NEWS

Full-Spectrum Farming

In a small town in eastern Germany, an imaging company is deploying a private satellite network to boost crop production

By MICHAEL DUMIAK / JUNE 2011

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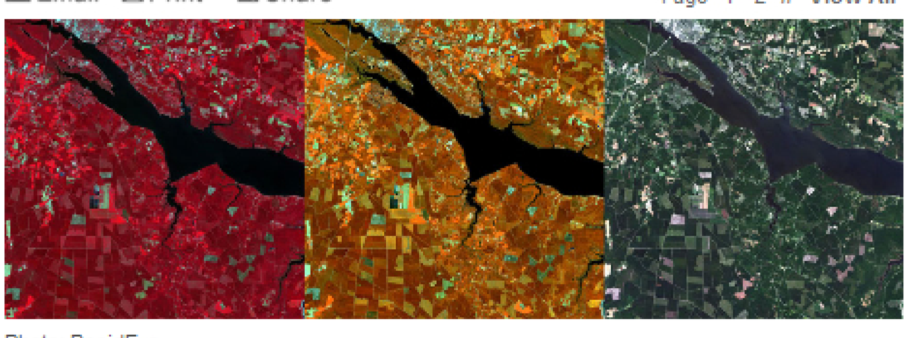

Photo: RapidEye

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15 June 2011—At the very least, says satellite image product manager Stefanie Grundner, a wheat farmer from the steppes of Kazakhstan is going to be skeptical that a small firm in Germany knows which fertilizer he should use in his field.

But Grundner and her colleagues at RapidEye, a geospatial information company in Brandenburg an der Havel, are quickly making converts all around the agricultural world. RapidEye owns a five-piece satellite network that delivers imaging in five bands of the electromagnetic spectrum, and it can now count among its customers cotton farmers in eastern North Carolina, alfalfa growers in western Canada, and, yes, even Kazakh wheat farmers.

Using images created by optical instruments—each sensitive to specific bands in and around the visual spectrum—farmers can get a detailed map of the fertility of their fields. Equipped with GPS units, the farmers can then use variable-rate sprayers to boost crop yields and produce more precision-managed crops.

Photo: RapidEye

But RapidEye is a long way off from the fields it follows. The big bowl of its S-band antenna reclines on the shingled roof of the company headquarters on the tidy central square in Brandenburg an der Havel, about 45 minutes by train from Berlin. This down-to-earth working town boasts a new mall and office complexes but still moves to the clank and squeal of its East German trams.

RapidEye's fleet of satellites are British-built SSTL UoSAT-12 models: 150-kilogram black cubes, each about the size of a dishwasher. Each one—Tachys, Mati, Trochia, Choros, and Choma—orbits the globe every 90 minutes at an altitude of 650 kilometers, spaced equidistant from one another, 75 degrees apart. This layout means the satellite constellation can touch any spot on the globe and image more than 4 million square kilometers (1.5 million square miles) daily through its precision-ground optical instruments.

Still, an ocean away, farm consultant Bill Peele understands RapidEye's appeal. The 55-year-old founder of Impact Agronomics is happy to explain how plant signatures taken across different spectral bands—blue, green, red, red-edge, and near-infrared—can help growers in the four counties in North Carolina where he operates.

Photo: USDA

ROOT OF EVIL: RapidEye's satellites spotted signs of nematodes in a field in North Carolina.

For example, chlorophyll reflects the intense energy of green-band spectra (which is why we often see leaves as green), but it strongly absorbs the red-edge band, from 690 to 730 nanometers. An image taken with an optical instrument sensitive to this band can mark the varying concentrations of chlorophyll. This information can then be used to color-code a chlorophyll field map. These maps show the relative health and vitality of the crops and vegetation growing across the farmer's field.

The images rely on the variety of spectral reflective properties of vegetation. Looking at a different mix of spectra can reveal the density and percentage of ground covered by green leaves when seen from above, or the characteristics of the soil. The resulting ground cover images show variability in growth in a field, allowing farmers to predict yield and better distribute fertilizer

Peele consults for farms ranging from 200 to 3200 hectares—the cotton, corn, and soybean growers of North Carolina's lowland coast. As spring turns to summer, he will stop at the office, transfer satellite-generated soil brightness or chlorophyll maps to a handheld GPS receiver, and work in the fields from the back of his truck. He recalls checking on a cotton and soy farm near Pantego, N.C., last year: A noticeable thinning of ground cover on a RapidEye map showed unproductive patches in the field. Peele broke these areas out of the normal management zones and took special soil samples in those areas. "We were able to isolate some root-knot nematodes," he says, referring to a plant parasite that flourishes in the higher-acidic type of soil that the samples revealed.

Precision-data-driven and even satellite-aided farming isn't a new idea and has roots stretching back to the start of the "green" revolution in agriculture. What is changing is the kind of customization and instant access offered by combining a farmer's handheld GPS and a consultant's scientific knowledge with a global network of satellites available to a private clientele. NASA isn't going to survey a given farmer's patch of field with Landsat on request.

Still, RapidEye has challenges on both competitive and technological fronts. France's Astrium GEO-information Services can compete using similar satellite services, although its spectral vegetation instruments are on two satellites as opposed to five. In Peele's case, he and the farm's owner most likely could have made the same nematode discovery by walking the fields and sampling the soil in various locations. But it would have taken longer and involved a lot more guesswork, and, perhaps, many more soil samples sent to a laboratory.

Precision spectral sensors can also be mounted on tractors as a land-based alternative. The trade-off is much higher up-front and maintenance costs and the need for technical know-how. RapidEye can produce an image for as low as a US $0.40 per hectare. But a tractor system isn't affected by cloud cover, which is a weak spot for the space entrepreneurs and probably their biggest technical challenge.

"We can get to any point on Earth on a daily basis," Grundner says wryly, "if there are no clouds." But since there are always clouds somewhere, detailed global weather forecasts fly around the RapidEye headquarters like water-cooler gossip. If there is a break in an area that is normally cloudy, the firm leans on its five-satellite reach and takes the chance to cover it. The coordinates are punched into the telemetry PC, and the images soon download to antenna dishes in Svalbard, Norway. The satellite fleet was launched into sun-synchronous orbit, which sets the inclination of the satellite to match the motion of the sun across the sky. This ensures that a given point in an image will always be shot at the same solar time, providing consistent illumination when the time comes for a cloudless shot.

As Grundner explains all this, Choros slips farther south, bound for an image run somewhere in the neighborhood of Bulgaria. Soon it will zoom over the Indian Ocean bound for the South Pole, roll through the dark side of the planet, and come up again into the Arctic morning light.

About the Author

Michael Dumiak is a freelance journalist based in Berlin who writes about technology and society. In October 2010 he reported on the disappearance of incandescent light bulbs in Germany.

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