorporated into, for example, an integrated service solution to aid nitrogen fertiliser efficiency or identify crop phenology and growth status.

The concept of big data processing from space is based on workflow systems that enable the rapid production of large amounts of product data using flexible and scalable computation power. Within each of these workflows, a chain of successively running algorithms enables a standardised operational data processing.

“With the AGRO-DE project, all farmers in Germany can benefit for the first time from the latest satellite information. AGRO-DE will provide access to usable information products, which will stimulate the application of precision farming technologies. We’re looking forward to using the information in our current practice,” says Dr Dominik Gerwers, agriculture consultant at Hanse-Agro

A practical example

The following example provides a high-level insight into the system. A farmer is interested in checking the status of different crop sites and wants to verify if there has been an unexpected change of biomass. AGRO-DE will translate this into a workflow for optical satellite imagery from the Sentinel-2 mission, which includes a processing chain of atmospheric correction, spectral sharpening, cloud and shadow masking and the deviation of vegetation parameters (relative and absolute) and yield predictions. Furthermore, a workflow for the radar satellite Sentinel-1 data allows the identification of significant crop phenology stages, such as flowering, greening or senescence. The derived information will help the farmer to make decisions about fertilisation (for example, site-specific or non-site specific fertilisation), soil and moisture issues (such as drainage planning, maintenance or sowing density). Beyond that, customised support can be provided by the AGRO-DE consortium.

Suitable delivery formats will be developed, tailored to the needs of farmers and service providers, such as a web app, web map services (WMS), which can be used in a GIS, FTP or an email attachment. These allow easy visualisation, analyses and integration into farming software.

The project will be backed by farmers, who will use and evaluate AGRO-DE products over the next few years to increase service readiness and portfolio. Currently, 19 farms will be involved but the service will be made available to all German farmers this year.

“Through environmental policy requirements and economic concerns, we farmers in Germany are forced to use a very efficient use of production resources, such as fertilisers. The data from AGRO-DE will help



Real colour image in 10m resolution of a rural area in northern Germany



Multi-temporal pseudo-colour image of a rural area in northern Germany. Colours enable the identification of crop types and variability of soil properties and crop vegetation



Multi-temporal pseudo-colour image at 10m spatial resolution

us to apply these scarce resources even more efficiently to the partial areas on our fields,” says Andreas Bertram, a farmer and owner of the domain Bahrdorf, as well as a member of the AGRO-DE experiment farms.

In addition, information products from AGRO-DE can assist research institutions, federal and state agencies in their work. Thinking ahead the AGRO-DE infrastructure can be upscale to include further regions or countries in Europe or worldwide. Copernicus will also be extended after 2020 with new satellites, which will make the development of a data and analysis cluster

with operational processing chains interesting in the longer-term.

THE DATA FROM AGRO-DE WILL HELP US TO APPLY THESE SCARCE RESOURCES EVEN MORE EFFICIENTLY TO THE PARTIAL AREAS ON OUR FIELDS

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