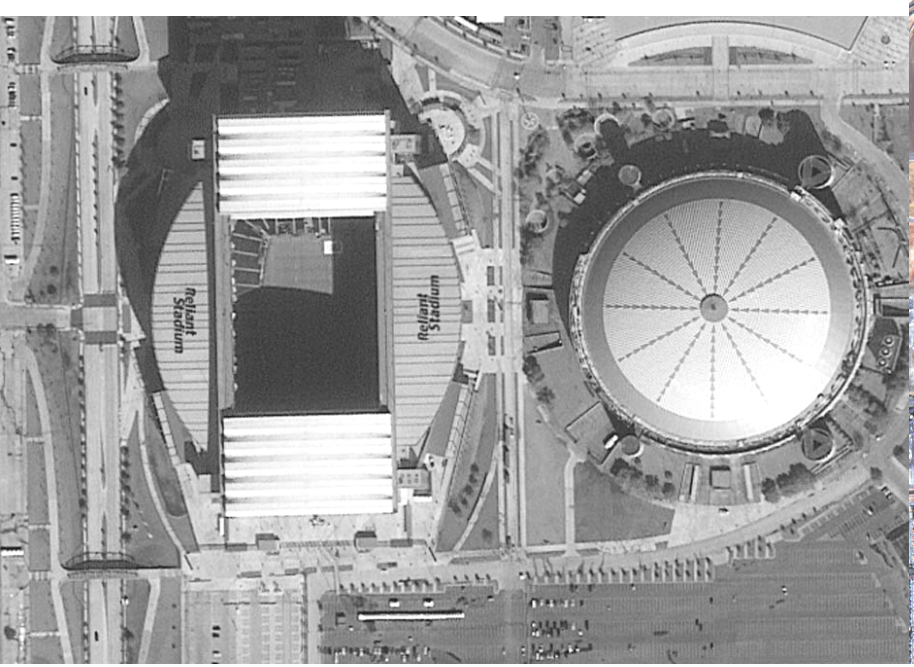
Turning Imagery into Intelligence

ORBIMAGE
GLOBAL IMAGING INFORMATION

Overview

- ORBIMAGE Overview
- OrbView-3 Update
- OrbView-3 Products Overview
- Summary



ORBIMAGE Overview

ORBIMAGE Highlights

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- **Our Business**
  - Collect, Process and Distribute Digital Imagery of the Earth's **Land**, **Oceans** and **Atmosphere**
  - Supply Imagery and Value-Added Geospatial Information Products and Services Worldwide to four primary markets:
    - Government & National Security
    - Mapping & Surveying
    - Natural Resources
    - Consumer
- **The System**
  - Constellation of Satellites (currently OrbView-2, OrbView-3 and Aerial data sources)
  - Worldwide Network of Ground Stations (OrbView-2 and OrbView-3)
  - Two Advanced Image Processing Facilities (Dulles, VA and St. Louis, MO)
  - One Satellite Control Facility Terminal with Remote Terminals in Alaska and West Virginia

A Geospatial Information Technology Company

Primary Operations Centers

- **ORBIMAGE HQ – Dulles, VA**
  - Imaging Systems
  - Satellite Operations
  - Ground Systems
  - Advanced Image Processing
  - Image Archive / Dissemination
  - Commercial Operations

- **St. Louis, MO Operations**
  - Photogrammetric Engineering Services
  - Sensor Design/Calibration
  - Math Modeling
  - Systems Engineering
  - Geospatial Information and Mapping Services
  - Applications Software
  - Image-to-Product Verification

Products and Solutions

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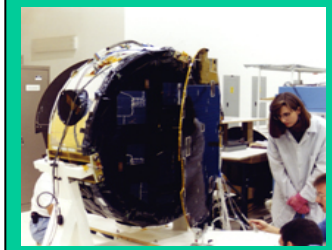
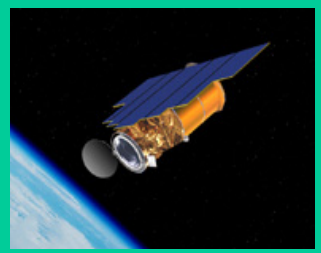
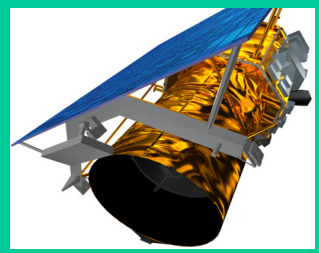
Imagery Data Sources

OrbView Satellite Constellation


OrbView-1

OrbView-2


OrbView-3


OrbView-5

Third-Party Systems

Aerial Systems

Information Systems

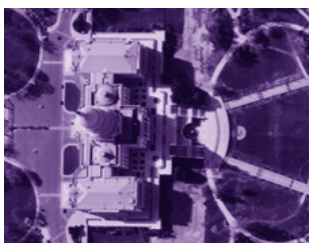
Antenna Systems

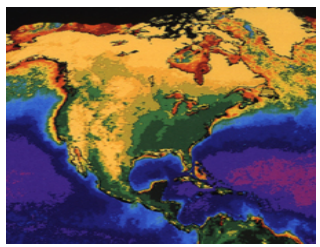
Business Systems

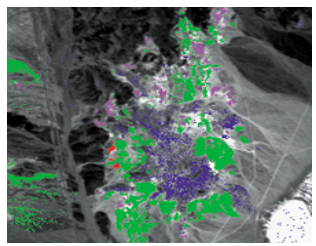
Image Processing & Solutions

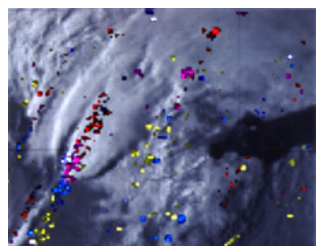
System Integration

Imagery Products









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Satellite Engineering and Operations Primary Responsibilities

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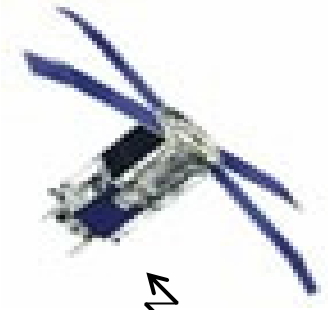
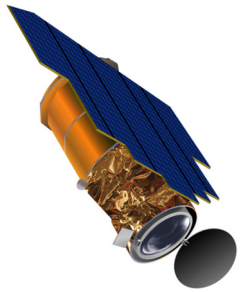
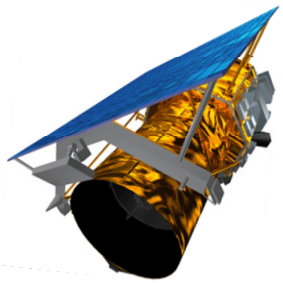
Operate OrbView-2 Satellite and Ground System

Operate OrbView-3 Satellite and Ground System

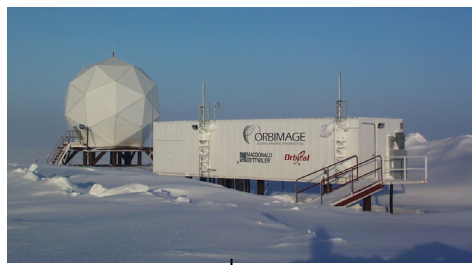
Space Systems Development (OV-3, OV-5, OV-X)







Fairmont, WVA Ground Terminal



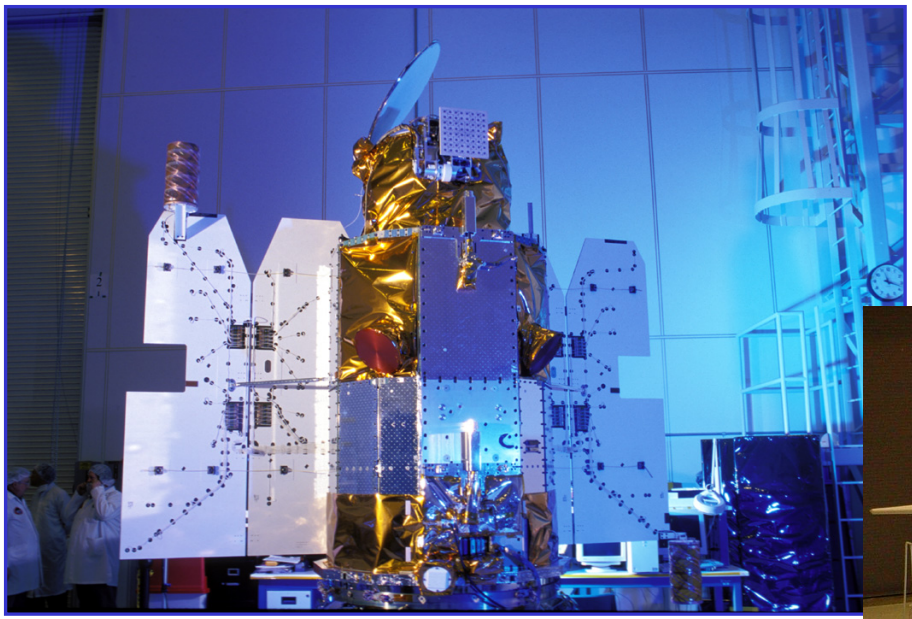
Barrow, AK | Ground Terminal

Dulles, VA Ground Terminal

Satellite Operations Center

OrbView-3

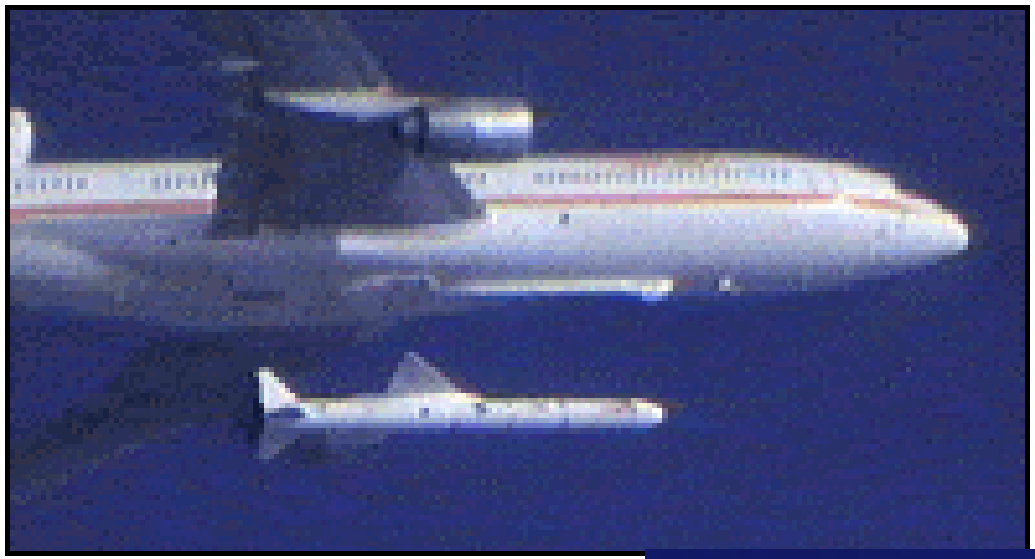
OrbView-3 Satellite Pre-Launch



OV-3 Final Assembly

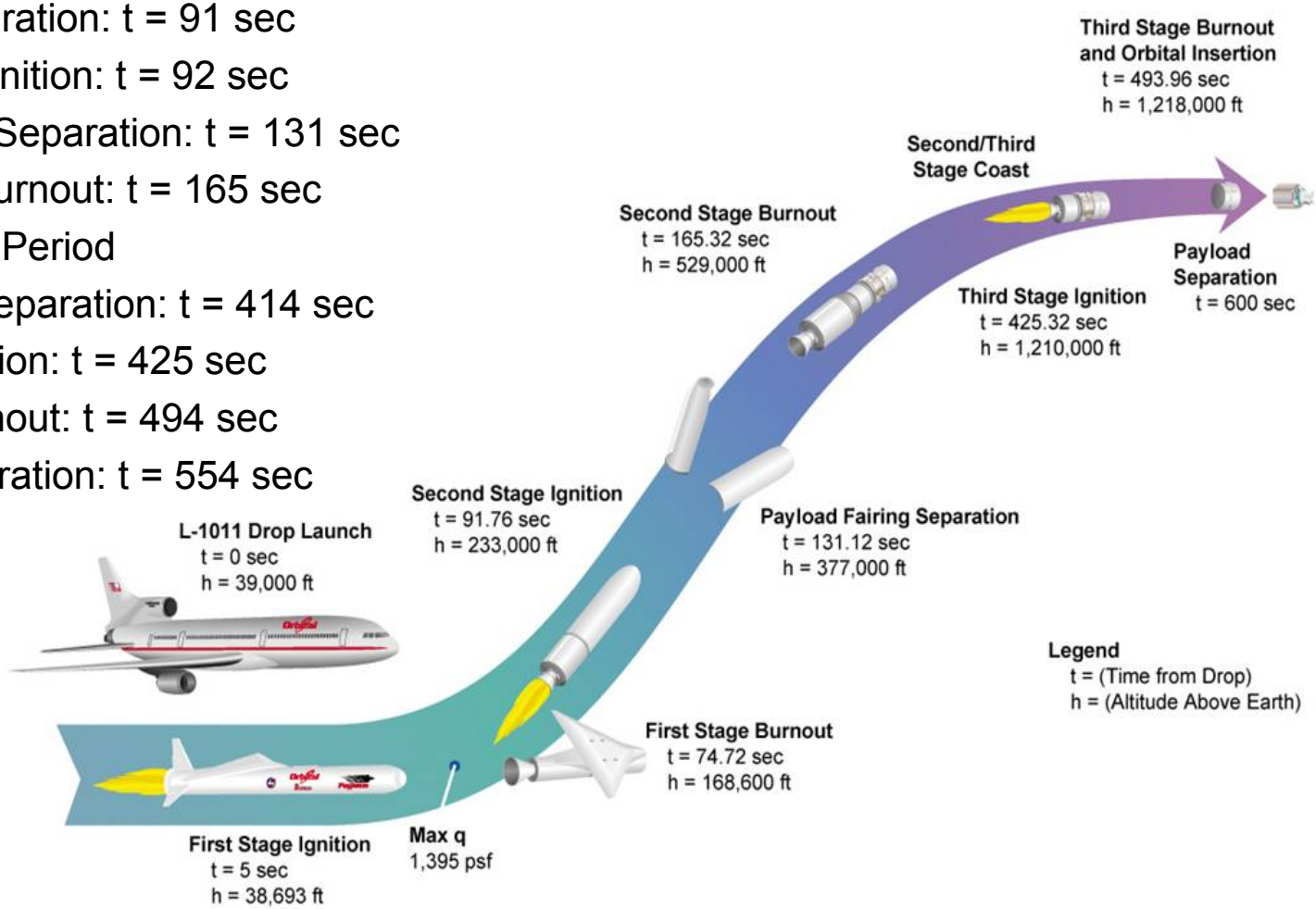
OV-3 / Pegasus Integration

Pegasus Rocket Launch



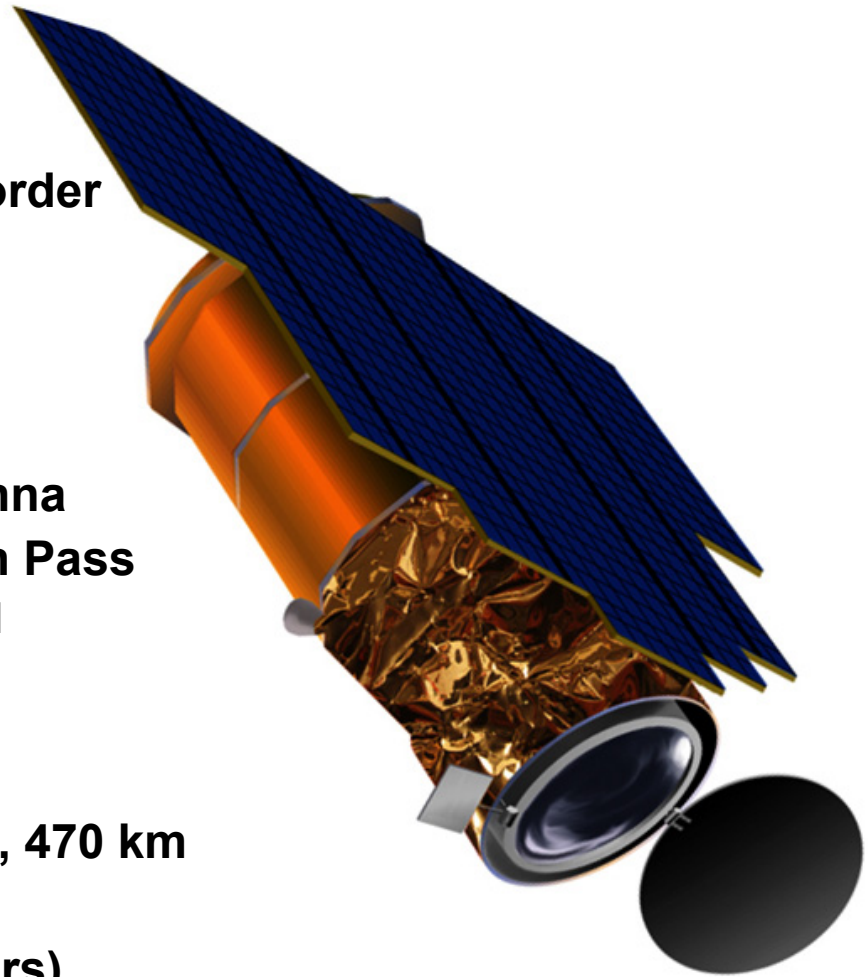
OrbView-3 Launch Profile

- Pegasus Drop/Launch: t = 0 Sec
- First Stage Ignition: t = 5 sec
- First Stage Burnout: t = 75 sec
- First Stage Separation: t = 91 sec
- Second Stage Ignition: t = 92 sec
- Payload Fairing Separation: t = 131 sec
- Second Stage Burnout: t = 165 sec
- Stage 2/3 Coast Period
- Second Stage Separation: t = 414 sec
- Third Stage Ignition: t = 425 sec
- Third Stage Burnout: t = 494 sec
- OrbView-3 Separation: t = 554 sec



OrbView-3 Baseline

- Resolution/Swath-Width
  - Pan: 1m at 8 km
  - MS: 4m at 8 km
- On-Board 32 Gb Solid Stage Recorder
  - 1m Pan: 226 Images
  - 4m MS: 904 Images
- 11 Bit Detector Dynamic Range
- Max Data Rate: 150 mbps
- Gimbaled X-Band Downlink Antenna
- Maximum Area Imaged per 10 min Pass
  - At scan rate of 5,000 lines/second
    - 1m GSD (Mono): 20,320 km2
    - 1m GSD (Stereo): 7,200 km2
- Revisit Time: <3 Days
- Orbit: 97° Sun Sync at 10:30 a.m., 470 km
- Launch Mass: ~300 kg
- Mission Life: 5 years (Fuel >7 Years)



Launched on June 26, 2003

OrbView-3 Specifications

Imaging Modes	**Panchromatic**	**Multispectral**
Spatial Resolution	**1 meter**	**4 meter**
Imaging Channels	**1 channel**	**4 channels**
Spectral Range	**450-900 nm**	**450-520 nm** **520-600 nm** **625-695 nm** **760-900 nm**
Swath Width	**8 km**	**8 km**
Image Area	**User Defined**	**User Defined**
Revisit Time	**< 3 days**	**< 3 days**
Orbital Altitude	**470 km**	**470 km**
Nodal Crossing	**10:30 A.M.**	**10:30 A.M.**
Design Life	**5 years**	**5 years**

OrbView-3 PAN 1m Image

Whiteman AFB - October 22, 2003

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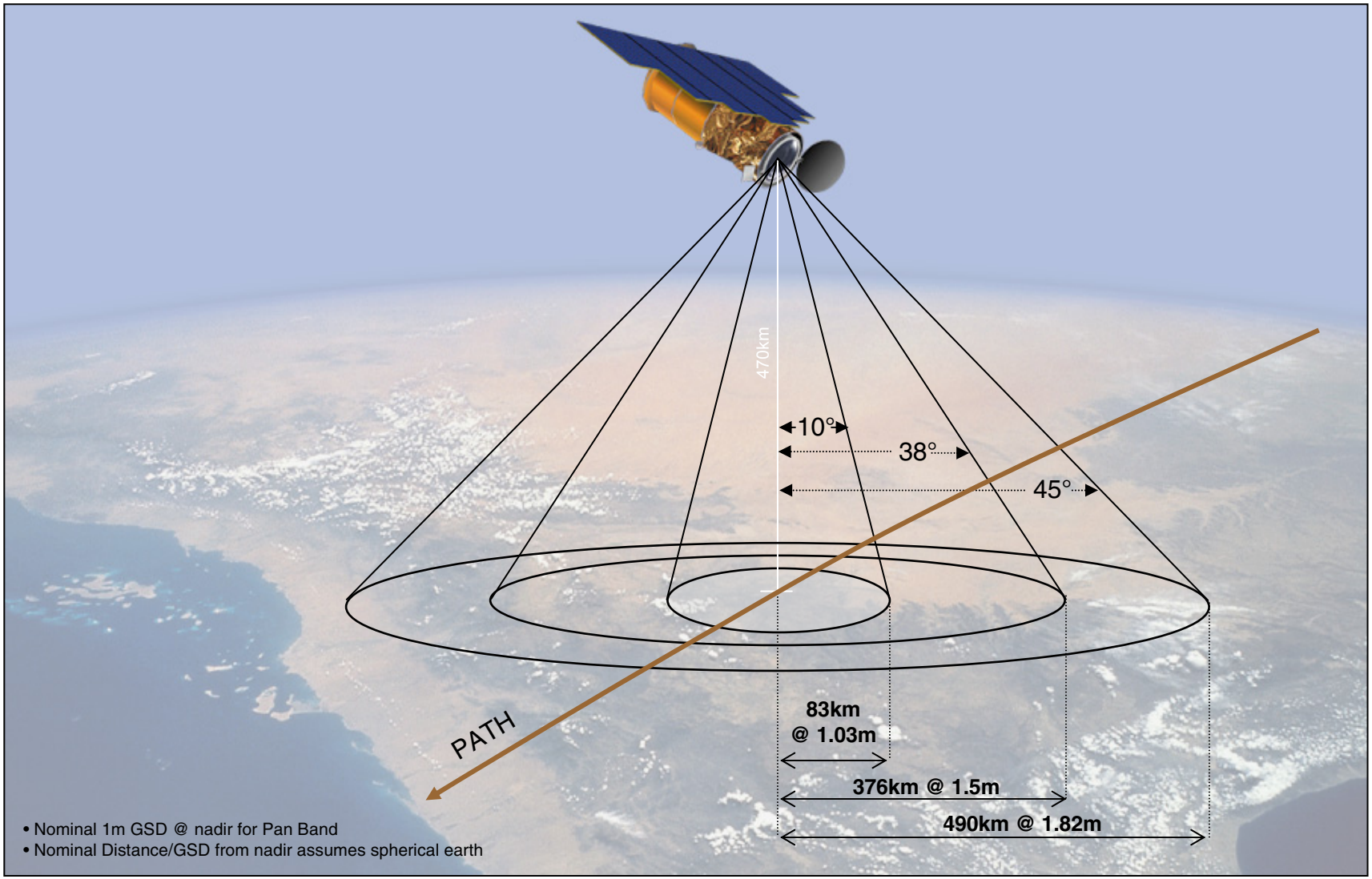
OrbView-3 MultiSpectral 4m Image

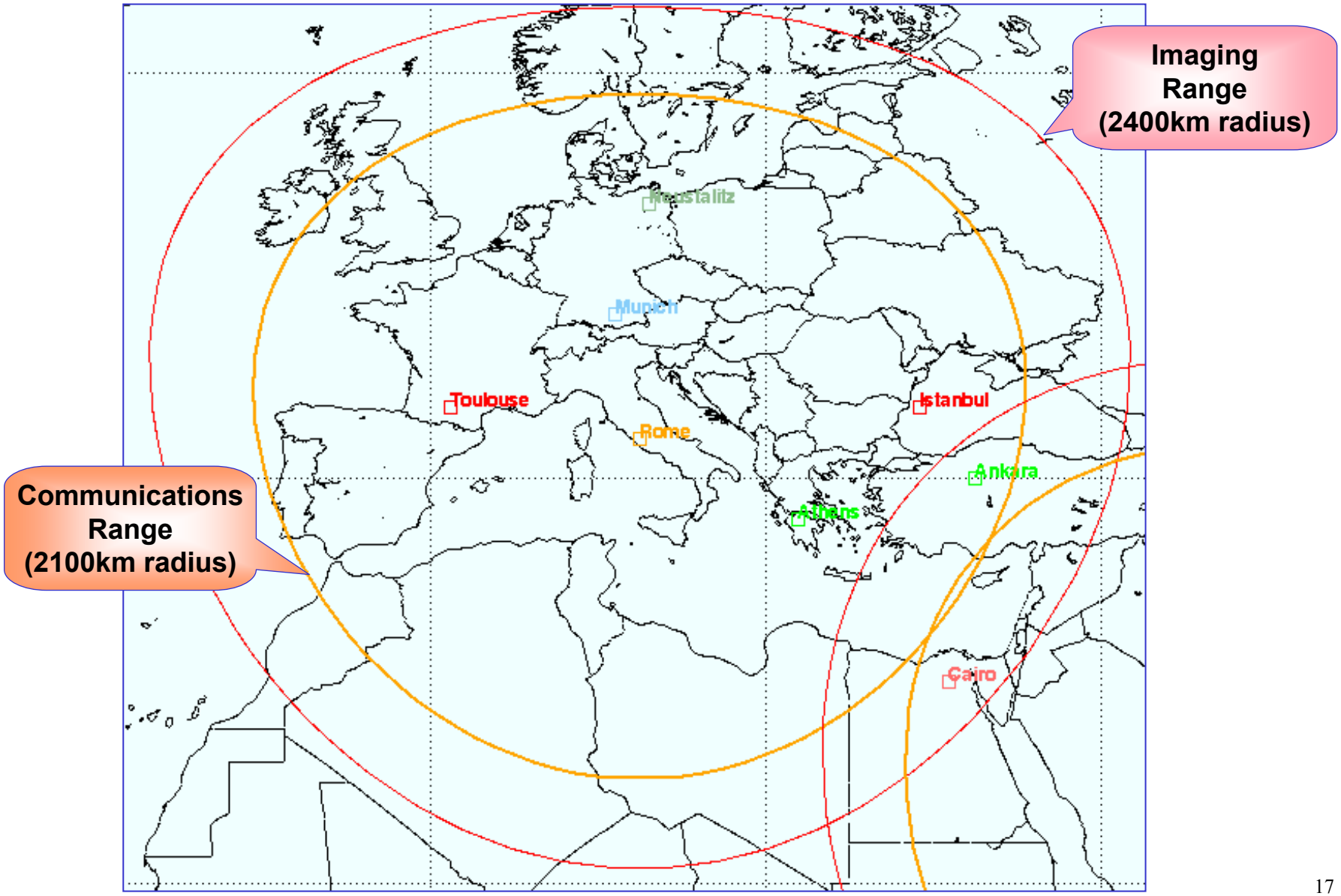
Fiji – May 13, 2004

Satellite Field of Regard

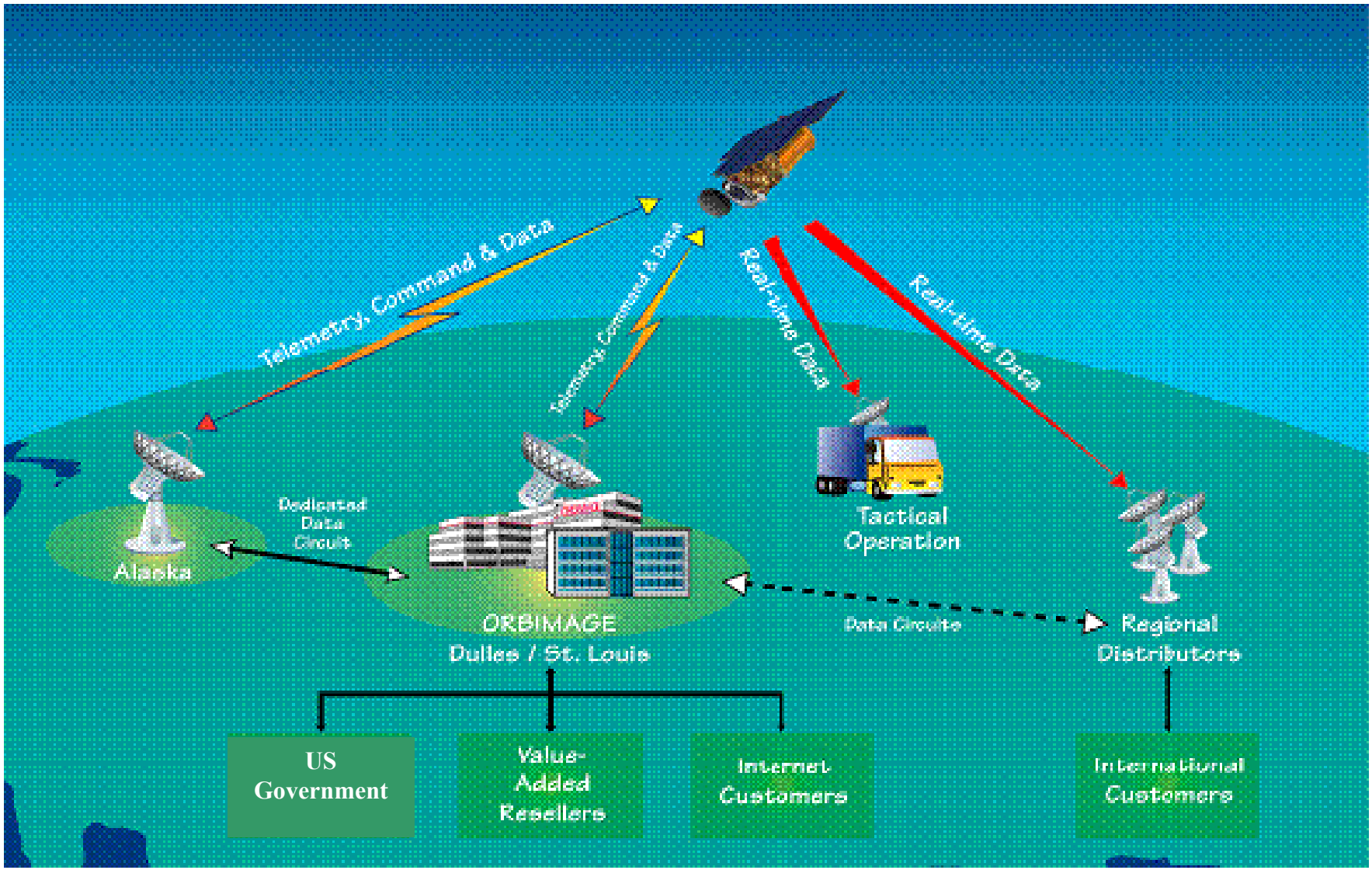


- Nominal 1m GSD @ nadir for Pan Band
- Nominal Distance/GSD from nadir assumes spherical earth

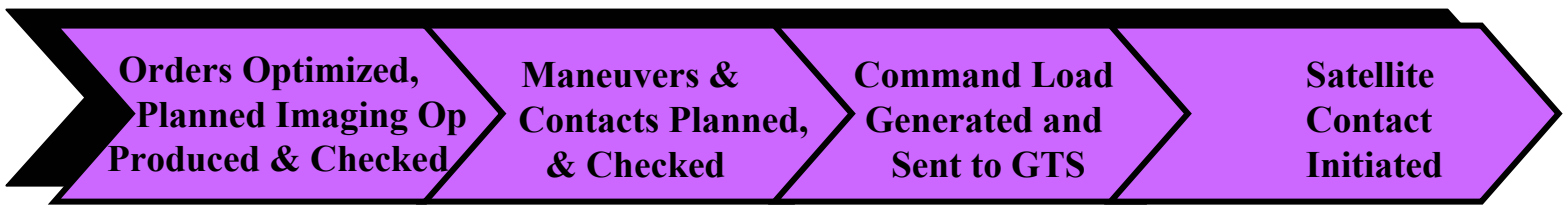
OrbView-3 Coverage (Typical)



OrbView-3 CONOP



OrbView-3 Operations



Collection Acquisition Repeats for Each of 12 Orbits per Day!

A Day in the Life of OV-3 Operations

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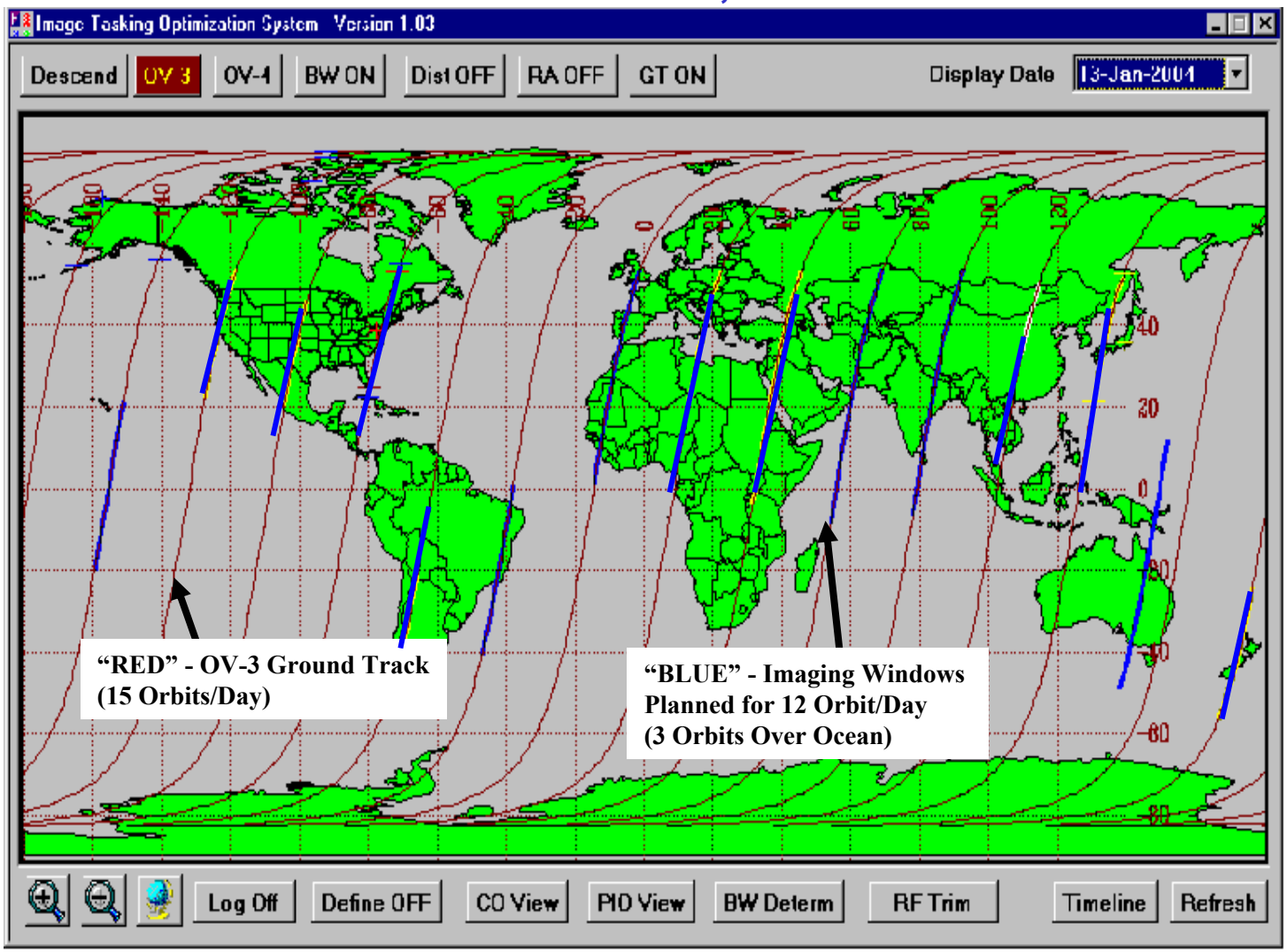
Actual Collection Plan for Jan 13, 2004 Orbits 3079 – 3094



A Day in the Life of OV-3 Operations

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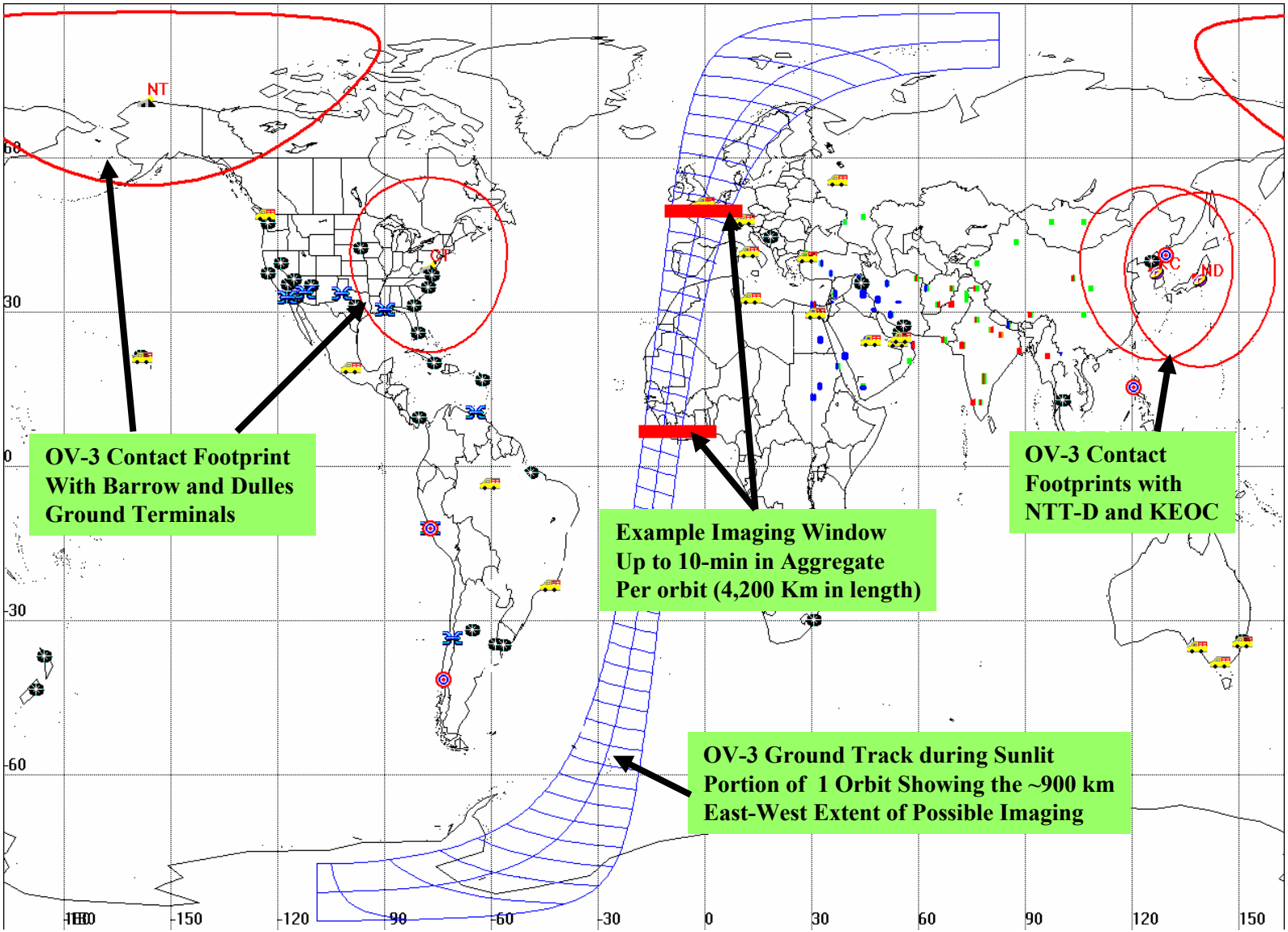

OV3 Sensors and Collection Rates

- Sensors
  - PAN has 8,000 detectors, 1m resolution
    - Scan rates up to 5,000 lines/second (or 40km^2/second)
  - MS has 8,000 detectors (2000 per band x 4 bands), 4m resolution
    - Scan rates up to 2,500 lines/second (or 80km^2/second)
- Collection Rates (scanning at 5000 lines/second)
  - Strip at 1-1.03m resolution = 650km (or 5,200km2)
    - Satellite must reposition to take next strip on same pass
  - Strip at 1-1.5m resolution = 2,540km (or 20,320km2)
    - Satellite must reposition to take next strip on same pass
  - Maximum image strip length = 4,200km (or 33,600km2) at 26º acquisition angle off nadir
    - Resolution is less than 1m (at 1.2m)

Point Target (8km x 8km) Collection Capability

Over a typical 10-minute pass in the 1m GSD Panchromatic mode, the satellite is capable of collecting the following quantities of point targets (at 8km x 8km):

Target Cross-Track Separation (Deg)	Target Cross-Track Separation (Km)	Number of Point Targets	Total in Km2
5°	40km	18	1,152 km2
10°	81km	16	1,024 km2
15°	123km	15	960 km2

Revisit Time to a Point Target				
	Max. GSD = 1.06 meters (Max. F.O.R. Angle = 15°)		Max. GSD = 1.5 meters (Max. F.O.R. Angle = 38°)	
Latitude (degrees)	Ave. # Visits Per Year	Ave. # Days to Revisit	Ave. # Visits Per Year	Ave. # Days to Revisit
10°	36	9.9	108	3.3
25°	39	9.1	119	3.0
40°	49	7.3	143	2.5

NOTE: F.O.R. = Field of Regard

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OrbView-3 Products Overview

OrbView-3 Product Types

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Imagery Products

- Basic Data Sets
  - Basic Express
  - Basic Enhanced
  - Basic 1:50k
  - Basic 1:24k
  - Basic 1:12k
- Geo Data Sets *(Future)*
  - GEO Express
  - GEO 1:50k
  - GEO 1:24k
  - GEO 1:12k
- Ortho Data Sets
  - Ortho 1:50k
  - Ortho 1:24k
  - Ortho 1:12k

Derived Products

- Digital Elevation Products
  - DSM
  - DEM
- Thematic Map Products
  - Vegetation Index Maps
  - Land Cover Maps
- Feature Maps
  - Topo 1:50k
  - Topo 1:24k
  - Topo 1:12k

St. Louis Ops -- Advanced Production

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Product Type	Spec Available	Source Materials	Mono/Stereo Imagery	Applications
1. Control Generation (Geopositioning)	Yes	I, M, O, Q, S	M/S	• Prerequisite for All Product Generations
2. CIB = Controlled Image Base (at 1m and 5m)	Yes	D, I, M, O, Q, S	M	• Positioning • Navigation • Simulation • Mission Rehearsal
3. DTED = Digital Terrain Elevation Data	Yes	I, M, O, Q, S	S	• Visibility/Obstruction • Simulation • Trafficability, Etc.
4. FFD = Foundation Feature Data	Yes	D, I, M, O, Q, S, V	M/S	• Planning/OPS • Cross County Movement • Ordinance Delivery, etc.
5. DPPDB = Digital Point Positioning Data Base	Yes	I, M, O, Q, S	S	• Targeting • Ordinance Delivery

D – Digital Terrain Elevation Data (DTED)
I – IKONOS imagery from Space Imaging
M – Metric Support Data (MSD)
O – OV-3 imagery from ORBIMAGE
Q – QuickBird imagery from DigitalGlobe
S – SPOT 1,2,4 imagery
V – Vector Product Format Data (VPFD)

1m PAN – Santiago, Chile

4m MSI – Santiago, Chile

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OrbView-3 PAN 1m Image

Pyongyang, North Korea - October 9, 2003

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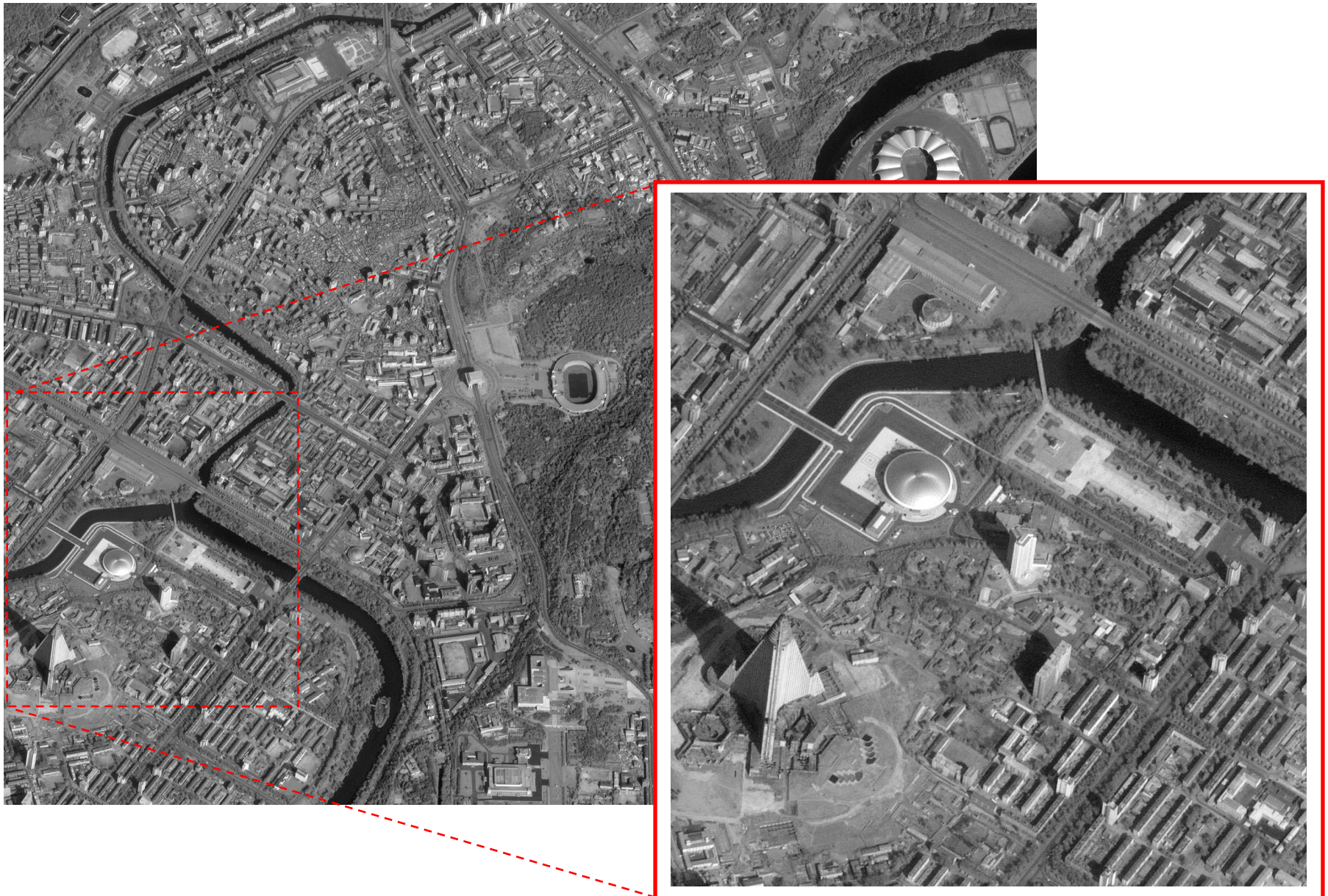

OrbView-3 PAN 1m Image
Great Pyramids of Giza, Egypt – April 16, 2004

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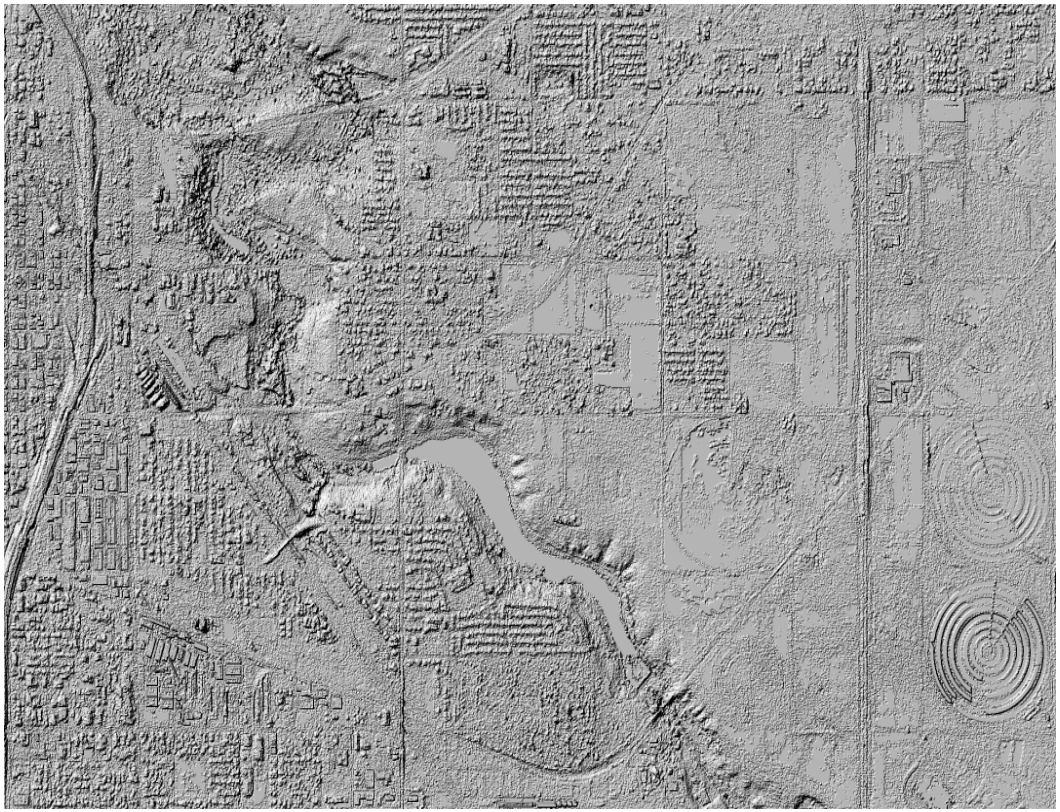
Terrain Data Generated



Computer Generated Shaded Relief Graphic
3 Meter (6 feet) spacing between points on the Ground

- **Captures manmade and Small Surface Features**
- **Vertically Seamless Assembly Of Elevations from Multiple Image Pairs.**
- **Product Sample Distance (Grid Spacing) Sufficient for Terrain Definition.**

Product Characteristics

- All imagery products are radiometrically corrected
- All imagery products are geometrically corrected to appear as if they were collected with an ideal linear array (detector alignment)
- Imagery products are annotated with ancillary data
  - Satellite time
  - Position
  - Attitude
- Available as either pan or multispectral imagery, as monoscopic or stereo data sets
- Use various levels of geopositioning models depending on desired product accuracy
- Product Format: GeoTIFF or NITF (8 or 11 bit quantization)
- Media: Electronic, CD-ROM, DVD, 8mm Tape

Note: Derived Product sizes may differ depending on the product

Product Geometric Accuracy

- Specifications for geometric accuracy ***without*** ground control points (depending upon look angle):
  - 20m/25m (CE/LE 90%) for single stereo pair
  - 12m/10m (CE/LE 90%) for 3 stereo pairs (in same pass)

- Specifications for geometric accuracy ***with*** four ground control points (depending upon GCP source) is 2-4m (CE/LE 90%)

Description – OrbView BASIC *Products*

- ***BASIC EXPRESS* Products**
  - High volume product for customers who wish to generate their own value-added products (e.g., digital orthoimages, DEM, thematic maps and feature maps). Imagery is not resampled with geometry data and is available minutes after collection.
- ***BASIC ENHANCED* Products**
  - Products use post processed GPS based ephemeris with OV-3 rational functions. Serves as baseline product for higher level products (e.g., orthos can be made from DEM or Stereo Pairs).
- ***BASIC 1:50K* Products**
  - Accuracy equivalent to 1:50,000 scale map product (pan 25 m CE 90%). Geopositioning based on tie points from multiple images.
- ***BASIC 1:24K* Products**
  - Accuracy equivalent to 1:24,000 scale map product (pan 12 m CE 90%). Geopositioning based on tie points plus ground control points in rough terrain
- ***BASIC 1:12K* Products**
  - Accuracy equivalent to 1:12,000 scale map product (pan 10m CE 90%). Geopositioning based on ground control points and accurate DEM

OrbView BASIC *Products* *(continued)*

Product Name	Model / Configuration		Spectral Bands	Ground Sample Distance	Geolocation Accuracy (CE/LE 90%)
Basic	**Express** (Mono or Stereo)		Panchromatic	1.0m	60m/60m
			Multispectral	4.0m	65m/65m
	Enhanced (Mono or Stereo)		Panchromatic	1.0m	28m/44m
			Multispectral	4.0m	37m/51m
	1:50K (Mono or Stereo)		Panchromatic	1.0m	25m/8m
			Multispectral	4.0n	30m/12m
	1:24K (Mono or Stereo)		Panchromatic	1.0m	12m/5m
			Multispectral	1.0m	15m/10m
	1:12K (Mono or Stereo)		Panchromatic	1.0m	10m/4m
			Multispectral	4.0m	12m/5m

Description - OrbView GEO *Products*

- ***GEO EXPRESS* Products**
  - Image data is rectified and projected onto a horizontal reference plane
    - Corrects for earth rotation, earth curvature, panoramic effects, spacecraft position and attitude changes and sensor distortions
  - Data is Geo-corrected using a 900m post spacing elevation model
    - Terrain induced distortions are coarsely corrected
  - Coarse mosaic processing may be used for more than 1 source image. Uses tie points to minimize relative error

- ***GEO 1:50K* Products**
- ***GEO 1:24K* Products**
- ***GEO 1:12K* Products**

Products generated using geopositioning model.
Limited applications - Available by special order only

OrbView GEO *Products* *(continued)*

Product Name	Model / Configuration	Spectral Bands	Geolocation Accuracy (2) (CE / LE 90%)	Nominal Control Source	View
OrbView *GEO*	Express	Pan	65m*	None	View
		MS	65m		
	1:50k	Pan	25m	TPs	Mono
		MS	30m		
	1:24k	Pan	12m	TPs, CPs	Mono
		MS	15m		
	1:12k	Pan	10m	TPs, CPs	Mono
		MS	12m		
			* Function of the terrain model		

OrbView ORTHO *Products*

- ***ORTHO 1:50K*** **Products**
  - Uses Medium Accuracy geopositioning model and DTED Level 1 or OrbView DEM 100m
- ***ORTHO 1:24K*** **Products**
  - Uses High Accuracy geopositioning model and DTED Level 2 or OrbView DEM 30m
- ***ORTHO 1:12K*** **Products**
  - Uses Very High Accuracy geopositioning model and OrbView DEM 10m

Product Name	Model / Configuration		Spectral Bands	Ground Sample Distance	Geolocation Accuracy (CE 90%)
Ortho	1:50K		Panchromatic	1.0m	25m
			Multispectral	4.0m	30m
	1:24K		Panchromatic	1.0m	12m
			Multispectral	4.0m	15m
	1:12K		Panchromatic	1.0m	6m
			Multispectral	4.0m	10m

Derived Products – Digital Elevation Data

- ***DIGITAL SURFACE MODELS*** (DSM)
  - "Reflective Earth" - top of the trees, buildings, etc.
- ***DIGITAL ELEVATION MODELS*** (DEM)
  - "Bald" Earth" - morphologically correct terrain shape
    - Both products made from pan, stereo pairs
    - Format: DTED, GeoTIFF, TIN

Product Name	Model / Configuration			Geolocation Accuracy(2) (CE/LE 90%)	Nominal Control Source	View
OrbView DEM	**100m** Post Spacing			30m/15m	TPs	stereo
	30m Post Spacing			20m/10m	TPs, CPs	stereo
	10m Post Spacing			10m/5m	TPs, CPs	stereo
OrbView DSM	**100m** Post Spacing			30m/15m	TPs	stereo
	30m Post Spacing			20m/10m	TPs, CPS	stereo
	10m Post Spacing			10m/5m	TPs, CPS	stereo

Derived Products – Thematic Maps

- **1:24K Vegetation Index Map**
  - Orthorectified Normalized Difference Vegetation Index (NDVI) made from MS imagery
- **1:24K Land Cover Map**
  - Orthorectified at 4m GSD raster depiction based on USGS land cover categories made from MS imagery

Product Name	Model / Configuration	Spectral Bands	Ground Sample Distance
Thematic Map	1:24k Veg Index	Multispectral	4m
	1:24k Land Cover	Multispectral	4m

Derived Products – Feature Maps

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- **Modeled from Vector Product Format (VPF) Standard Products**

Scale	1:50,000	1:24,000	1:12,000
Accuracy	26m/15m	14m/7m	5m/3m
NGA Equivalent	VMAP2	UVMAP	UVMAP

- **Source: Stereo or Orthorectified Mosaics (Pan, MS or Both)**
  - Format: NGA's VPF or USGS' DLG3 with OI metadata
  - Product Size: 3.75' x 3.75' ,7.5' x 7.5' or 15' x 15'

Product Name	Model / Configuration		Spectral Bands	Ground Sample Distance(1)	Geolocation Accuracy (2) (CE/LE 90%)
Feature Map	1:50k TOPO			20m	26m/15m
	1:24k TOPO			10m	14m/7m
	1:12k TOPO			5m	5m/3m

Summary

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- **OrbView-3 Continues to Function Well**
  - **Offers Broad Product Portfolio**
  - **Commercial Catalog on Web Site http://www.orbimage.com**
- **CCAP Evaluations Ongoing**
- **Global Distributorships: Partner Ground Stations Operational in Japan, Korea, and Taiwan**
- **VAR / Reseller Channel is Active**
- **Relevant Key Federal Contracts**
  - **NGA:**
    - **Commercial Imagery IDIQ**
    - **ClearView**
  - **USGS: Satellite Data Acquisition Contract**
- **Next Generation High Resolution System (OrbView-5) Development Underway....Anticipate Launch in Q1/CY2007**
- **Contact Information**
  - **Orders and Inquires: (703) 480-5698**
  - **Technical Support: (703) 480-5676**