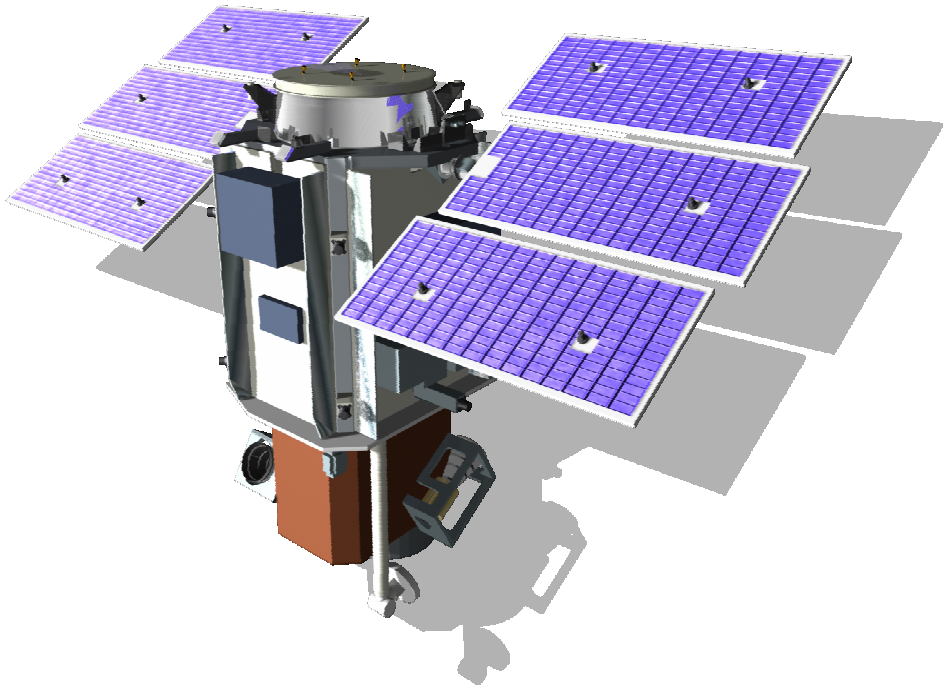
QuickBird Overview and Operational Status



Dr. Walter S. Scott
DigitalGlobe, Inc.
Executive VP and Chief Technical Officer

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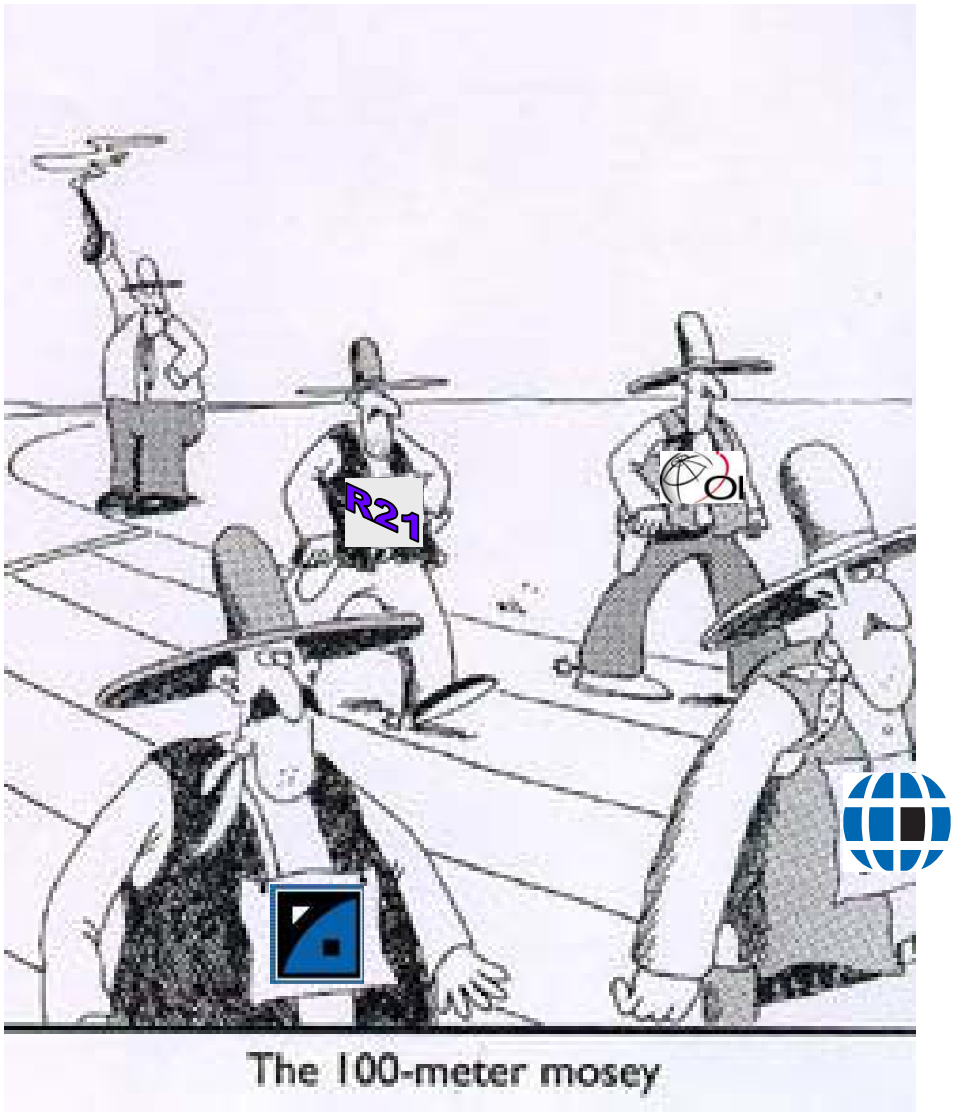
The Commercial Remote Sensing Industry



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Investor Challenges

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DigitalGlobe, Inc.

An international imaging and information company

- Founded in 1992 as Worldview Imaging
  - became EarthWatch in 1995
  - became DigitalGlobe, Inc. in 2002
- Based in Longmont, Colorado
- Majority Wall Street investment
- Open approach
  - Partnered with all ground station providers
    - MDA, Matra, Datron, Hitachi, …
  - Partnered with all exploitation software providers
    - ERDAS, BAE, Sensor Systems, RSI, PCI, …
- Focus on supporting the end-user directly

QuickBird Launch
October 18, 2001

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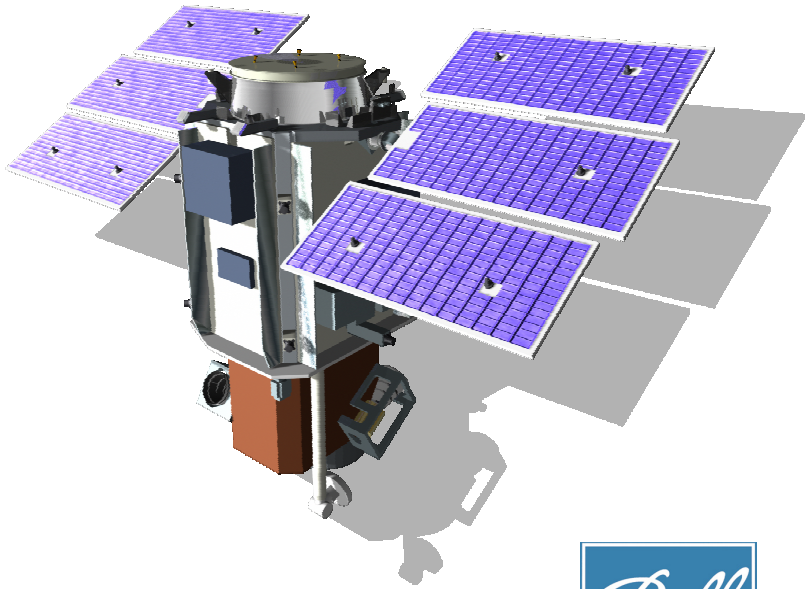
QuickBird

- Highest resolution (61 cm)
  - Lowered orbit from 600 km to 450 km
    - Provides competitive differentiator
    - Maintains 7 year mission life
  - License restrictions
    - 24 hour delay on release of all imagery better than 0.82 M GSD unless US government waiver granted



- Wide swath width (16.5 km at nadir)
- Large collection capacity
  - ~57 scenes per orbit
  - ~70 million km^2 per year
- Manufactured by Ball Aerospace
  - Focal plane by Kodak
  - ~2100 lbs, 10 ft tall

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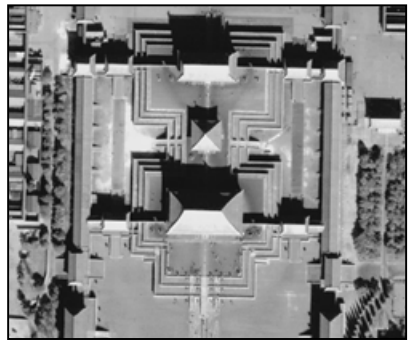
QuickBird Imagery Types

- Panchromatic
  - 61 Centimeter Resolution at nadir
  - 11-bit Dynamic Range
  - 450-900 nm (grayscale)
- Multispectral
  - 2.44 Meter Resolution at nadir
  - 11-bit Dynamic Range
  - 4 Spectral Bands
    - Blue: 450-520 nm
    - Green: 520-600 nm
    - Red: 630-690 nm
    - Near Infrared: 760-900 nm
- Pan-Sharpened (Fused)
  - 11-bit or 8-bit dynamic range
  - Natural Color (3 Bands)
  - Color Infrared (3 Bands)
  - 4 Bands



Forbidden City, Beijing, China

Port-au-Prince, Haiti

Abu Dhabi, UAE

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QuickBird Orbit

- Sun-Synchronous, Frozen Orbit
  - ~10:30am equatorial crossing
  - selected for better resolution over Northern Hemisphere

- Walking Groundtrack
  - better distribution of imaging opportunities
- Orbit Maintenance
  - orbit boost once per week
  - solar activity decreasing, reducing maintenance
  - mission lifetime thru 2008

- STK Ephemeris available at www.digitalglobe.com/ephemeris

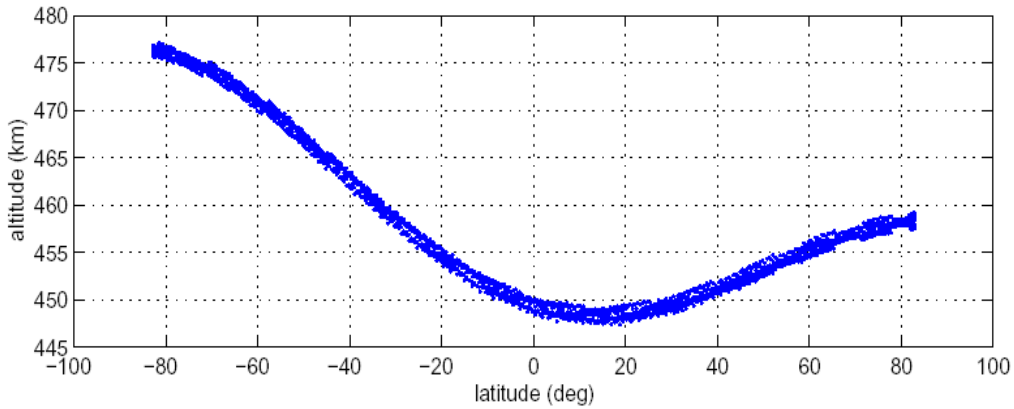

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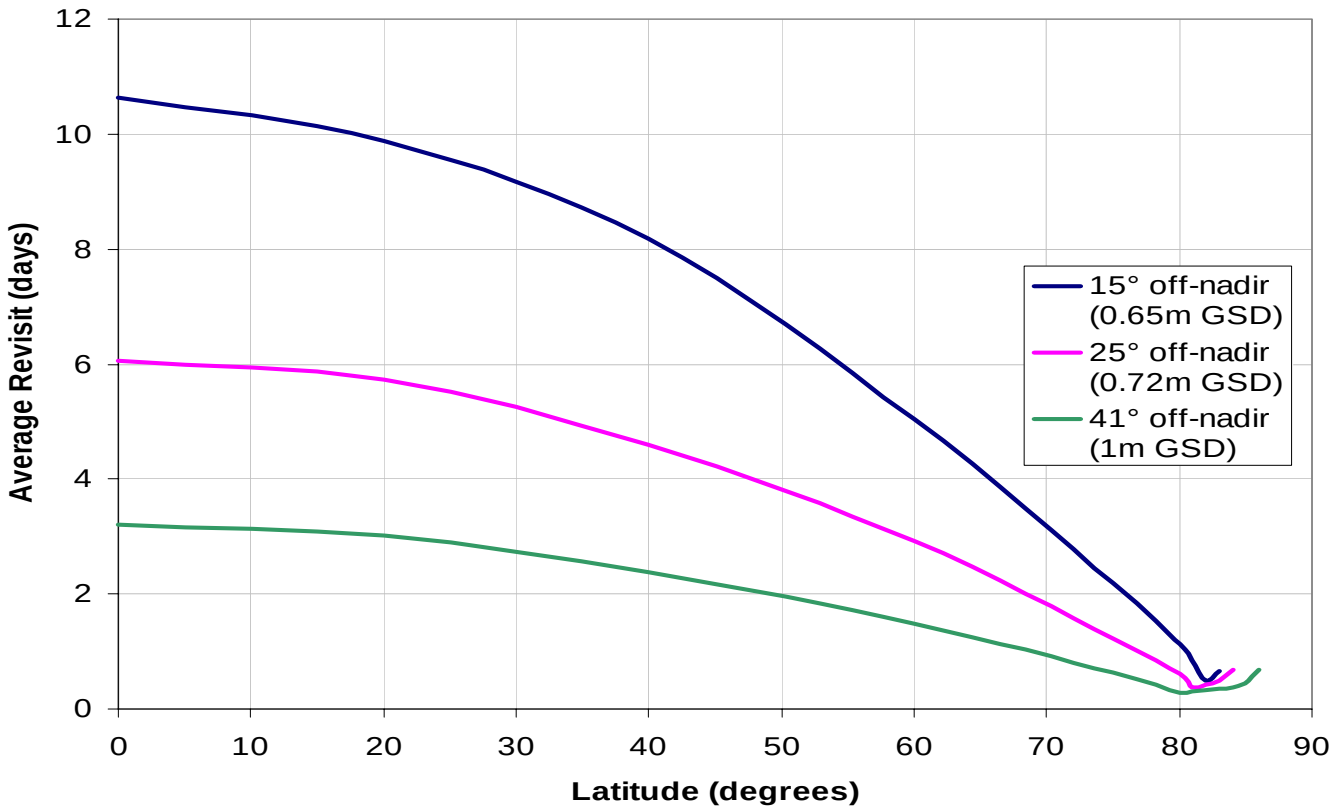
Image Acquisitions and Revisit

- collecting >130,000 km²/day
- in-track stereo collection capability
- strip capability >150 km



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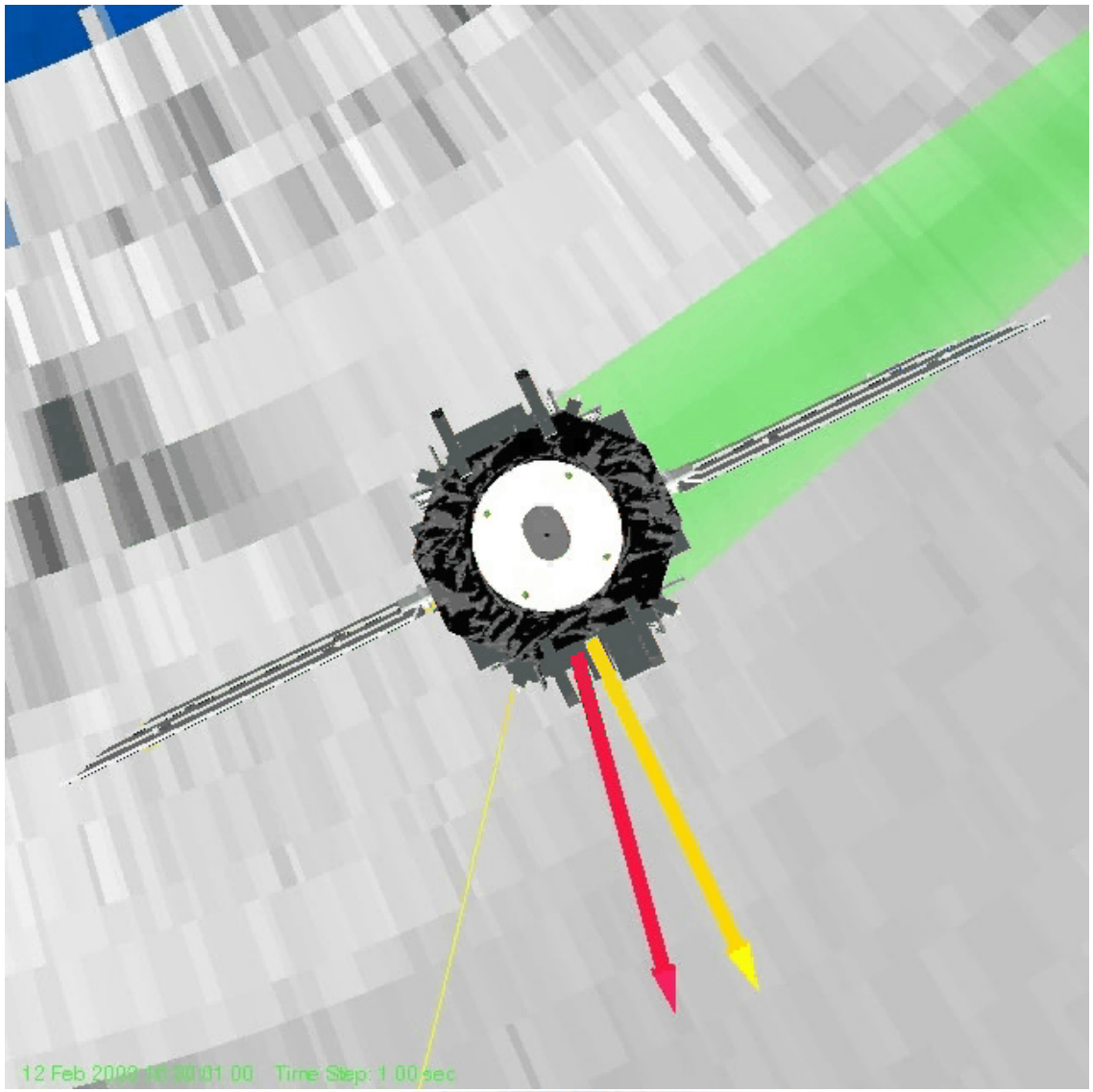
QuickBird Collection Example



uses QB telemetry in STK/VO simulation

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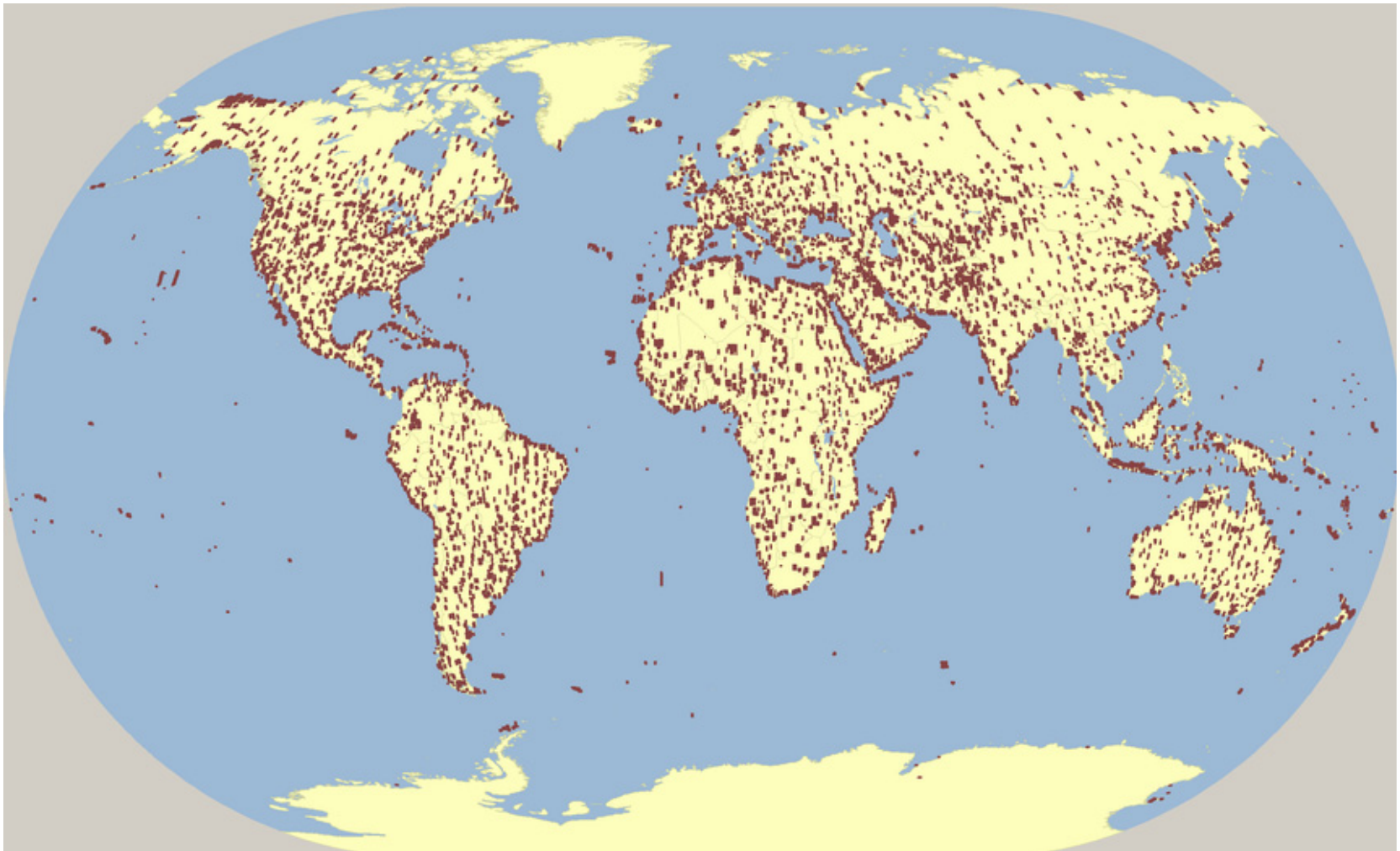
QuickBird Archive

DIGITALGLOBE™



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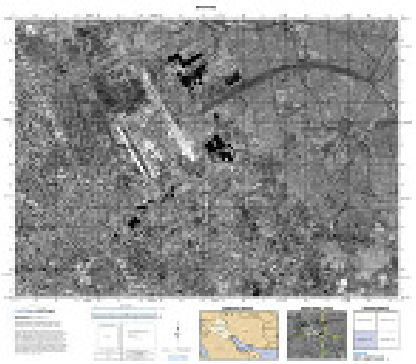
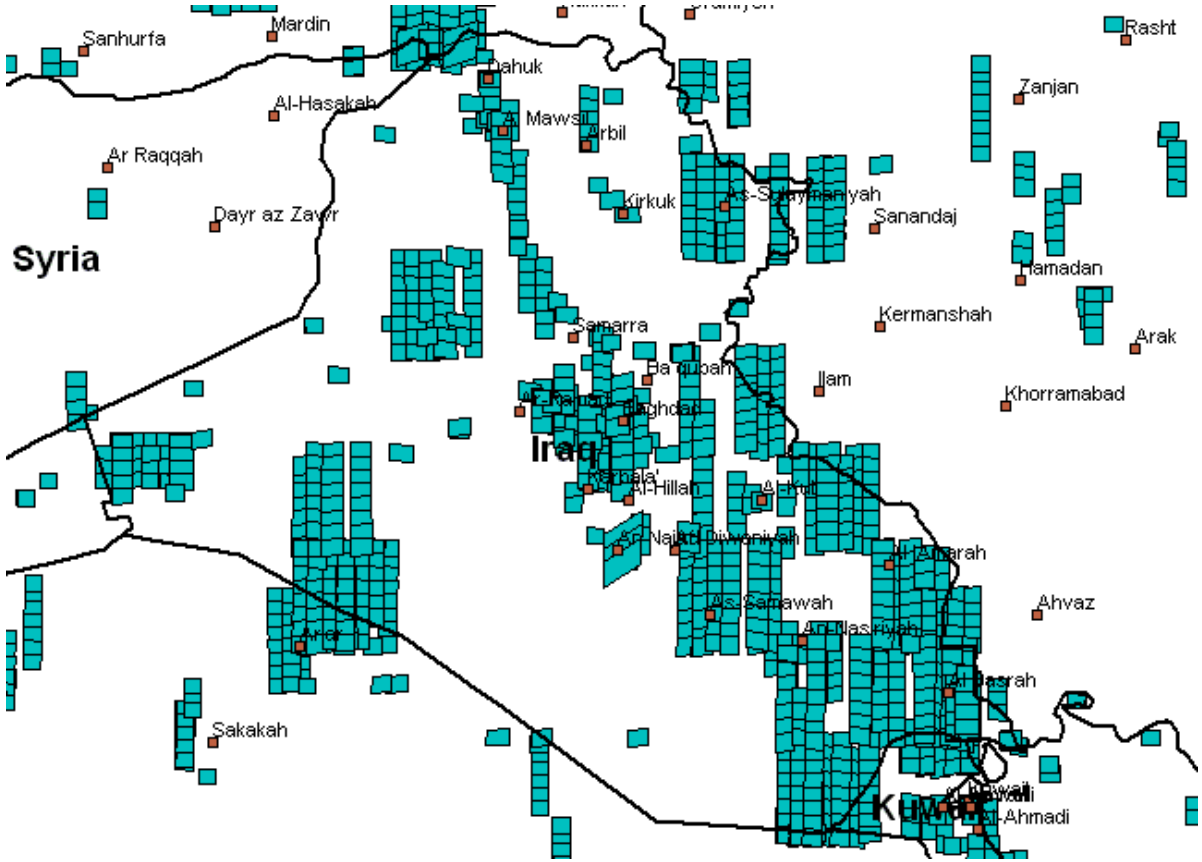
Supporting Operation Iraqi Freedom

Burning Oil Trench in Suburb of Baghdad
Collected April 9, 2003



Baghdad SW Image Map Includes :
Saddam International Airport
Abu Ghurayb Presidential Palace
Radwaniyah Palace Compound
Presidential Palace North

QuickBird Archive over Iraq



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Production Operations

- Consistent increase in image ingest and product generation
- Average of >450 product orders completed per week in 2003
- Surge capability of at least 1800 product scenes per week
- Products available in media (tape, CD, DVD) or FTP

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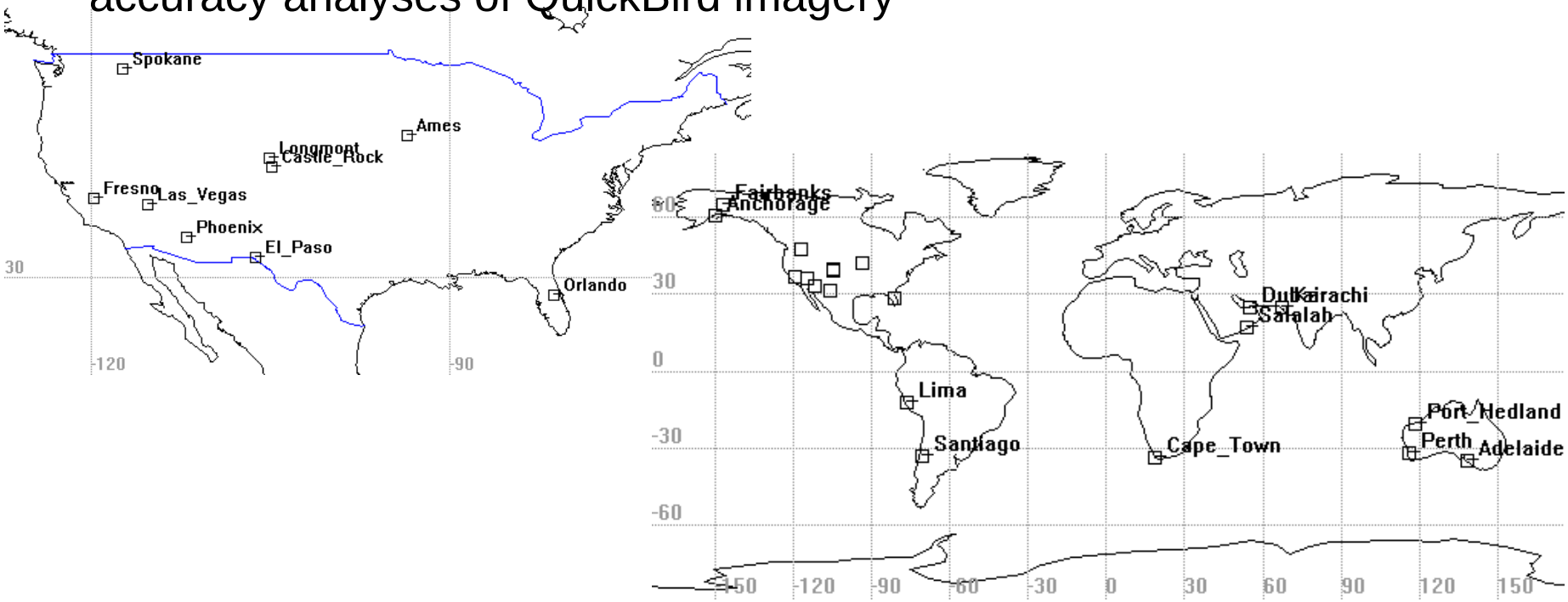
Geopositional Accuracy

- DigitalGlobe is using >20 sites, >140 scenes for geopositional accuracy analyses of QuickBird imagery



- QuickBird scenes currently meeting 23m CE90 spec
  - specification is at-nadir, excluding terrain effects
  - studies by BAE and EarthSat confirm analysis measurements
  - reprocessed imagery attitude in full archive with ADP 2.1

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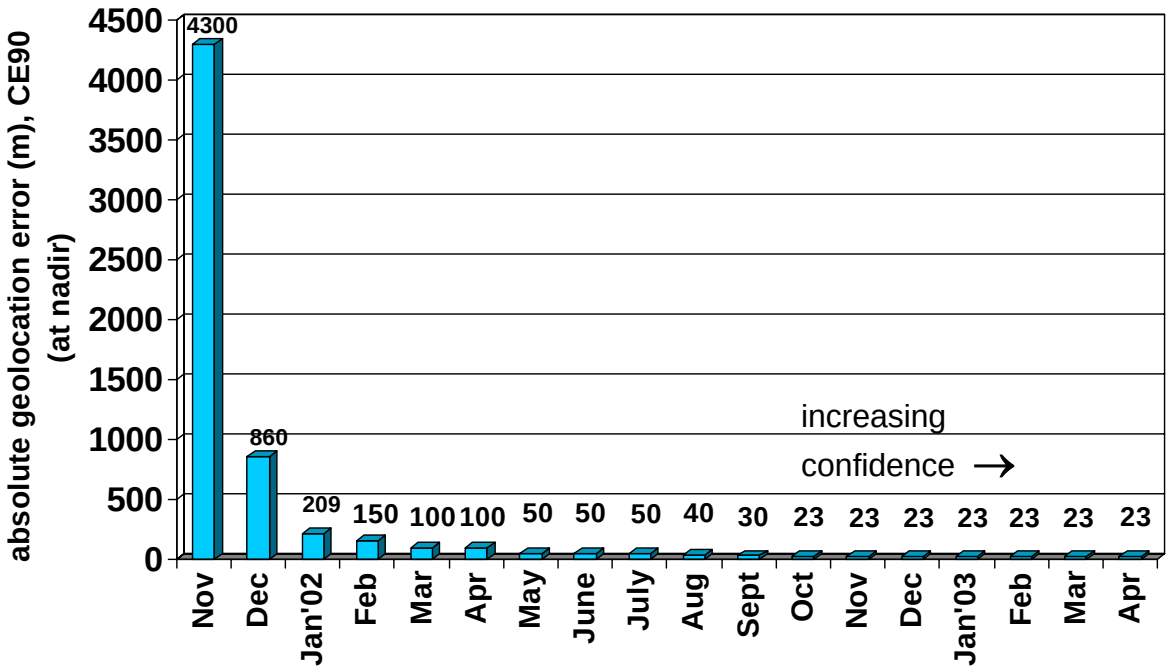
Geopositional Improvement

- Achieving accuracy specification has taken time
  - spacecraft not designed for new lower, sun-synch orbit
    - star tracker placement optimized for all-β sun angle mission
  - telescope on-orbit performance was substantially better than predicted
    - however, focusing took longer than expected
  - new gyros increased reliability, but at increased attitude noise



Lessons Learned in :
- system timing
- focus adjustment
- star tracker design
- attitude filter design
- production integration
- expectation

Expect More Improvements !

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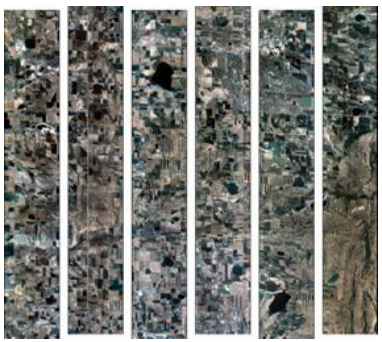
Products Overview

- Basic Product - sensor and optional radiometric correction
- Standard Product - geocorrection with coarse DEM
- Ortho Product - orthorectified with supplied DEM

- "Open Systems" approach
  - Working with major software vendors to ensure data compatibility
  - Customers can use software of choice
  - RPCs or Rigorous Camera Model for georeferencing

Raw Image



Basic Product

Standard Product

Ortho Product

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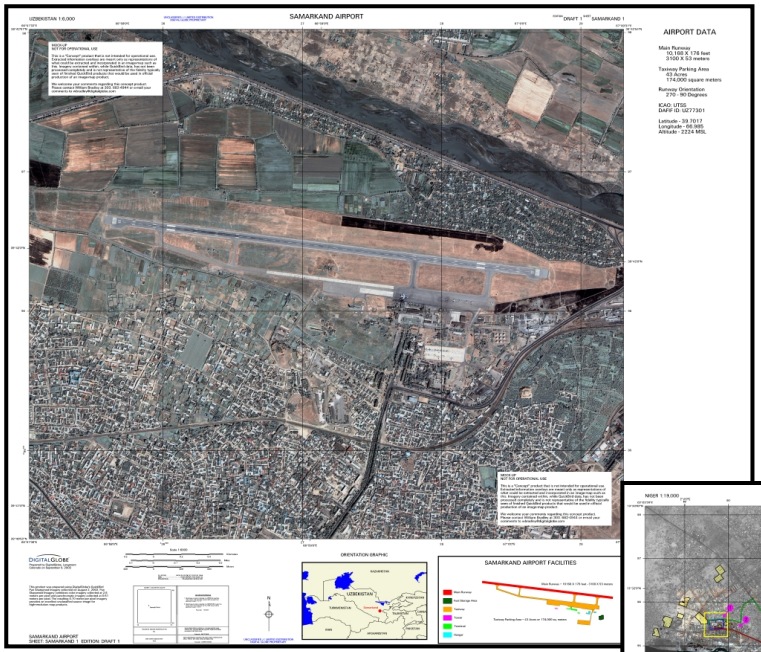
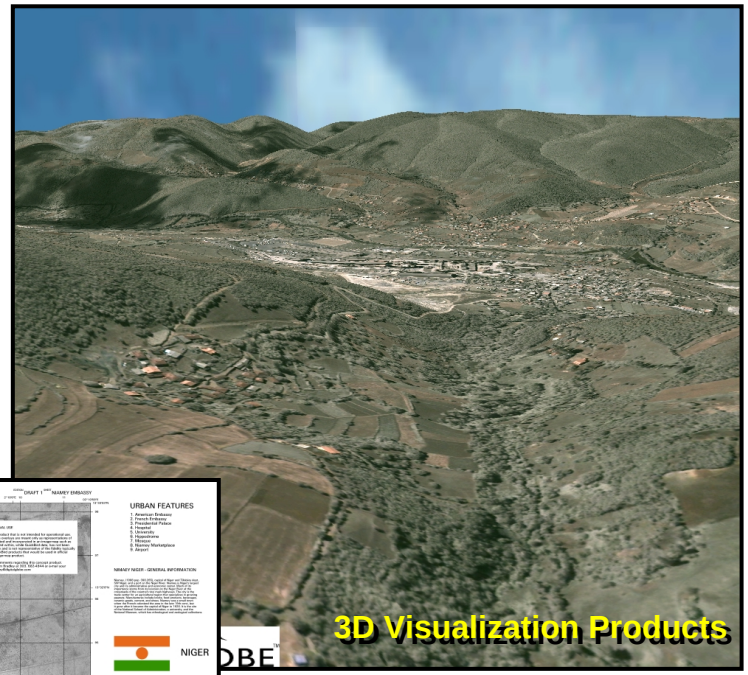
Value Added Products



Gridded Airfield Graphics



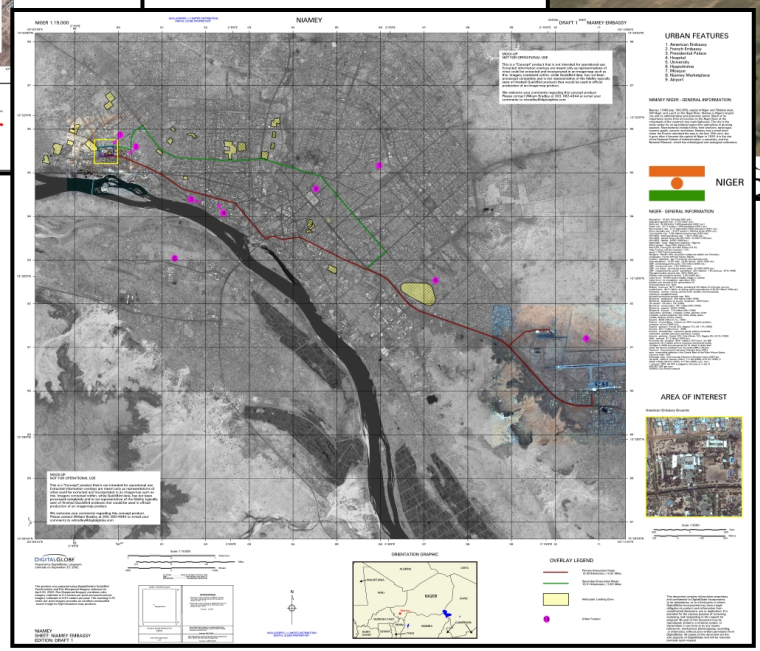


Image City Maps

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Visual Simulations

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Visual Simulations

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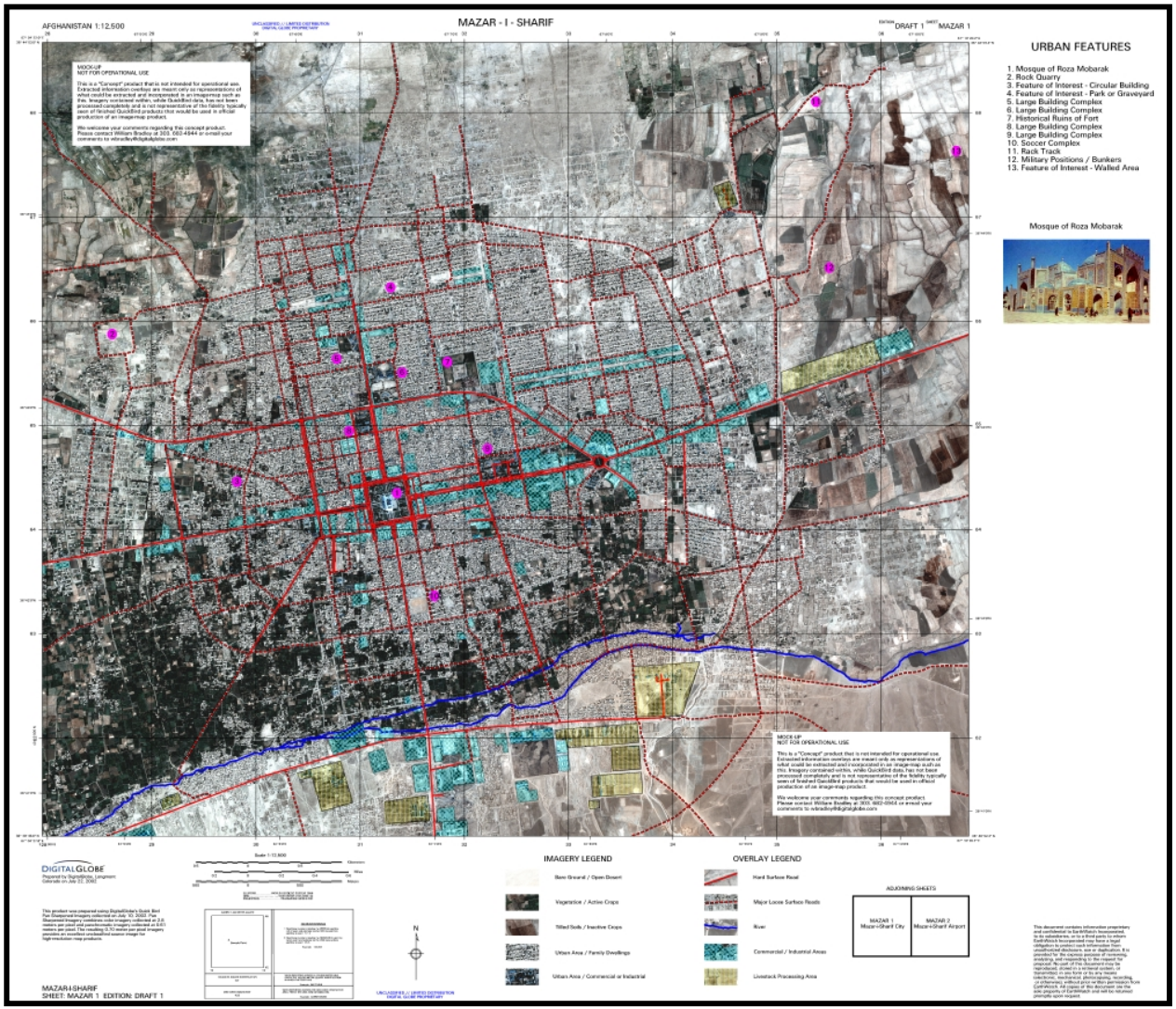
City Image Map Prototype



DigitalGlobe is developing QuickBird-based products that will address both commercial and government needs

Example of city-image map prototype product

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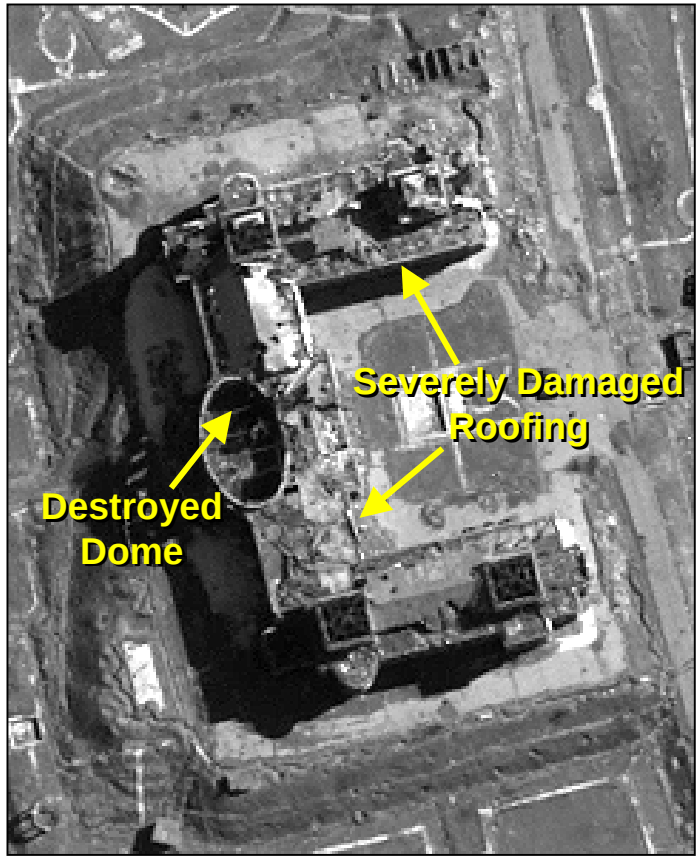
Homeland Security Applications

- Damage Assessments
  - Level/Extent of Damage
    - Structures

QuickBird 60 cm
Panchromatic
Kabul, Afghanistan



QuickBird 60 cm Color
Baghdad, Iraq, 27 March 2003

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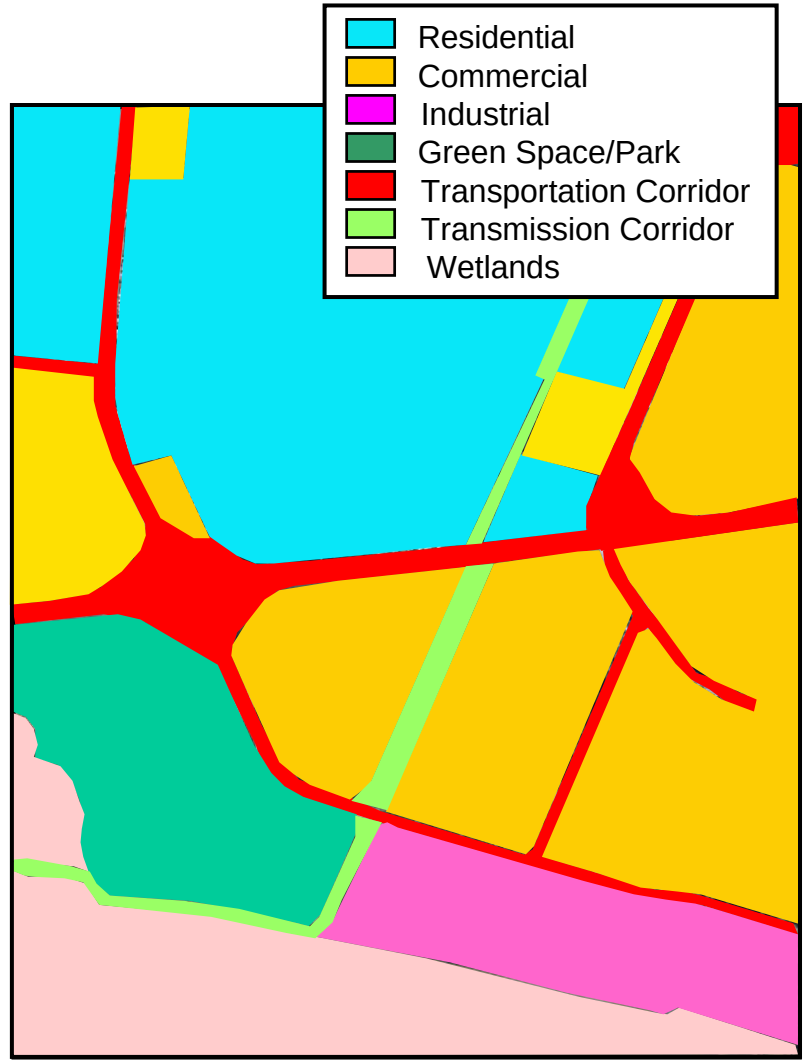
Land Use Planning

QuickBird high-resolution 61-cm panchromatic imagery allows for planning modifications to infrastructure, including road intersections and corridors.



QuickBird 2.4 m Multispectral
Sunnyvale, California

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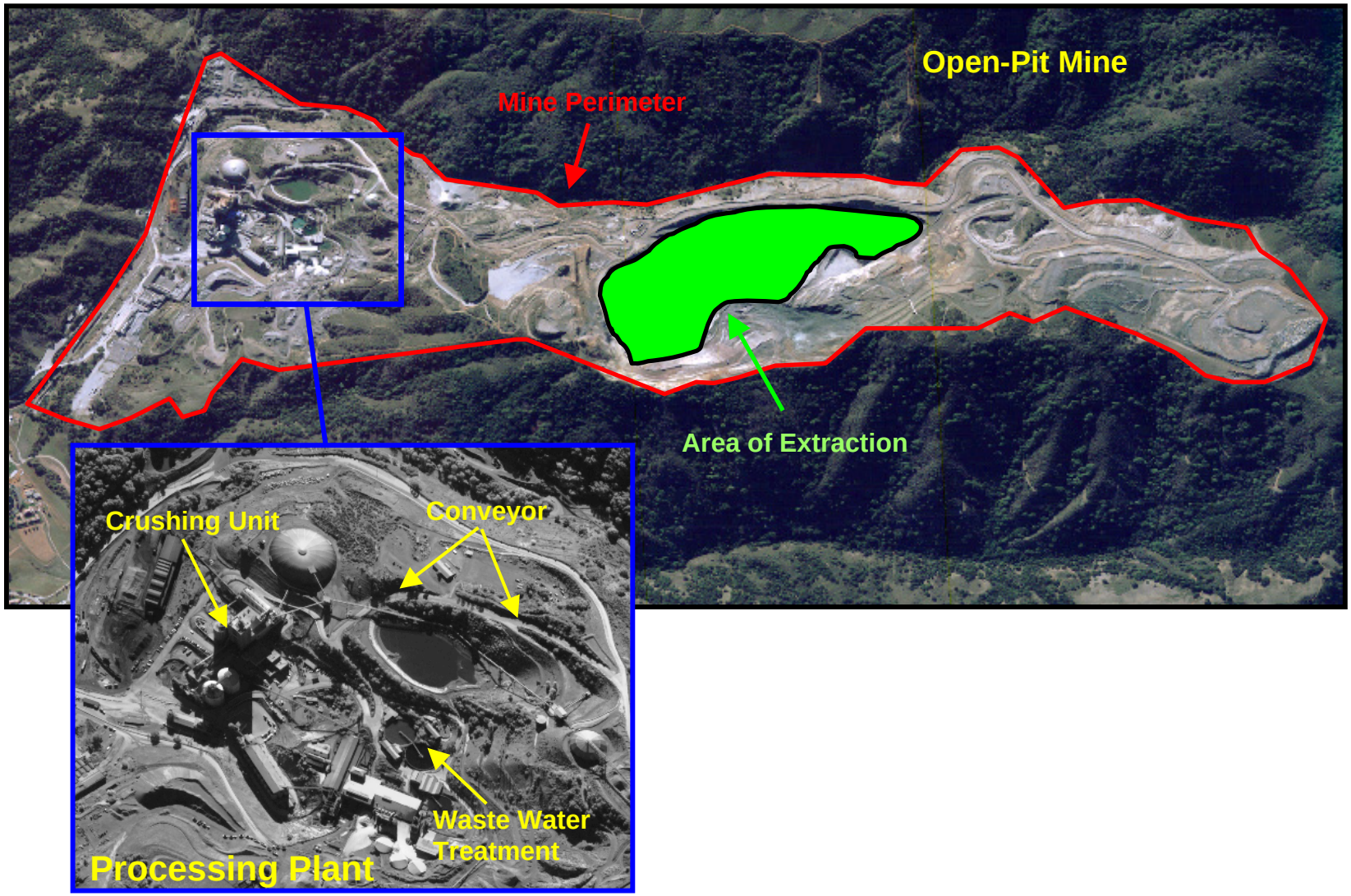
Industrial Facilities



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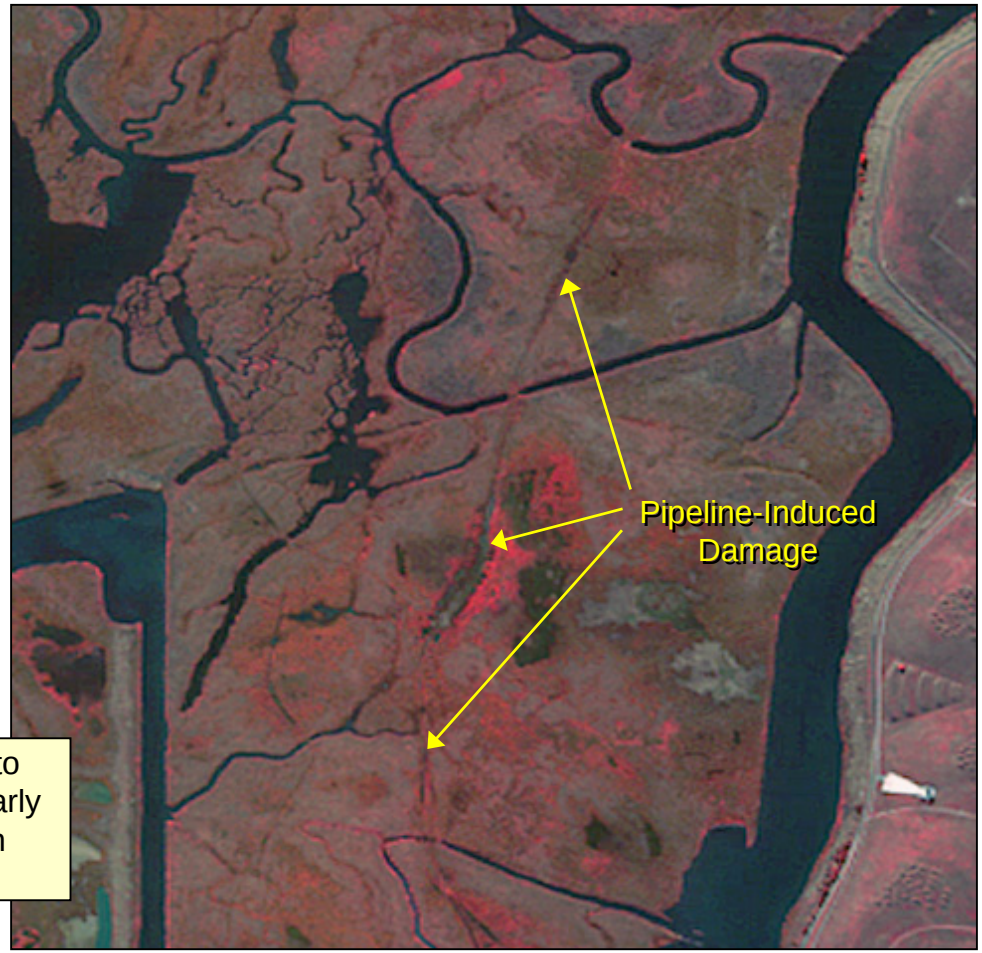
Environmental Applications

- Monitoring
  - Change Detection
  - Industrial Compliance
  - Pollution Sources
  - Habitat and Vegetation Monitoring
    - Wetlands
    - Coastal Environments

QuickBird 2.44 m Multispectral
Sunnyvale, California



QuickBird near-infrared bands can be used to assess damage to wetlands. Damage is clearly evident from placement of a pipeline through these wetlands.

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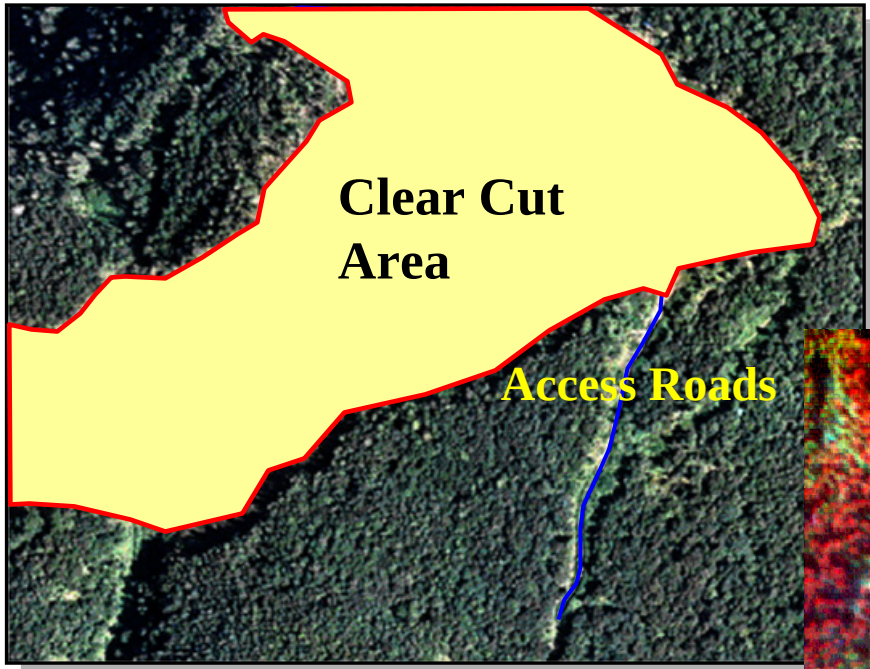
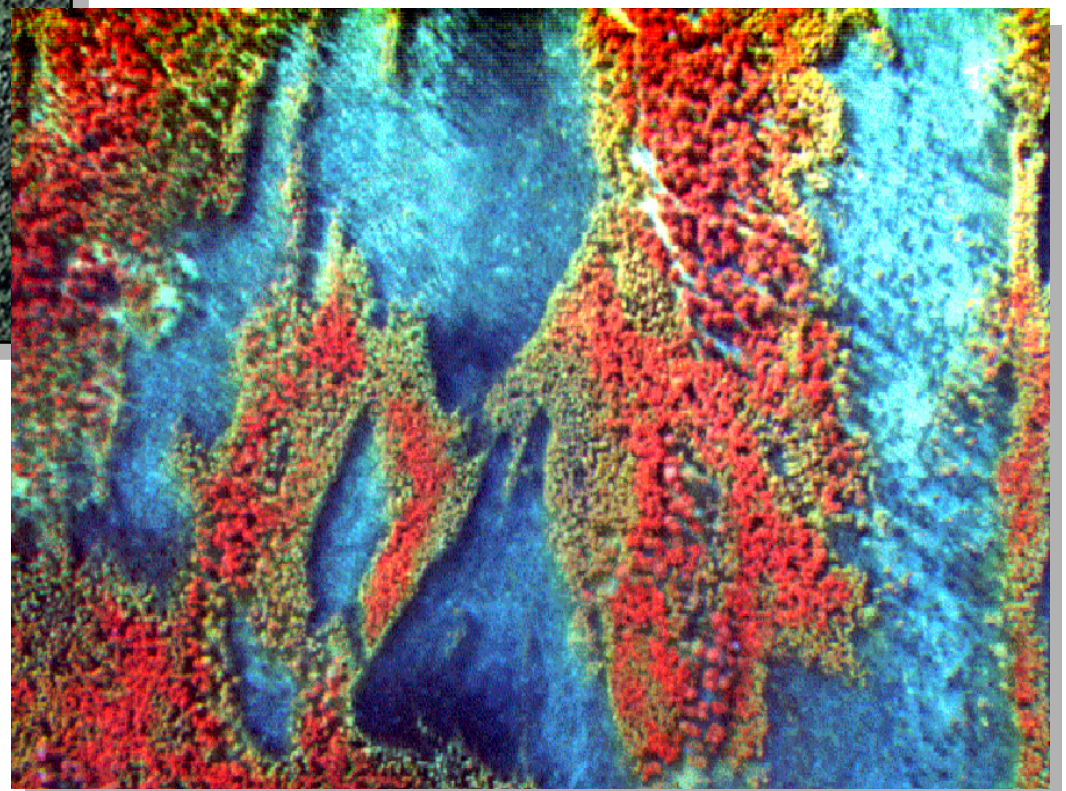
Forestry Applications



Timber Management
QuickBird multispectral imagery is used for mapping clear cuts and roads.



Forest Fire Damage Assessment
QuickBird multispectral imagery can clearly depict the aftermath of a forest fire.

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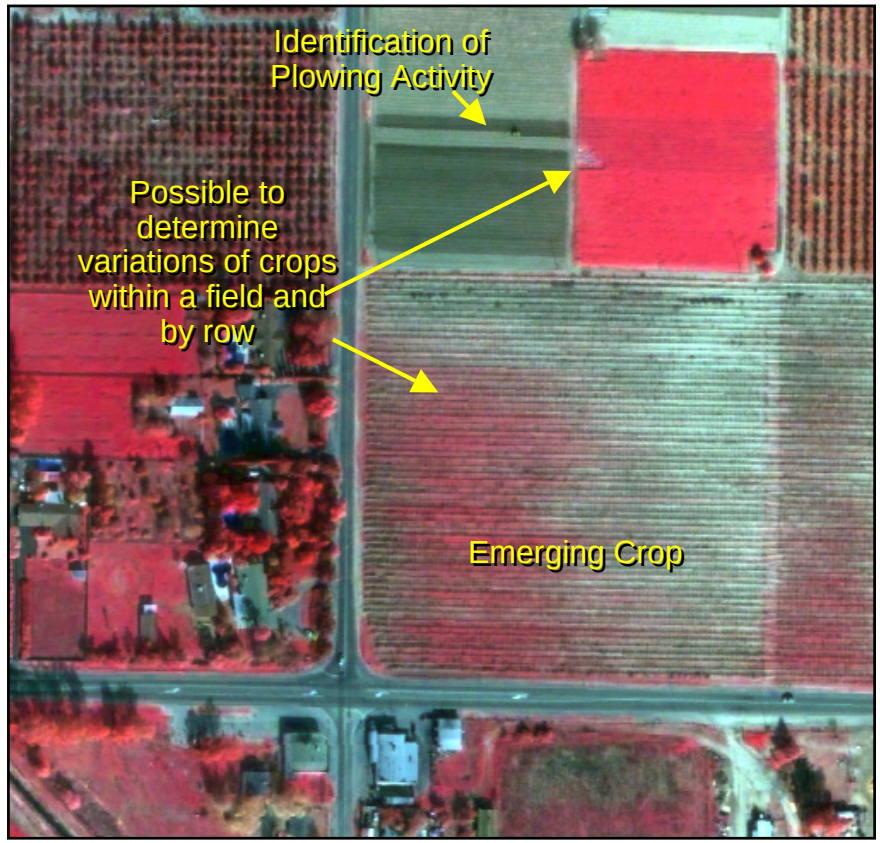
Agriculture

- Agricultural Assessments
  - Food Security Issues
    - Crop Health
    - Yields
    - Agricultural Infrastructure
  - Illicit Crops
    - Monitoring Eradication Efforts
    - Identifying Processing Labs
    - Identification of New Growing Areas

QuickBird 61 cm Pan-Sharpened
Fresno Region, California



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What's Next?

DigitalGlobe has licenses to operate multiple constellations, each with multiple satellites :

- 5-meter multispectral
- 1-meter high resolution
- 0.5-meter high resolution

We are in the planning phase to decide which systems provide customers the best product options to meet their needs.

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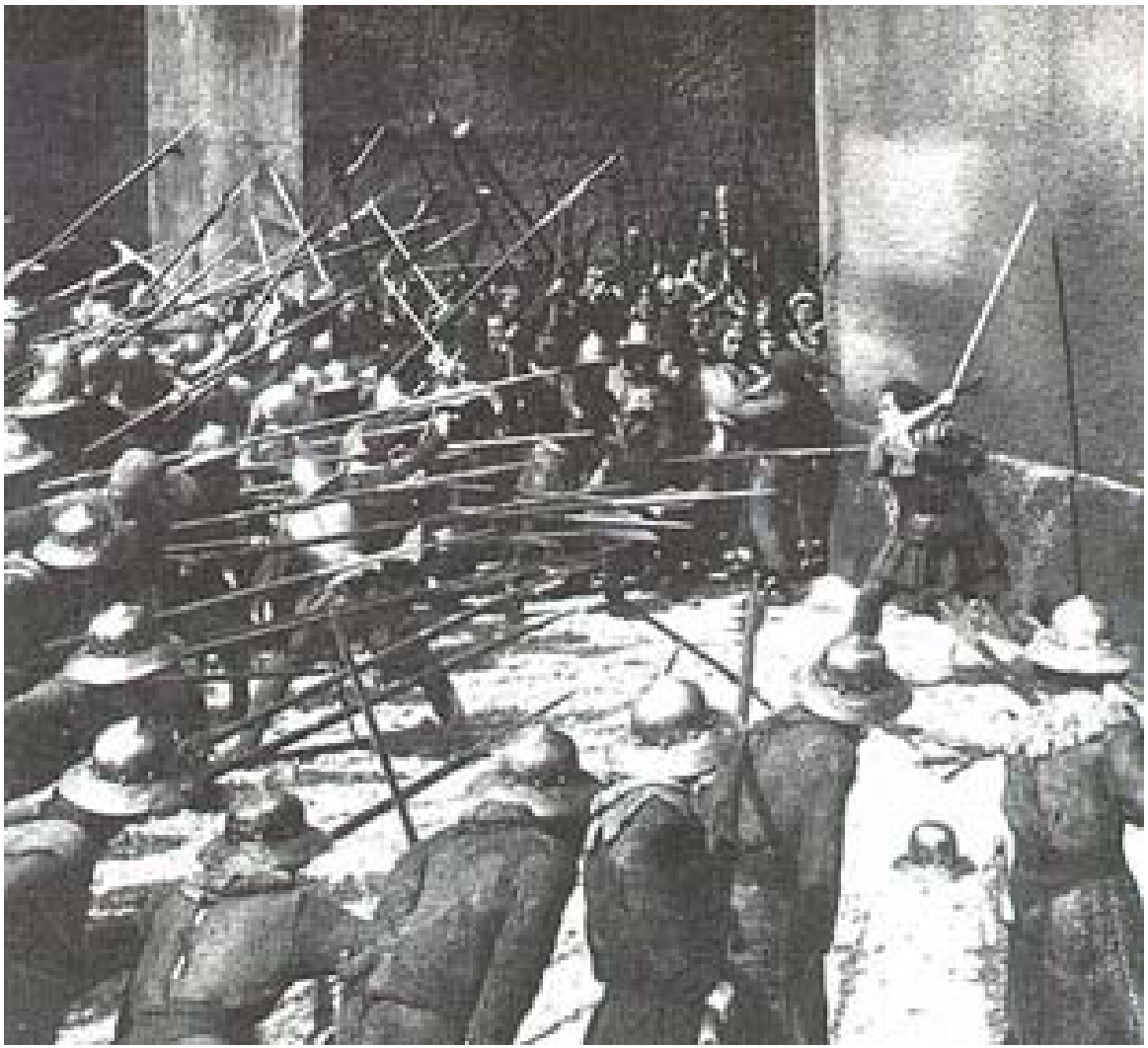
Next Generation Licensing Challenges



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