» GEOINT & CLIMATE CHANGE » USGIF MEMBERSHIP DIRECTORY » GEOINT SYMPOSIUM HIGHLIGHTS

2015 ISSUE 3

trajectory

THE OFFICIAL MAGAZINE OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

2015 USGIF MEMBERSHIP DIRECTORY

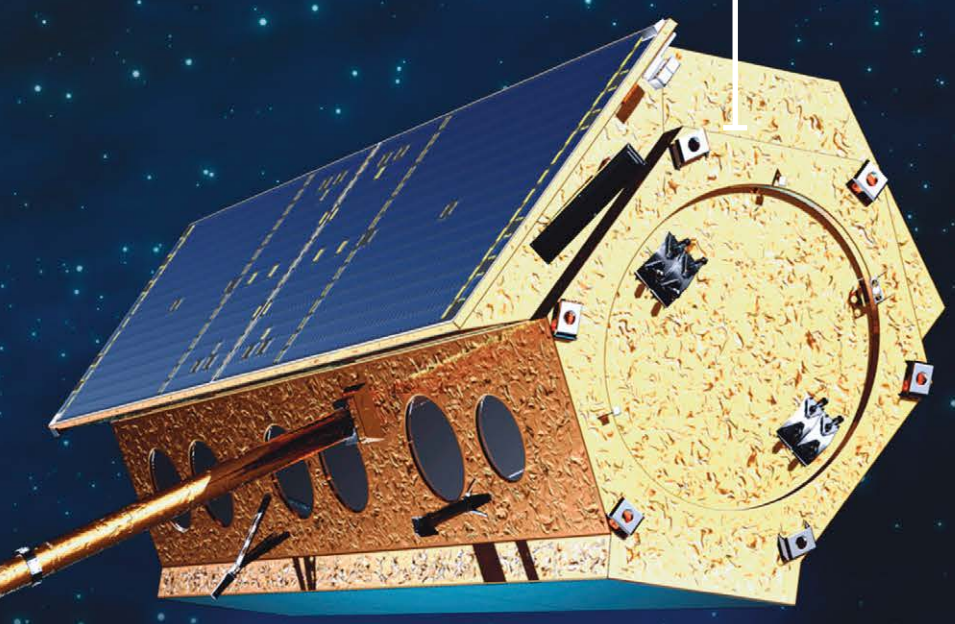
DARK SKIES, BRIGHT FUTURE

THE NEXT GENERATION OF COMMERCIAL REMOTE SENSING HAS ARRIVED—AND GEOINT WILL NEVER BE THE SAME.

THE NEXT GENERATION OF COMMERCIAL REMOTE SENSING HAS ARRIVED— AND GEOINT WILL NEVER BE THE SAME.

Data from the TerraSAR-X and TanDEM-X satellites, launched in a public-private partnership by the German Aerospace Centre and Airbus Defense and Space, is used to create WorldDEM, Airbus' global 3D Digital Elevation Model.

Even on the sunniest days, there is darkness beyond the Earth's blue firmament. And it's about to get darker, according to National Geospatial-Intelligence Agency (NGA) Director Robert Cardillo, who recently predicted: In just a few short years, mankind will witness a "darkening of the skies" over Earth. This new shade isn't from a dimming sun—which won't burn out for another 5 to 7 billion years, astronomers insist—but rather a rapidly expanding host of space-based systems, including commercial satellites collecting imagery for use by governments and, increasingly, private enterprises.



BY MATT ALDERTON

DARK SKIES, BRIGHT FUTURE

IMAGE COURTESY OF AIRBUS

Currently, there are more than 300 active Earth observation satellites orbiting the planet, 42 of which are wholly or partially commercially owned and operated, according to the Union of Concerned Scientists. By 2023, governments and commercial enterprises collectively will launch 353 more Earth observation satellites—many of which will be small and affordable enough to constitute constellations capable of imaging every inch of the Earth every day—predicts global space consultancy Euroconsult.

"I'm energized and enthused about this development … It means our analysis of world events is going to be holistic and persistent," Cardillo said in June at the GEOINT 2015 Symposium. "The democratization of GEOINT and the darkening of the skies is the opportunity of our time."

Indeed, the "darkening of the skies" isn't dark at all. For the GEOINT Community, especially, it's the opposite—bright—according to Rob Zitz, co-chair of USGIF's Small Satellite Working Group and senior vice president and chief systems architect for the national security sector at Leidos. "We're right on the cusp of having geospatial information become a commodity; we're going to be awash in pixels and geospatial data collection," he said. "The questions are: How do you combine that data with other data sources? How do you derive meaning from it? And how do you automate processes around it? GEOINT is the glue that will hold all these loose ends together for decision-making and action-taking."

As the Internet fueled the information age, the next generation of commercial remote sensing will drive the ubiquity and utility of GEOINT.

"The ability to image the Earth from space has revolutionized life on this planet," said SmallSat champion Rep. Jim Bridenstine (R-Okla.), a member of the House Science, Space, and Technology Subcommittee. "We can find better routes to where we're going. We can see when storms are coming. Our warfighters can know where the enemy is located. The implications of seeing the big picture are enormous and extend to nearly all aspects of the human experience. As the needs for remote sensing have grown over the decades, the responsibilities for providing this service have expanded to the private sector and today we are seeing a boom in this industry."

Although it's been decades in the making, the boom in commercial remote sensing is owed, in particular, to events of the last three years, which have increased the pace of change so much, so fast, that the next generation of commercial remote sensing isn't on the way anymore. It's here.

RESOLUTION SOLUTION

A major milestone in the recent history of commercial remote sensing was the August 2014 launch of DigitalGlobe's WorldView-3 satellite, the first commercial imaging satellite to offer 30-centimeter resolution imagery and 16 spectral bands.

"WorldView-3 is the most capable commercial satellite ever launched in terms of its ability to see the earth clearly and in new ways," said Tony Frazier, senior vice president for U.S. Government Solutions at DigitalGlobe. "From an analytic perspective, a 30-centimeter pixel—especially when you consider that it's 16 bands of spectral information—allows you to collect an enormous amount of content that can be unleashed to address a problem."

Until recently, DigitalGlobe could collect high-resolution imagery but couldn't sell it commercially. That changed in June 2014, when the U.S. Department of Commerce granted DigitalGlobe's request to sell 0.25-meter resolution imagery to its commercial customers. Because of national security concerns, the company could previously sell only 0.5-meter resolution imagery.

"I can remember a time when there was what we called the '10-meter rule'; a company could not commercially launch a satellite that would collect better quality than 10 meters resolution," Zitz said. "We went from 10 meters down to 50 centimeters, and now we're down to 25 centimeters, which is about a foot. Think about that. That's better than seeing home plate on a baseball field. That's discerning windshields on a car and understanding which direction the car is moving. It's very, very high quality."

The emergence of better supply has driven increased demand, according to Frazier, who said looser resolution restrictions allow space-based systems to compete for business in segments served primarily by the aerial market, such as agriculture, disaster relief, and land surveying.

These opportunities represent a major win not only for DigitalGlobe, but also for the U.S. government, which in recent years has become increasingly reliant on commercial imagery for its low cost and unclassified nature.

"Folks looked at [the cons] from a national security perspective," said John Charles, NGA's national geospatial intelligence officer for commercial imagery.

EACH PAIR of satellites in the UrtheCast constellation will include a SAR satellite and an optical satellite flying in tandem.

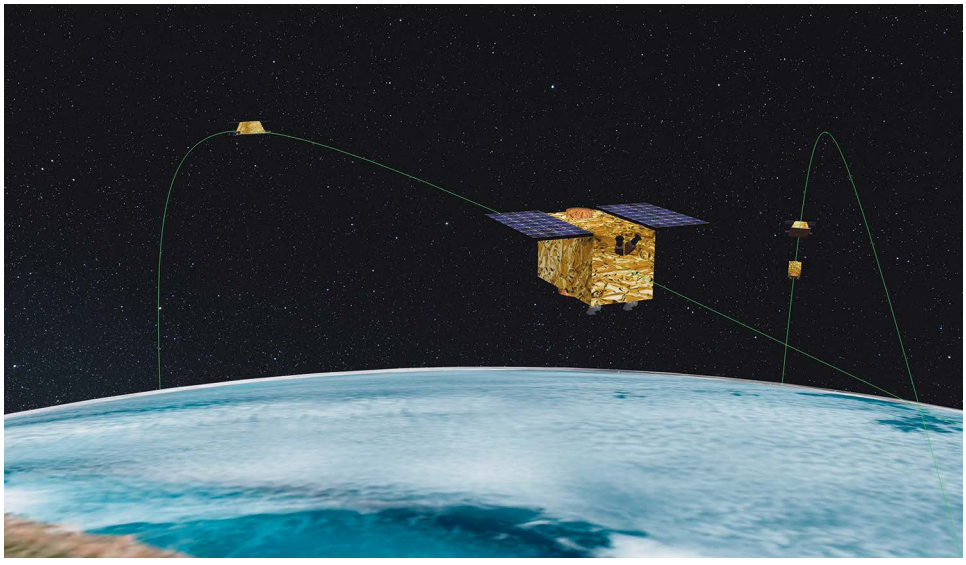


PHOTO COURTESY OF URTHECAST

BY 2019, BLACKSKY GLOBAL plans to have six satellites on orbit—Pathfinder-1 and Pathfinder-2 as well as Global-1 through Global-4.

PHOTO COURTESY OF BLACKSKY GLOBAL

"But we also looked at the pros in terms of what the commercial industry can bring to us as a partner, both in our DoD and our intelligence missions. We believe the pros outweigh the cons. … [Lower resolution limits] allowed our strategic partners to position themselves to be more competitive and therefore to go off and take some risks … in order to realize new and better capabilities. We believe this helps strengthen the industry and that we in the intelligence and defense communities can leverage that to our benefit."

In addition to DigitalGlobe, many commercial imagery providers are nurturing increased demand and innovation, according to Kevin O'Connell, president and CEO of Innovative Analytics & Training and co-author of "U.S. Commercial Remote Sensing Satellite Industry: An Analysis of Risks." "There has been a proliferation of people who are interested in and now participating at some level in this market," he said. "In that, we're seeing new kinds of partnerships and different kinds of demand for the data that's out there."

Case in point: Airbus Defense and Space has in the last year formed three significant partnerships—with Esri, Harris Corp. (formerly Exelis), and Hexagon Geospatial—allowing commercial access to Airbus satellite imagery.

"The commercial remote sensing industry has collectively made positive strides over the last decade," said Bernhard Brenner, head of the GeoIntelligence Programme Line at Airbus Defense and Space. "The key challenge for now is to make the transition into the mainstream and extend our customer client base."

LESS IS MORE

Lower-resolution limits aren't the only catalyst for the rise of commercial remote sensing.

"The resolution of a satellite image is an important consideration to the GEOINT Community," Brenner said. "However, it is worth emphasizing that this is not the only consideration when choosing the optimal solution."

Consider, for example, Airbus' twin high-resolution optical data satellites, known as Pléiades. Although they travel in the same orbit, they're far enough apart that at any given moment each is imaging an opposite side of the planet, giving extensive collection opportunities and a high temporal resolution.

"This constellation, especially when allied to the capabilities of [our] SPOT [wide-area optical imagery] constellation, allows for both greater change detection capabilities and improved map information updating capacity," Brenner continued.

Customer appetite for change detection and updated maps has helped spark the advent of SmallSats, which reached fever pitch this year following Google's $500 million acquisition of SmallSat pioneer Skybox Imaging in 2014.

"Based on Google's acquisition of Skybox, the introduction of venture capital into the market is a really important development," O'Connell said. "What venture capital seeks, of course, is something that's going to make a lot of money. It often does that on the basis of taking risks. What that means in the United States, at least, is that we're going to see proposals for systems that are potentially more innovative, potentially riskier, and for which there is the potential for a larger-scale return."

Added Adam Keith, managing director of Euroconsult Canada, "In the last four years, we've seen in the region of $400–$450 million of venture capital coming into the commercial remote sensing business. Prior to that, there were very few examples of venture capital coming into this world."

Planet Labs and UrtheCast are two companies that embody the SmallSat value proposition. Established in 2010, Planet Labs so far has launched 84 CubeSats, which it calls "doves." Totaling just 12 inches long, 4 inches wide, and 4 inches tall, each dove costs less than $1 million to build; by contrast, DigitalGlobe's WorldView-3 is 23 feet long, 8 feet wide, and 18.7 feet tall, and cost $650 million to build. The latter launched five years after its predecessor, WorldView-2; the former went through 12 iterations in less than two years.

> **"THE ABILITY TO IMAGE the Earth from space has revolutionized life on this planet."**
>
> — Rep. Jim Bridenstine (R-Okla.), a member of the House Science, Space, and Technology Subcommittee

READ MORE about the next generation of commercial remote sensing at trajectorymagazine.com.

A GLOBAL GAME

IN THE PAST DECADE, the commercial remote sensing landscape hasn't just changed. It's also expanded, according to global space consultancy Euroconsult, which reports a four-fold increase in the number of countries with space activities, up from 20 in 2000 to more than 80 today. According to its 2014 report, "Satellite-Based Earth Observation: Market Prospects to 2023," 33 countries launched Earth observation satellites during the last decade, and 41 countries are expected to do so during the next.

"There has clearly been a proliferation in demand across the globe," said Bernhard Brenner, head of the Geo-Intelligence Programme Line at Airbus Defense and Space.

Europe, where Airbus is based, has made especially large strides in commercial remote sensing. In a public-private partnership with Airbus, for example, the German Aerospace Centre launched TerraSAR-X and TanDEM-X—twin satellites constituting the world's first spaceborne radar interferometer, which uses microwave imaging to create high-resolution all-weather terrain maps, otherwise known as digital elevation models (DEMs). Subsequently, in April 2014, Airbus introduced WorldDEM, a global 3D DEM constructed using TerraSAR-X and TanDEM-X data.

"The accuracy of the base DEM is key to reliable information and merging of data from different sensors and sources," Brenner explained. "Thanks to WorldDEM, operators of civil and military Earth observation satellites now have a standardized elevation model at their disposal for high-quality image orthorectification—no matter where their acquisition area is located on the planet."

In April, Airbus launched the WorldDEM Digital Terrain Model, which provides a standardized representation of bare Earth elevation for any point on the globe.

"This addition completes the WorldDEM portfolio, enabling Airbus Defense and Space to provide both surface and terrain elevation information," Brenner said.

The Germans aren't alone. The French, for example, launched the seventh iteration of their SPOT electro-optical (EO) satellite (built by Airbus) in 2014, and the Italians will launch the second generation of their COSMOS-SkyMed (built by e-GEOS) synthetic aperture radar (SAR) satellites beginning in 2016. All three nations are collaborators in the European Commission's Copernicus program, which leverages unclassified data from shared EO and SAR satellites across missions of mutual interest, such as environmental protection, emergency management, and

"At Planet Labs we have what we call 'Mission 1,' which is to make change on the Earth visible, accessible, and actionable," explained Director of Government Affairs Dr. Richard Leshner, who said Planet Labs expects to have its first fully operational "flock of doves" orbiting Earth in 2016. "Our end goal is to have a satellite constellation in excess of 100 spacecraft that can image the entire surface of the Earth every day … We want decision-makers in all spheres of [society] to be able to make intelligent and informed decisions based on changes they're seeing in the conditions around them."

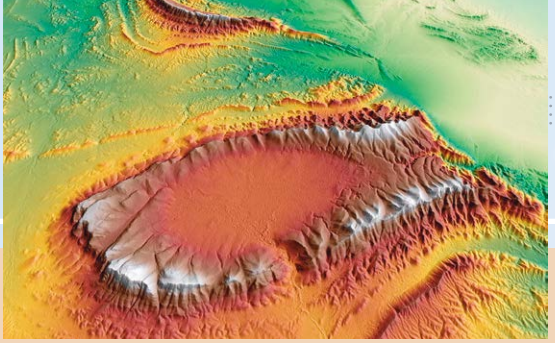
Planet Labs has joined the acquisition game as well. At press time in mid-July, the company announced its intent to purchase Canadian commercial imagery provider BlackBridge, including its five-system RapidEye constellation. The acquisition of RapidEye's six billion square kilometers of imagery at 5-meter resolution will allow Planet Labs to bring to the web one of the largest commercial satellite imagery data sets.

"It's not final, but our acquisition of BlackBridge and the RapidEye assets is a strategic business decision to get a historical data set and expand our access to a global network of customers and distributors," Leshner said. "The more data we have, the stronger we can make our data platform, which increases the speed that we're able to deliver data to our customers."

Vancouver-based UrtheCast plans to build, launch, and operate what it claims will be the first fully integrated, multispectral optical and synthetic aperture radar commercial earth observation constellation, scheduled to be deployed over multiple launches in 2019 and 2020. Although UrtheCast's satellites will be larger than conventional SmallSats—600 to 1,100 kilograms compared to less than 500 kilograms—they will have similar capabilities.

"Having all these sensors in space will help us realize our vision of democratizing Earth observation data, making these powerful resources more accessible and user-friendly," said Wade Larson, co-founder, president, and COO of UrtheCast, whose constellation will total 16 satellites deployed in pairs across two orbital planes, with four equally spaced pairs in each plane. "This number of

"OUR SWEET SPOT is a different kind of data set that doesn't exist anywhere else: an everywhere, everyday data set that's enabled by a platform that's affordable." — Dr. Richard Leshner, director of Government Affairs, Planet Labs



WorldDEM provides a pole-to-pole Digital Elevation Model. In addition to full availability of the African and Australian continents as well as the Middle East, large areas of North and South America, Northern Europe, and Asia are now available.

PHOTO COURTESY OF AIRBUS

national security. The intergovernmental European Space Agency (ESA) launched the first of these shared satellites, Sentinel-1A, in April 2014, and the second, Sentinel-2A, in June.

"The data from the whole [Copernicus] program is going to be given to industry for free," said analyst David Germroth, principal of international government affairs and business development firm PACE Government Services. "It's only 5- and 8-meter resolution, but that's good enough for a lot of things users want to do with geospatial data."

According to Germroth, commercial remote sensing knows no boundaries.

"The Argentinians are putting up an L-band satellite with the Italians," he continued. "And the Japanese are throwing a ton of money into laser communications with EO and radar capabilities. They're really determined and they're moving really quickly, so we're going to see them catch up to a lot of our own capabilities within 10 years or less."

Even small nations are getting in on the action, according to Kevin O'Connell, president and CEO of Innovative Analytics & Training and co-author of *U.S. Commercial Remote Sensing Satellite Industry: An Analysis of Risks.*

"Countries like Vietnam and Egypt are both experimenting with SmallSat systems and constellations, and others—like the United Arab Emirates—are being pioneers by saying, 'We're not going to build space systems, but we're going to buy what's commercially available from everyone else,'" O'Connell said.

For the United States GEOINT community, the globalization of commercial remote sensing creates both opportunity and challenge.

"It means the GEOINT Community is going to have to do a couple things," O'Connell said. "One, it's going to have to innovate on its own in order to stay ahead of the curve. And two, it's going to have to improve its ability to leverage capabilities from the outside."

Added Orrin Mills, director of the Source Operations Group at the National Geospatial-Intelligence Agency (NGA), "The genie's out of the bottle. There's no going back [to when the United States and Russia were the only players in space], so we have to look at this as an opportunity to embrace new technologies and new capabilities, and to use them to our advantage against our adversaries."

satellites and this configuration will enable the best revisit in the industry—not the best coverage, to be clear, but the best revisit."

Although resolution of their satellite imagery—3 to 5 meters—doesn't match that of a larger system such as WorldView-3, Planet Labs, UrtheCast, and their commercial SmallSat peers dangle a different carrot in the form of persistence and better access to specific tasking.

"Our sweet spot is a different kind of data set that doesn't exist anywhere else: an everywhere, everyday data set that's enabled by a platform that's affordable," Leshner said.

The data doesn't have to be perfect; for some customers, "quick" and "current" are more important than "clear" and "precise."

"[SmallSats] might not be defense-grade satellite systems, but if you can guarantee daily or weekly revisits regardless of weather, that can have a lot of value in the area of change detection, which has applications across multiple sectors," Keith said. "With those capabilities, these companies have the potential to open up existing markets and even develop new ones."

The possibilities are staggering, according to Jason Andrews, president of SmallSat startup BlackSky Global and president and CEO of Spaceflight Systems, a space logistics company providing "rideshare" launch services for commercial satellites.

"Ten years ago we didn't even have Google Maps. We went down to the local map store, and that was our view of the world," Andrews said. "For the last decade we've been able to go on the Internet and look at Google Earth, but it's a very static environment. The future we're working toward is 'Google Earth Live.' If you want to see how many cars in a Wal-Mart parking lot in Duluth at 4:30 in the afternoon, these new constellations will be able to tell you."

In 2016, BlackSky Global will launch the first six satellites in what will eventually be a constellation of 60.

"Moore's Law has advanced the size, weight, and power of modern electronics into something that can be packaged cost effectively in a small form factor," said Andrews. "You have to live with the fact that it's only going to last in space for a couple of years, but because it's cheap enough, that's OK; you can afford to replace it. On top of that, the availability of launch services like Spaceflight means there's much more ready access to space. That supports everybody in this industry."

NURTURING INNOVATION

SmallSat operators face just as many challenges as opportunities, acknowledges Andrews.

"The number of satellites being launched is very exciting. But at the same time, a lot of promises so far have gone unfulfilled," he said. "As an industry, we have to be really careful about overhyping the potential. Our customers are receptive to these new capabilities, but we have to deliver. That requires management of expectations, realistic timelines, and focusing on the end product."

It also requires government support, according to Leshner.

"As more companies try to get into commercial remote sensing, it will put added pressure on NOAA (the National Ocean and Atmospheric Administration) to respond efficiently and rapidly to provide licenses for operation, and

on the national security community to become comfortable with the explosion of data providers."

To that effect, Bridenstine in May introduced the Commercial Remote Sensing Act of 2015, proposing regulatory reform to encourage growth in the U.S. commercial remote sensing industry.

"I have been focusing on these issues for the past two years [and] have seen constant innovation within industry. Every few months, companies come to tell me about new products or capabilities they've developed … I think it is crucial that government not stamp out this momentum."

A second bill Bridenstine co-sponsored that was introduced in March—the Weather Research and Forecasting Innovation Act—would authorize $9 million for a pilot program under which NOAA would be required to purchase space-based weather data from commercial providers and test it against NOAA proprietary data.

"While this is a small amount, it serves as a necessary first step," Bridenstine said. "The pilot program signals to the private sector and potential investors that Congress and NOAA are interested in buying data, and it allows NOAA to verify that forecasts can be enhanced with commercial providers."

The weather bill, which passed the House in May and is awaiting action in the Senate, could be a major boon to commercial remote sensing, according to Dan Stillman, senior manager of corporate marketing and communications at PlanetiQ, a SmallSat company aiming to launch the world's first commercial weather satellite constellation by 2017. "If it's passed, it will send a clear signal to those who would invest in companies like ours that there is going to be a buyer for our data," Stillman said.

NOAA isn't the only government agency looking to leverage emerging commercial capabilities. NGA is also taking steps to fortify industry.

"In the last few years we've made some architectural changes on our side, as well as process changes, so that we're better positioned to take advantage of the abilities that commercial imagery has brought to bear," Charles said. "The biggest thing, though, is that commercial imagery has changed from being a one-off, unusual piece of source material to being something that our team … and our customers are more accustomed to using on a regular basis. We include it in our everyday workflows and processes. That, combined with the greater facilitation with our architecture and our processes, has really made it a continuing and important piece of where we are going forward."

In May, NGA issued a request for information targeting the SmallSat sector. The "NextGen Commercial Imagery Strategy and Architecture to Acquire Imagery Products and Services" RFI indicates NGA's intent to acquire commercial imagery from "one or more" SmallSat vendors beginning as early as FY 17.

"The SmallSat providers have certainly caught our attention," said Charles. "Often, an RFI is nothing more than an RFP with the word 'RFI' stamped on top of it. In this case, it is really an RFI. We're trying to understand the business plans, business desires, and goals of emerging providers … so we can position ourselves to best take advantage of [their data] as these capabilities mature."

NGA is particularly interested in the revisit rates—ranging from multiple times a day to multiple times an hour—promised by SmallSat constellations.

"We think there's opportunities there for analytics that simply aren't possible when your revisit rate is every three days," Charles added.

NGA support is not just welcome, but essential, according to Zitz.

"There is rationale for NGA and the rest of the national security community to take a hard look at investments stimulating this industry so small satellites … can realize what I honestly think they can achieve," Zitz said. "That's how GeoEye and DigitalGlobe came about—from early investments by the government to stimulate that class of capability."

PIVOTING TOWARD ANALYTICS

The GeoEye-DigitalGlobe merger in January 2013 was a seminal event for commercial remote sensing. The product of federal budget constraints, which in 2012 led NGA to abandon its 10-year EnhancedView contract with GeoEye after only one year, the merger has ushered in a new era for the combined companies, according to Frazier, who said DigitalGlobe is moving from a focus on data collection to a focus on data analysis.

In addition to merging with GeoEye, which previously had an analytics business run by Frazier, DigitalGlobe acquired Tomnod in 2013 and Spatial Energy in 2014. Tomnod enables crowd-sourced image analysis, while Spatial Energy provides aggregation and dissemination of multiple sources of remote sensing data for the oil and gas industry. The company is also developing new products and partnerships to integrate data from social media and SmallSats into its base maps.

"If you have the ability on the ground to ingest myriad sources of information, you could bring in very coarse imagery at 3- or 5-meters [from SmallSats], but then real-time correlate that with higher-quality imagery that has been shot in the recent past and tie it to video and other geo-referenced data sources," Zitz explained.

Which is exactly what customers like NGA covet.

"We cannot allow ourselves to become inundated with all the data that's out there," said NGA's director of persistent GEOINT Jennifer Daniel. "We have to be able to create coherence. We have to be able to take data, and we have to be able to connect it and understand it … to maximize the capabilities of all our [data] sources."

The fusion of the new variety of commercial data sources represents the future of the GEOINT Community, which through automation and integration will be able to turn geospatial information into a commodity that's searchable, shareable, and actionable.

"[We're entering] a revolutionary period that's going to change the way people can view where they are in context and what they're doing in context with data sources that are multiple and varied and can be combined to provide a lot of rich information content in a way that wasn't really feasible just a handful of years ago," Leshner said.

The skies may be darkening, but the next generation of commercial remote sensing promises to shed more light on Earth than ever before.

READ MORE about the future of forecasting at trajectory magazine.com.