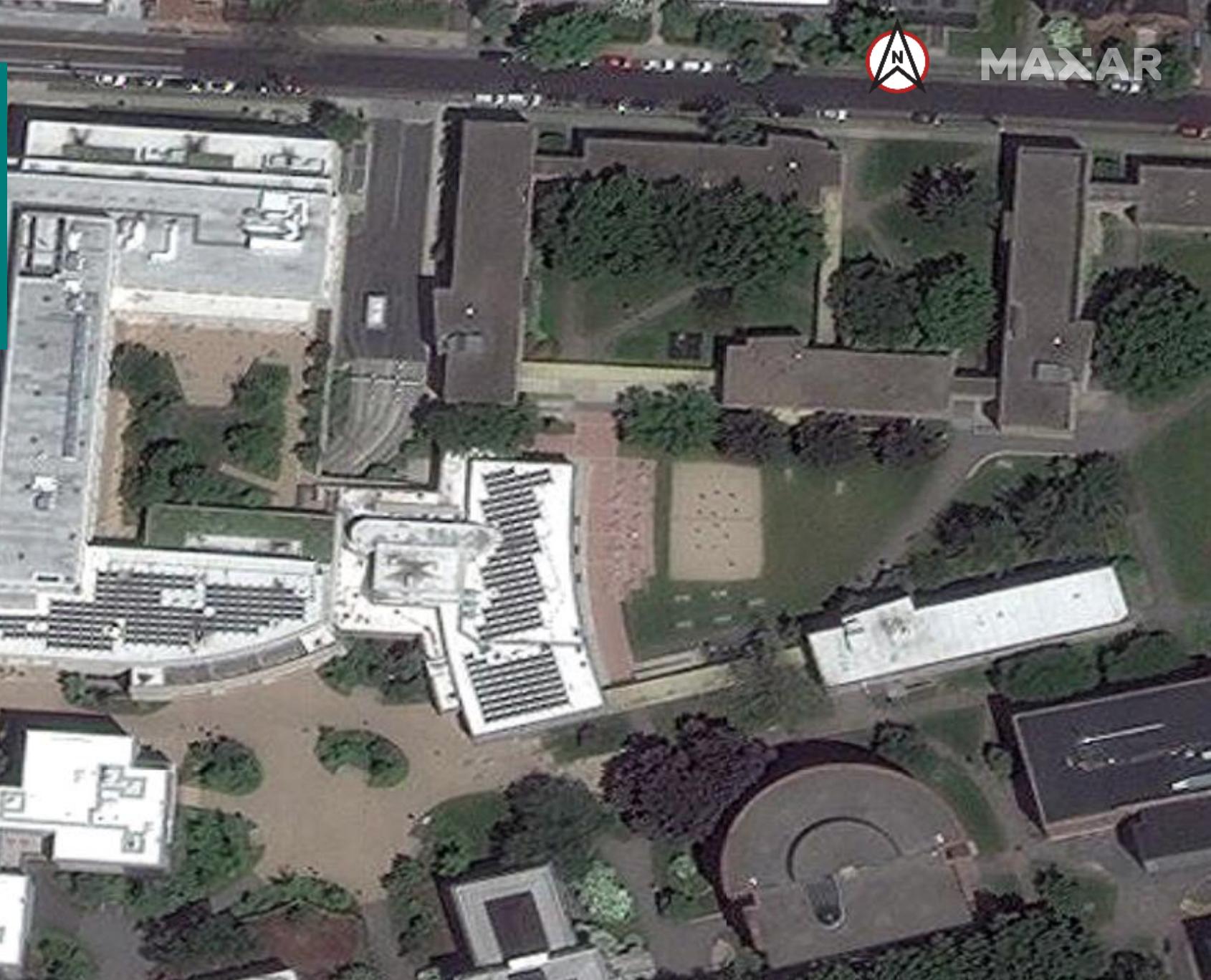




Commercial Satellite Imagery and Analysis: Origins and Applications

June, 2019

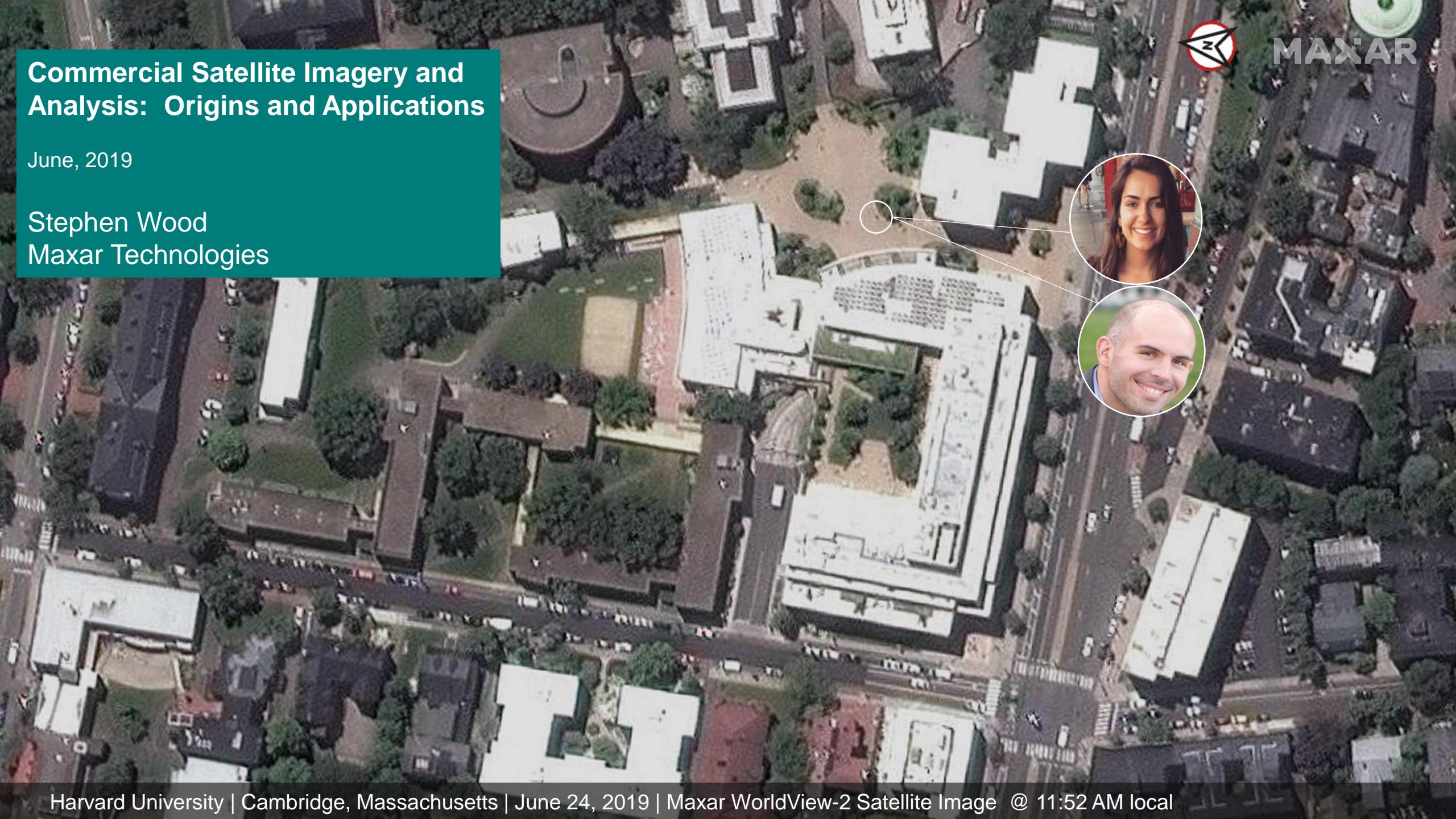
Stephen Wood
Maxar Technologies



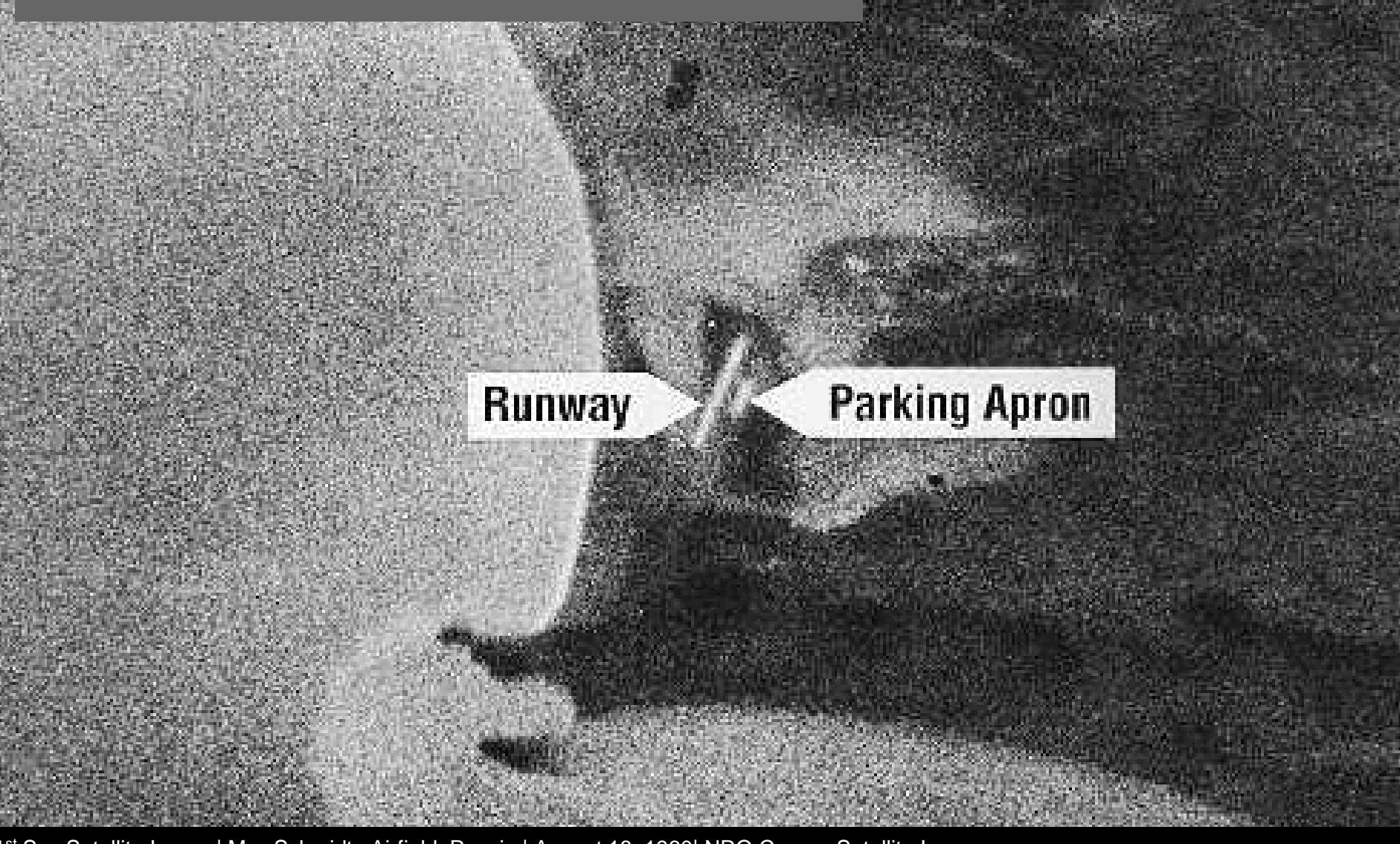
Commercial Satellite Imagery and Analysis: Origins and Applications

June, 2019

Stephen Wood
Maxar Technologies



The Past: Origins and Evolution of Commercial Satellite Imagery



Runway Parking Apron

May 16, 2016
Image



Mount Everest Summit
29,035 ft

Approximate location of
GPS coordinate of
climber Goutam Ghosh

Everest Base
Camp 4

Everest
Base Camp
2

Everest Base
Camp 3

May 12, 2017
Image



Climbers on Route to
summit

May 12, 2017
Image



<https://www.nytimes.com/interactive/2017/12/18/sports/everest-deaths.html>

Close Up View of Last Reported GPS Coordinate of Climber | Mount Everest, Nepal | May 12, 2017 | DigitalGlobe WorldView-2 Satellite Image

Eradicating disease with reliable maps

The Bill & Melinda Gates Foundation turns to Maxar for current, high-resolution imagery that reveals uncharted roads and villages in Africa. With up-to-date maps, health workers can access the answers they need to reach disease-affected areas and deliver life-saving medical supplies.



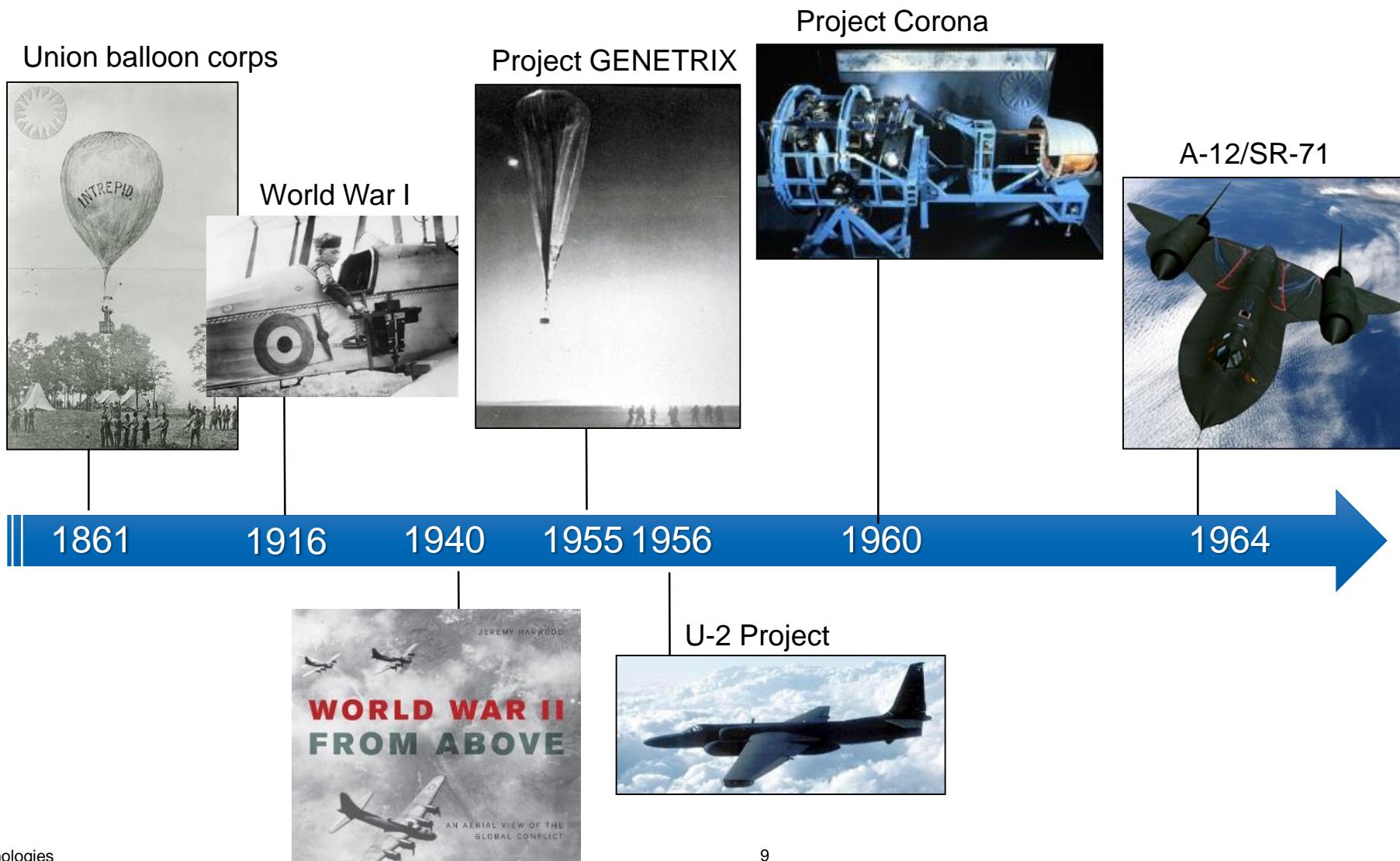
Imagery Quiz!

MAXAR

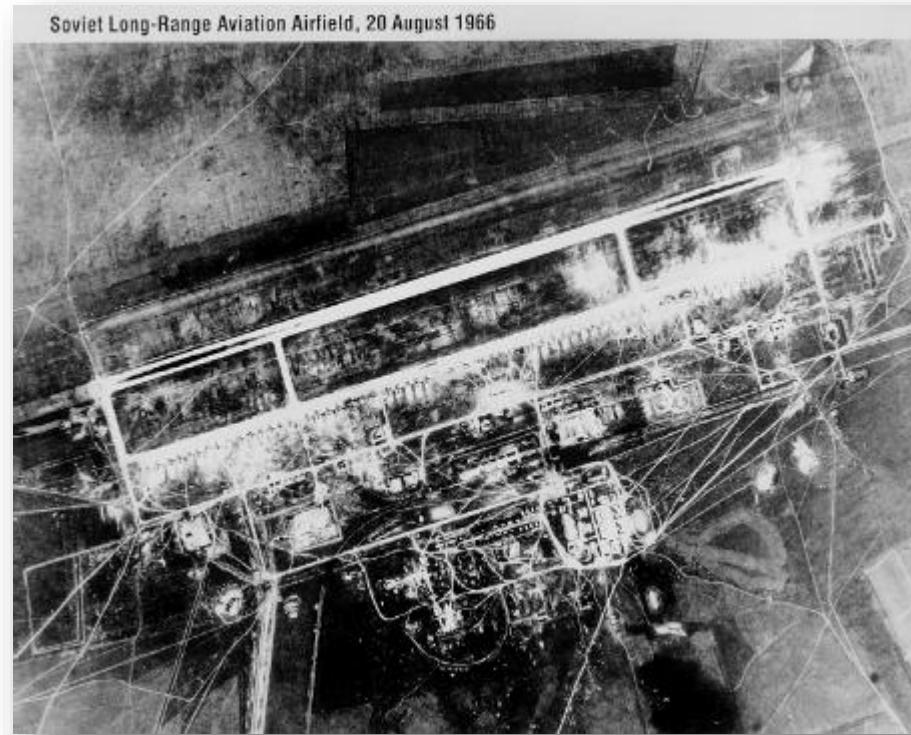
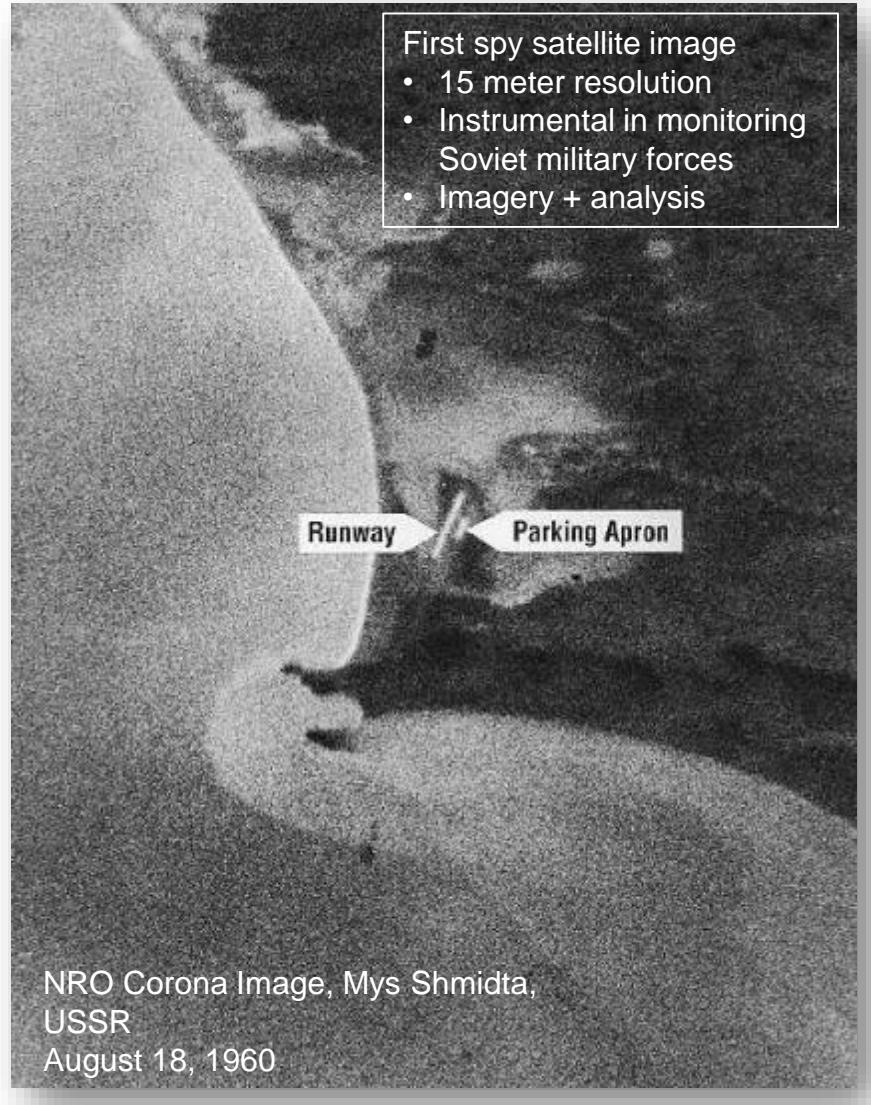




Origins of (Satellite) Imagery Intelligence



Origins of (Satellite) Imagery Intelligence (cont.)

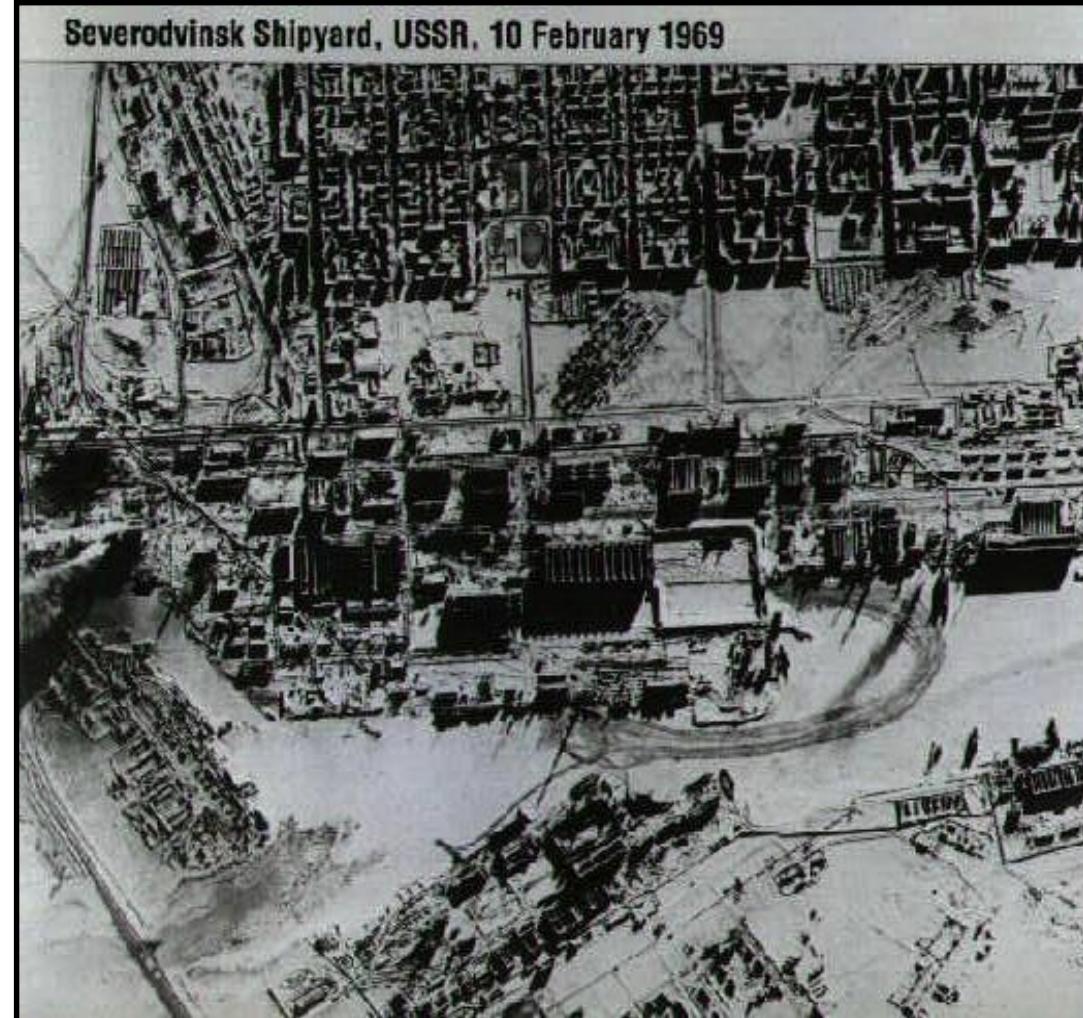
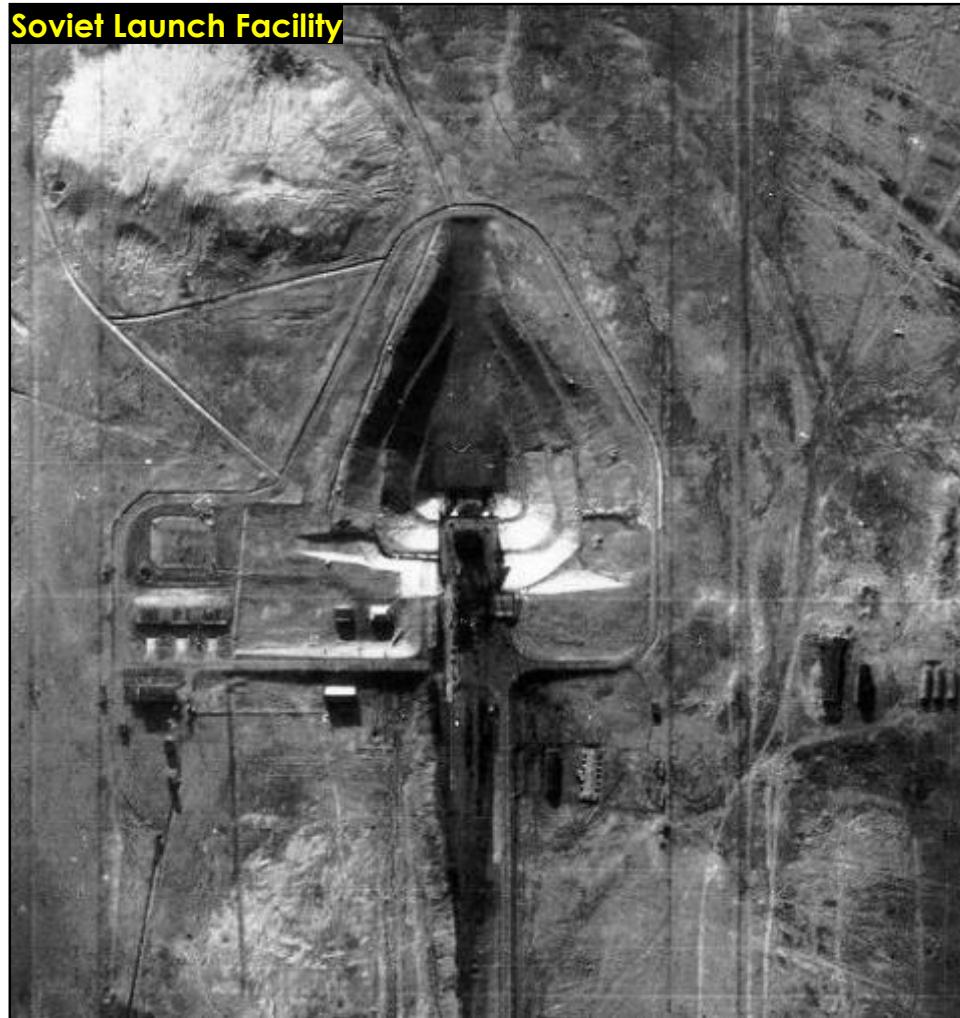


13 Failed Missions Before 1st Success!



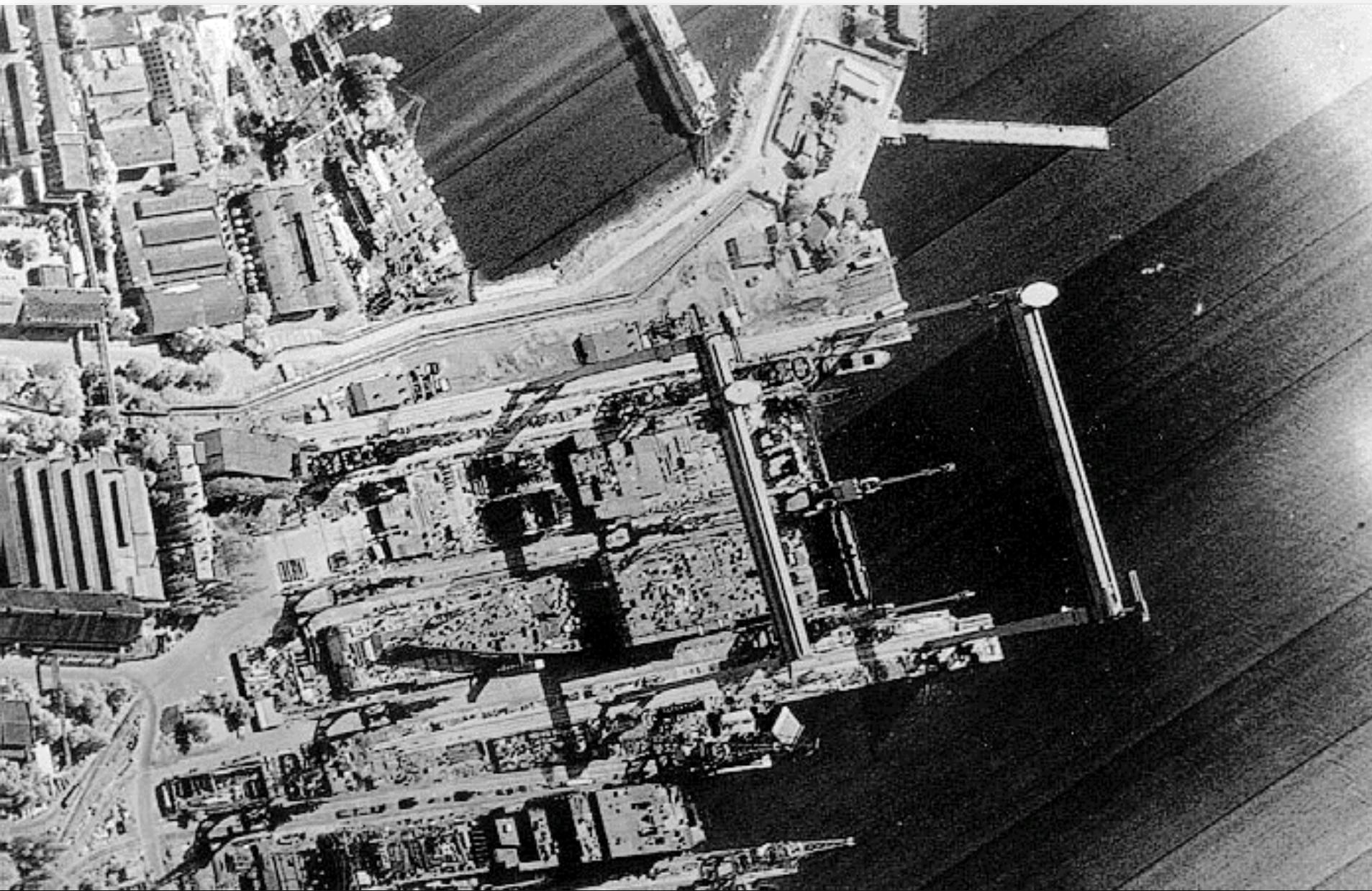
It started with the idea of global transparency

KH-4B Satellite Images: GSD: 1.57 meters



A “Top Secret” Satellite image in 1984

X



Kiev-Class Aircraft Carrier Under Construction | Nikolayev Shipyards, USSR | 1984 | Published by Jane's Defense

MAXAR

Modern uses of old (spy satellite) imagery

BBC Sign in News Sport Weather Shop Reel Travel More

NEWS

Home | Video | World | US & Canada | UK | Business | Tech | Science | Stories | Entertainment

See why millions of investors are choosing Vanguard ETFs® [Join us →](#)

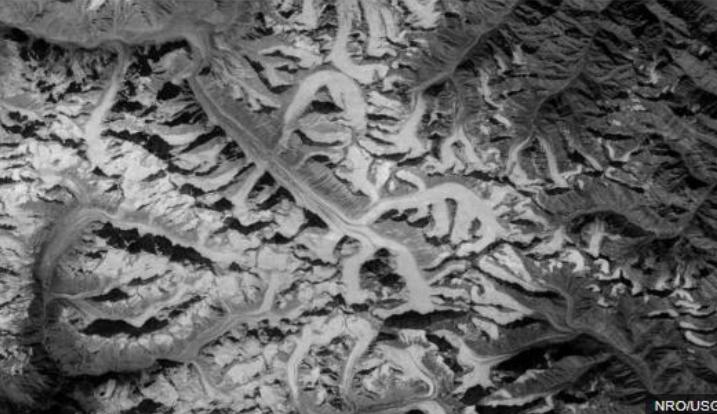
Science & Environment

Spy satellites reveal extent of Himalayan glacier loss

By Rebecca Morelle
Science Correspondent, BBC News

19 June 2019 [f](#) [t](#) [e](#) [m](#) [Share](#)

Cold War



NRO/USGS

The Hexagon images were declassified in 2011 and digitised for scientific study





Commercial imagery intelligence: 1986



Spot Image: Chernobyl Nuclear Power Plant, USSR; May 6, 1986

The first time satellite imagery was used in a breaking news story was in 1986.... well before there was a license available in the U.S. to commercialize Earth Observation technology.

The Washington Post

FRIDAY, MAY 2, 1986

THE NUCLEAR ACCIDENT AT CHERNOBYL

Civilian Satellites Penetrate Soviet Secrecy, Photograph Plant

Space Competition Takes New Direction

By Nat Hentoff
Managing Editor

A new kind of space competition was launched this week as the world turned to two civilian satellites to penetrate the Soviet cloak of secrecy and produce photographs of the damaged nuclear reactor at Chernobyl.

Unable to obtain aerial photos of the site within the Soviet Union, western governments turned to their first satellite glimpse of the scene. On Tuesday from London, the U.S. government-owned remote sensing satellite that has sat space since the Earth since 1972.

That day, a new French satellite produced a more detailed view of the reactor, showing damage to the ground next to the reactor and breaking Landor's 14-year monopoly on such services.

Computer analysis of the photos, taken from 500 miles above the earth by the French Spot satellite and released in Sweden, showed the reactor had stopped following the quake that stopped following the reactor and revealed a long dark streak marks on the ground next to the reactor, said Robert Lunn, a scientist assigned to Spot Image Corp., of Brussels, the wholly owned subsidiary of the French company created to market Spot's services.

The marks, at least 600 feet long, is believed to be "the probable result of a blast," Lunn said. Damage to the building cannot be discerned from the photo, but it is clear that the nuclear reactor on the earlier Landor photo is gone, he said. Lunn cautions, however, that the lack of smoke does not mean the fire at the reactor has been extinguished.

The Landor photo revealed less detail of the plant itself, but covered a larger area and was influenced mainly by slow vegetation surrounding the concrete facility.

While floating at an uncharmingly world with images of an inaccessible site, the two photos illustrated the strengths and weaknesses of the only two non-military satellites that will their services to anyone who will pay the price.

Lundor, the old war horse of civilian space photography, provided the first photo. Spot, only launched last year, was able to provide the satellite's services in a more timely manner than Lundor, a kind of data currently available only to the military. Technically not yet open for business, Spot's capabilities have already drawn scattered news agencies, lawyers and diplomats into a spin over the possibility of a new era in civilian space-based photography.

The technology is not entirely new—former and U.S. military satellites are said to be capable of creating lower photos and even images per headlines from space. What is new is the detail now available to the public, and the two local companies now competing to sell it.

Since 1972, former oil companies, geologists, bankers, foreign governments and others interested in how resource management have bought satellite photos taken in Landor. The photos covered large areas of the Earth, showing resources and vegetation patterns, mineral and oceanic resources. The smallest discernible object is 88 by 88 feet.

Now, by contrast, comes a smaller area, but offers much more detail than a 10-mile resolution, which means as object 22 feet by 22 feet in size, or about half the size of a tennis court, can be identified. The photos show clearly drivable roads, bridges, utility poles and steps.

Spot represents a \$200 million investment by the French government. Neither satellite actually takes photographs. Their cameras record infrared energy reflected off the Earth's surface. The data is sent to a computer that is used to create a photograph or even translated onto a floppy disk.

Spot's prices range from \$125 for a black-and-white print to \$1,500 for a top-of-the-line compact or computer tape. Landor's rates are monitored by the British Observatory Satellite Co. (Oasis), based in London, a joint venture of Hughes Aircraft Co. and ECA Corp. Landor's prices vary from \$50 to \$1,200.

Even so, Landor has the advantage of being able to record images in a wide range of specific bands. Spot's photographs in some infrared bands are said to identify certain materials that Spot images cannot detect, said Peter Prentiss, chairman of Spot.

Spot, however, has the advantage of being able to view the same scene more frequently than Landor. Both Landor and Spot circle the globe in near polar orbits. Landor covers nearly every location on earth in 18 days, while Spot takes 26. But while Landor's sensors "look" straight down, Spot's sensors "look" straight down, Spot's sensors "look" straight down, the sensor turns to either side—thus Landor can catch a passager who can view every 16 days, while Spot can view the same scene about twice a week. By viewing a site from two angles, the satellite can generate a stereoscopic image.

Thus, London, by luck, obtained the first photo of the Chernobyl site

of a new era in civilian space-based photography.

SATELLITE PHOTO OF REACTOR SITE

MAP 1: PHOTOGRAPH TAKEN FROM AN ALTITUDE OF APPROXIMATELY 500 MILES

This "snapshot" of the Chernobyl site was taken by the French civilian Spot satellite, which were electronic sensors to record energy pictures from the surface of the Earth that are then turned into a picture to manipulate.

French SPOT image of Chernobyl Reactor Site

Image from May 1, 1986

gas and chemical governments, and the Belgian telecommunications and aerospace industries.

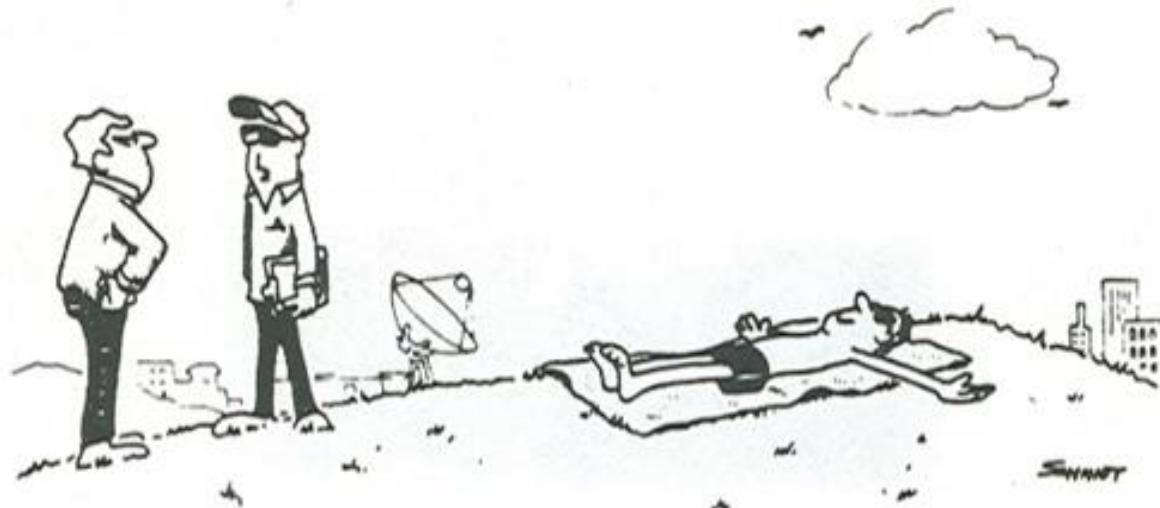
Spot expects most of its business to come from traditional Landor users such as foresters monitoring their crops, geologists looking for mineral deposits and energy companies searching for oil and gas. The company acknowledges that new uses are possible—but long could buy photos of land, while Lunn could buy photos of downtown Manhattan.

While opening new windows on the world, the prospect of advanced satellites for low orbit attracted space law experts in various nations. News executives have begun writing

about how far a company can go in trying to profit from licensing their satellite assets into the 21st century."

One of the keys to news agencies interest is the prospect of obtaining "overhead" looks at territory where word photography is not allowed. ABC News has used Landor photos of the first Iraq border, a Libyan military airfield and Soviet naval bases. "We would have access to the world we wouldn't have otherwise," said Mark Bonner, an ABC News editor.

The use of the Chernobyl Reactor Site image captivated the news media in 1986



Drawn for BROADCASTING by Jack Schmidt
"He's not sunbathing. We're testing the picture resolution of the remote-sensing satellite."

- ▶ Later the same year, this cartoon was drawn for a broadcasting magazine that used the word "remote sensing"
- ▶ If this was a technology that could be made available to the news media on a wide scale, it could change the way we report the news and understand changes on our planet.

The end of the Cold War opened new opportunities



End of the Cold War



1992 Land Remote Sensing
Policy Act

WorldView Imaging Corporation
Business Plan

WorldView Imaging Corporation Confidential



The first US license to operate a commercial imaging satellite (1993)

THE NEW YORK TIMES, FRIDAY, FEBRUARY 12, 1993

L D3

A Plan for Close-Up Images of Earth From Space

By JOHN MARKOFF

Special to The New York Times

SAN FRANCISCO, Feb. 11 — A small California company formed by a scientist who worked on the military's so-called Star Wars program has been licensed by the Government to launch a series of photo satellites that will make it possible for customers to directly dial up high-resolution images of earth and view them on their personal computers.

The new system, even though capable of producing the highest-quality commercially available images from space, will not approach the close-up power of military spy satellites, which is why the Department of Defense agreed to permit the license for the relatively weaker system. Military satellites can discern objects as small as one foot in diameter, civilian experts say. The permit is the first granted under a law passed last year by Congress.

Political and Economic Impact

Readily and widely available high-resolution images of the earth could have a significant political and economic impact, according to business experts and Government officials. Besides making it harder for the world's military powers to launch surprise attacks, the pictures might

The only better pictures are classified secrets.

be used for purposes like corporate espionage or news gathering.

The Worldview Imaging Corporation, an Oakland, Calif., start-up venture with Silicon Valley financing, received approval for the project from the National Oceanic and Atmospheric Administration in January.

The company was founded early last year by Walter Scott, a computer scientist who until the end of 1991 was the head of the controversial Lawrence Livermore Laboratories projects "Brilliant Pebbles" and "Brilliant Eyes," which are part of the Strategic Defense Initiative — the formal name for the Star Wars program. His co-founder was Doug Gerull, an executive at the Intergraph Corporation, the leading company in the geographic information systems market.

"If the images are cheap and available quickly, this will change a lot of things," said Mr. Gerull, Worldview's chief executive. "You could sit at your desk and get an image from

anywhere on the earth."

The resolution of the Worldview system is still nowhere near what the United States Government spy satellites can obtain. Those systems can take pictures that clearly show objects as small as footballs, while the Worldview system would show objects of "under three meters," according to several people familiar with the project. Still, that would be enough resolution to distinguish objects the size of cars and military vehicles.

Moreover, it would be significantly more resolution than is currently possible from Government public systems like the United States Landsat satellites used for map making and other data gathering, or the French Spot system used for similar purposes. Spot can resolve images up to about 10 meters while Landsat's resolution is about 30 meters.

The Worldview project is certain to generate interest — and controversy. High-resolution images have been a closely protected technology by the nations that are space powers because of the crucial military and economic information the pictures contain. Currently the United States, France and the Soviet Union are selling only lower-resolution images to a variety of commercial concerns, ranging from agribusiness and petroleum companies to environmental organizations searching for evidence of

pollution.

If all goes as planned, the company will begin supplying satellite photos in 1996 from a single small satellite and gradually add additional satellites to make it possible to get quicker turnaround time on a photo request from a customer.

Industry analysts said that Mr. Gerull had been a significant force in turning Intergraph into the leading player in the geographic information systems, or G.I.S., market. This computer hardware and software is increasingly being used by both corporations and local government planners in sophisticated data-analysis applications.

Last year the G.I.S. market was \$2 billion, according to Kathy Hale, a market researcher at Dataquest in San Jose, Calif. Ms. Hale said that she expected the market to double by 1996 and that growth in G.I.S. would be fueled in part by the availability of cheap satellites, such as Worldview's.

"It's really a new industry and this will be driven by the free-market."

One of the key members of Worldview's advisory board and architect of the project is Dr. Teller, who has been involved in the development of global satellite systems for military and commercial applications.

EarlyBird-1 completed in late 1997



First launch was on a converted Russian ICBM (Start-1)



A successful launch!



... but EarlyBird-1
died four days
later

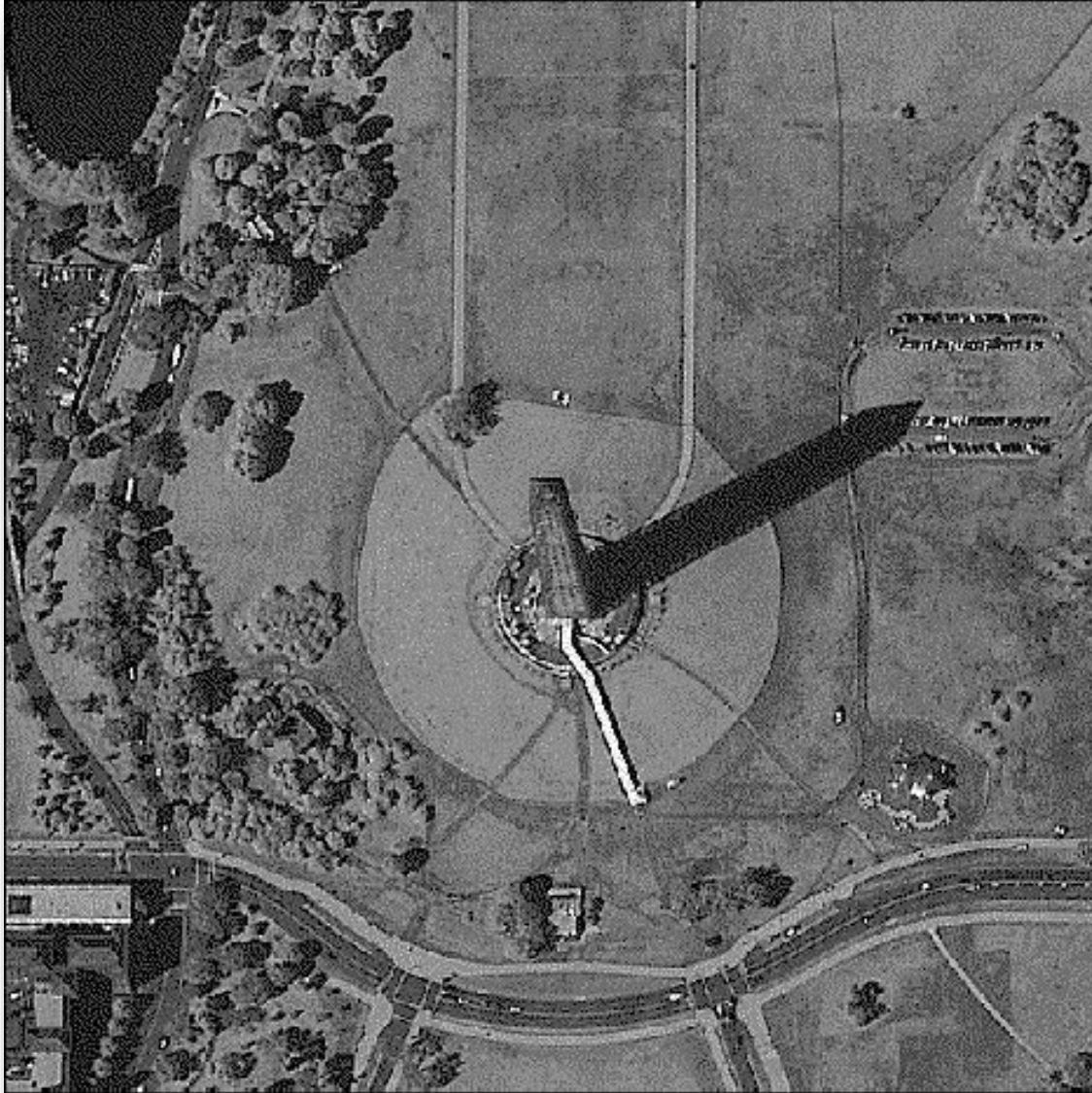
Space Imaging launch: April, 1999



Payload fairing
never separates;
satellite plunges
into the Pacific!

SPACE
IMAGING^{TM/SM}

The world's first high-resolution commercial satellite image! (1999)



October, 1999

Space Imaging's
IKONOS imagery of
the Washington
Monument

1-meter resolution

UNCLASSIFIED!

It wasn't until 13 years later, the first U.S. image was shown in mainstream media from an American commercial company.

Image collected by DigitalGlobe's IKONOS satellite October 13, 1999.



CAPTION READS:

A New Era in the Sky

A photograph of Washington, D.C. is the first high-resolution image of Earth taken by a commercial satellite to be made public.

QuickBird-1 (2000)



A good launch.....



2nd stage of rocket did not burn properly. Satellite and rocket falls into Atlantic Ocean

Not for the faint of heart!



November 20, 2000: Amateur astronomer photo of QuickBird-1 imaging satellite re-entering atmosphere off coast of Montevideo, Uruguay



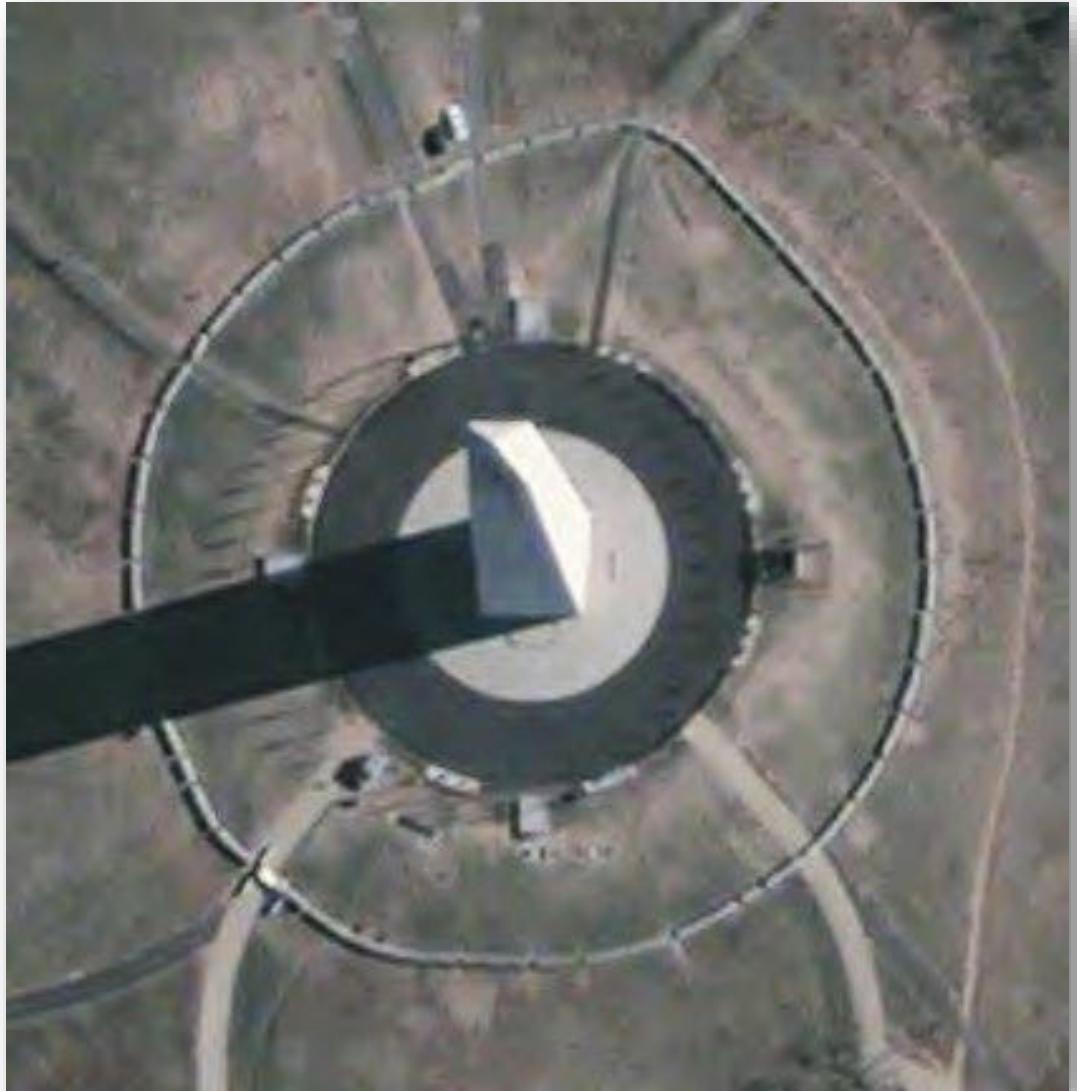
September 2001:
OrbView-4 launch failure

QuickBird-2 (2001)



Success!

The world's first sub-meter resolution commercial satellite image

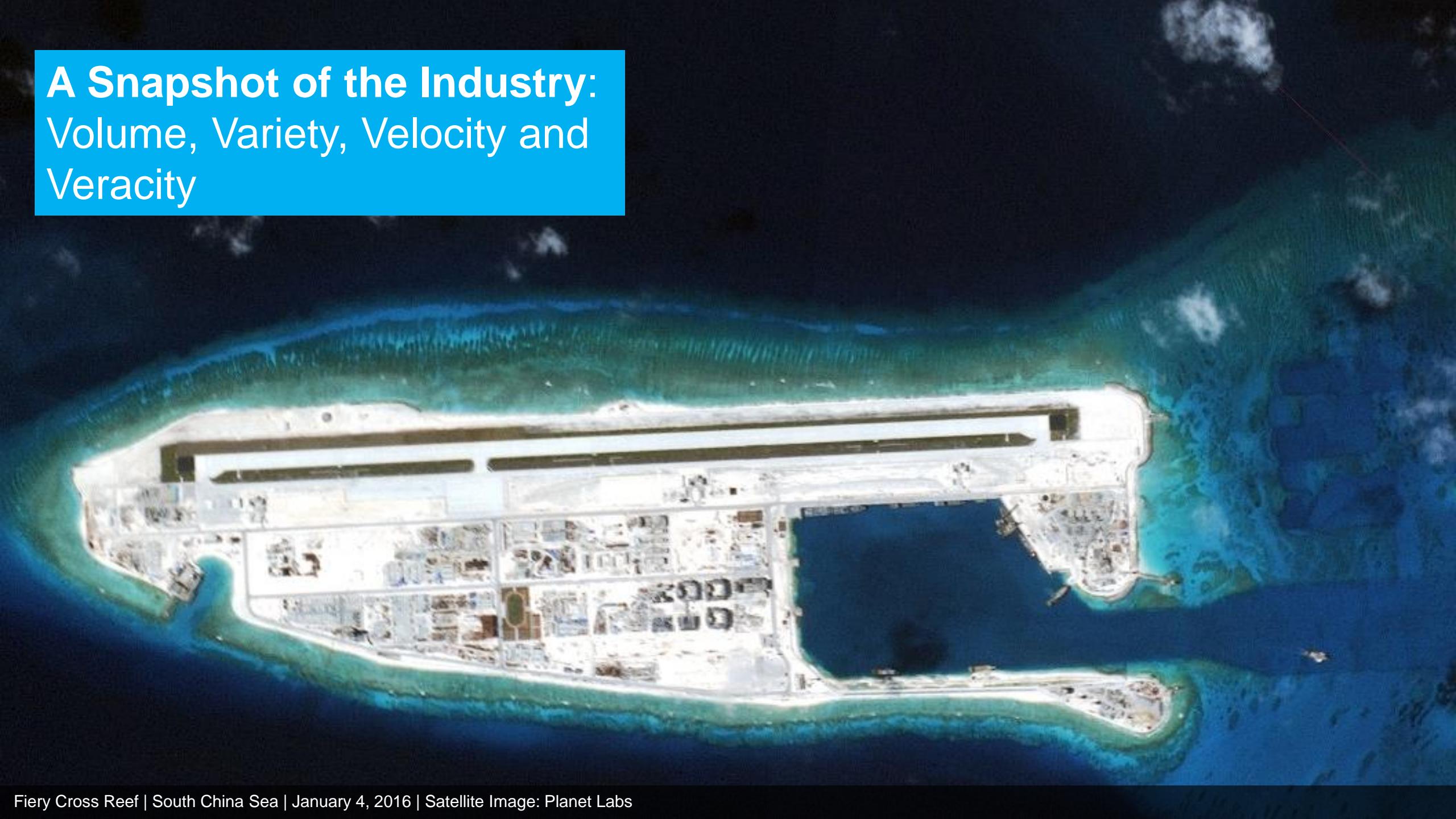


January, 2002

DigitalGlobe's QuickBird imagery of the Washington Monument

60-cm resolution

A Snapshot of the Industry: Volume, Variety, Velocity and Veracity



MAXAR

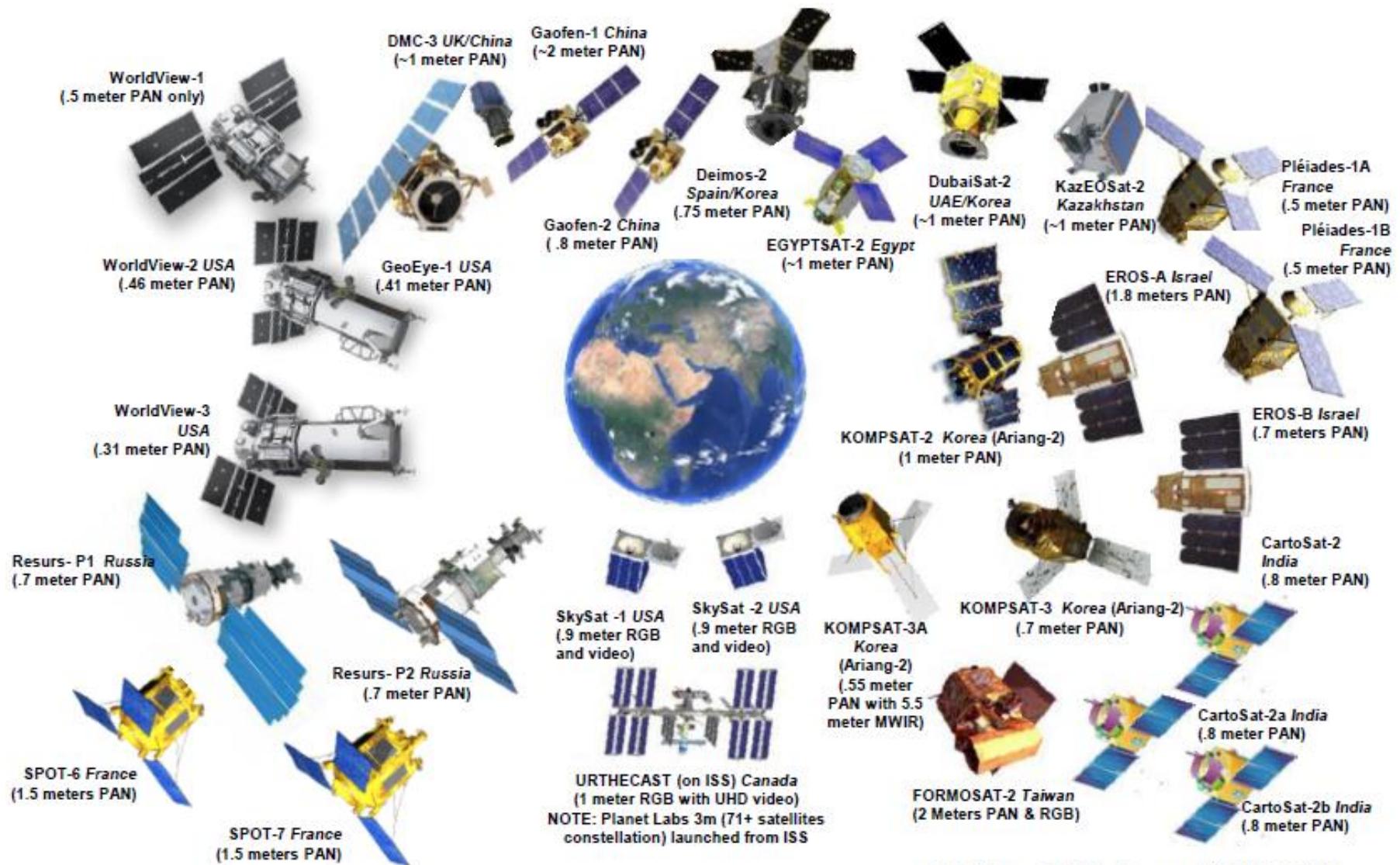
Imagery Quiz!



Russian Airbase | Latakia, Syria Maxar Satellite Image |



Earth Selfies!



Disclaimer: Satellite sizes are NOT TO SCALE



Countries that have orbited land-imaging satellites

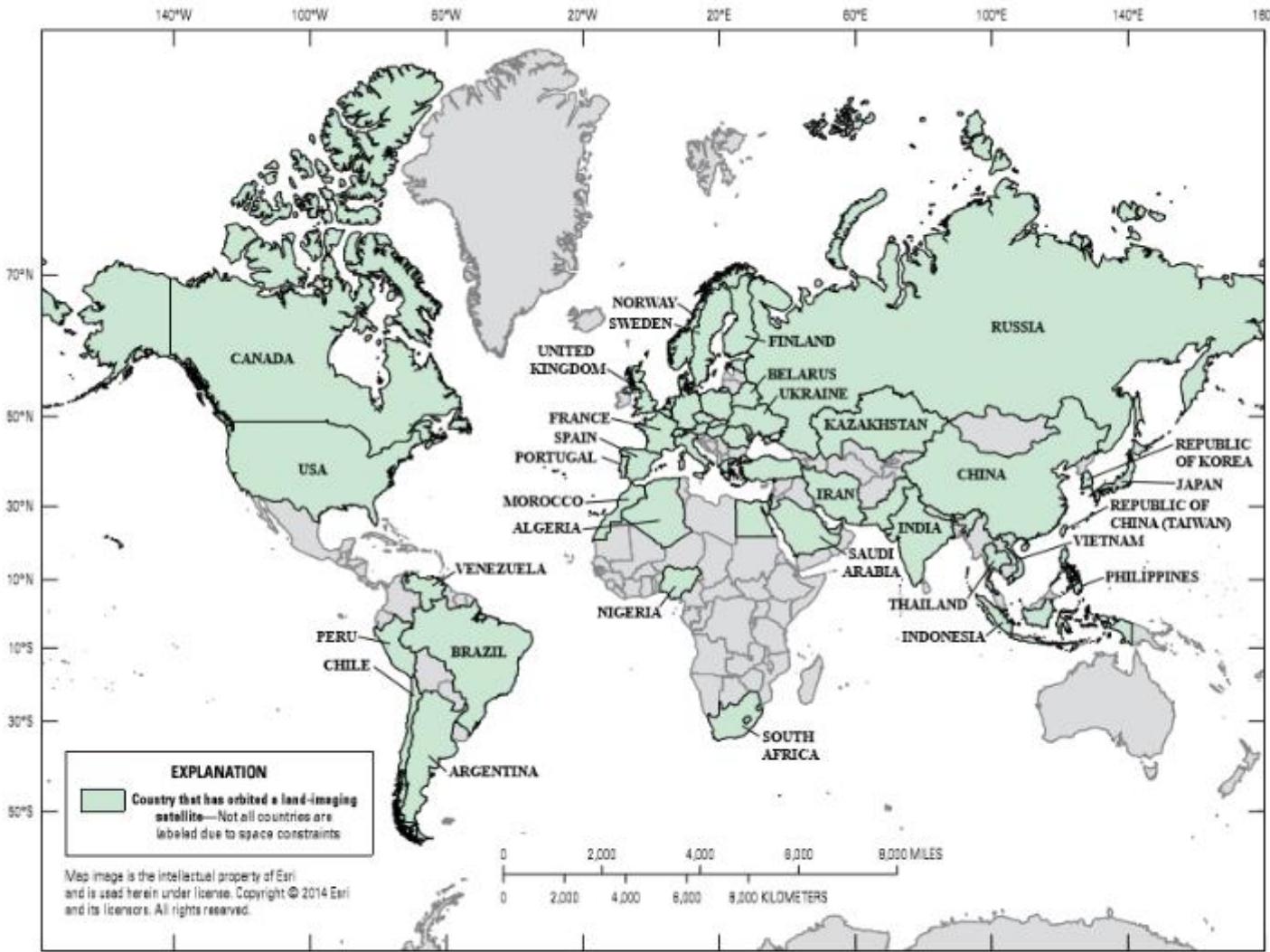


Figure 7. Countries that have orbited land-imaging satellites.

Source: USGS JACIE Guide, 2019

Countries with land-imaging satellites in orbit

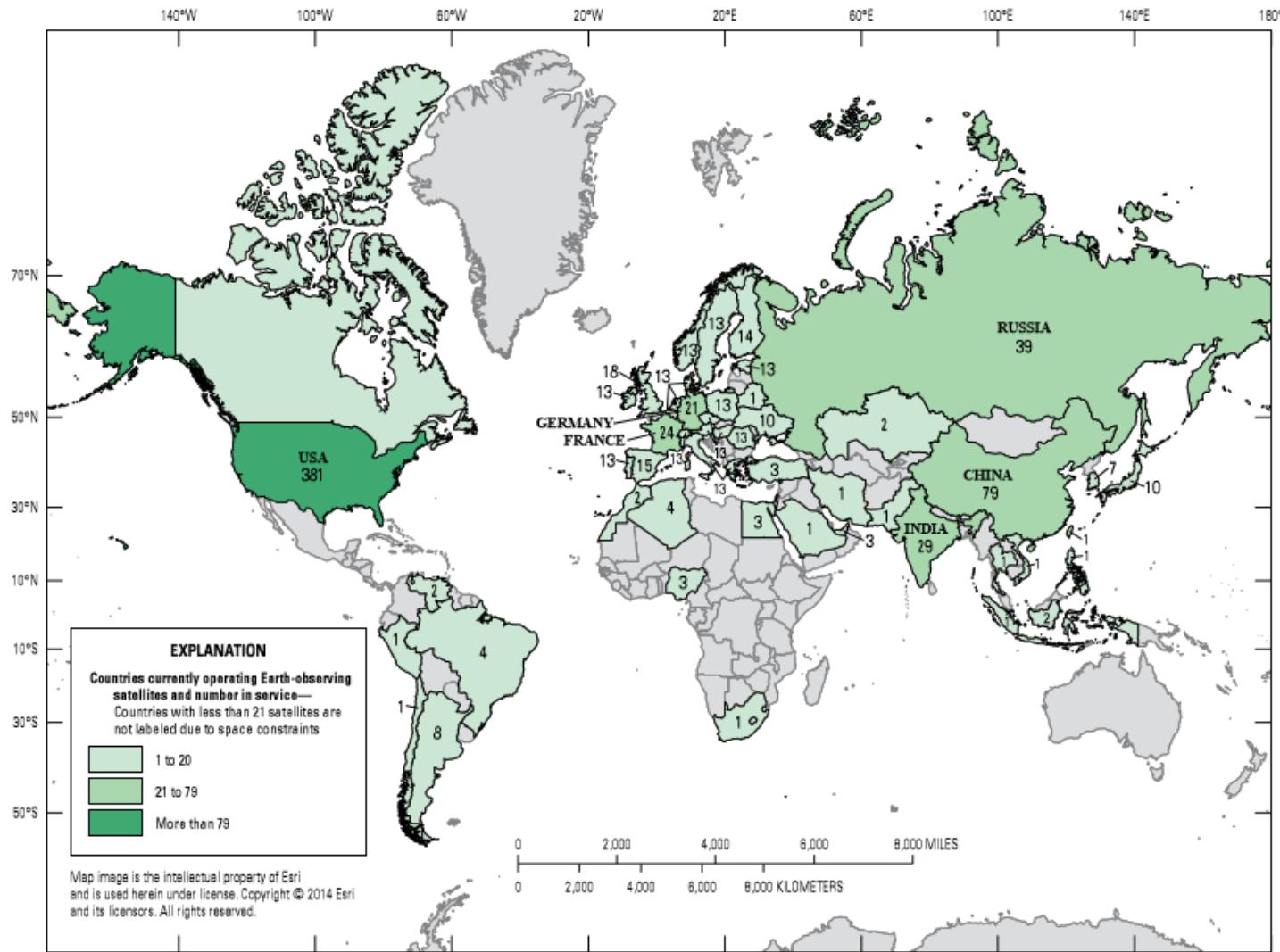
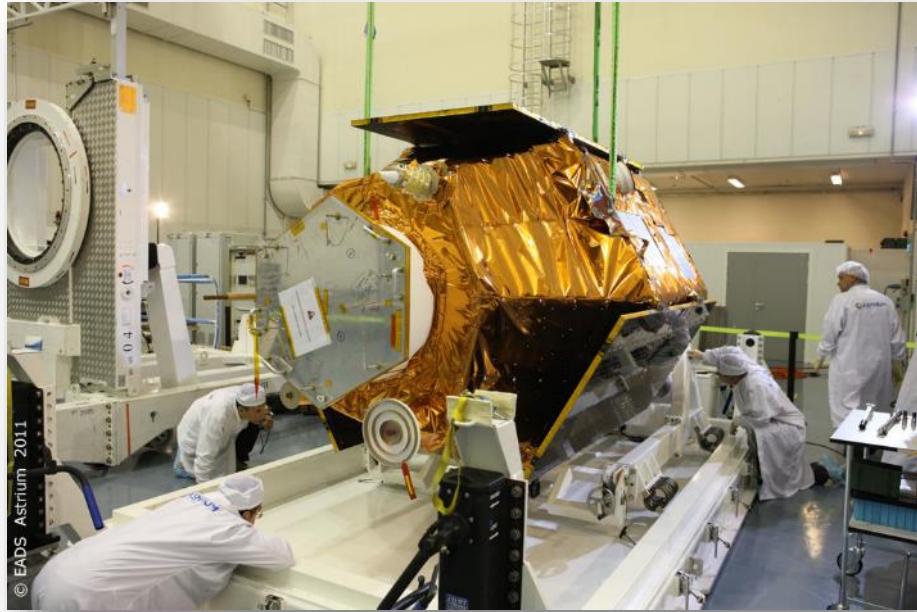


Figure 8. Countries currently (2018) operating Earth observing satellites with number in service.

Big Commercial Satellites



DigitalGlobe's WorldView-2 Satellite



Astrium's Pleiades Satellite

A typical imaging satellite in 2013 costs between half-a-billion and \$1 billion. They're about the size of a large SUV and they take three to four years to build.

MAXAR



Big (and expensive) rocket launches



Atlas V Rocket: Vandenberg AFB, USA
Launch costs: >\$100 million



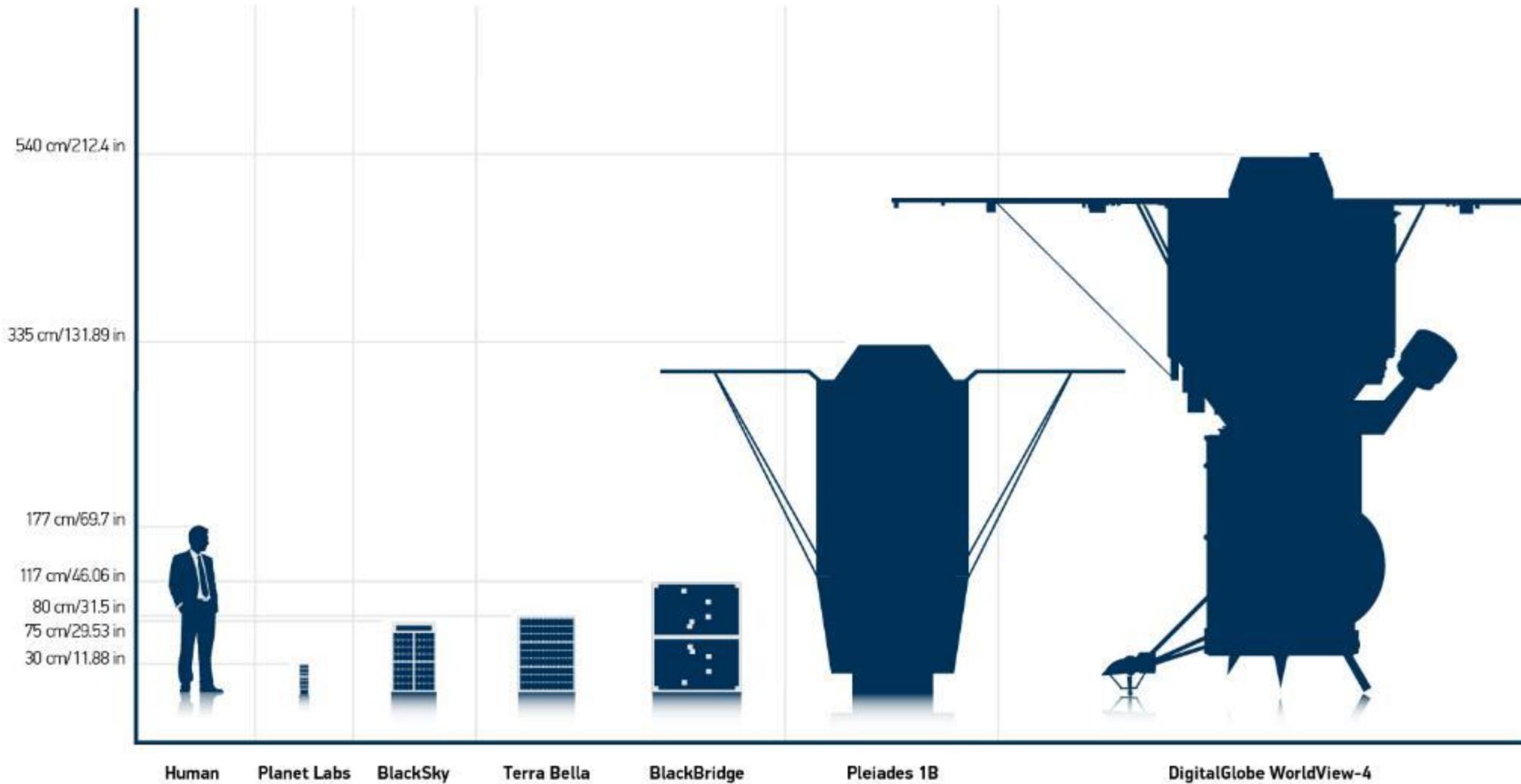
Soyuz Rocket: Kourou, French Guiana
Launch costs: ~\$75 million

Small Commercial Satellites



DAN BERKENSTOCK, (formerly of Skybox Imaging):
“We’re trying to build the iPhone of satellites. We take processors off the shelf so that we can fly the latest and greatest components in space that are available in the commercial marketplace. The beauty of this approach is that for less than the cost of a single imaging satellite in today’s world, we can launch an entire constellation of satellites.”

Comparative satellite sizes



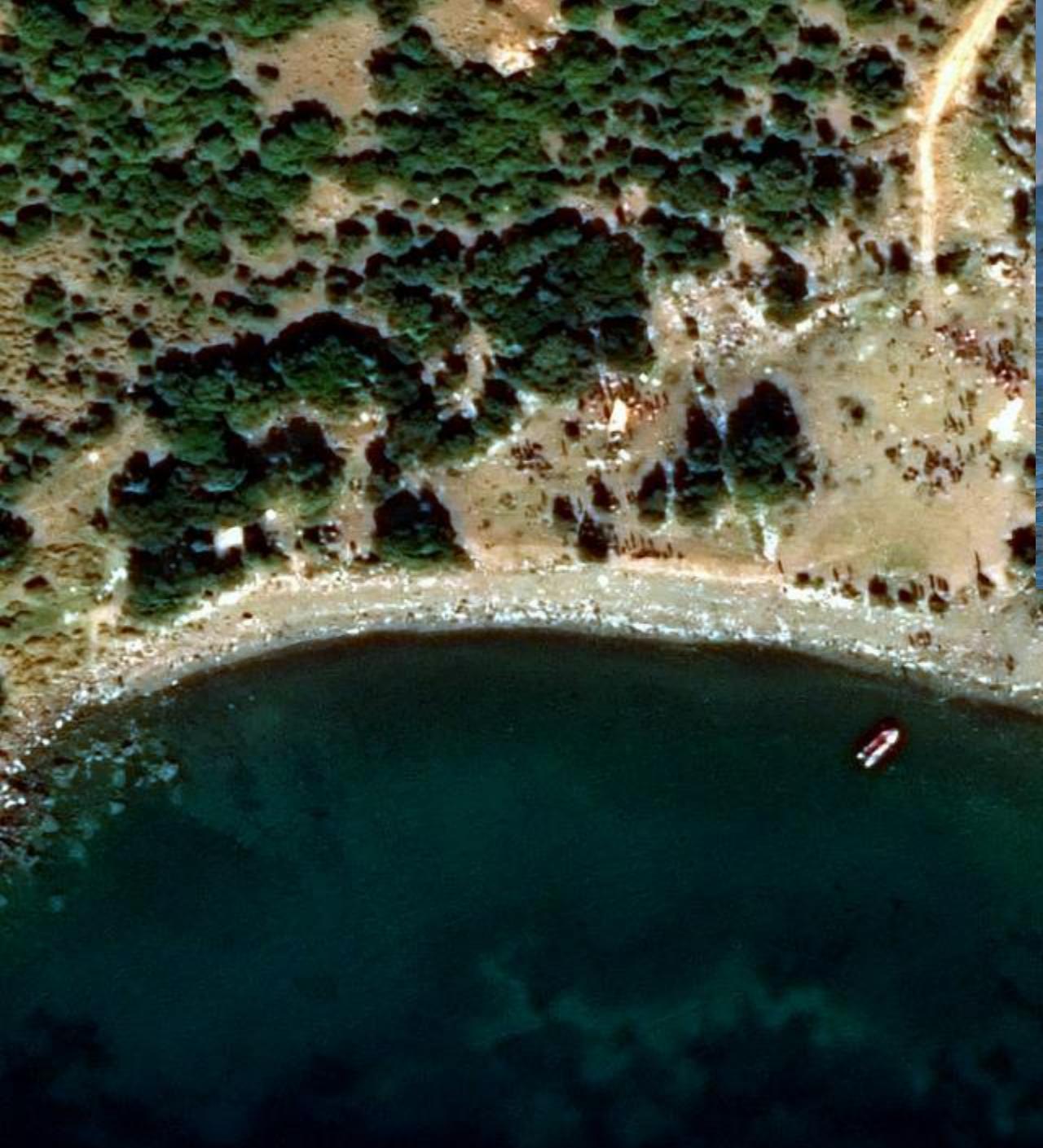


Unable to detect
and count number
of vehicles

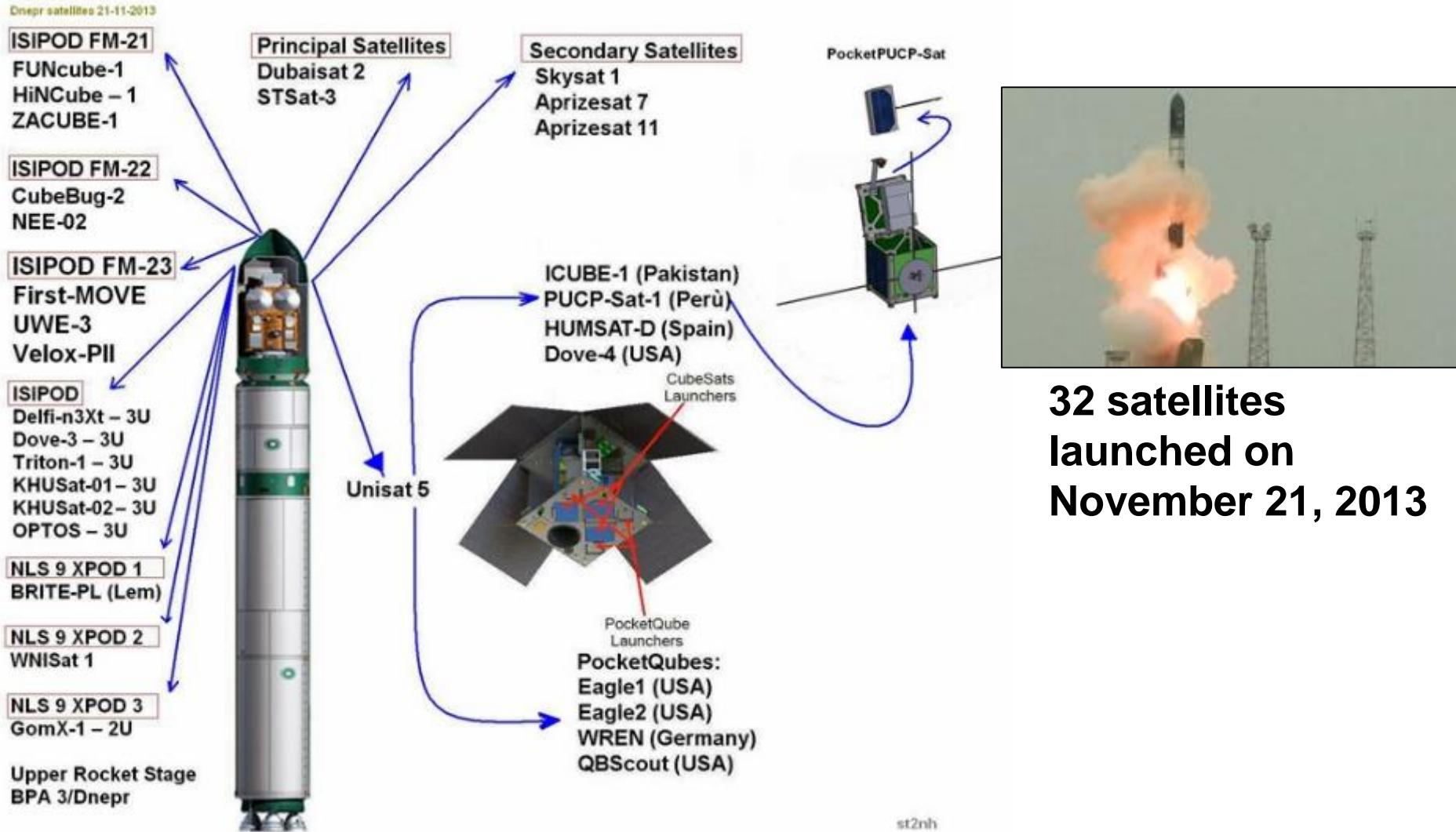
Able to detect possible
fighter aircraft based
on size and wing shape

Able to detect fixed wing
aircraft based on size,
shape





Ride sharing on rocket launches



Satellite launches by year

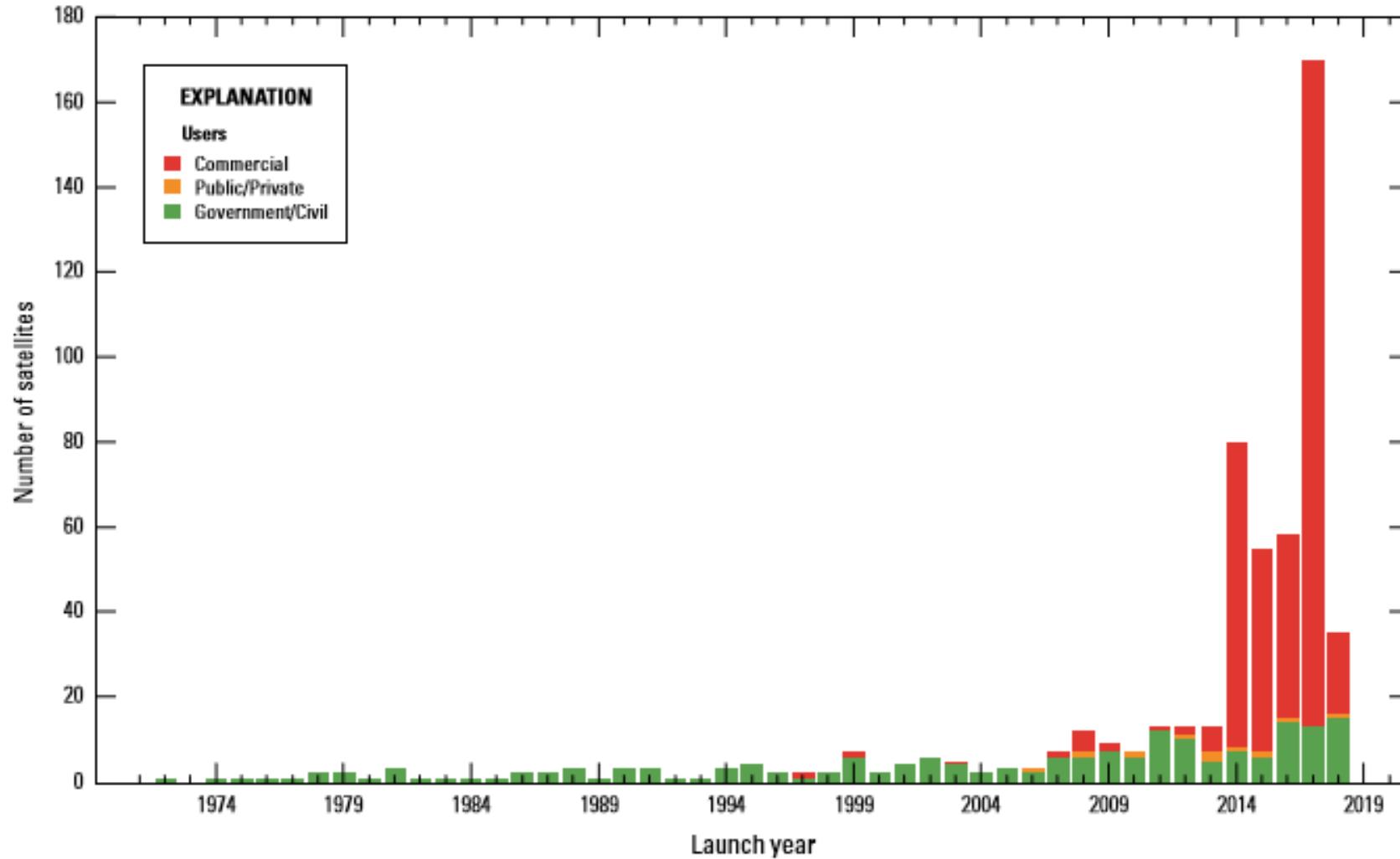


Figure 10. Satellite launches by year.



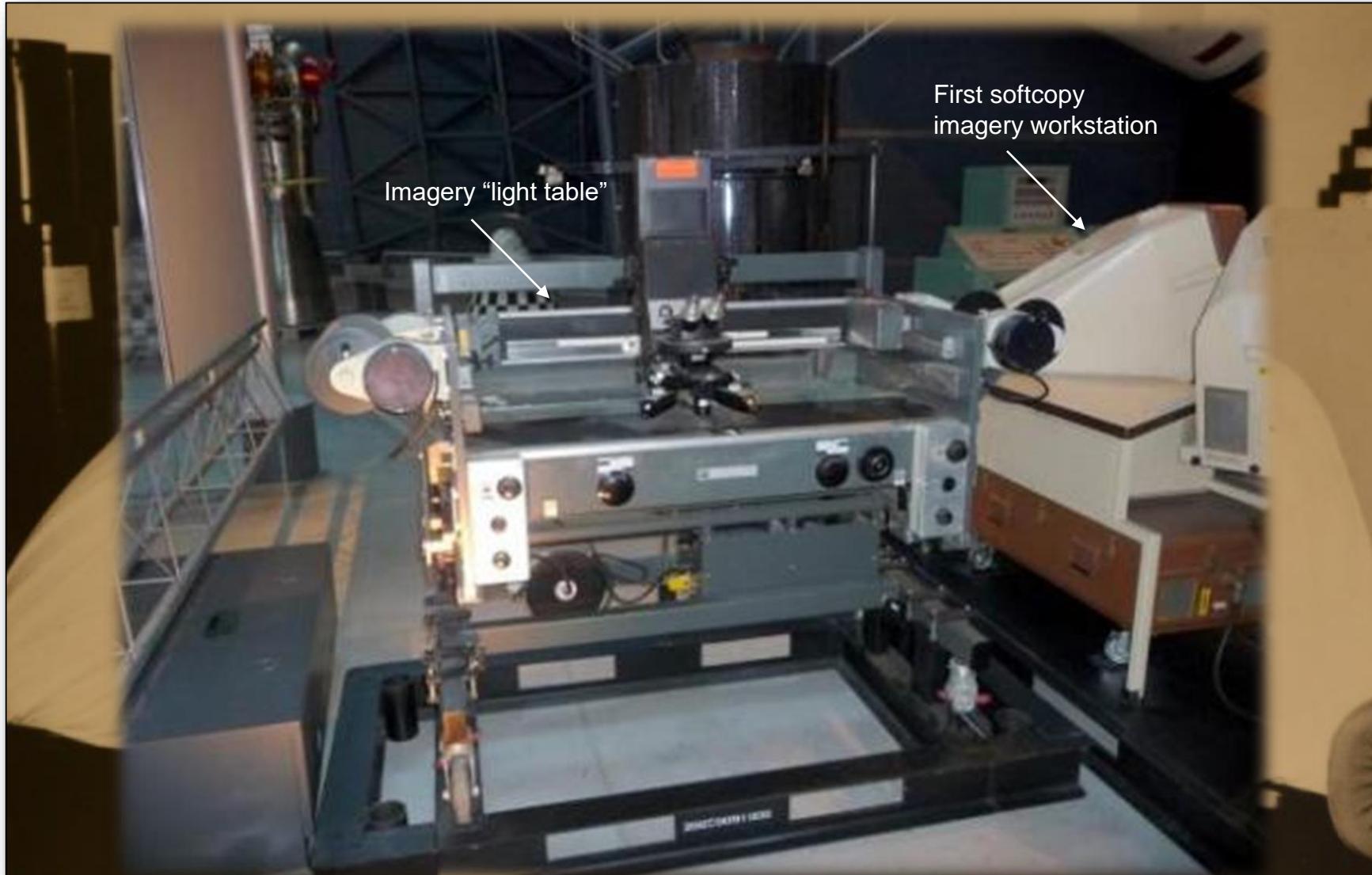
Antares rocket
explodes on launch.
Planet loses 26
Dove satellites

Imagery Collection, Analysis and Technologies

MAXAR



My Background and Career



The Evolution of Analysis

1st Phase: Resolution

Customers need to be assured that satellites can augment aerial



One meter resolution imagery becomes the new standard

2nd Phase: Accuracy

Emerging map making and web portal industry drives growth and requirements for accuracy



Improving map accuracy becomes expected from imaging systems

3rd Phase: Speed

Increasing reliance on priority, speed and relevancy



Customers are no longer willing to wait for days to receive time-sensitive imagery

4th Phase: Analytics

New markets beginning to emerge for non-traditional customers and need for imagery insight

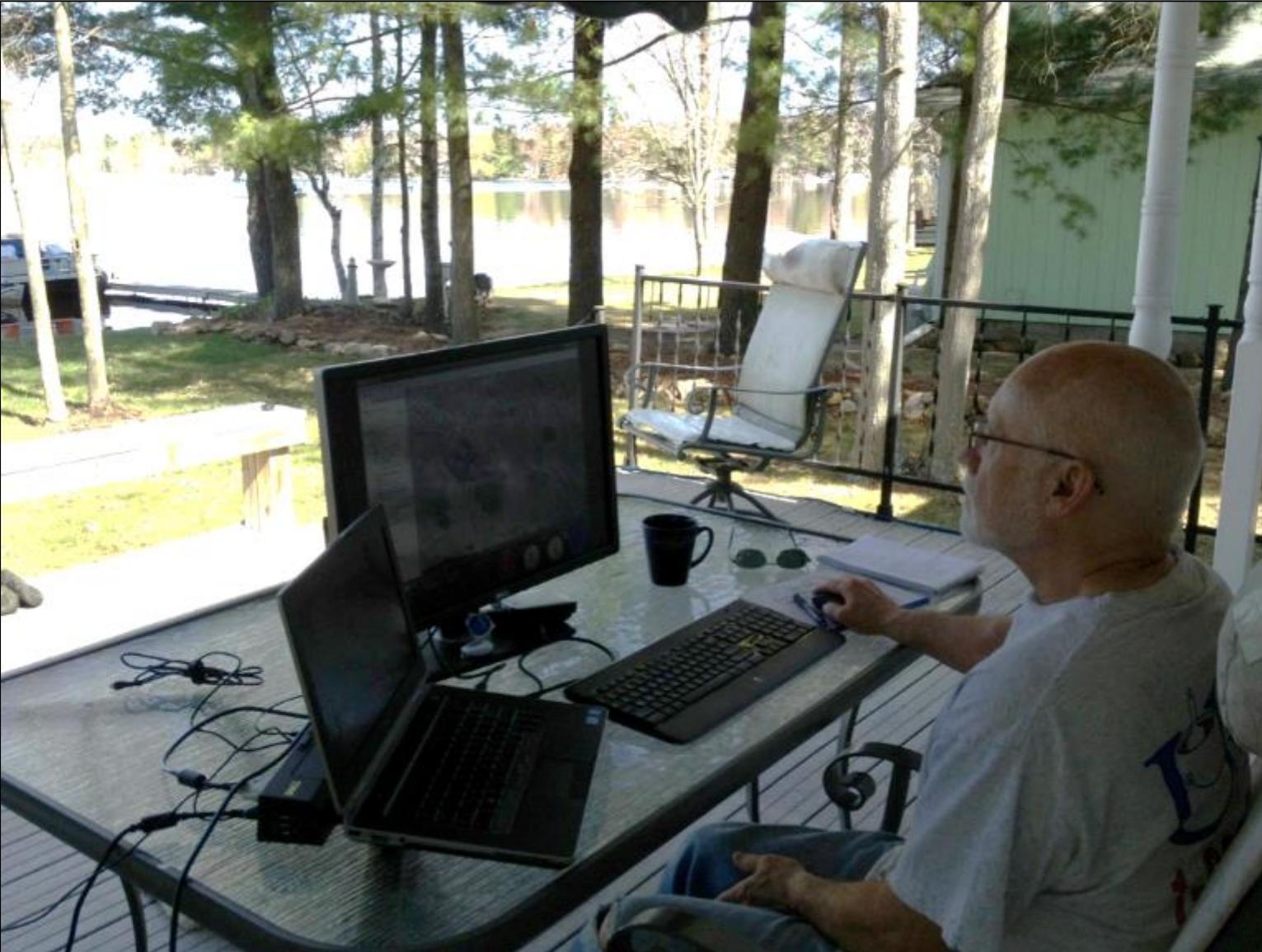


Imagery-derived information becoming increasingly important

Imagery Analysis & Exploitation: 2010

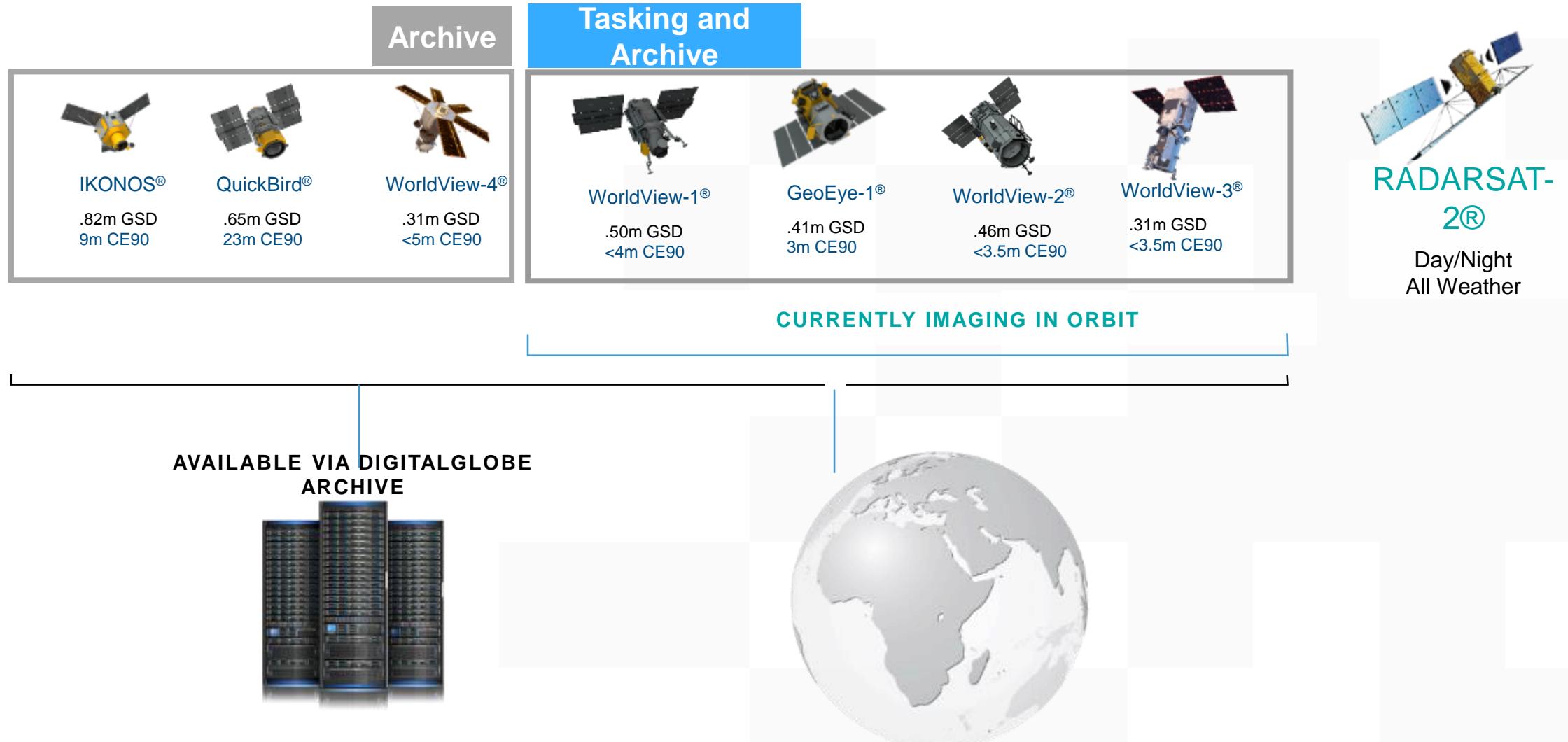


Imagery analysis & exploitation: 2019





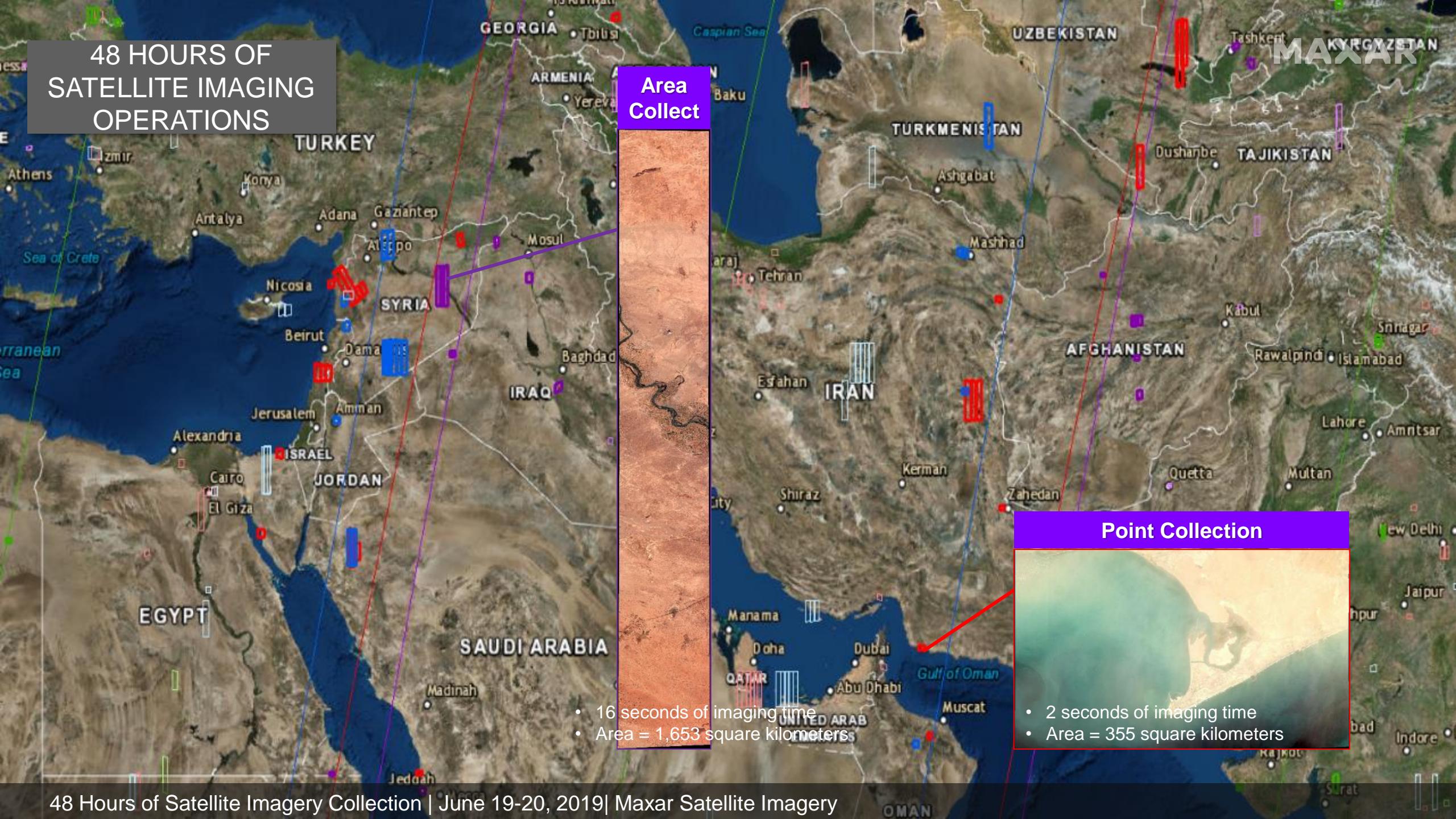
Our satellite imagery constellation



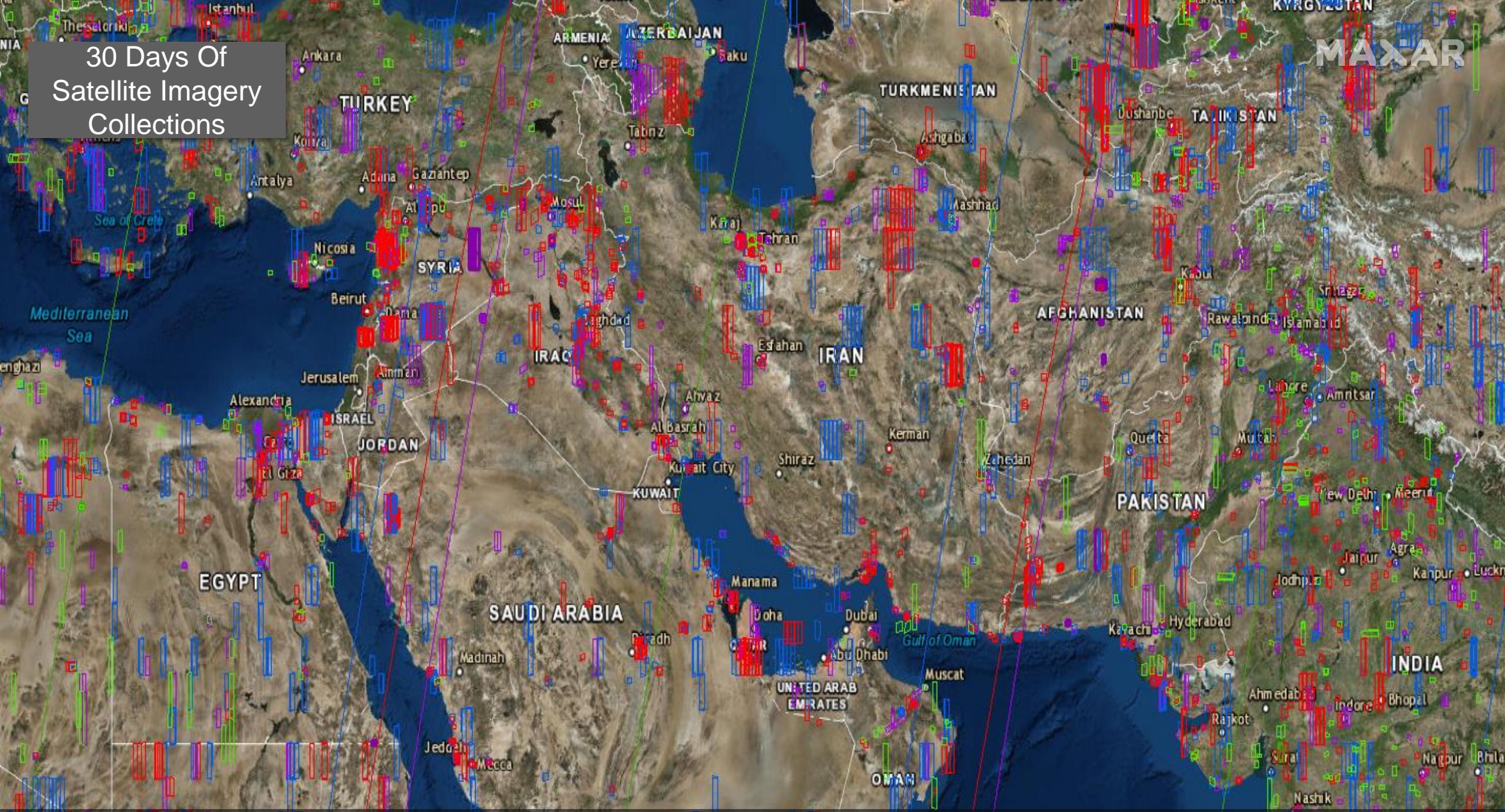
48 HOURS OF SATELLITE IMAGING OPERATIONS



48 HOURS OF SATELLITE IMAGING OPERATIONS



30 Days Of Satellite Imagery Collections

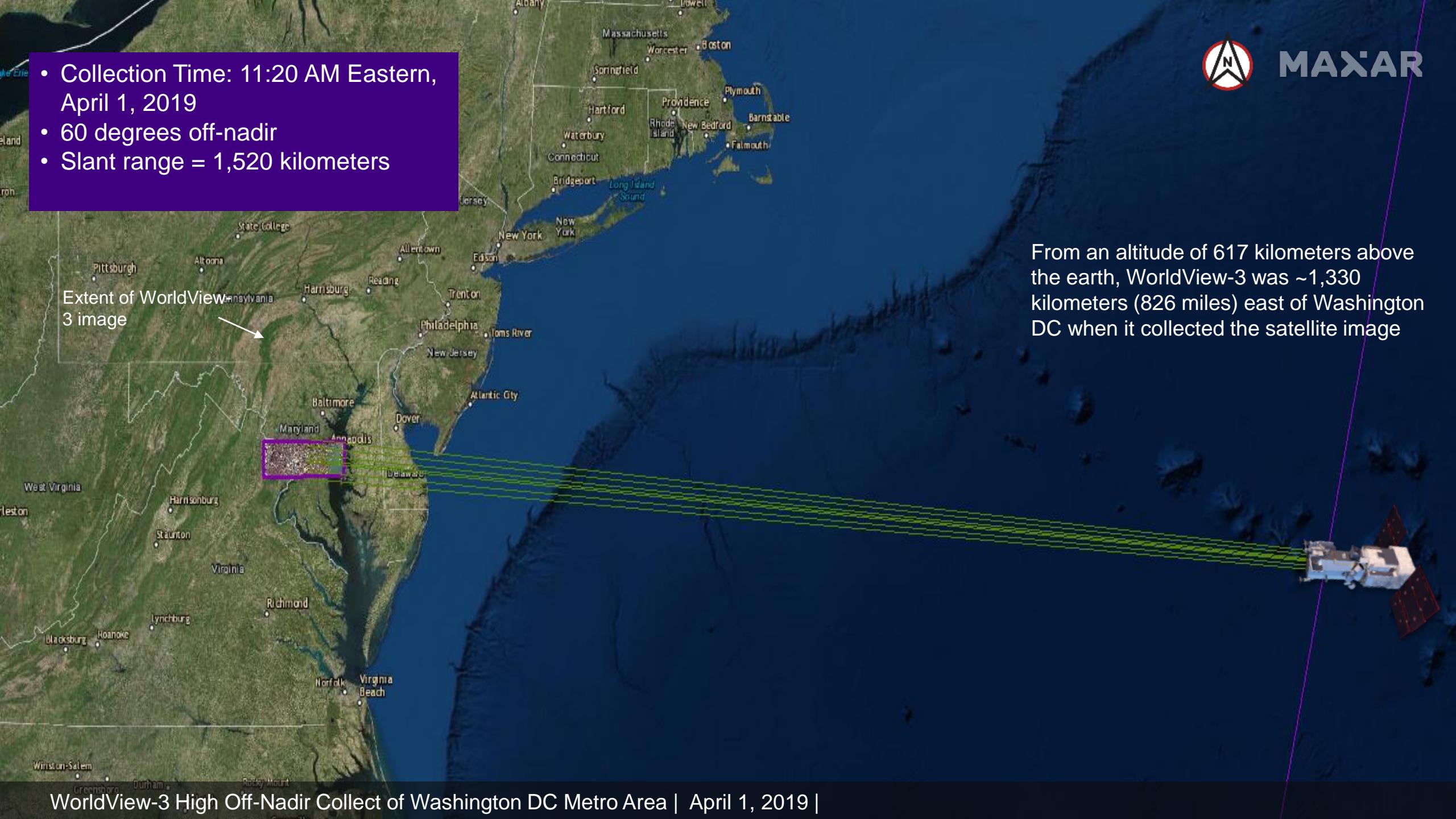


MAXAR



MAXAR

- Collection Time: 11:20 AM Eastern, April 1, 2019
- 60 degrees off-nadir
- Slant range = 1,520 kilometers



From an altitude of 617 kilometers above the earth, WorldView-3 was ~1,330 kilometers (826 miles) east of Washington DC when it collected the satellite image



MAXAR



Overview (browse) image of April 1, 2019 WorldView-3 high off-nadir collection



DC Mall | Washington D.C. | April 1, 2019 | WorldView-3 High Off-Nadir Satellite Image



US Capitol | Washington D.C. | April 1, 2019 | WorldView-3 High Off-Nadir Satellite Image

HIGH OFF-NADIR COLLECTIONS

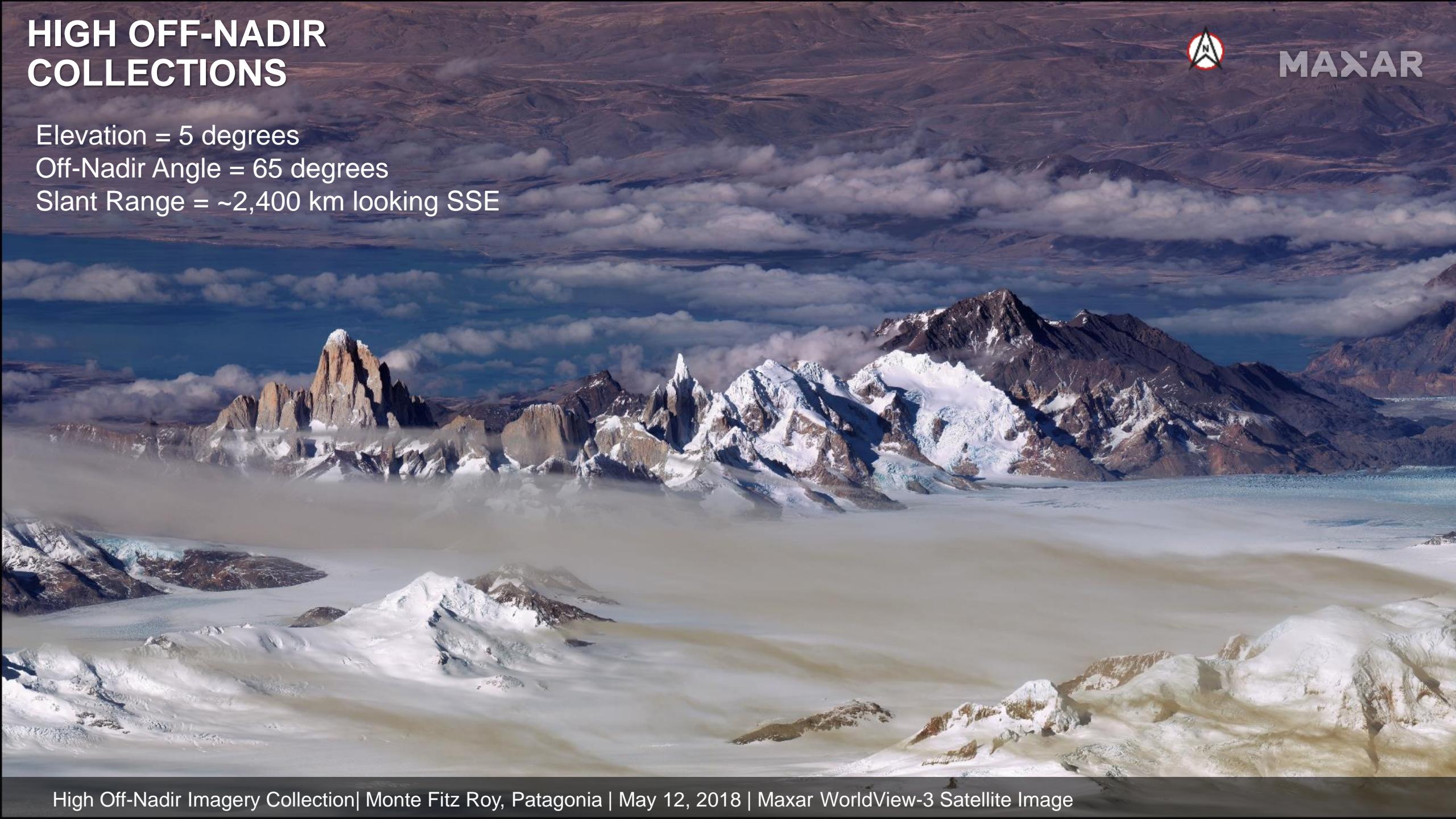


MAXAR

Elevation = 5 degrees

Off-Nadir Angle = 65 degrees

Slant Range = ~2,400 km looking SSE



HIGH OFF-NADIR COLLECTIONS

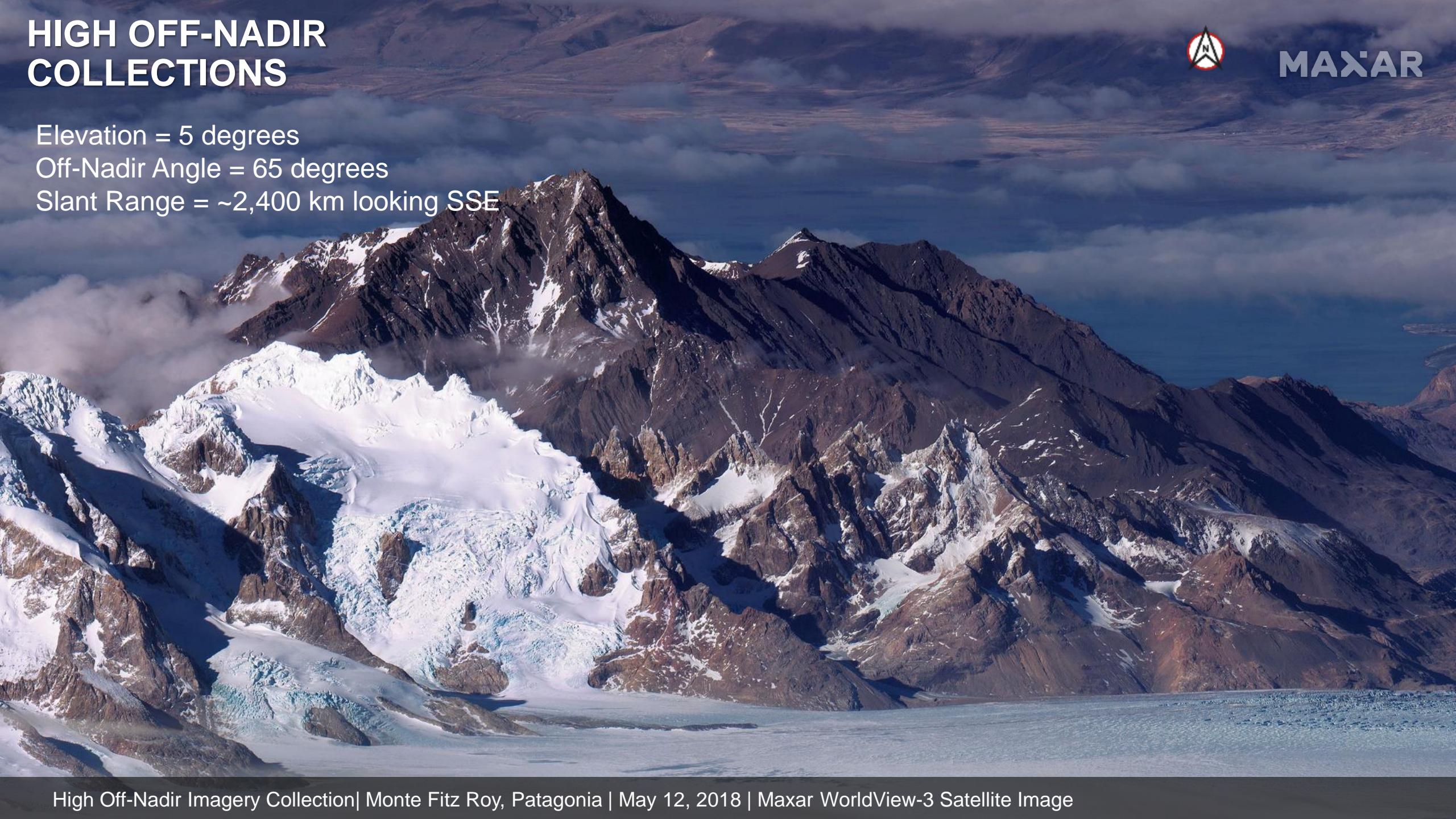


MAXAR

Elevation = 5 degrees

Off-Nadir Angle = 65 degrees

Slant Range = ~2,400 km looking SSE



MAXAR



50-degree High Off-Nadir Image of Atlas 5 Rocket | Launch Pad 39B, Cape Canaveral | October 16, 2018 | Maxar WorldView-3







DigitalGlobe's Natural Color Image October 7, 2011



DigitalGlobe's Natural Color Image October 7, 2011

Imagery artifacts can be helpful

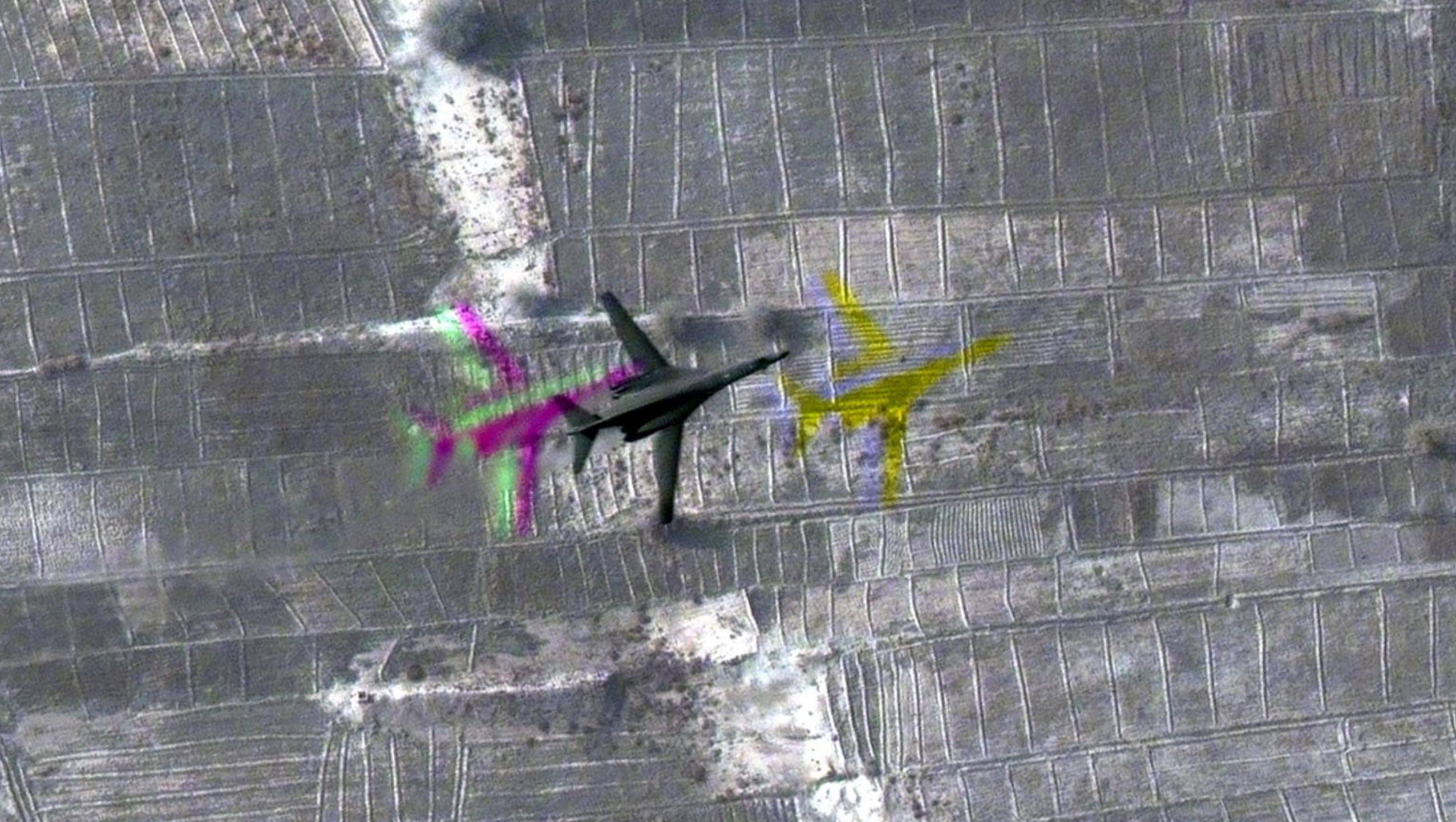


MAXAR

Il-76 (Candid)
in flight

Equipment dropped from
airplane, drag chute about
to open

Parachutes with
equipment about
to land on ground







Burned Area

Destroyed
Buildings

Burned Area

NATURAL COLOR SATELLITE
IMAGE



MAXAR



Outbreak of Camp Fire | Near Pulga, California| November 8, 2018 | Maxar GeoEye-1 Natural Color Satellite Image

COLOR INFRARED SATELLITE IMAGE



MAXAR

This is a Maxar color infrared satellite view of the same area. With color infrared imagery, healthy vegetation appears red/pink while burned vegetation appears black/grey.

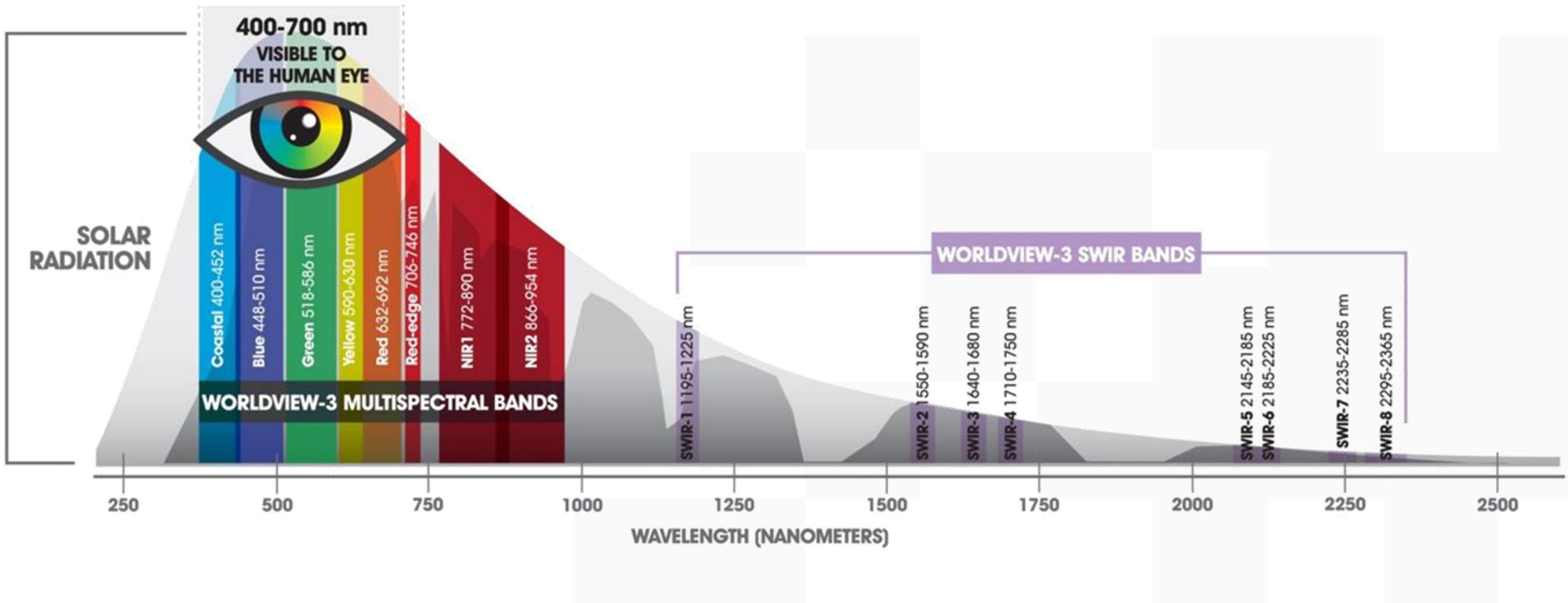
Burned vegetation

Healthy vegetation

Pulga

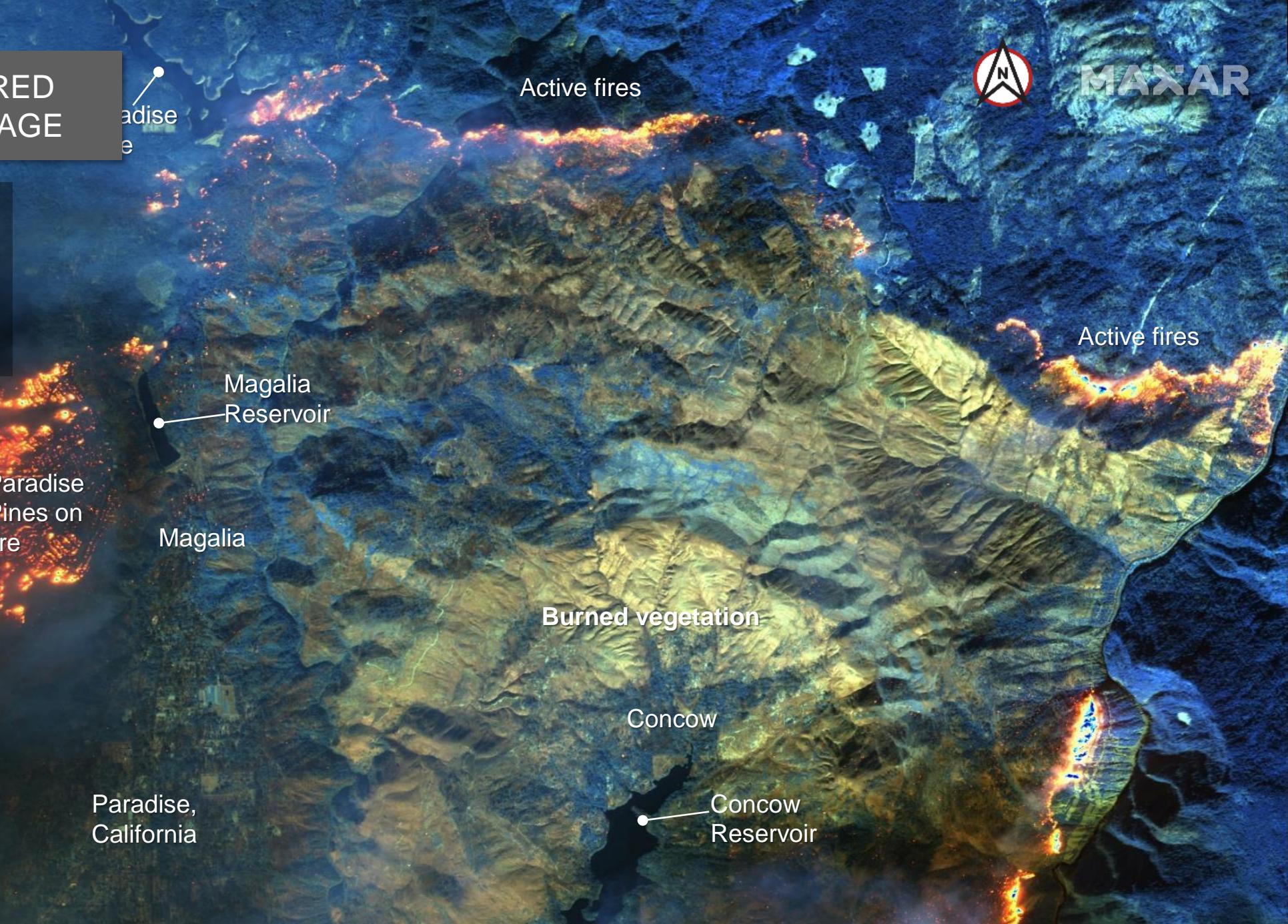
North Fork Feather
River

WorldView-3 Spectral Coverage



SHORTWAVE INFRARED (SWIR) SATELLITE IMAGE

SWIR satellite imagery can penetrate smoke and detect fires. In SWIR imagery, healthy vegetation appears blue. Burned areas appear orange/yellow and active fire lines glow.



SHORTWAVE INFRARED
(SWIR) SATELLITE IMAGE

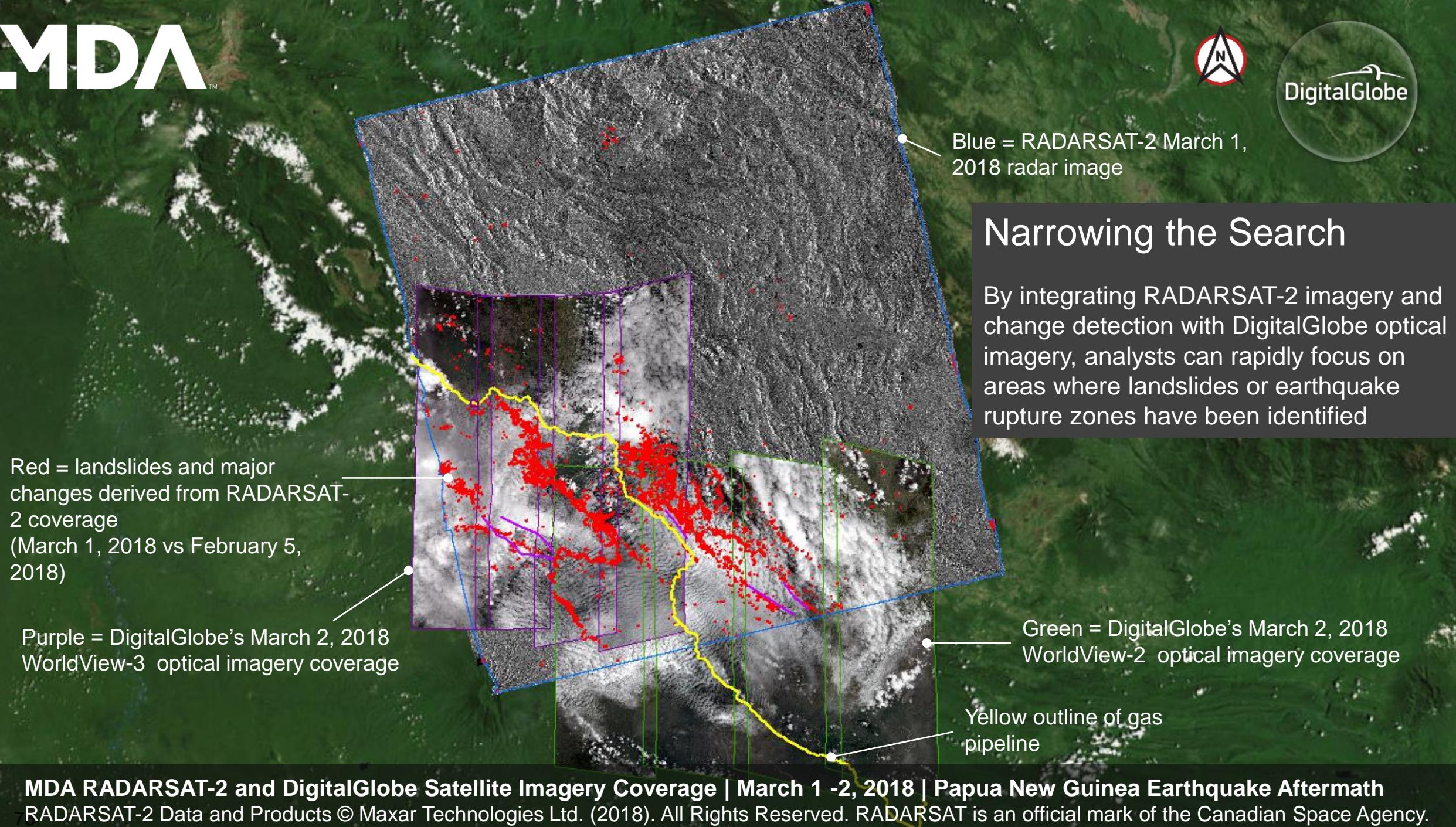


Paradise Pines
Neighborhood

Magalia

Magalia Reservoir







After Earthquake



DigitalGlobe

Komo Airfield
(10,500 feet runway)

Outline of gas
pipeline

Red outline of landslides and
major changes derived from
RADARSAT-2 coverage (March
1st vs February 5, 2018 imagery)

MDA RADARSAT-2 Satellite Imagery of Komo Airfield | March 1, 2018 | Papua New Guinea Earthquake Aftermath

RADARSAT-2 Data and Products © Maxar Technologies Ltd. (2018). All Rights Reserved. RADARSAT is an official mark of the Canadian Space Agency.

After Earthquake

Landslides

Tagari River

Komo Airfield

Outline of gas pipeline

Red outline of landslides and major changes derived from RADARSAT-2 coverage (March 1st vs February 5, 2018 imagery)

Downed trees, dirt blocking river

Surface disturbance near edge of runway

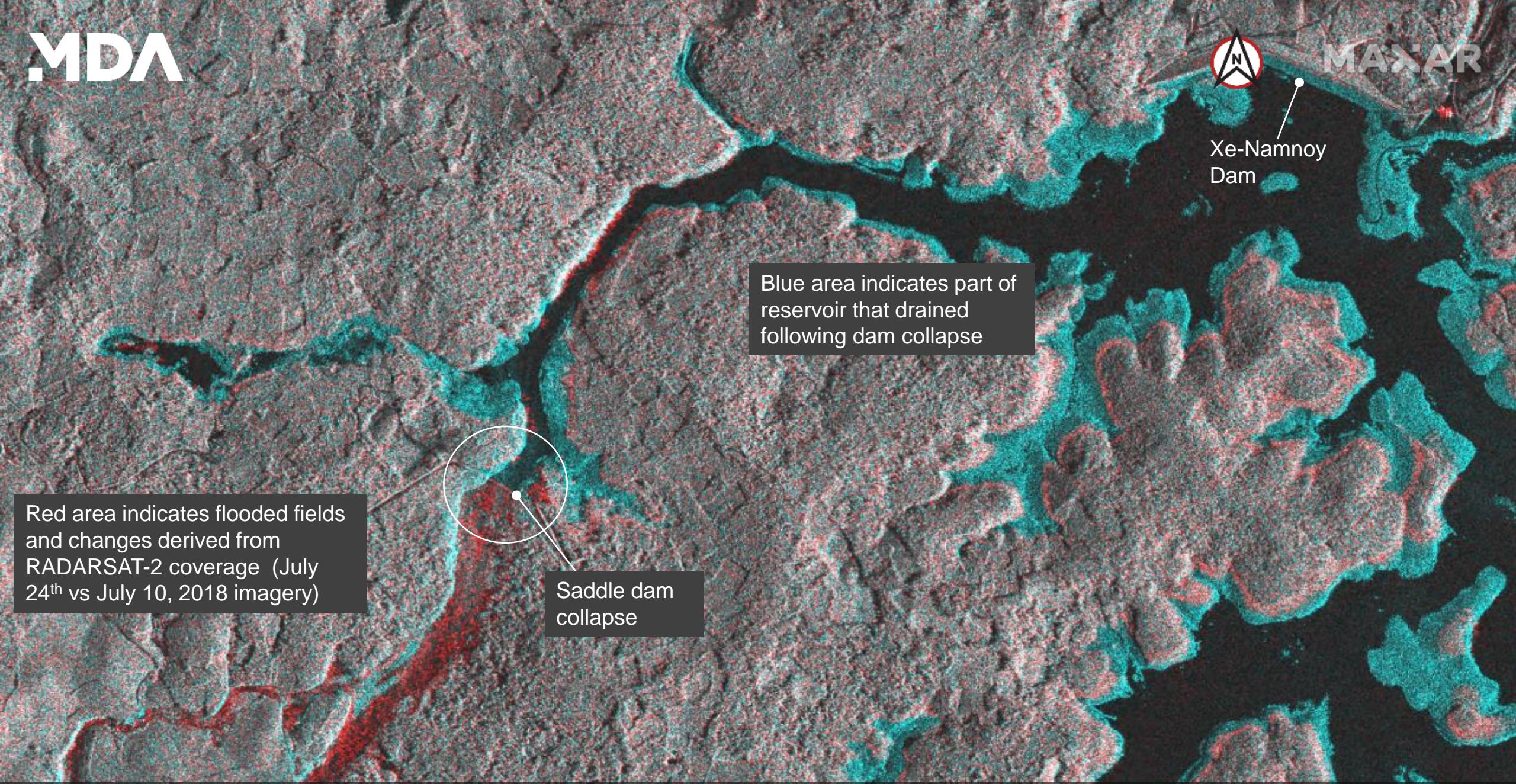
Landslides

Landslides

N

DigitalGlobe





MDA RADARSAT-2 Satellite Imagery of Xe-Namnoy Dam, Laos | July 10, 2018 – July 24, 2018 Change Product |

RADARSAT-2 Data and Products © Maxar Technologies Ltd. (2018). All Rights Reserved. RADARSAT is an official mark of the Canadian Space Agency.

After Saddle Dam Collapse



MAXAR

Breach in saddle dam caused reservoir to drain and flood downstream villages





Yesterday morning's email

----- Original message -----

From: Ron [REDACTED]
Date: 6/23/19 10:38 PM (GMT-05:00)
To: Scott [REDACTED]
Cc: SIVAN [REDACTED]
Subject: Missing U.S. tourist near Bali, Indonesia

Aviv [REDACTED] an American tourist has been missing since Monday, June 17 around 2:30 PM local time in Mushroom Bay, on Lembongan Island, Indonesia. He was last seen paddleboarding when winds pushed him into a very fast current. The family is working with Magnus Search and Rescue, U.S. and Indonesian authorities to locate Aviv. Requests to get satellite images of the area from the time of the disappearance and shortly thereafter have yet to be met. Please contact magnussearch@gmail.com or Or Magnus at [REDACTED] for details.

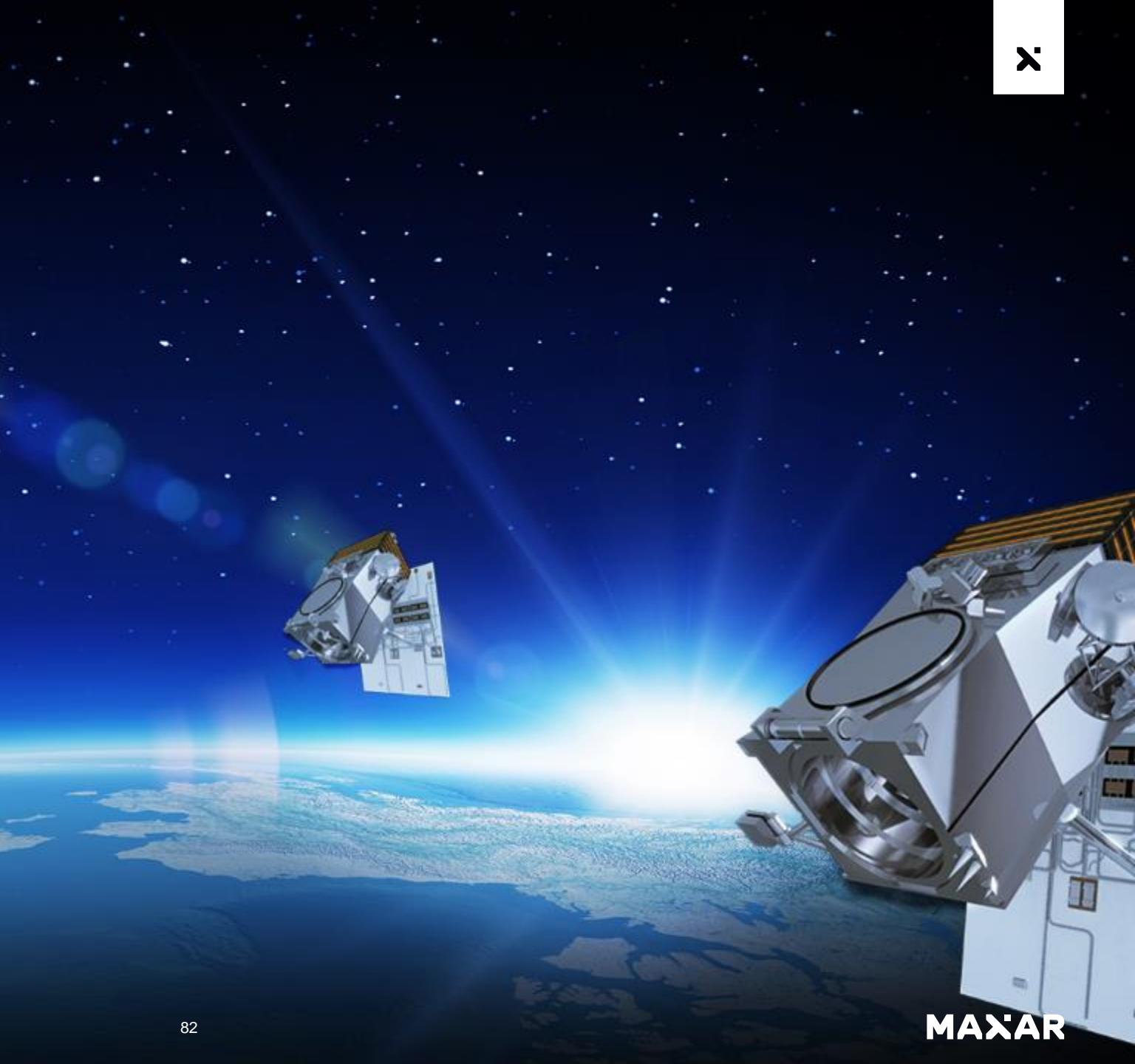
Get [Outlook for Android](#)

WorldView Legion

A next-generation low Earth orbit constellation, using the most innovative and flexible imaging satellite for exceptional on-orbit performance, value, and reliability.

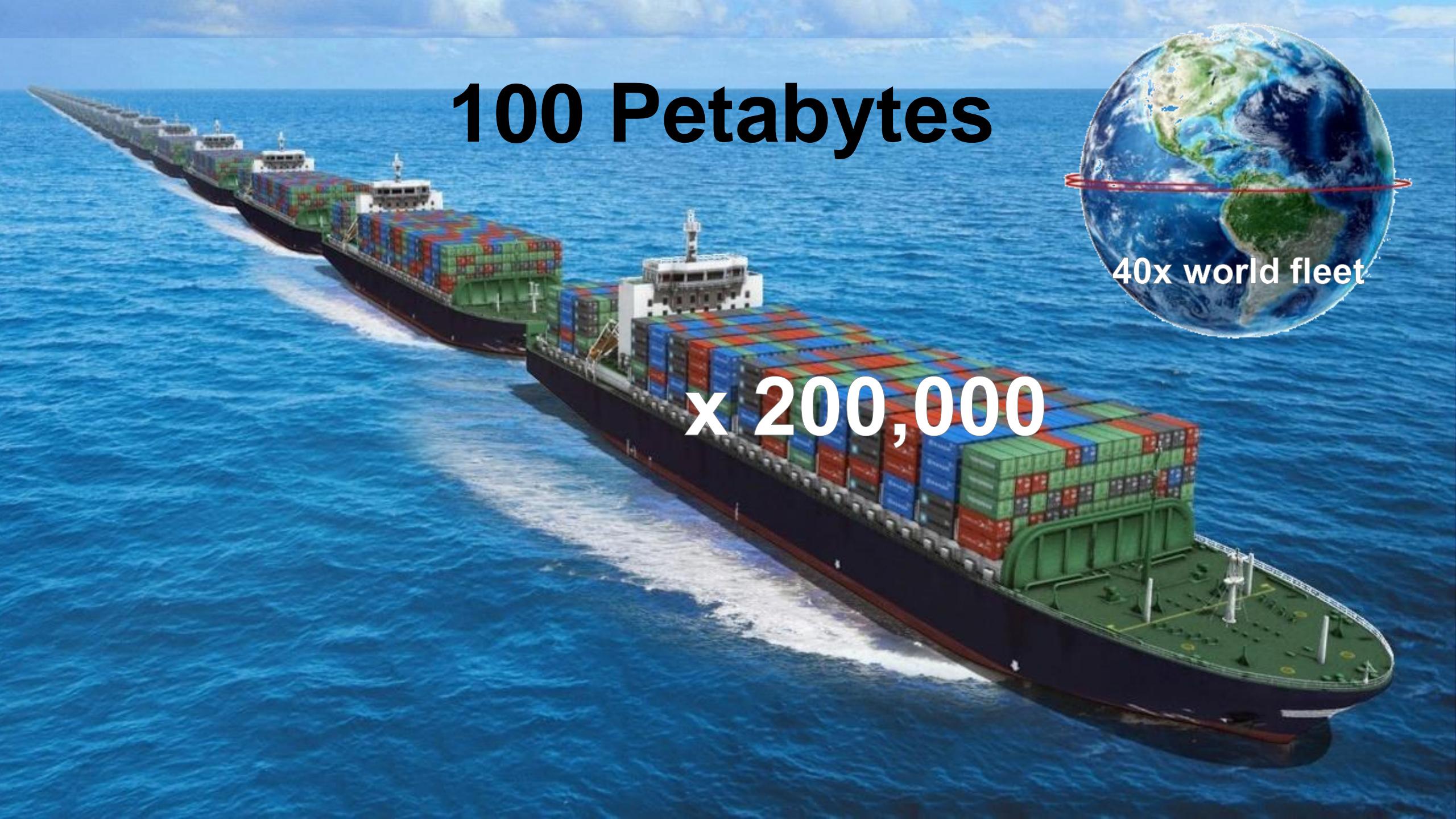
- Launch in 2021-2022
- Triples Maxar's 30 cm resolution collection capacity
- 500 kg class spacecraft bus

**Providing even greater insights
into global events of significance,
for critical decision-making when
time is of the essence.**



1 byte



A fleet of cargo ships sailing across the ocean.

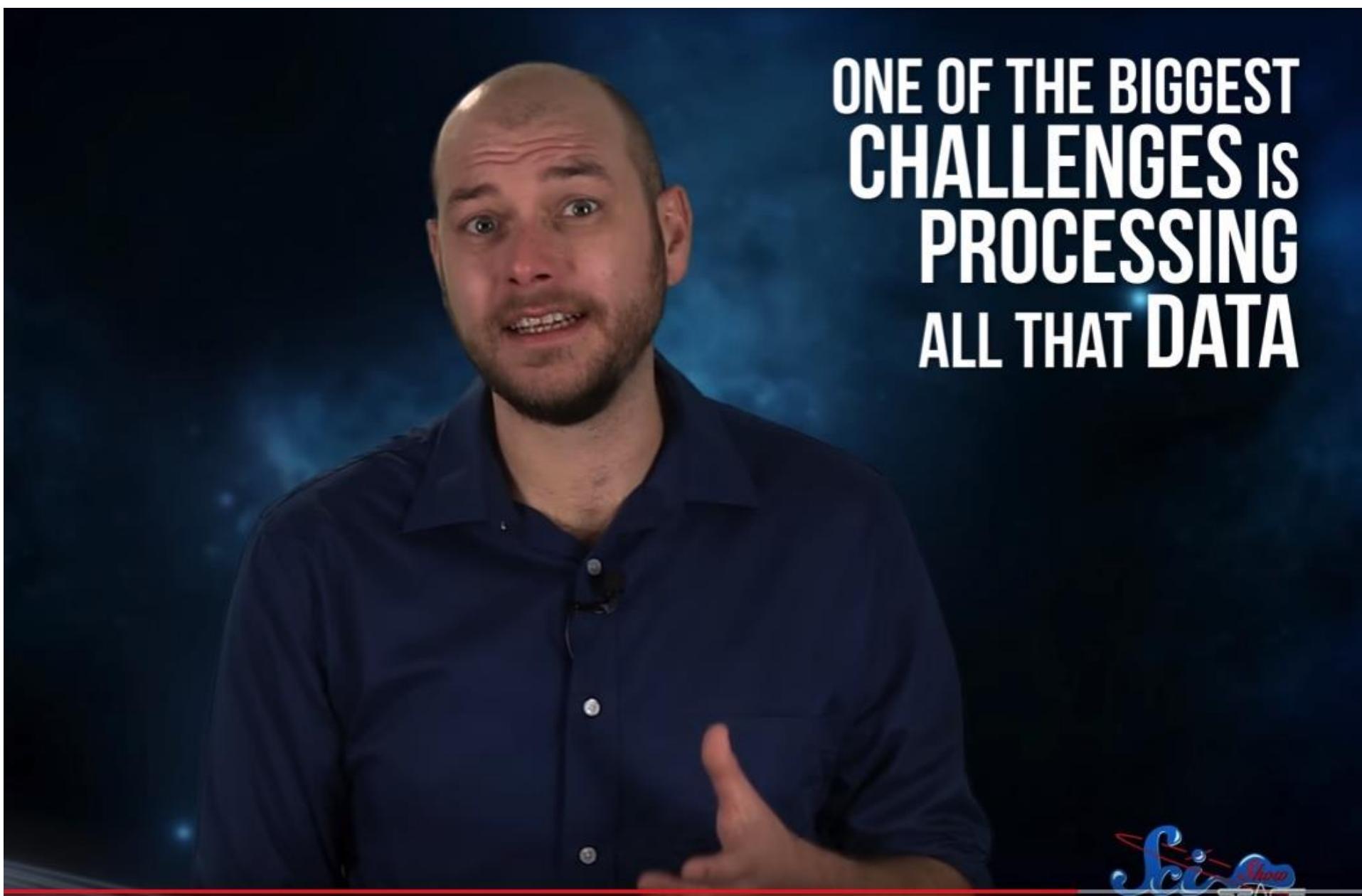
100 Petabytes

x 200,000





ONE OF THE BIGGEST
CHALLENGES IS
PROCESSING
ALL THAT DATA



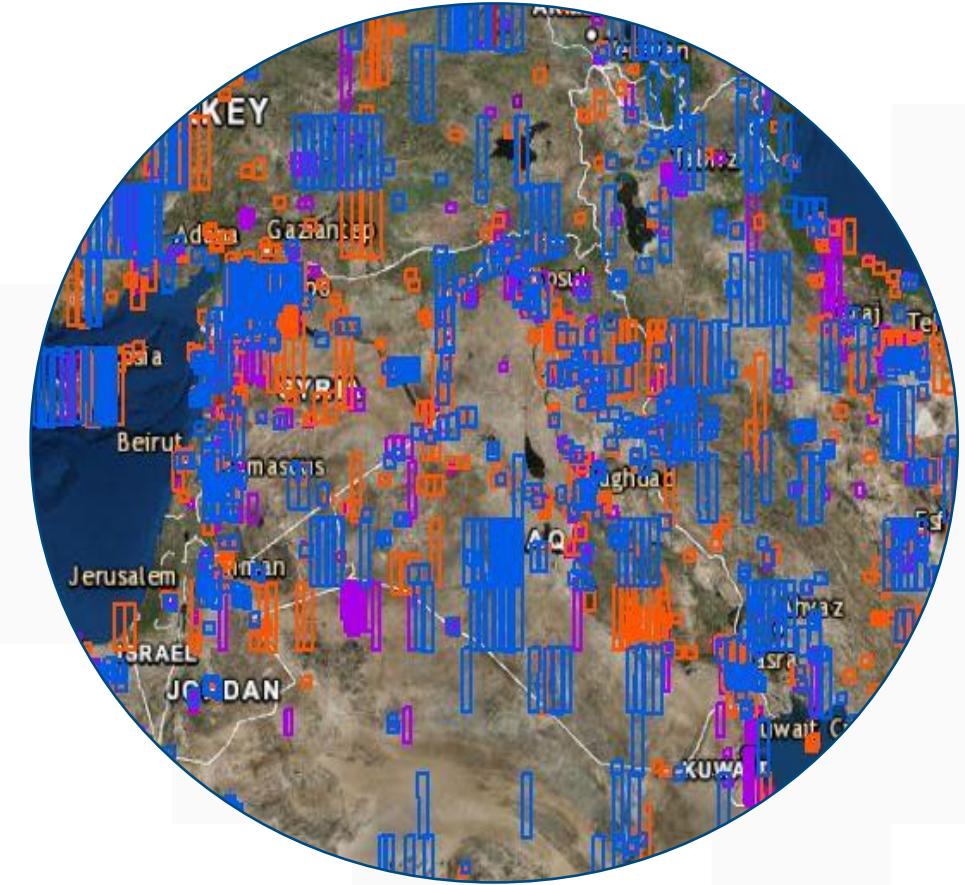
The Evolution of Spy Satellites; SciShow Space: <https://www.youtube.com/watch?v=LSWcnA2iQN0>

The analytic challenge

"If we were to attempt to manually exploit the commercial satellite imagery we expect to have over the next 20 years, we would need eight million imagery analysts.

We're focused on how to automate 75% of the manually-intensive work our analysts currently conduct to provide them more time to analyze critical changes and more accurately anticipate future events."

Robert Cardillo
Director, NGA



What about machine learning?

Click on a feature of interest in the map of San Francisco below. Terrapattern will find map tiles in the region that look the most similar to the place you selected. For example, try clicking on these yellow crosswalks.

Search for a location in the San Francisco metro region

Google

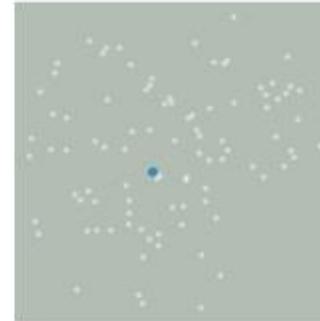
Imagery ©2016, DigitalGlobe, U.S. Geological Survey, USDA Farm Service Agency | Terms of Use | Report a map error

Below are the top results returned from your search, displayed in a geographic overview, a set of thumbnail images, and a plot of their relative similarity. Download your results as GeoJSON below.

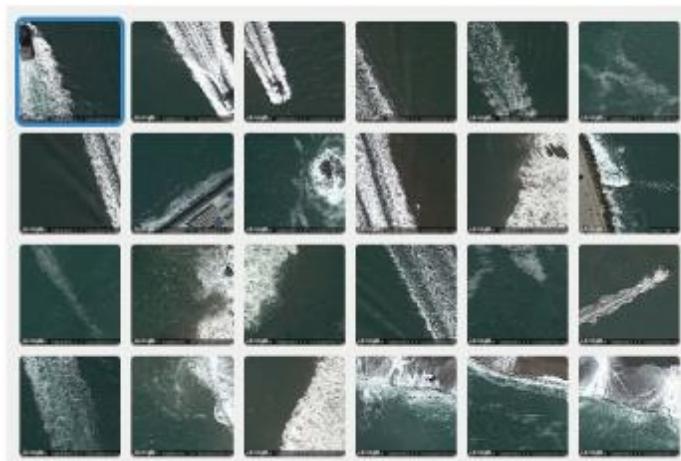
Geographical Plot



Similarity Plot



Search Results

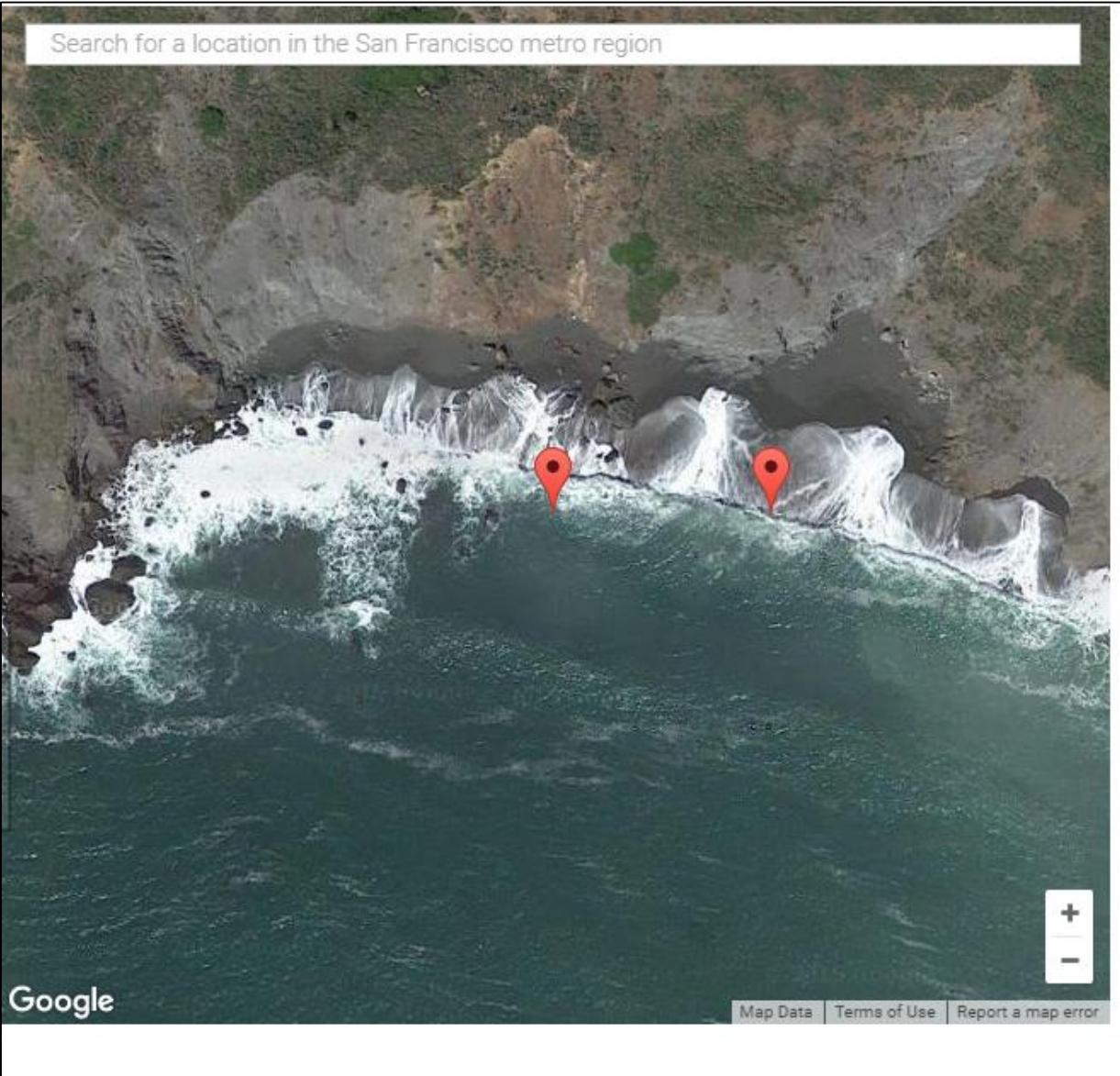


COMPUTER
SOFTWARE
ISN'T THAT GREAT
AT RECOGNIZING
SMALL OBJECTS
IN PHOTOS



The Evolution of Spy Satellites; SciShow Space: <https://www.youtube.com/watch?v=LSWcnA2iQN0>

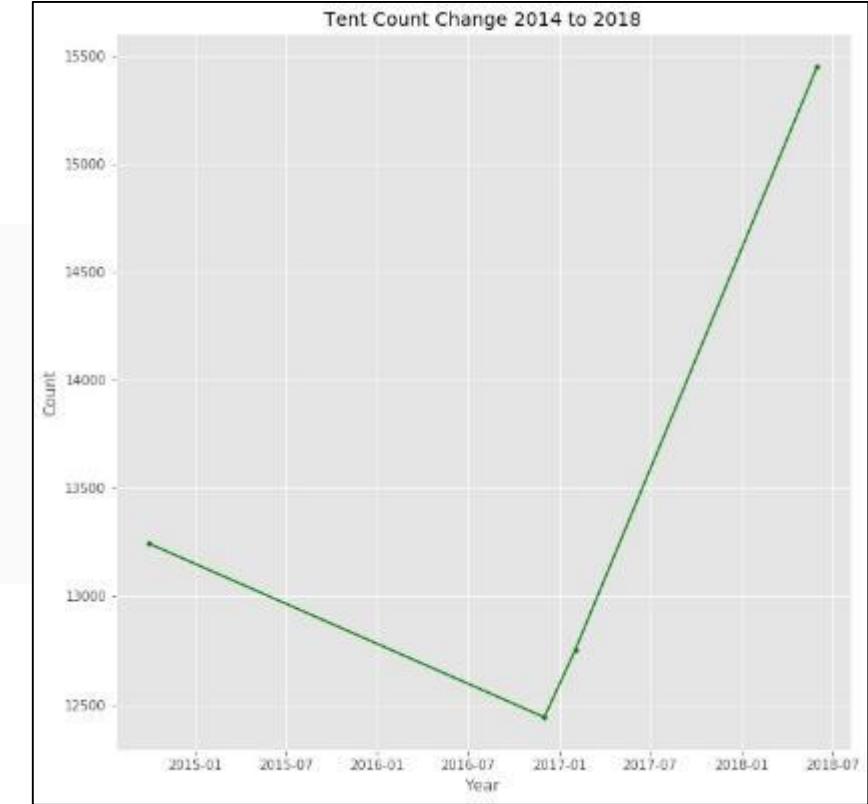
Positives....and false positives



Good results with quantification tasks



AI applications for humanitarian missions





Uzammah

平年, 12月 2018
3.20.2018
3/20/2018

RODA

BERMAS





Everybody is an expert!



Source: Mirror.co.uk

Stop The Presses! Courtney Love Has Cracked The Case! Takes To Twitter To Show Proof That She Found The Missing Malaysian Flight MH370!

3/17/2014 8:45 PM ET | Filed under: Courtney Love • Twitter • Scary! • News

[Like](#) 698 [Twitter](#) [g+1](#) 2 [Email](#) [Pinterest](#) [+ 260](#)



Well, this is an, errrr, innnneresting development?

Courtney Love has taken to her Twitter to PROVE that she has located the missing Malaysian flight, MH370, that disappeared without a trace over a week ago!

The singer is absolutely convinced that she's found the plane's crash site and she posted the picture (above) as proof.



USA TODAY

Search



Collage

NEWS SPORTS LIFE MONEY TECH TRAVEL OPINION 51° CROSSWORDS ELECTIONS 2016 OLYMPICS VIDEO STOCKS

≡ MENU

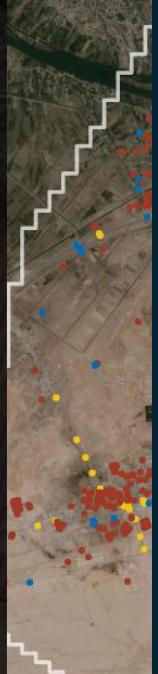
Ramadi score

APRIL, 2016

Each dot on this crowdsourced map represents a bomb crater or blocked road.

tomnod

1 km
4000 ft



f 4

t 4

in



AP Exclusive: Images Show Destruction Of Ramadi



STEPHEN WOOD

SATELLITE IMAGERY ANALYST, ALL SOURCE ANALYSIS



0:28

| 2:57

AP Exclusive: Images Show Destruction Of Ramadi



MAXAR



New automation tools for users

Highest Classification is up to UNCLASSIFIED

EVWHS Map Options My Imagery Use With Cart DG Internal Dev 1 Steve Wood ?

Google Maps OpenStreetMap Map Edit Map Transparency LAT: 35°41'17.7" - LON: 35°55'49.7" SRTM2 - 30m: 56 m, 184 ft

Automated Information Request x

Draw AI Request

Select a Date Range ?

Start Date: 04/19/2018

End Date: 06/30/2018

Name: AI Assad Aflid_RP_1

Place: Select a Place...

Shared:

Algorithm: Detect Aircraft

Email Address: stephen.a.wood@digitalglobe.com

100 m 100 ft Zoom Level: 10

With Selected...

Batrah سلوان Batrah بطرة

08-19 2017-09-26 2017-09-29 2017-11-12 2017-11-17 2017-11-30 2017-12-04 2017-12-21 2018-01-13 2018-02-15 2018-02-23 2018-02-23 2018-02-23 2018-04-15 2018-04-18

Highest Classification is up to UNCLASSIFIED

SWIR Multiband

Mosaic



Streaming imagery + analytics

Highest Classification is up to UNCLASSIFIED

EVWHS Name or coordinates Map Options My Imagery Use With Cart DG Internal Dev

Google Maps OpenStreetMap MapEdit Map Transparency LAT: 12.99814 LON: 42.74587 Elevation: N/A

Dashboard AI Results Clear Notifications Search Dashboard

10 Actions Request Name Place New Result Detections Algorithm Threshold

AI Test

Assab port

Assab port None No 10 Detect Ships

Assab port None No 10 Detect Ships

Assab port None No 10 Detect Ships

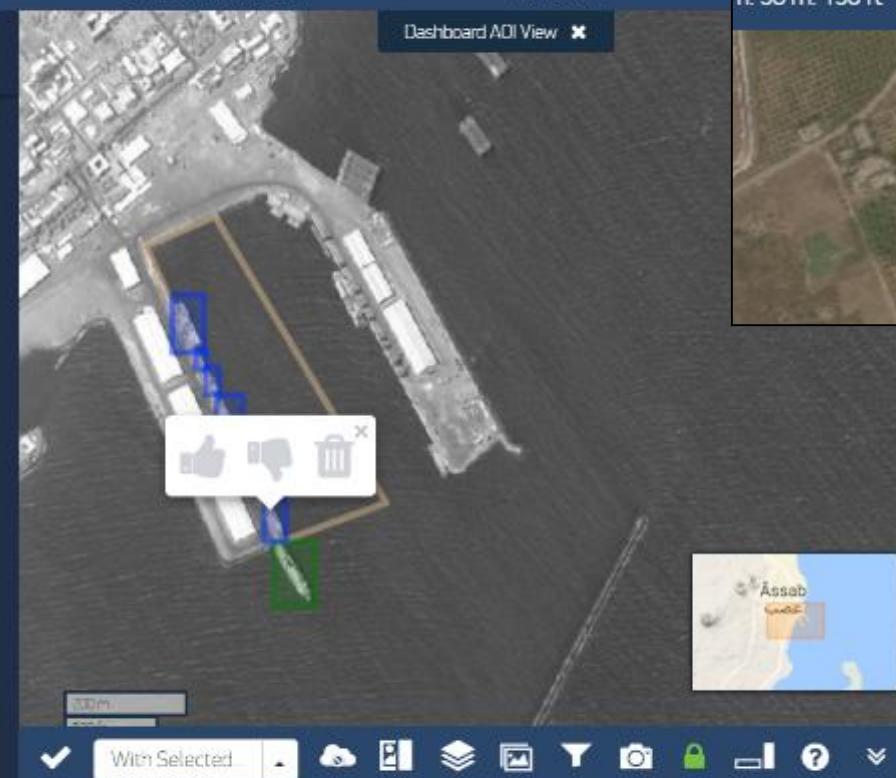
Assab port None No 7 Detect Ships

Showing 41 to 50 of 83 entries < 1 4 5 6 9 >

With Selected Cloud Print Download Filter Camera Lock Help

2018-03-19

Highest Classification is up to UNCLASSIFIED

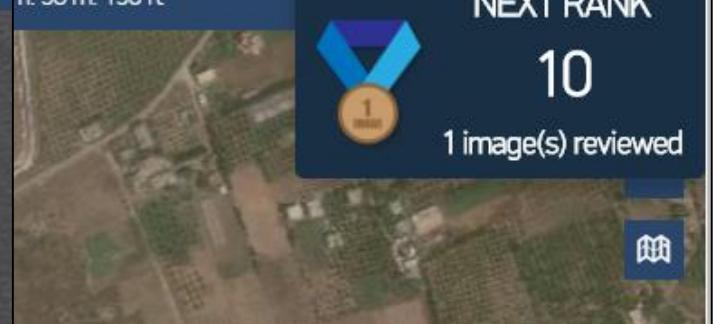


DG Internal Dev 1 Steve Wood ?

Rank: 58 m. 190 ft

NEXT RANK 10

1 image(s) reviewed





In sea of satellite images, experts' eyes still needed

January 29, 2016 5:45am EST



Can You Find The Herd of Elephants?



3.5-meter resolution
satellite image

Can You Find The Herd of Elephants?

30-centimeter resolution
satellite image



Can You Find The Herd of Elephants?

30-centimeter resolution
satellite image



A MAXAR COMPANY





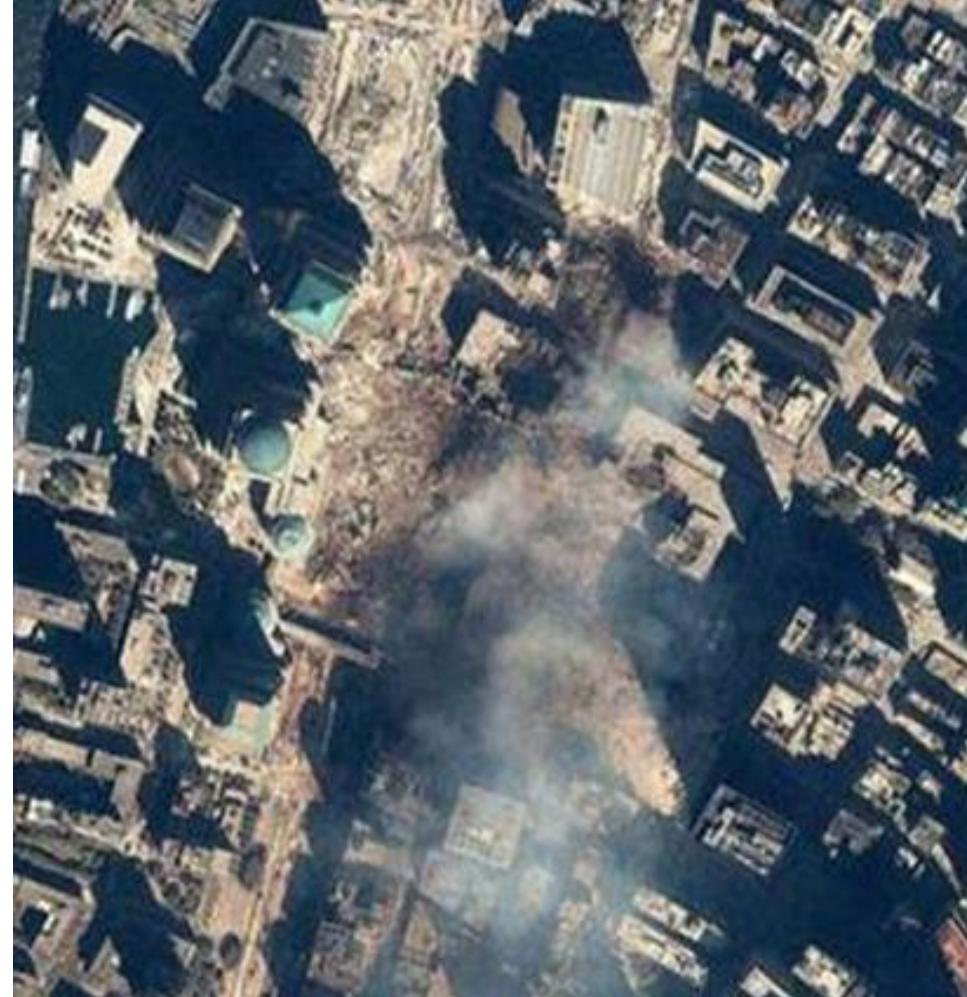
A PIXEL IS WORTH A THOUSAND WORDS

Fulfilling our Purpose to Build a Better World

with the Maxar News Bureau

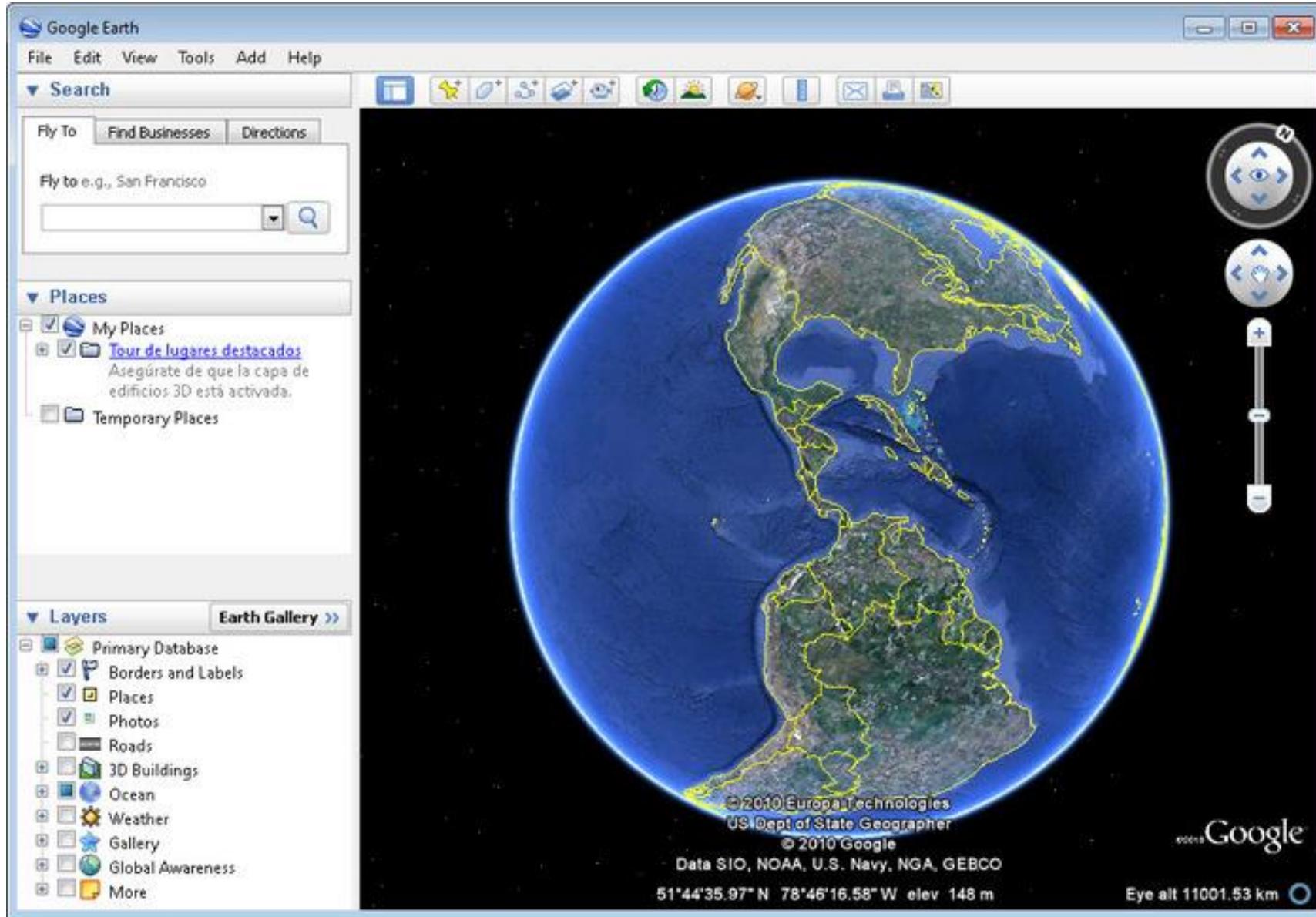
A watershed moment that changed our industry was right after 9/11 when the airspace was cleared above the Twin Towers site for days.

- ▶ This satellite image was the only available overhead picture the public saw of the devastation.
- ▶ What is even more interesting is this was six years before Google Earth existed.





A new killer application!





“

For the first time
media is the least
trusted institution
globally.”

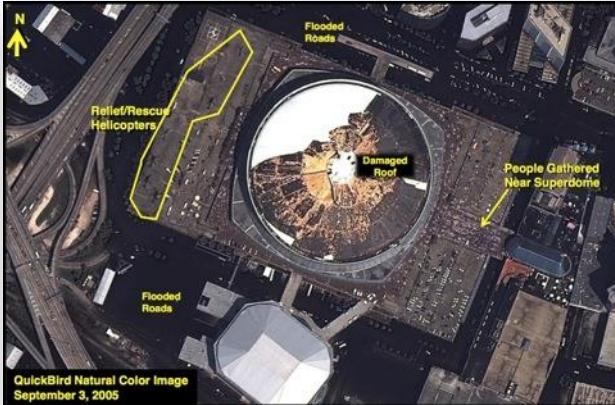
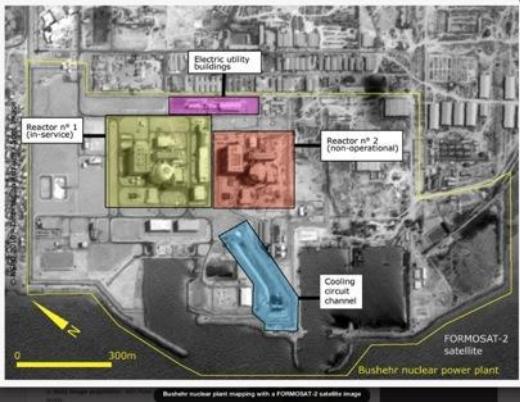




Analysis Fusion

“The ultimate value of satellite data comes from integration with other technologies of the information age. Satellite data becomes much more useful after it has been analyzed and fused with other geospatial technologies...”

David B. Sandalow; Assistant Secretary for Oceans and International Environmental and Scientific Affairs; June 6, 2000





Maxar's News Bureau works closely with worldwide media partners to raise public awareness of disasters

CNN World | Africa | Americas | Asia | Europe | Middle East Live TV U.S. Edition Search

Satellite images show how Irma devastated parts of the Caribbean

Updated 2:44 AM ET, Tue September 12, 2017

BREAKING NEWS **LIVE CNN**

SATELLITE PHOTOS REVEAL HURRICANE IRMA DEVASTATION

TROPICAL STORM IRMA MPH 0 200

0:11 VE 0:50 BUILDING COLLAPSES IN HAVANA, STATE TV REPORTS

Now Playing Satellite images reveal Irma's impact Every hour: Hurricane Irma got visibly worse 0:17

0:55 Chainsaw-wielding nun clears debris after Irma NASA video shows 10 days of Irma in 30 seconds 0:49 First resp... To answer I

(CNN) — Hurricane Irma devastated several Caribbean Islands when it tore through the area as a Category 5 storm, killing at least 36 people, knocking down trees and leveling buildings.

Satellite images from before and after the storm show wrecked houses, debris scattered everywhere and previously forested areas laid bare.

abcNEWS VIDEO LIVE SHOWS More Search

Before-and-after images show Guatemala volcano's devastation

By THE ASSOCIATED PRESS

SAN MIGUEL LOS LOTES, Guatemala — Jun 7, 2018, 5:29 PM ET

This June 6, 2018 satellite image provided by Digital Globe shows the hamlet of San Miguel Los Lotes, Guatemala, after the hamlet was encased in volcanic ash and debris from Sunday's eruption of the Volcano of Fire in Guatemala.

Before-and-after satellite photos show the destruction wrought by deadly flows of superheated materials and debris from Sunday's eruption of the Volcano of Fire in Guatemala.

USA TODAY

Before-and-after satellite images show tornado and flood damage in central US

PBS RMPA Visit CAI Discover

PBS NEWS HOUR WEEKEND

Record floods breach Arkansas

MAXAR

By Andrew DeMillo, Associated Press
By Jill Stodd, Associated Press

AP Exclusive: AP tracks slave boats to Papua New Guinea

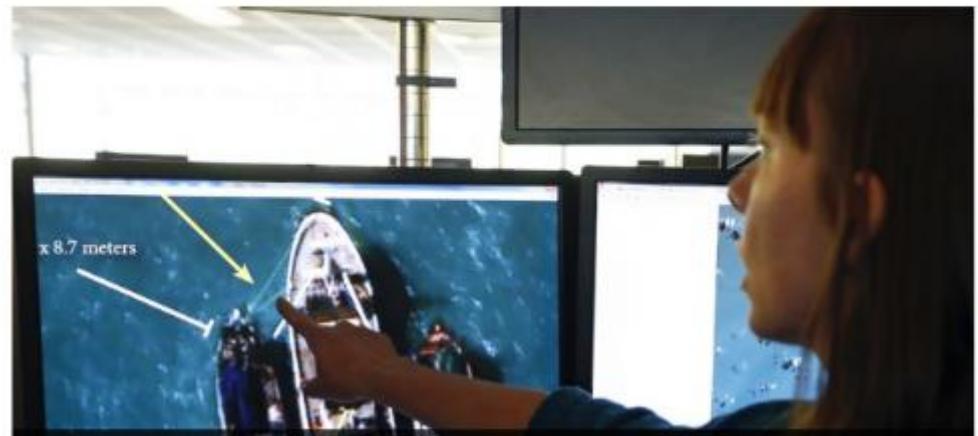
By ROBIN McDOWELL, MARTHA MENDOZA and MARGIE MASON Jul. 27, 2015 9:13 AM EDT

[Link]

AP Investigation Prompts New Round of Slave Rescues

Jul 31, 2015, 12:15 AM ET

By MARGIE MASON and MARTHA MENDOZA Associated Press



More than 2,000 enslaved
fishermen rescued in 6 months

Sept. 17, 2015

Obama bans US imports of slave-
produced goods

Feb. 25, 2016



The Associated Press @AP · 1m

BREAKING: Associated Press wins public
service Pulitzer for stories on slave labor in

Maxar provided the satellite image that served as the smoking gun that allowed the government to take action against boats that were using slaves to illegally catch fish off Papua New Guinea.



► Because of the combination of high-quality and high-resolution detail in the image, two trawlers loading slave-caught seafood onto a refrigerated cargo ship were caught from space.

► The AP investigation ultimately won a
► 2016 Pulitzer Prize for their work ...

...and reunited slaves
with their families



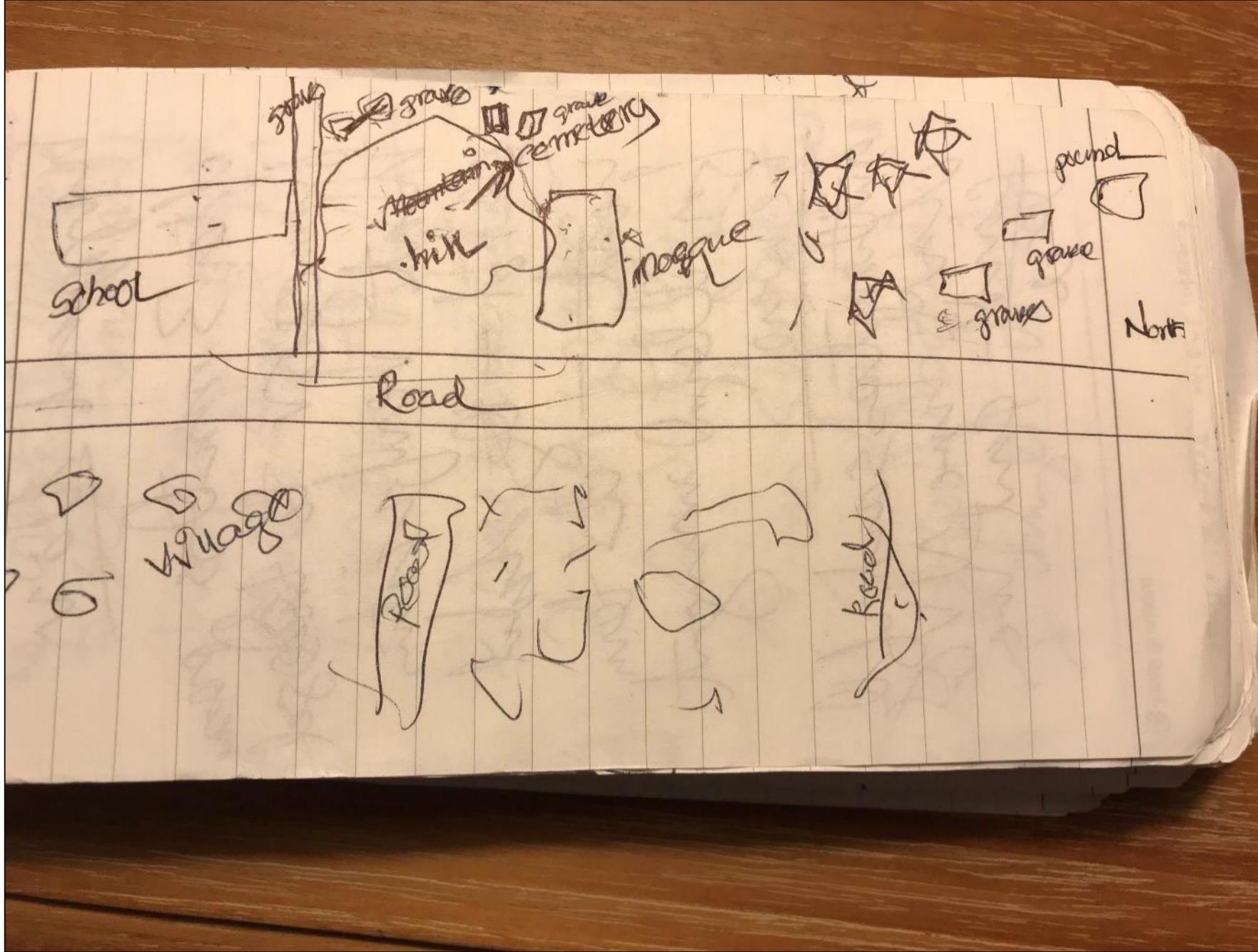
AP

After Destruction of Village
September, 2017



MAXAR

**Houses and buildings
burned/destroyed**



Map of Gu Dar Pyin
village identifying key
features and location of
graves

(see next page for
satellite imagery of
corresponding area)

After Destruction of Village December, 2017







Imagery Sources for Humanitarian Missions



 EO Browser

Login

Search Results Visualization Pins

Dataset: SENTINEL-2 L1C SHOW L2A

Date: 2019-06-20

Custom Create custom rendering

True color Based on bands 4,3,2

False color Based on bands 8,4,3

False color (urban) Based on bands 12,11,4

NDVI Based on combination of bands (B8 - B4)/(B8 + B4)

Moisture index Based on combination of bands (B8A - B11)/(B8A + B11)

[Free sign up for all features](#)

Powered by [Sinergise](#) with contributions from the European Space Agency v2.18.3



Carto © CC BY 3.0, OpenStreetMap © ODbL



May 28, 2019

Ar Raqqah_28May2019, 2019-05-28, Sentinel-2A L1C, False color



| 5 km

Credit: European Union contains modified Copernicus Sentinel data 2019, processed with EO Browser



Kafr Nabudah
2.5km



WORLDVIEW

Layers Events Data

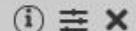
Kadapa

<https://worldview.earthdata.nasa.gov/>

Band, Enhanced Near Constant Contrast)
Suomi NPP / VIIRS

0 255

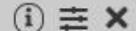
Place Labels
© OpenStreetMap contributors,
Natural Earth



Coastlines / Borders / Roads
© OpenStreetMap contributors,
Natural Earth

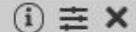


Coastlines
© OpenStreetMap contributors



BASE LAYERS

Corrected Reflectance (True Color)
Suomi NPP / VIIRS



Corrected Reflectance (True Color)
Aqua / MODIS



Corrected Reflectance (True Color)

+ Add Layers

Start Comparison



DAYS

2019 JUN 16 < > 📹

APR 2019

MAY 2019

JUN 2019



Before Drought

Puzhal
Reservoir

Korattur Lake



During Drought

Puzhal
Reservoir

Korattur Lake

EarthExplorer - Home

Home Save Criteria Load Favorite ▾ Manage Criteria

Search Criteria

Data Sets

Additional Criteria

Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place

Path/Row

Feature

Circle

Show Clear

Coordinates

Predefined Area

Shapefile

KML

Degree/Minute/Second

Decimal

 No coordinates selected.

Use Map

Add Coordinate

Clear Coordinates

Date Range

Result Options

Search from: mm/dd/yyyy



to: mm/dd/yyyy



Search months: (all)

Search Criteria Summary (Show)

Map

Satellite



March, 1985



Merida

Glacier

April, 2019



Merida

Glacier

44 datasets, Res. < 2.0m, Cloud < 100%, Off-Nadir < 100%



Date ↓ Res Cloud Off-Nadir

DEM 50 cm 0.0% DEM ⓘ ^

DEM 50 cm 0.0% DEM ⓘ ^

7 06-22-2019 1.5 m 3.0% 20.9 ⓘ ^

06-19-2019 50 cm 0.0% 26.0 ⓘ ^

06-19-2019 50 cm 0.0% 28.0 ⓘ ^

7 06-15-2019 1.5 m 0.0% 28.1 ⓘ ^

06-14-2019 70 cm 0.0% 4.0 ⓘ ^

Page: 100▼ 1-100 of 1771 < >

2 / 1771 selected

APOLLO MAPPING

Al Qata القطا

Birqash برقاش

Al Mansourah المنصورية

Sheikh Zayed City مدينة الشيخ زايد

Kirdasah كرداسة

Kafr Ghatati كفر عطاطي

AL MOTAMAYEZ DISTRICT الحي المتميّز

DREAM LAND دريم لاند

PYRAMIDS GARDENS حفانق الأهرام

Al Khankah الحنكه

Al Qalai القلعي

https://imagehunter.apollomapping.com



<https://www.terraserver.com>

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PRODUCTS

INDUSTRIES

L

EASY, UP-TO-DATE SATELLITE IMAGES

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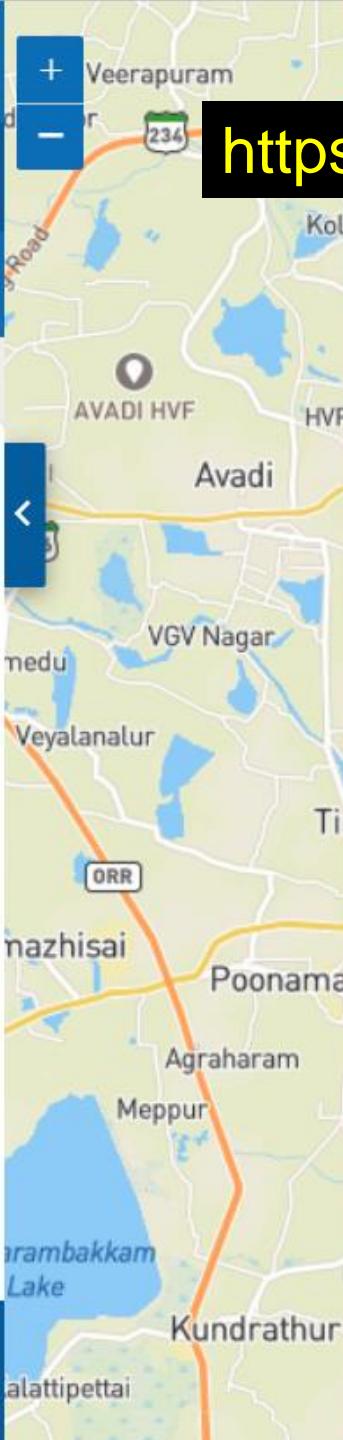
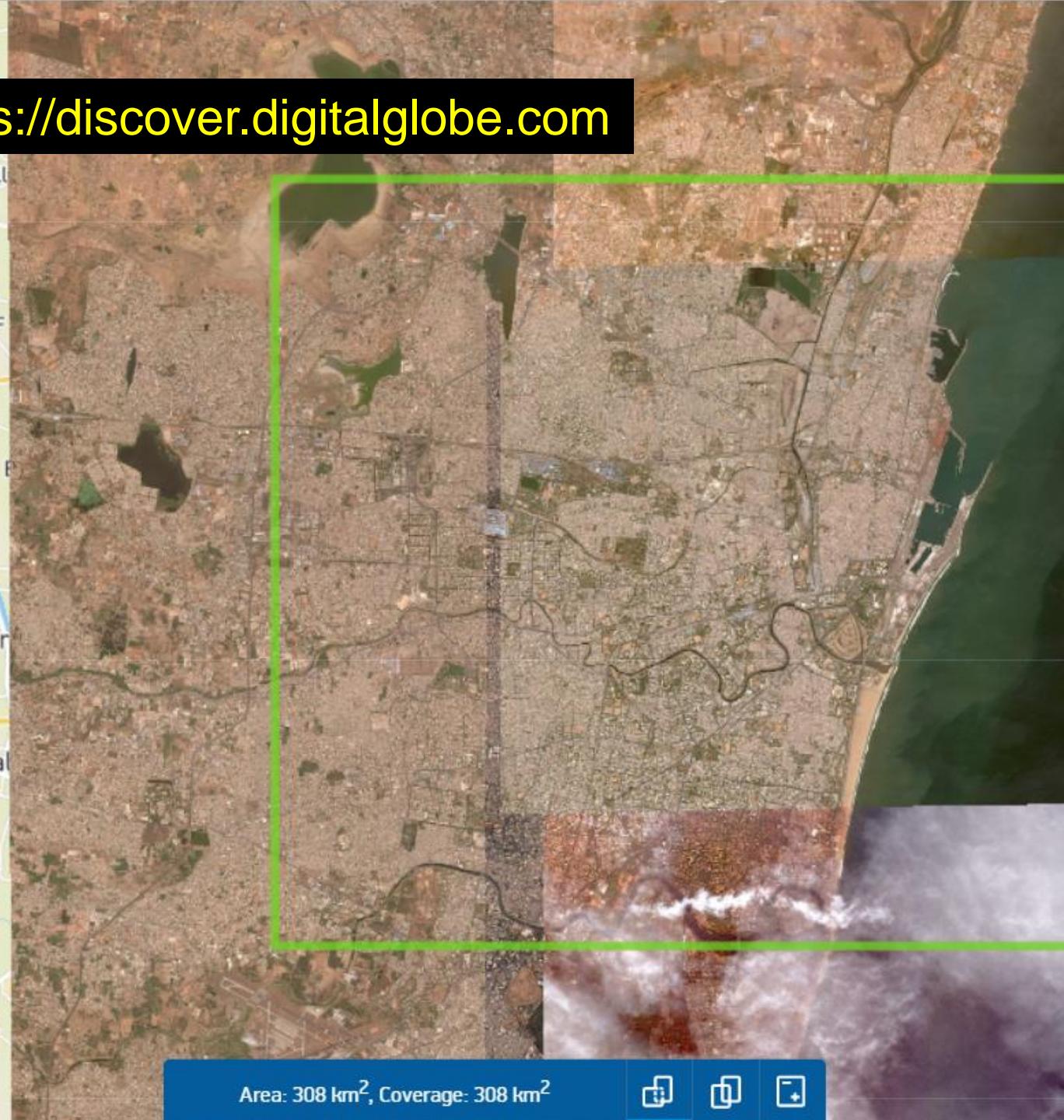
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LEARN MORE

[Sign in](#)

Feedback | Help

Chennai, Tamil Nadu, IND

<https://discover.digitalglobe.com>[Area of Interest](#)[Filters](#)

Area Name

Selected Coverage



AOI 1

5/73 100%



Source Collected ▾ Area Clouds Area Off Nadir

<input checked="" type="checkbox"/> WV03	2019-06-14	0.0%	25.9°	
<input checked="" type="checkbox"/> WV03	2019-06-08	0.0%	22.0°	
<input checked="" type="checkbox"/> WV03	2019-04-25	12.2%	16.7°	
<input type="checkbox"/> WV03	2019-04-19	0.0%	6.6°	
<input checked="" type="checkbox"/> WV02	2019-04-07	0.0%	24.6°	
<input checked="" type="checkbox"/> WV03	2019-04-06	0.0%	23.3°	
<input type="checkbox"/> WV02	2019-03-30	0.0%	22.8°	
<input type="checkbox"/> WV02	2019-03-25	0.0%	27.7°	

Actions ▾

Area: 308 km², Coverage: 308 km²



Maxar's EarthWatch imagery platform

EarthWatch Map Options My Imagery Use With Usage Cart EW_P +Daily 1 EarthWatch User ?

Google Maps OpenStreetMap Map Transparency LAT: 15.58377 : LON: 32.49241 Elevation: 375 m. 1230 ft

669

+ - 🔍

500 m
3000 ft

Zoom Level: 14

Omdurman ام درمان
Khartoum الخرطوم

With Selected... ✓

2019-03-22 2019-03-22 2019-04-10 2019-04-10 2019-04-10 2019-04-10 2019-04-14 2019-04-14 2019-04-22 2019-04-22 2019-05-17 2019-05-17 2019-05-29 2019-05-29 2019-06-02 2019-06-02 2019-06-08 2019-06-08 2019-06-14 2019-06-14 2019-06-20 2019-06-20

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Open Data Program

- Formally launched in January 2017, the Program releases open imagery for major crisis events to support response and recovery in the wake of large-scale disasters
- Activated for 17 events in 2018 and 4 events in 2019, covering floods, hurricanes, earthquakes, mudslides and wildfires
- Maxar's objectives are twofold: (1) accelerate disaster response efforts with timely, actionable information and (2) foster a community of practice around satellite imagery and geospatial intelligence for disaster management
- The Open Data Program helps support Maxar's purpose
For a Better World



Open Data Program (cont.)

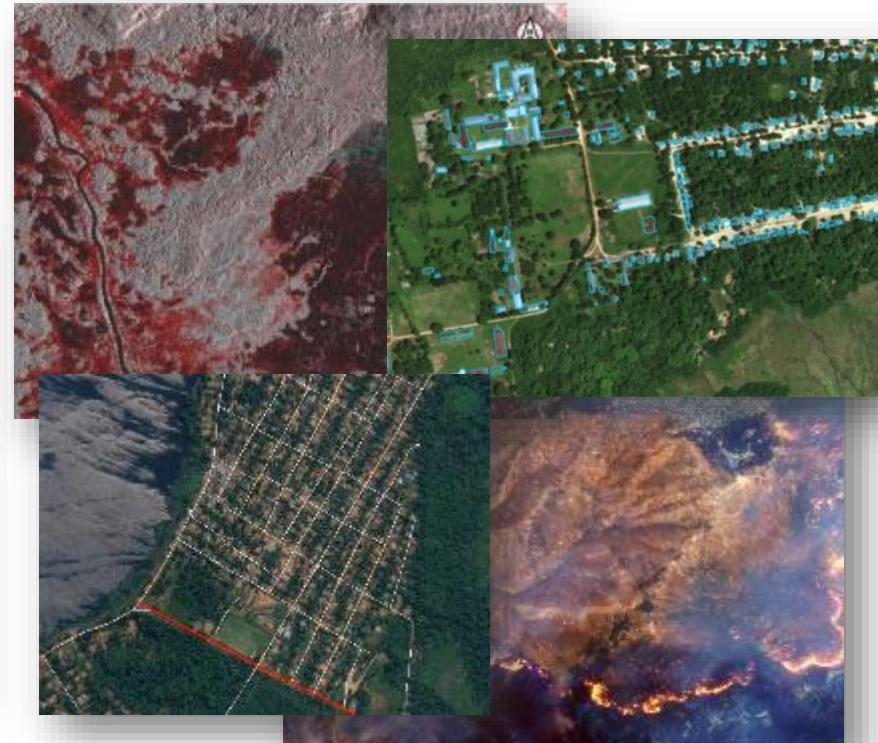
Dependable Partner

Since we launched the Open Data Program in 2017, Maxar has supported 29 natural disasters or humanitarian crises. Relief agencies have come to expect and rely upon our data to guide their emergency response efforts.



Mission Critical Information

We bring the breadth of Maxar's capabilities to save lives and rebuild communities.



Global Impact

Through our partners, we get data to the frontlines when it's needed most and help communities become more resilient.



Contact Information

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Maxar Technologies

stephen.a.wood@maxar.com
303-684-1251