HEAD
AEROSPACE GROUP

Defense & Intelligence Solutions

JL1KF01A, 2020 jan 24th,
Boufarik Airport BLIDA,
Algeria, 50 cm

2021

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Defence and Intelligence Challenges in Space Surveillance

Sovereignty Defence – Surrounding countries

- Border Monitoring
- Non-intrusive from space

Disaster Response

- All conditions access from space
- Fresh capture comparing with archive images

Peace Keeping – Global conflicts areas

- Non-intrusive from space

Major functions of Space Surveillance

- Target identification
- Mission planning and overview of the AOI's

Requirement

- Immediate access

1m Constellation; Most Viable Solution for Space Surveillance

Target Identification: DCRI resolution requirements

- Detection <= 2.5m
- Classification <= 1m
- Recognition <= 1m
- Identification <= 1m with local knowledge

50 cm to 1m is the best combination of spatial resolution and temporal resolution for Surveillance from Space

- Technically and financially viable solution
- UAV and Airborne can be considered for higher resolution

Observation capabilities

- Targeting every 15 minutes: 108 satellites required from 9am to 5pm

Global Daily Coverage

- 150 satellites with 17km swath

Early morning

- 9:20 orbit that is one hour earlier that most EO satellites at 10:30am

Night - targeting once per night

- 3 satellites in constellation

Full weather/SAR - once per day

- 3 satellites in constellation

Value Proposition for D&I Challenges

Monitoring

- Daily collect at resolution < 1m (even large AOI)
- All weather collect with 3 SAR satellites (up to 1m)
- JL1 constellation aiming at every 15 minutes targeting capability from 9am to 5pm

Mission planning with

- JL-1KF01 136 km swath at 75 cm/50 cm
- Night Imaging (3 constellations ➔ 3 times a day)
- Very High Resolution: 11 sensors from 42 cm to 75 cm

DLG Mapping without GPC

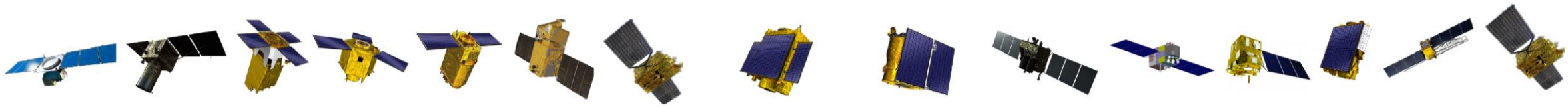
- 1:50,000 with ZY-3 03 2.5 Tri-Stereo + laser altimeter
- 1:10,000 with GF07 0.65m Stereo + laser altimeter

Disaster response and change detection with Extensive archive Database

Real time delivery/Immediate access direct tasking with Ground Station and mobile ground station

One Stop Shop for Imagery from 40+ Satellites

Optical VHR | Optical MR | C-Band SAR | Hyperspectral



Satellite	GFMM	Superview 01,02,03,04	EarthScanner JL-1KF01	Jilin GXA JL-1GXA	Jilin Stereo JL-1GF02A/02B	GaoFen-7	GaoFen-2	NightVision & Video Constellation JL-1SP03,04,05,06,07,08 JL1-GF03C01,02,03	DailyVision@1m JL-1GF03A/ JL-1GF03B01, 02,03,04,05,06	NaturEYE GaoFen-1 a,b,c,d/ GaoFen-6	ZY Tri-Stereo ZiYuan-3 01/02	CBRERS	HyperScan JL-1GP01/02	GaoFen-3	GaoFen-4
# of sats	1	4	1	1	2	1	1	9	7	5	2	1	2	1	1
Launch	2020	2016 & 2018	2020	2015	2019	2019	2014	2017, 2018 & 2020	2020 (6 sats) & 2019 (1 sat)	2013 & 2018	2012 & 2016	2014	2019	2016	2015
GSD	0.42m PAN, 1.68m MS (8 bands)	0.50m PAN, 2m MS Stereo	0.50m PAN, 2m MS	0.72m PAN, 2.88m MS	0.75m PAN, 3m MS Stereo	0.65m PAN, 2.6m MS Stereo	0.80m PAN, 3.2m MS	0.92m (6 sats)/ 1.21m (3 sats) Night Image, Color Video & Stereo	0.98 (6 sats)/ 1.06 (1) PAN, 3.92m (6)/ 4.24m (1) MS	2m PAN, 8m MS, 16m MS (GF-1a,b,c,d) 2m PAN, 16m MS (GF-6)	2.1m PAN, 5.8 MS Stereo	5m PAN, 10m MS	5m 25 bands, 3m RGB bands	1m	50m PAN & MS, 400m MW
Swath	15 km	12 km	136 km	11.6 km	40 km	20 km	45 km	19 km	18.5 km (1) 17 km (6)	60 km (GF1b,c,d) 830 km (GF-1a) 850 km (GF-6)	51 km	120 km	110 km	10-650 km	400 km
Revisit	5 Days	Daily	Together Daily			5 Days	5 Days	Three times per day	Twice Daily (7 satellites)	Daily	3 Days	3 Days	2 Days	3 Days	20s

27 VHR Satellites

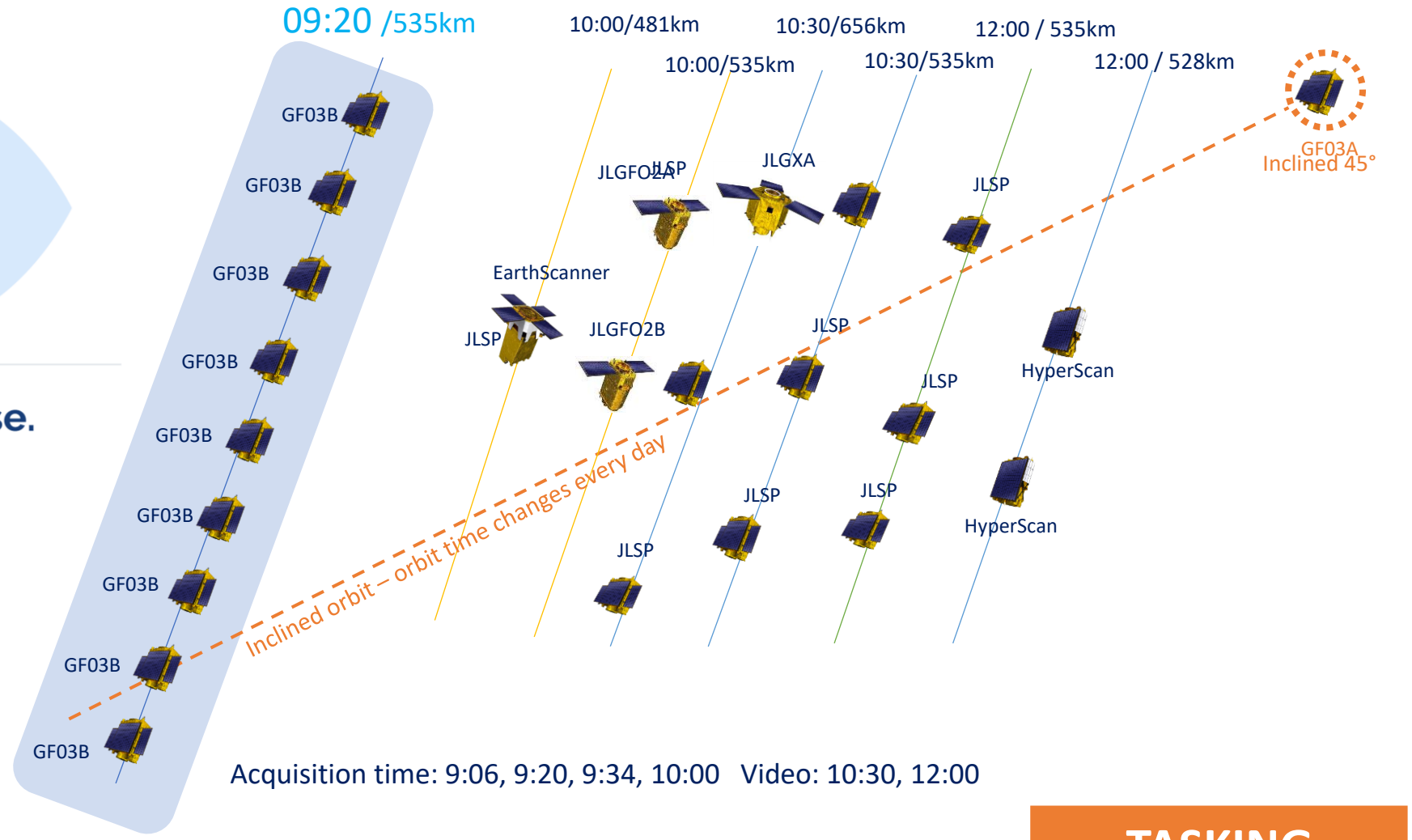
- Constellation of 4 sats At 50 cm
- Huge swath at 50 cm 2 sats constellation in 2021
- Stereo 65cm Sat with laser altimeter
- Night image at 1m 6 sats constellation
- 18 Sats <1m in 2 orbits: 10:40 & 13:20 6 Sats <1m with 3 video satellites in 9:20 orbit
- 3 Tri-stereo 2m Sats +1 0.65m Tri-stereo Sat with laser altimeter in 90º phased constellation
- 3 SAR satellites in 2021

Five Different Local Time Orbits Constellation - Available now

EarlyEye & DailyScan

See the globe before anyone else.

from 09:06 AM
(usually satellites fly around 10.30 AM)



Acquisition time: 9:06, 9:20, 9:34, 10:00 Video: 10:30, 12:00

JL1 constellation in orbit captures submeter images
4 times per day with **13 satellites**

TASKING
4 times / day

8 Different Local Time Orbits Constellation by End of 2021

By the end of 2021

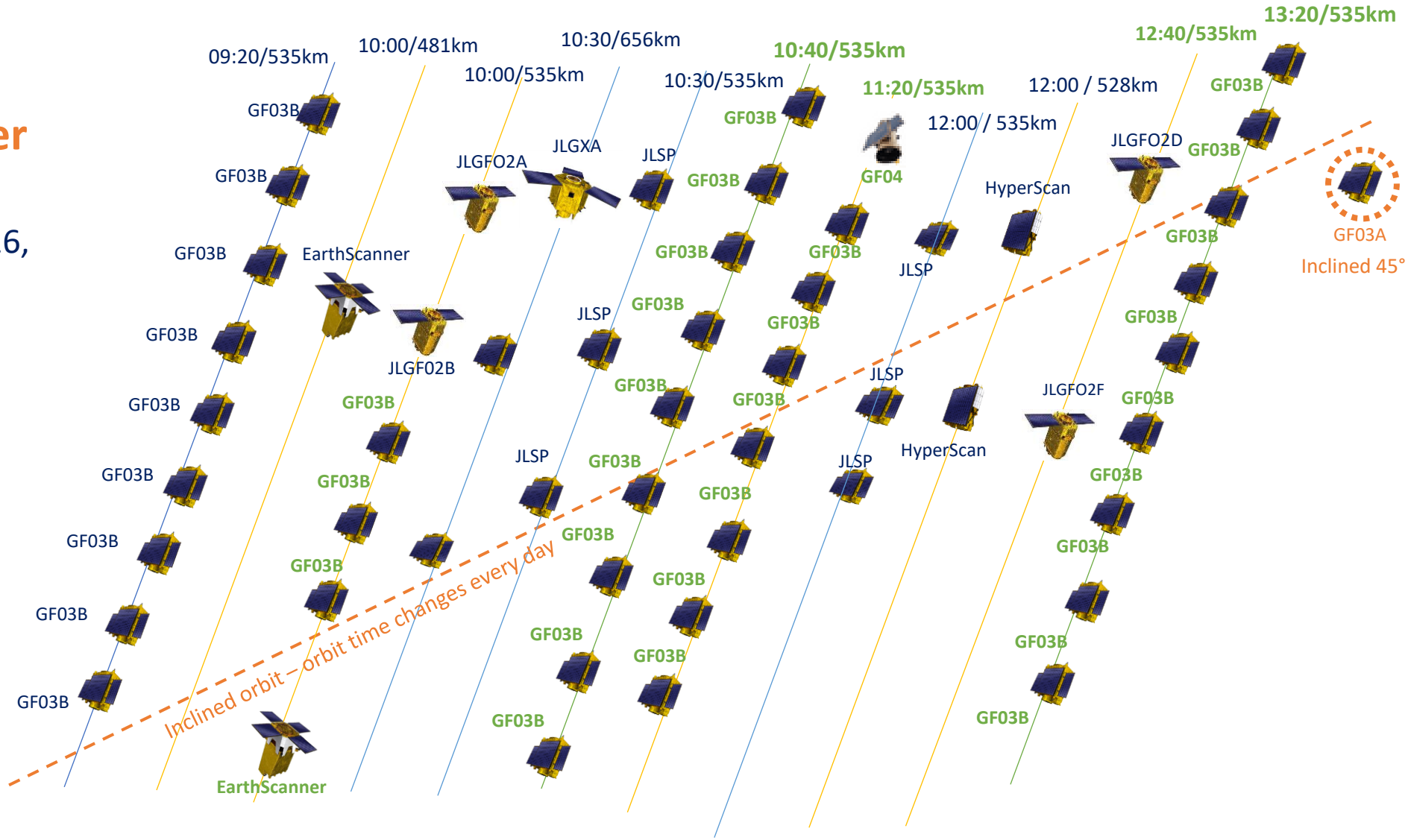
12 revisit at submeter resolution per day

9:06, 9:20, 9:34, 10:00, 10:26, 10:40, 10:54, 11:20, 12:40, 13:06, 13:20, 13:34

Video: 10:30, 12:00

When constellation is complete:

Collect every 15 mins a small AOI



Abu Dhabi Airport: 5 Collects at 14 Minutes Interval in same Day

9 Satellites in same orbit with subsequent orbit every 40 minutes of 12 orbits

EarlyEye

Targeting anywhere every 15 minutes

JL constellation captures submeter images **4 times an hour and half earlier** at 09:06 with **13 satellites**

Inclined 45° JL satellite
Capture images anytime.

Demonstration of EarlyEye and 15 Minutes Unique Capabilities

DailyVision
JL1GF03B
1m
9:49:18

DailyVision@1m, 1m, 2021, Abu Dhabi Airport

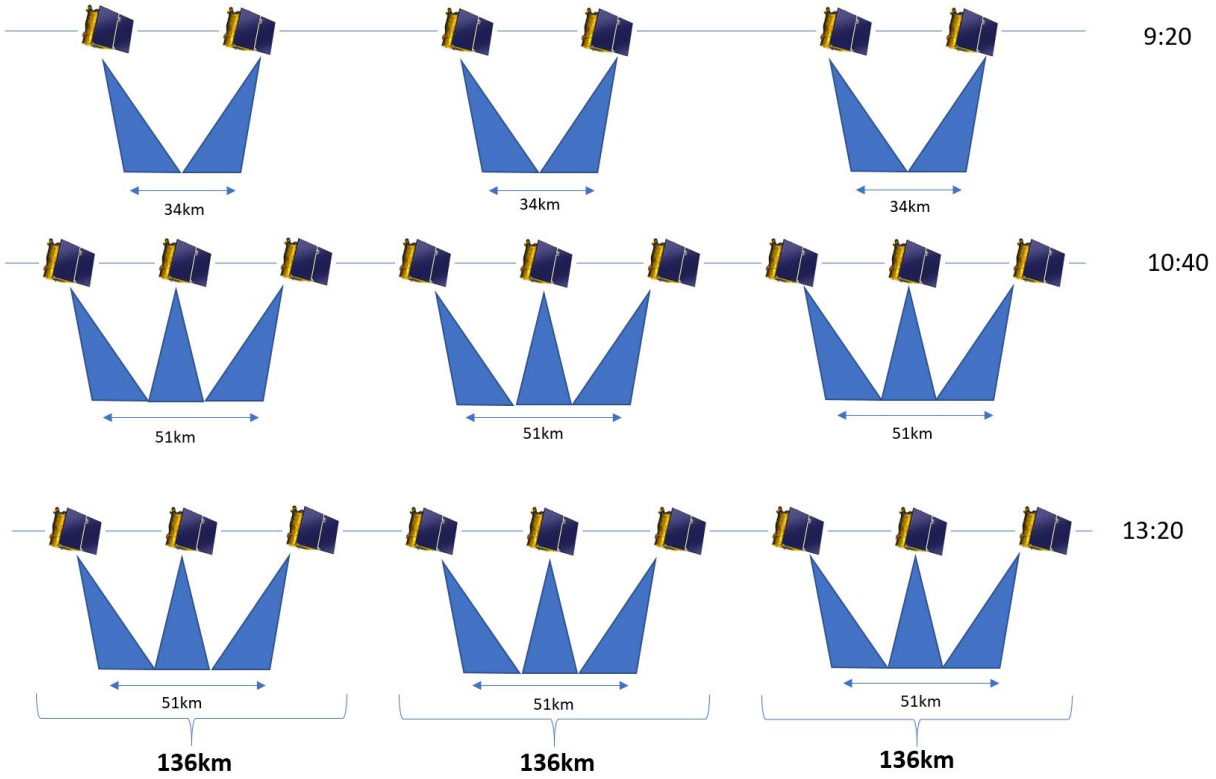
Demonstration of EarlyEye and 15 Minutes Unique Capabilities

DailyVision
JL1GF03B
1m
10:05:38

DailyVision@1m, 1m, 2021, Abu Dhabi Airport

Guaranteed Daily Monitoring over Large AOI

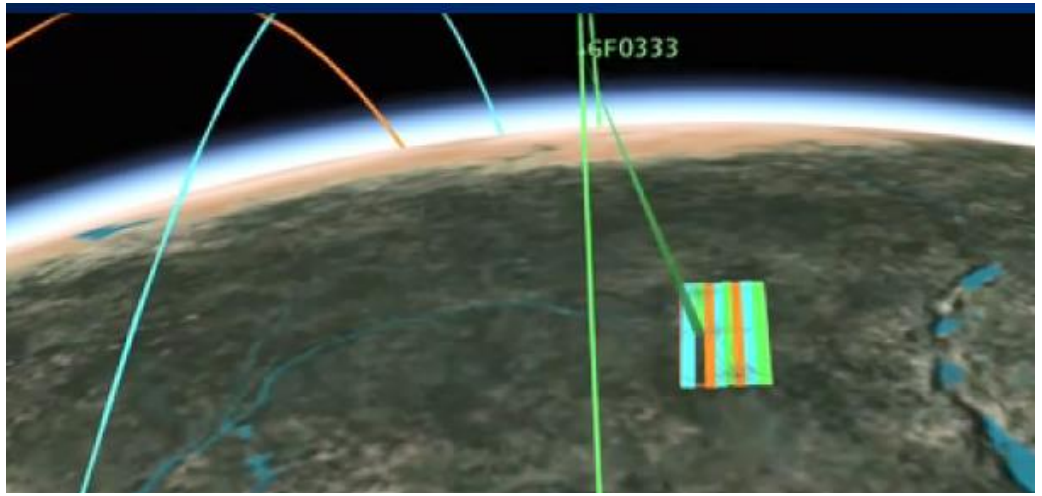
DailyVision



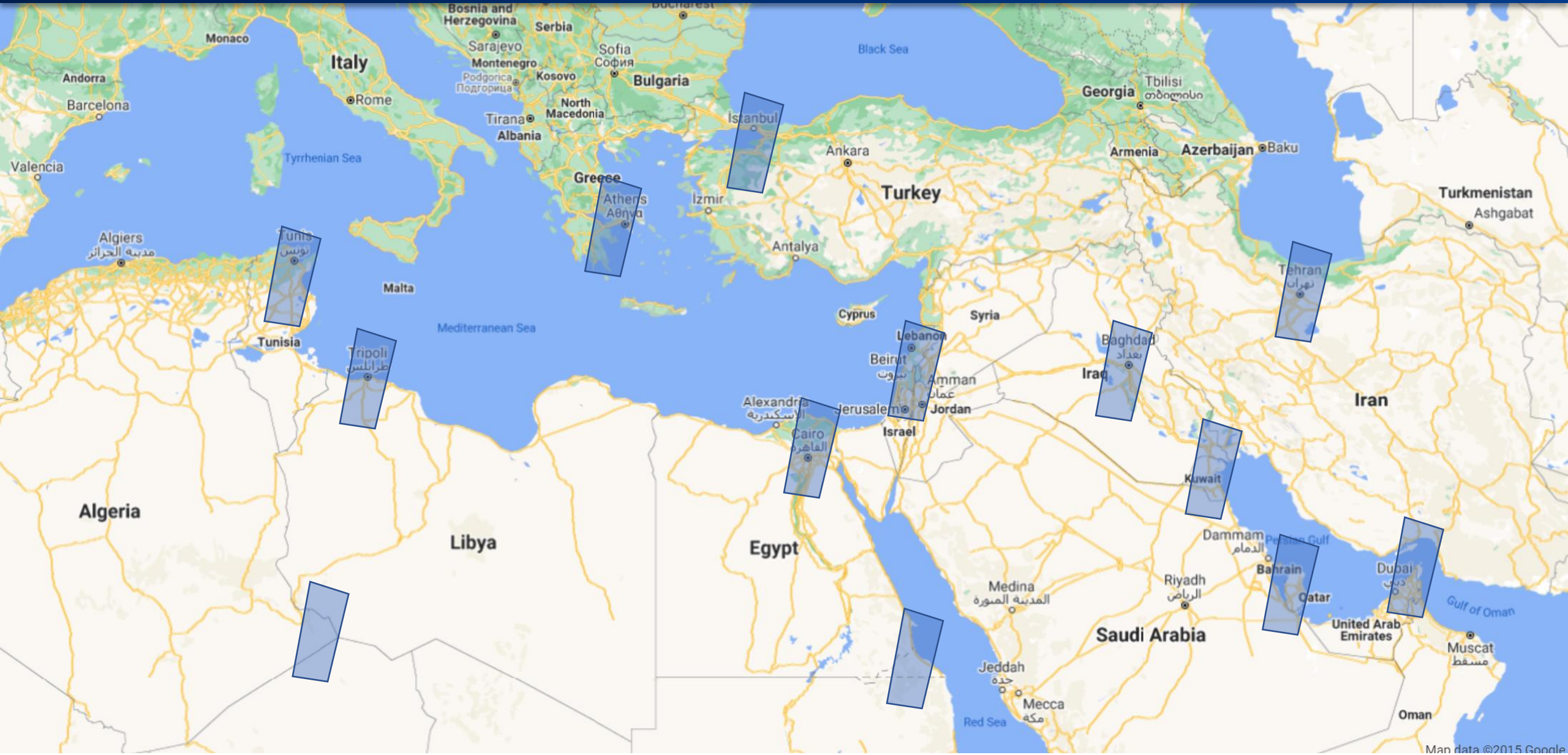
JL1 constellation in orbit captures submeter images with 8 swath of 17 km wide = 136 km wide AOI

Large AOIs daily coverage:

- 136 km wide x 300 km long
- <1m resolution

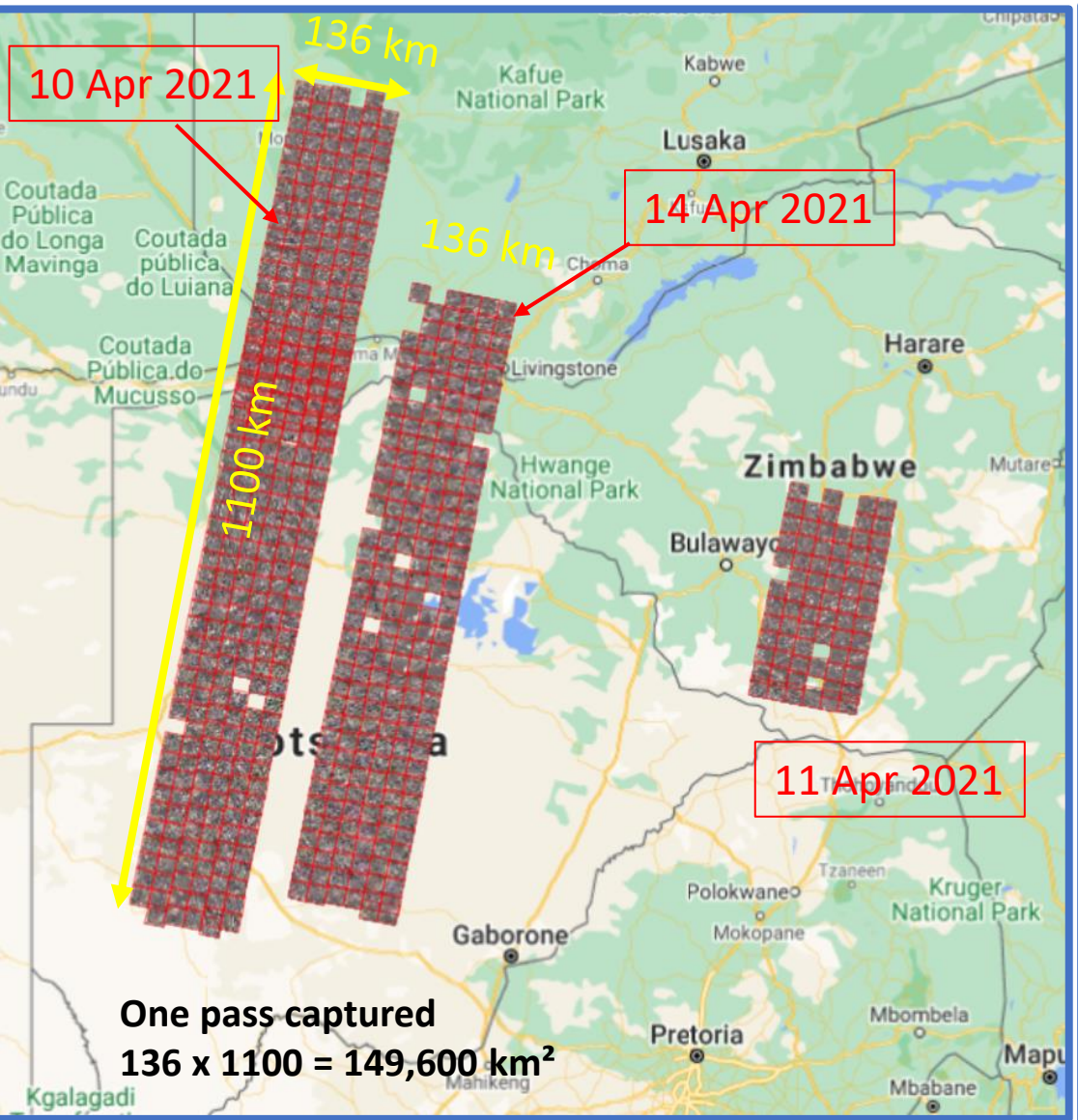


Examples of Areas that can be covered Daily once per Orbit

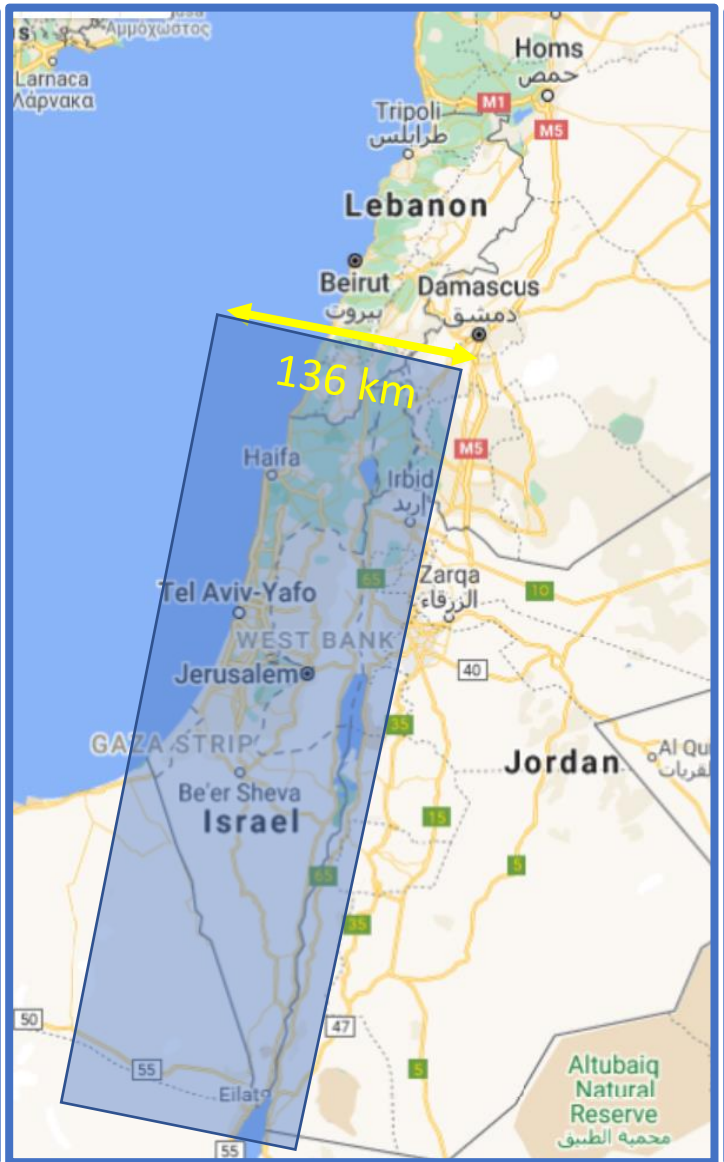


50cm EarthScanner 136km Swath

Revisit for huge AOI at Very High Resolution



Examples of countries that can fit in single collection at 50 cm



Two Countries Captured in One Pass by EarthScanner
Full resolution zoom on Doha Airport

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EarthScanner

JL-1 KF1 - 0.50m

2020-10-05

Bolivia

JL1KF01A, 2020 jan 24th, Boufarik Airport BLIDA, Algeria, 50 cm

EarthScanner (JL1KF01)

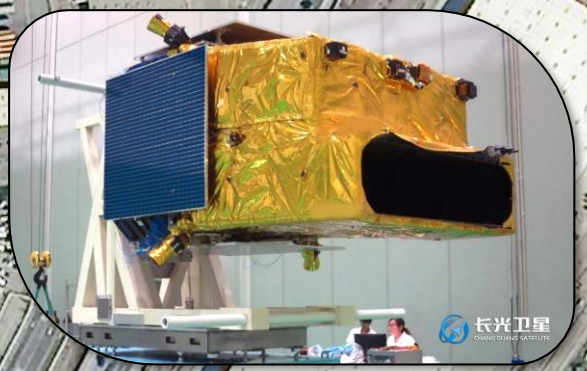
1 → 2 satellites at 50 cm

- Revisit 4 days (2 days after launch of JL1KF01B)
- Swath width 136 km
- Imaging length 4000 km
- Excellent quality (1200kg)

"Grand Princess"

(1200kg)

Epidemic detection tents for COVID-19

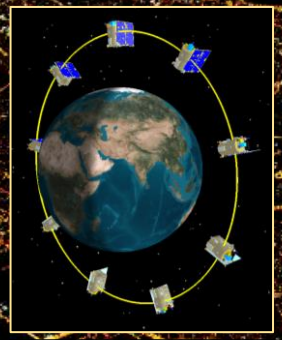


JL-1 KF01 - Oakland Marina, San Francisco 20190314

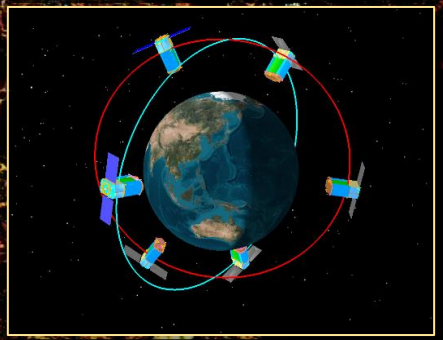
Night Vision Constellation
9 satellites (night & video)

JL-1SP07, 0.92m, video, 2020 Madrid, Spain

3 SP Sats constellation in 12:00 orbit



Three GF03A equally spaced in 9:20 orbit

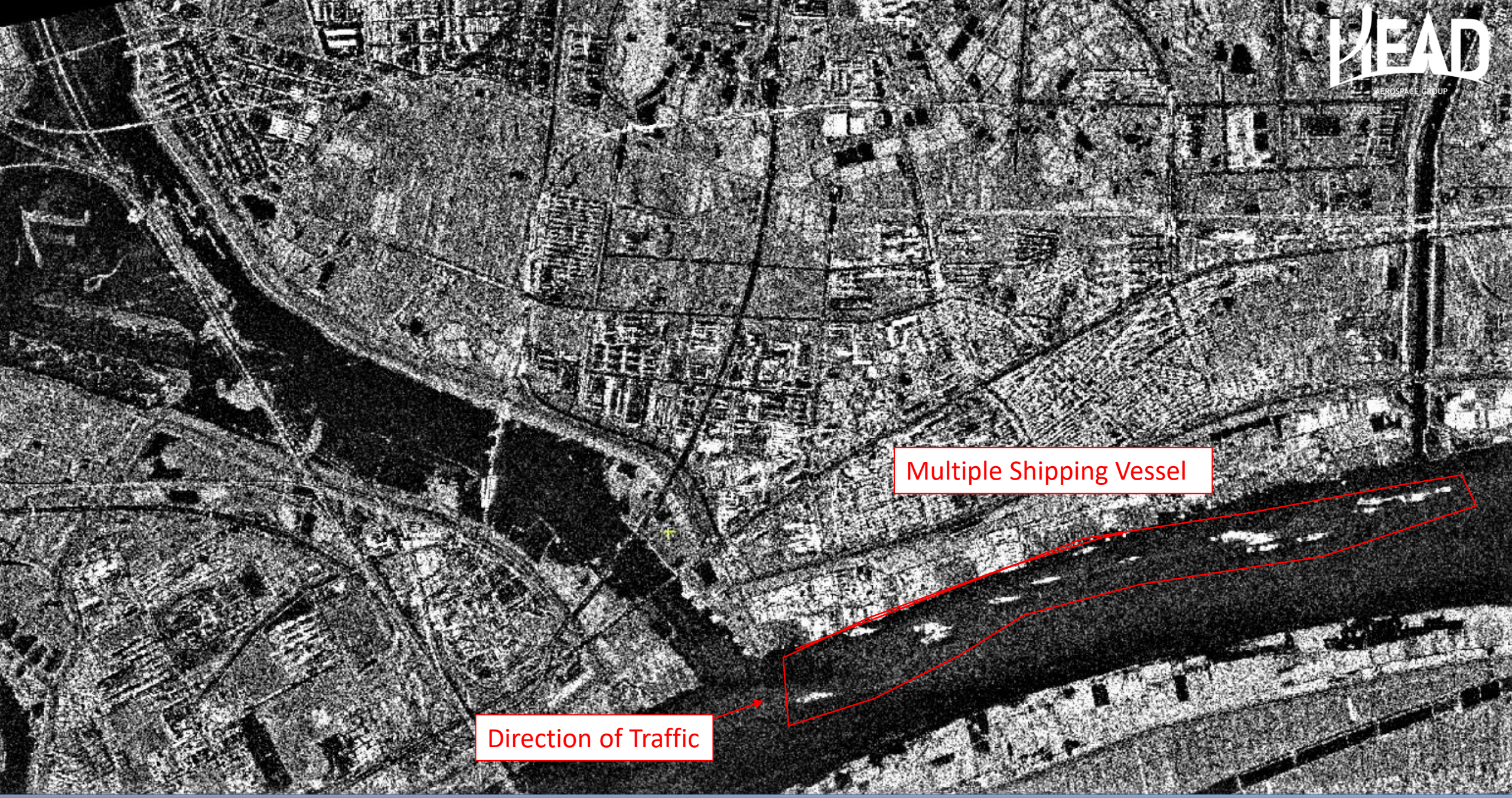


3 SP Sats constellation in 10:30 orbit

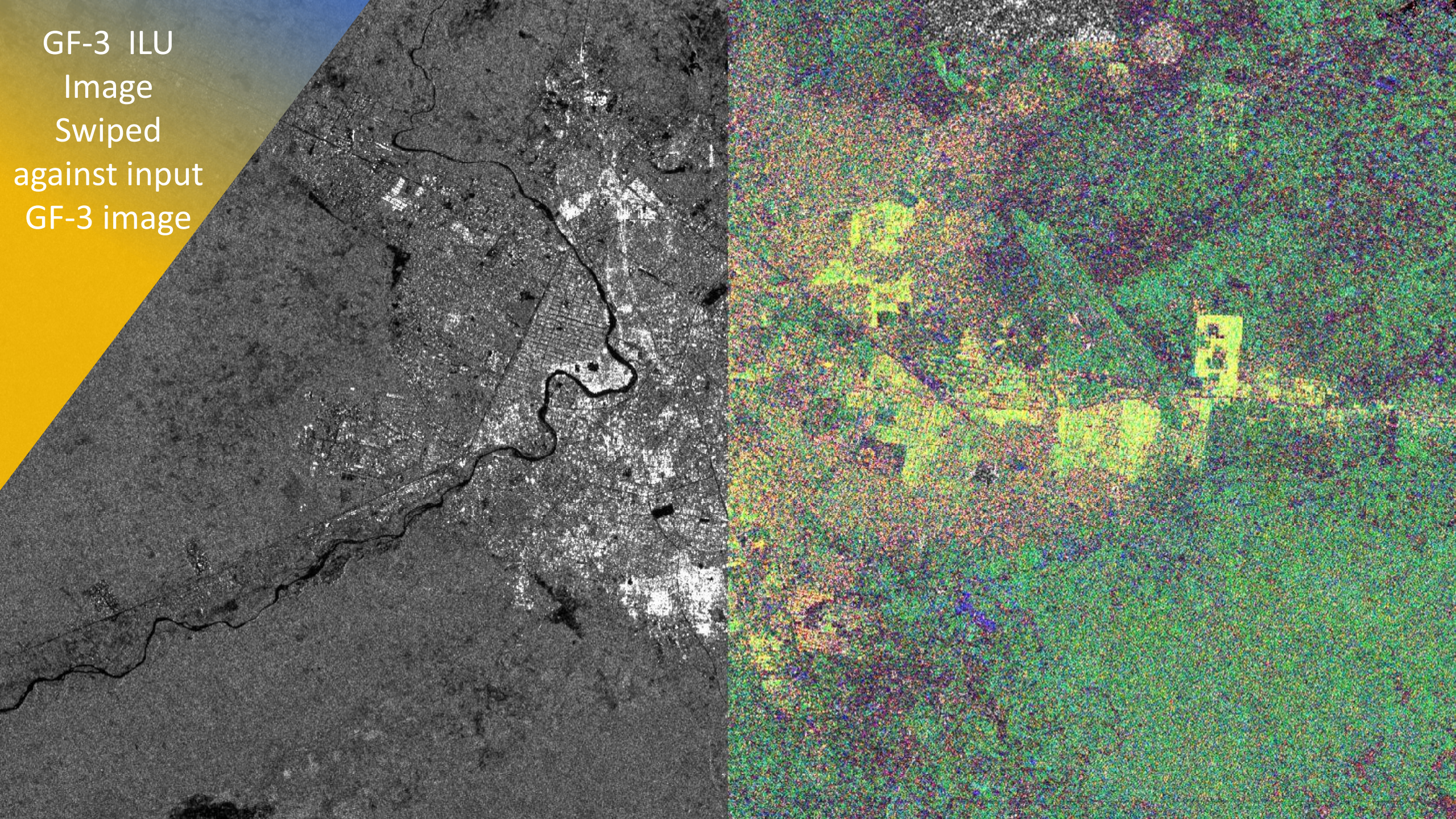
C-BAND RADAR Satellite GF3

- GF3; SAR radar imagery down to 1m
- Collect ~6am and ~6pm local time.
- Two new GF3 launches scheduled in 2021

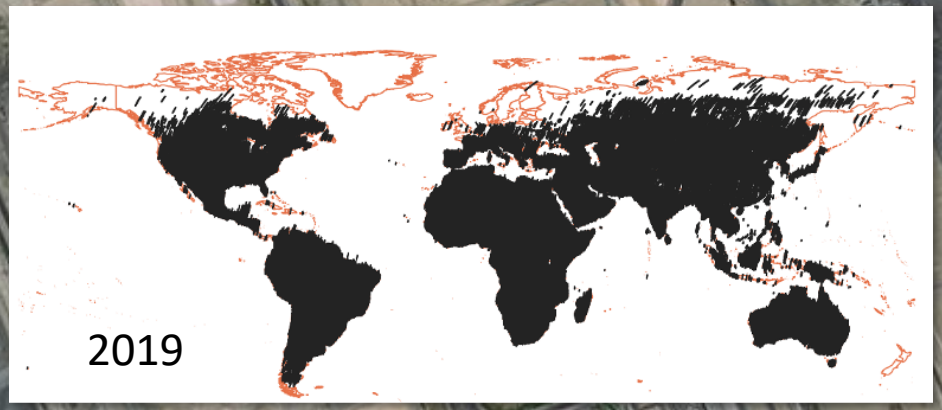
C-Band SAR: GF3

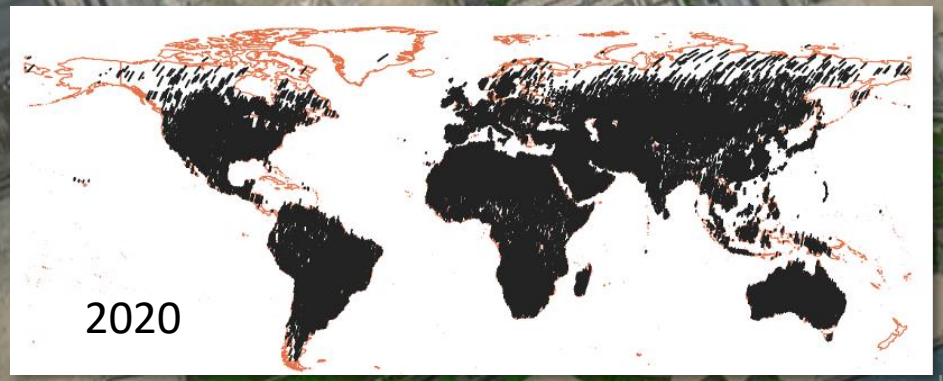


GF3, 1m, 17-08-2016, Wuhan, China


GF-3 ILU
Image
Swiped
against input
GF-3 image

Superview
4 satellites at 50 cm





6 x passenger aircraft

5 x passenger aircraft

Aircraft Taxiing to take off

- Agile / Stereo
- Tasking ~every day.
- Great archive database

SV, 0.5m, 24-08-2020 Doha, Qatar

Superview 50 cm data

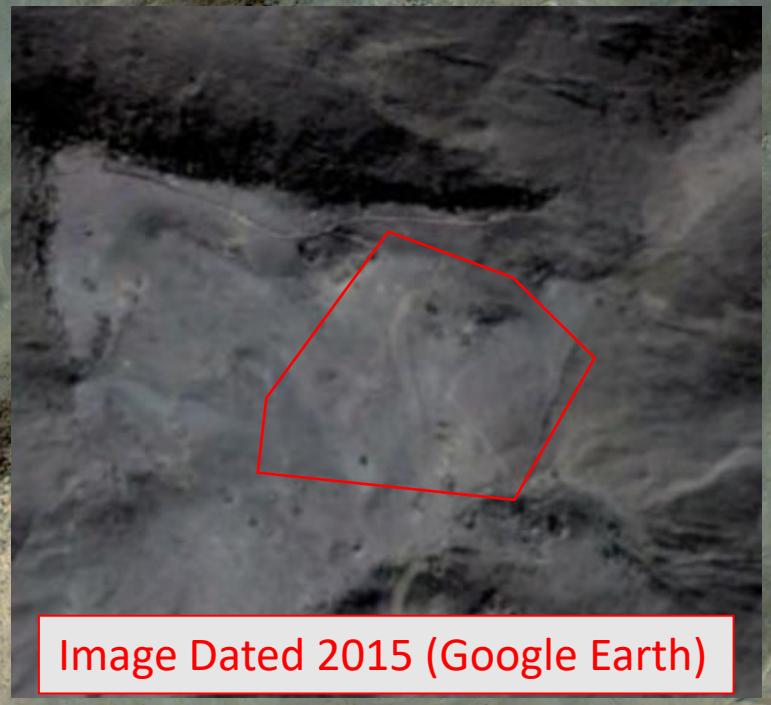


Image Dated 2015 (Google Earth)

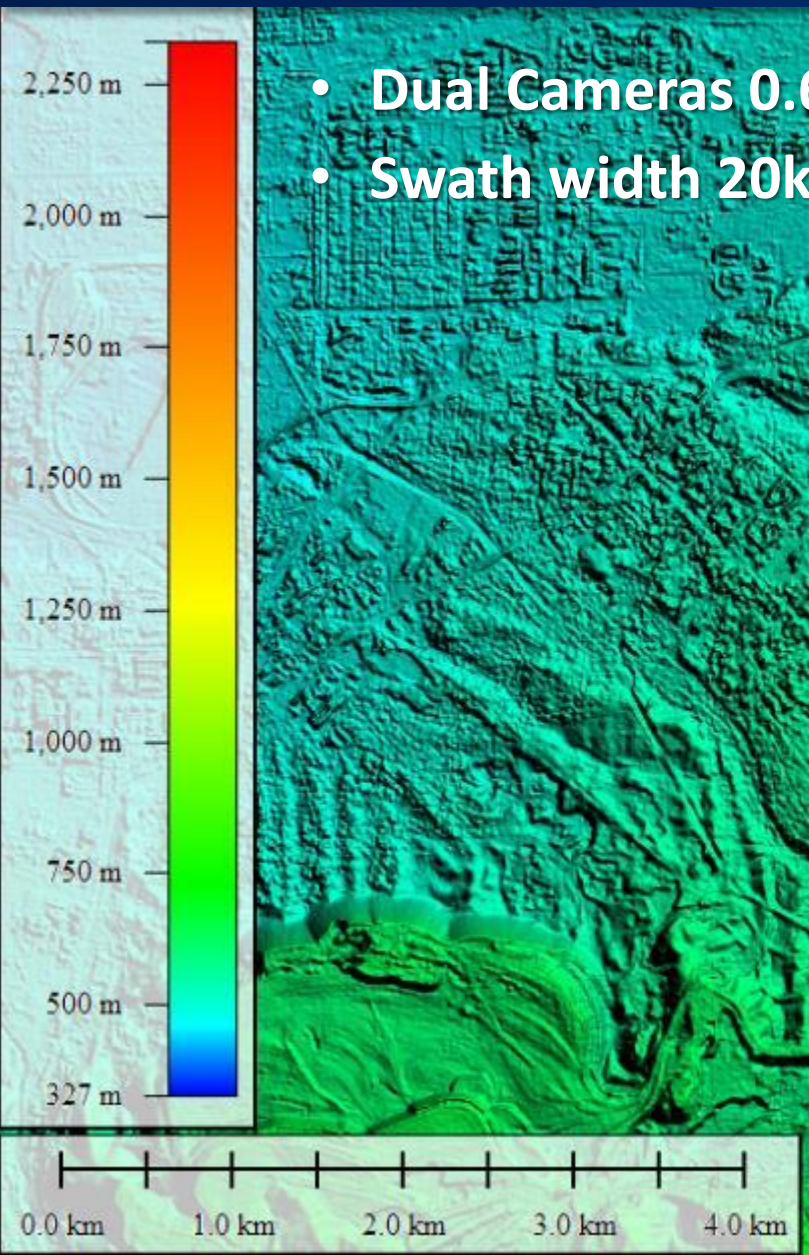
New Installation

Access Route

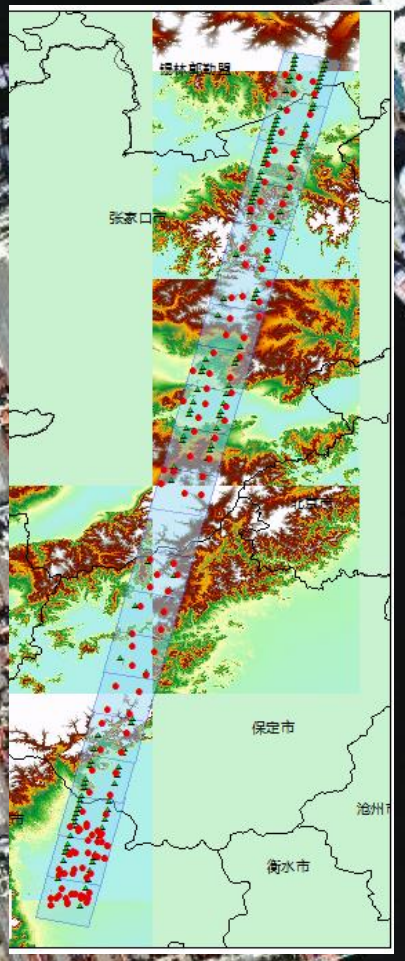
SV1-01_2020 dec 23rd, West Algerian Border North West of Tindouf

1:10,000 Mapping with GF-7 for Stereo Imaging with laser altimeter

- **Dual Cameras 0.65m-0.8 GSD in Pan**
- **Swath width 20km**

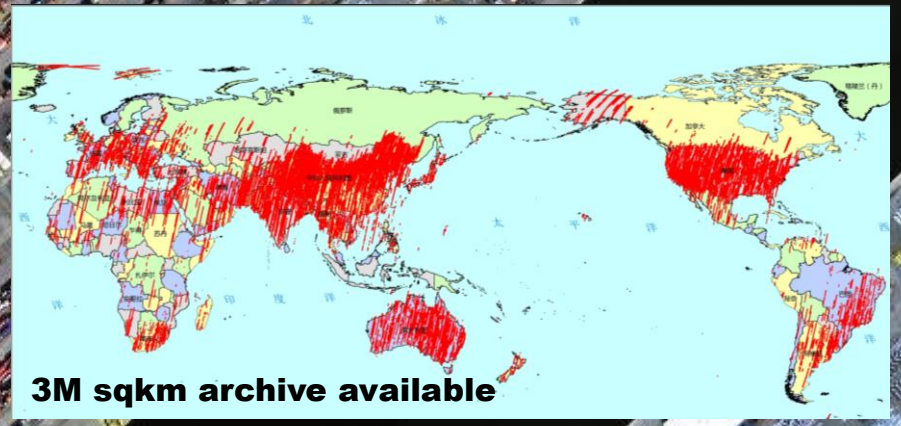


GF-7 Stereo Imaging with laser altimeter: vertical accuracy 1.2m without GCP



Vertical Accuracy of 1.2m without GCP

thanks to Laser data collected at same time as stereo pair

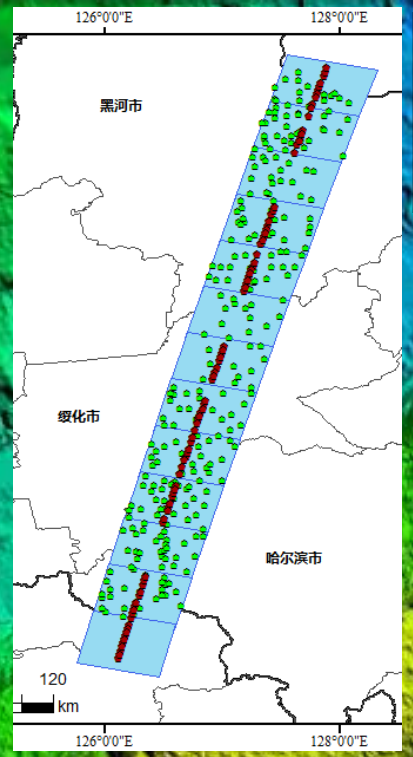


GF-7, 0.70 m, Dubai harbor, UAE

1:50,000 Mapping with ZY-3 03 Tri Stereo Images + Laser Altimeter Vertical Accuracy 5m without GCP

- Phased constellation for high revisit
  - Tri stereo ZY-3 01 (2012) / ZY-3 02 (2016)
  - Tri stereo + **Laser altimeter** ZY-3 03 (2021)
- Triple Cameras **2m GSD in Pan /** 5m MS (RGB-NIR)
- **Swath width 51km**

Othro product of Pyramid
Cairo, Egypt



Vertical Accuracy 5m without GCP

Thanks to laser data collected at the same time as Stereo Triplets

DSM of of Pyramid
Cairo, Egypt

Available Mobile Ground Station for Military and Emergency Uses

For emergency scenes where remote sensing data needs to be acquired urgently, **On-site scheduling planning**, **command uploading**, **live tasking/transmission**, **on-site interpretation** and **comprehensive analysis** of satellites in orbit can be realized with a mobile kit.

Summary & Conclusion

HEAD solutions can support the defence customers in target identification and strategic planning for:

- ✓ Sovereignty Defence
- ✓ Disaster Response
- ✓ Peace Keeping

Thanks to our unique submeter capabilities (80 satellites in orbit by 2021):

- ✓ 15 minutes targeting
- ✓ EarlyEye
- ✓ Large AOI daily coverage
- ✓ Country coverage with single shot
- ✓ Night imaging
- ✓ Daily All weather imaging with SAR
- ✓ 1:50,000 DLG mapping without GCPs
- ✓ 1:10,000 DLG mapping without GCPs
- ✓ Immediate access via ground station, particularly mobile ground station for real time tasking

- ✓ D&I customers have access to Priority Tasking at Cost effective prices