Landsat Data Continuity Mission On-orbit Calibration and Validation Development

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Outline

• Overview of Government Calibration and Validation Team
• Overview of Ground System
• Development of Cal/Val tools
• Current Status
Government Calibration and Validation Team (CVT)

- Made up of both NASA GSFC and USGS EROS personnel
- Lead by NASA prior to commissioning
  - Pre-launch calibration
- On-orbit operations turned over to USGS
  - Continued monitoring throughout mission life
Calibration and Validation Functions

• Oversight and coordination of Cal/Val activities
  – Covers portions of ground system, spacecraft, instruments and other external entities

• Algorithm development
  – Review instrument provider algorithms
  – Deliver algorithms to ground system developers
  – Data processing, characterization and calibration
  – OLI and TIRS data simulators
Calibration and Validation Functions

- Instrument performance characterization
  - Pre-launch, on-orbit checkout and on-orbit operations
  - Supports instrument acceptance
- Calibration parameter determination & validation
  - Pre-commissioning validation of vendor provided parameters
  - Validated parameters ensure quality products
  - Determine parameters during operations
- Independent calibration verification and calibration continuity
  - Ensures traceability and continuity with historical products
- Product performance characterization
  - Reports for science and user community
- Anomaly resolution
  - Includes anomalies in product generation and image assessment
  - Supports observatory and other anomaly resolution
Cal/Val Interfaces During Development

– Vendor/Supplier
  • OLI
  • TIRS
  • Spacecraft
– Ground System
  • Data Processing and Archive System
– Landsat Science Team
– Independent Groups
  • Vicarious Calibration
Ground System Concept
from CVT perspective

Spacecraft
- OLI
- TIRS

Capture → Ingest → Product Generation → Image Assessment → CVT

- Characterization Data
- Cal/Val Products
- Image Data

CVT Toolkit

- Instrument Performance Characterization
- Calibration Parameter Determination and Validation
- Product Performance Characterization
- Anomaly Resolution

User and Science Community

Control
Characterization Data
Image Data
Calibration and Validation Toolkit

• Description
  – Mixture of different languages (C, Matlab, IDL, Excel)
  – Configuration controlled by CVT using Subversion
  – Analyst intensive, low efficiency, non-operational code

• Uses
  – Validate algorithms and verify ground system implementation
  – Improve algorithm functionality
  – Investigate processing and instrument anomalies
  – Support instrument acceptance

• Contains working copies of all algorithms
  – Instrument provider algorithm baseline
  – Ground system algorithm baseline (ingest, product generation, image assessment)
  – Algorithm prototyping/working versions, including algorithms not implemented in the ground system
Phased Algorithm Development

- Algorithm delivery synchronized with instrument and ground system major reviews
  - Phase 1
    - Includes brief descriptions
    - Supports ground system preliminary design
  - Phase 2
    - Based on preliminary provider algorithm descriptions
    - Supports ground system detailed design
  - Phase 3
    - Based on instrument testing
    - Supports ground system implementation
  - Phase 4
    - Based on on-orbit instrument analysis
    - Supports post-launch ground system update

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Relational Schedule

Mission

Ground System

Instrument

Algorithm Development

Algorithm Draft

Algorithm Final

Algorithm Update as needed

Phase 1 Development

Phase 2 Development

Phase 3 Development

Phase 4 Development

Preliminary Design Development

Detailed Design Development

Implementation

Sustaining Engineering

PDR

CDR

T/V

T/V

PSR

GRT

Launch

Commissioning

CVT

Ground System

Instrument Developers
Current Status

- Algorithms received from instrument providers
- Algorithms delivered to ground system developers
- Initial release of image assessment subsystem completed
  - Only minor issues remain to be resolved with second release
- One more image assessment release to go
  - Lower priority algorithms
  - Changes found during testing
In-line Characterization Algorithms

- Dropped Frame Characterization
- Impulse Noise Characterization
- Saturated Pixel Characterization
- Histogram Statistics Characterization
- SCA Overlap Statistics Characterization
- Striping Characterization
Off-line Characterization Algorithms

- White Noise Characterization
- 1/f Noise Characterization
- Coherent Noise Characterization
- Relative Gain Characterization
  - Side Slither and Histogram Method
- Detector Response Characterization
  - Solar Diffuser and Internal Lamp
- Radiometric Stability Characterization
- Nonlinear Response Characterization
- Lunar Irradiance Characterization
Processing Algorithms

✓ Bias Removal
  – Bias Model Calibration
  – Bias Determination

✓ Response Linearization

✓ Gain Application
  • SCA Discontinuity Correction
  • Residual Striping Correction
  • Saturated Pixel Replacement
  • Inoperable Detectors Fill

✓ Reflectance Conversion
Initial Image Assessment Subsystem

Example of radiometric processing to generate floating point Level 1R “product” for band 1, SCA 1