

Data Products Working Group

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Topics of Telecon May 14

- **Standard OLI Products**
 - LORp
 - Level-1
 - L1Gt and L1T
 - TOA reflectance
 - QC Band
 - Browse images
- **Off-nadir Products**
- **Higher Level OLI Products**
- **TIRS data**
- **Higher Level TIRS Products**
- **Cloud/shadow masks**
- **Path forward towards the generation of higher level OLI and TIRS data products**



Summary of Telecon May 14 1/4

- **Level 1 Products**
 - Recommendation is to use the scene-center solar zenith in calculating TOA reflectance
- **QA Band**
 - Keep QA mask as simple as possible (8-bit)
 - Browse products must have a cirrus designation
 - Recommend that a tool be available to unpack the bits of the QA band
- **Off-Nadir Products**
 - Filenames should include designation as off-nadir
 - WRS-2 path/row designation should be the closest that is viewed
 - Pointing angle needs to be included in metadata



Summary of Telecon May 14 2/4

- **TIRS Data**
 - Standard product should be in units of linearly scaled at-aperture radiances
 - Co-registration with OLI is critical
 - Brightness temperature preferred if higher level processing opportunities are possible
 - Surface temperature/emissivity has challenges
- **Higher level OLI products**
 - Surface reflectance is highly desirable but uncertainties need to be quantified
 - Limitations to the data usefulness must be understood
 - What bands should be used and in what context?
 - SAIC is developing a value-added product based on LEDAPS



Summary of Telecon May 14 3/4

- **Cloud and Shadow Masks**
 - **Terrain occlusion in off-nadir images will be identified**
 - **Need to distinguish cloud shadows from terrain occlusion**
 - **Cloud shadow discrimination is not is current baseline for QA band**
 - **Could be incorporated post-OIV**
 - **Reiterated the need to provide tools to unpack the bit-mapped QA band**

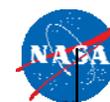


Quality Control (QC) Band File Format

What is the breadth and depth of image QA information that is needed?

To what extent can we quantify and provide uncertainties?

16-Bit Quality (QA) Band		8-Bit Quality (QA) Band	
Bit	Description	Bit	Description
0	Designated Fill	0	Designated Fill
1	Water	1	Cloud
2	Water Confidence	2	Cloud Confidence
3		3	
4	Snow/Ice	4	Cirrus
5	Snow/Ice Confidence	5	Cirrus Confidence
6		6	
7	Cirrus	7	Other (terrain occlusion)
8	Cirrus Confidence		
9			
10	Cloud		
11	Cloud Confidence		
12			
13	Artifact Masks		
14			
15			



Summary of Telecon May 14 4/4

Actions

- **Provide comments to Dwyer on L1 products (QA bit attributes, browse images)**
- **Develop white paper on usefulness and limitations of surface reflectance product**
- **Discuss requirements for Level 1 (L1T) and higher level products at LST meeting**
 - **OLI and TIRS**



Backup Slides



Product Generation

Operations Concept

- Collect 400 Operational Land Imager (OLI) scenes / 24-hour cycle
- Process 400 Level-1 products / day to the highest radiometric and geometric accuracy possible
 - Radiometric calibration
 - Processed to top of atmosphere (TOA) reflectance
 - Geometric correction
 - Observatory ephemeris, ground control points, elevation data
- Produce a quality control (QC) band as cloud cover mask
- Generate full spatial resolution browse from Level-1 products
- Provide web-enabled product distribution of Level-1 products and full resolution browse



Standard Level-1T Products

Consistency with heritage Landsat products

- Pixel size: 15m/30m
- Media type: FTP
- Product type: Level-1T (precision, terrain correction)
- Output format: GeoTIFF
- Map projection: UTM (Polar Stereographic for Antarctica)
- Datum: WGS84
- Orientation: North up
- Resampling: Cubic convolution
- Accuracy: 12m circular error, 90% confidence



Quality Control (QC) Band File Format

- Accurate cloud cover assessment requires thermal data
 - No thermal infrared sensor is currently included in the LDCM manifest
- QC mask would enable generation of cloud reduced composites
- Cloud cover confidence levels:
 - 00 = None or Unset.
 - 01 = 0-33% confidence
 - 10 = 34-66% confidence
 - 11 = 67-100% confidence
- Final content and format are TBD

Bit	Description
0	Designated Fill
1	Water
2	Water Confidence
3	
4	Snow/Ice
5	Snow/Ice Confidence
6	
7	Cirrus
8	Cirrus Confidence
9	
10	Cloud
11	Cloud Confidence
12	
13	Artifact masks
14	
15	

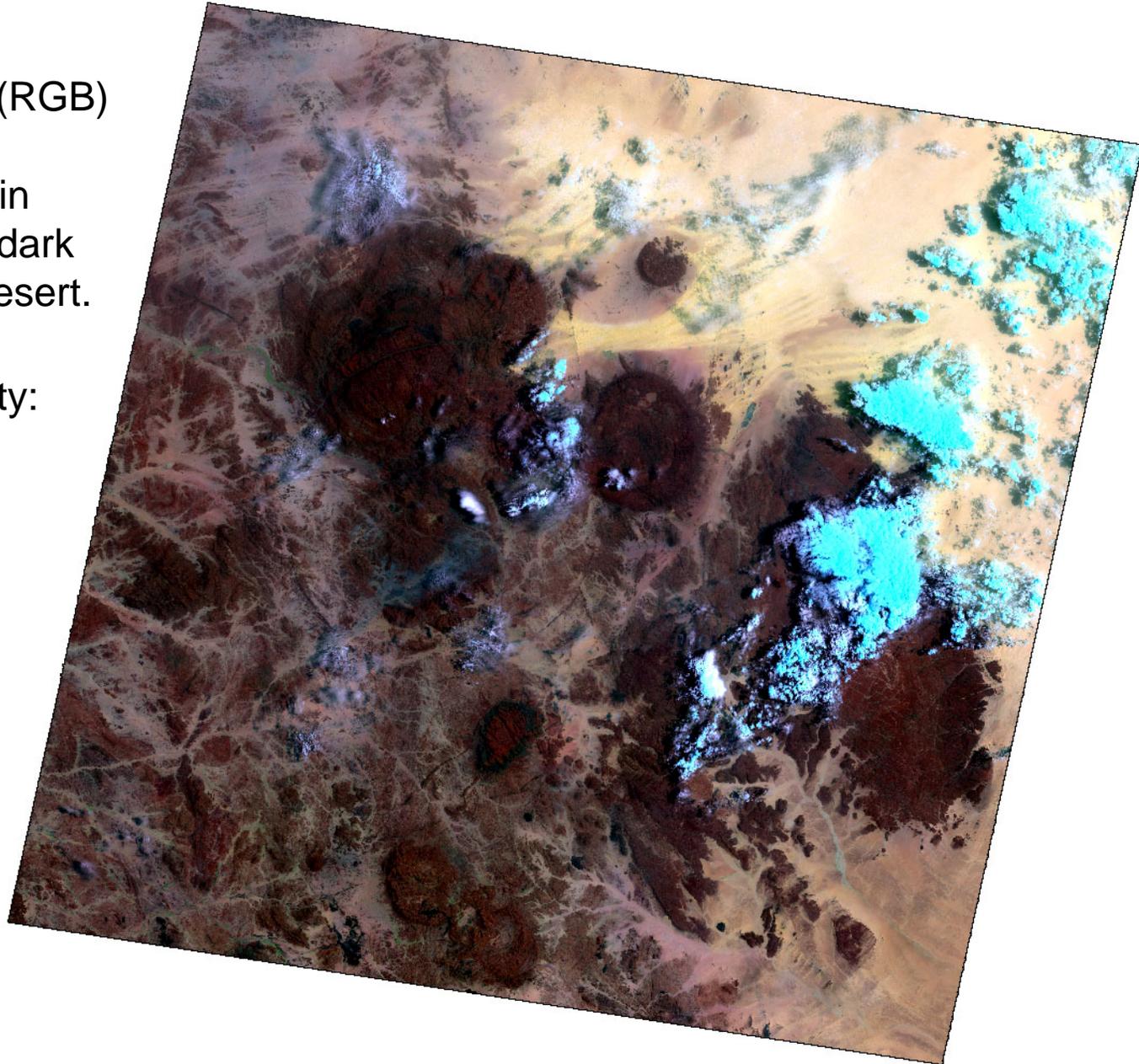


Landsat 7 ETM+ Image p189 r47 (8/5/2001)

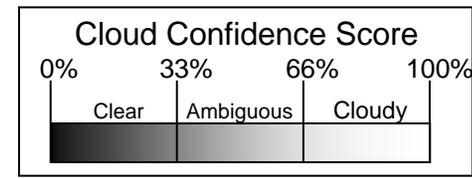
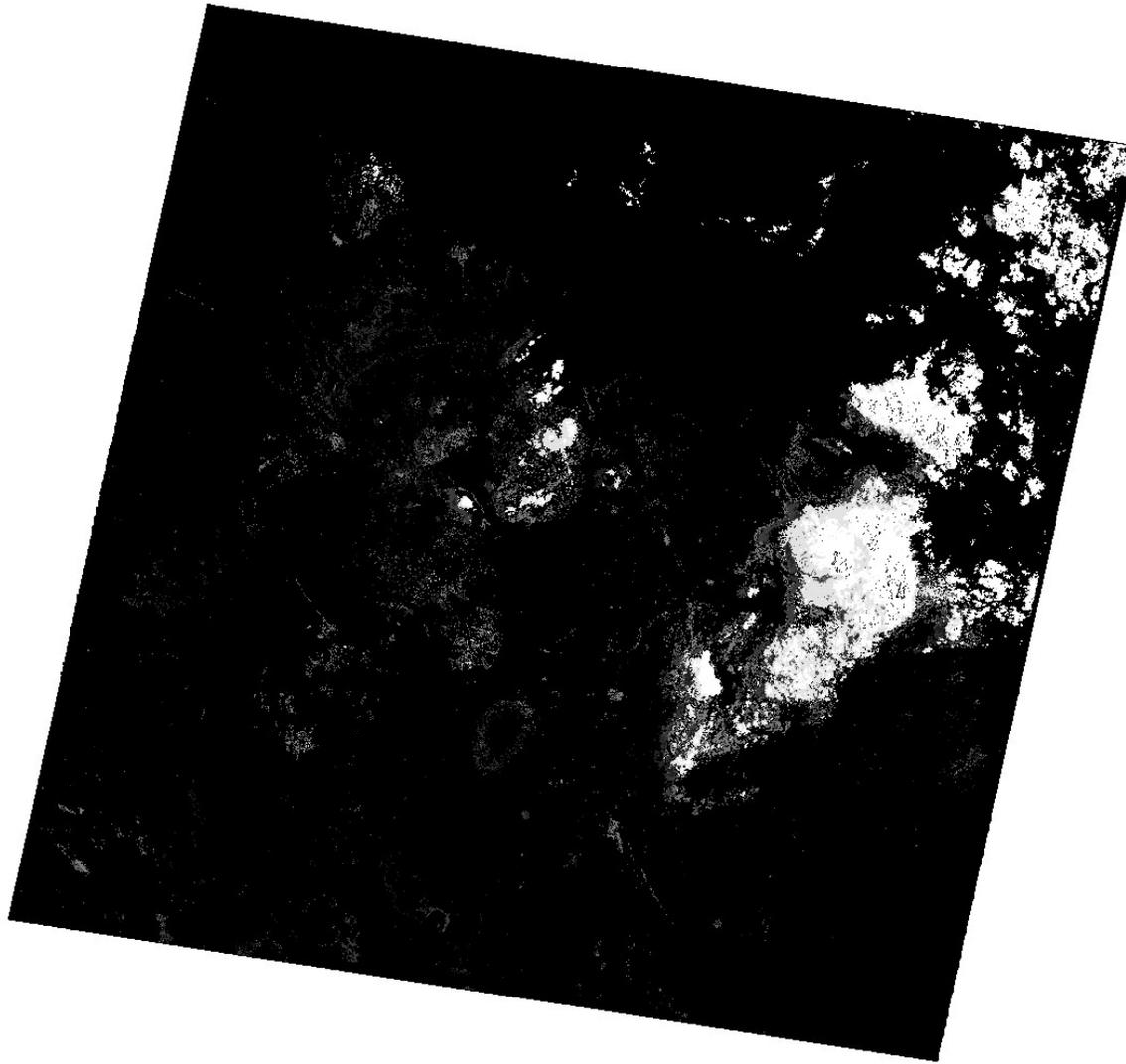
Bands 7,4,2 (RGB)

Thick and thin
clouds over dark
and bright desert.

CCA Difficulty:
Moderate



Prototype Cloud Cover Confidence



Full Resolution Browse

- Full spatial resolution image
- 3-band image from OLI consistent with legacy Landsat browse
- Single band from TIRS
- Derived from Level-1T product
- 16-bit OLI TOA reflectance and TIRS at-aperture scaled radiance data rescaled to 8-bits per band
- GIS-ready format (JPEG)
- Intended to satisfy broader use without the need for sophisticated processing
- Data will be published in compliance with Open Geospatial Consortium (OGC) standards for web mapping services
 - Enables saving subsampled or subsetted browse from viewer



L0Rp Data Format

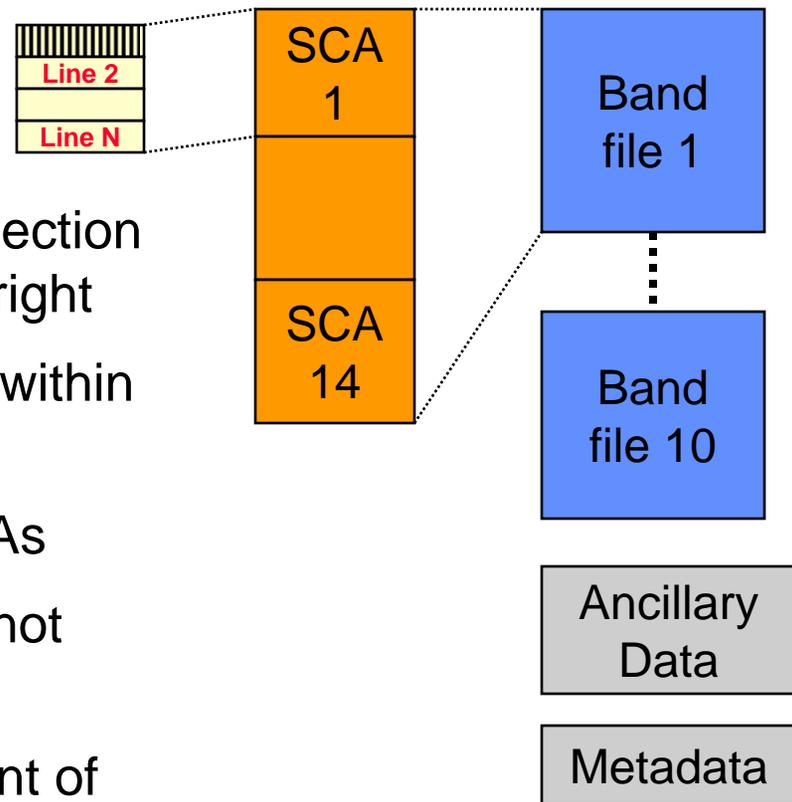
- **Level-0 Reformatted Archive (L0Ra) data is made up of 12 files**
 - **HDF5 format**
 - **Uncompressed**
- **L0Rp is the base format from which Level 1 products are created using bias and calibration parameter files**
- **Details documented in the L0Rp Data Format Control Book**

L0Rp File	Band	Color	Format	Type
Coastal/Aerosol Band Image File	1		MS	VNIR
Blue Band Image File	2		MS	VNIR
Green Band Image File	3		MS	VNIR
Red Band Image File	4		MS	VNIR
Near Infrared (NIR) Band Image File	5		MS	VNIR
Shortwave Infrared 1 (SWIR1) Band Image File	6		MS	SWIR
Shortwave Infrared 2 (SWIR2) Band Image File	7		MS	SWIR
Panchromatic Band Image File	8		Pan	VNIR
Cirrus Band Image File	9		MS	SWIR
Blind Band Image File	10		Blind	Blind
Ancillary Data File (OLI and spacecraft)	n/a	n/a	Ancillary	n/a
Metadata	n/a	n/a	Metadata	n/a



Notional LORp File Structures

- Bands are in separate HDF5 files
- SCAs are “stacked” within the file
- SCAs are reversed from order of collection so that pixels are ordered from left to right
- Odd and even detectors are aligned within each line
- No fill is added to align bands or SCAs
- Format is structured for processing, not visualization
- Image construction requires alignment of spectral bands and SCAs



Ancillary Data File

- The ancillary data file is optimized for production
 - HDF5 format
 - Telemetry points are in engineering units
 - Telemetry is “corrected” for specific errors
- The ancillary data file is made up of 4 groups
 - OLI
 - Frame Header
 - Line Headers (includes CRC)
 - OLI Housekeeping
 - Contains housekeeping data generated by the OLI
 - Spacecraft
 - Contains spacecraft housekeeping data used for production
 - Original Data
 - Unaltered ancillary data from the spacecraft



Metadata File

- **The metadata file contains 3 groups**
 - **File**
 - **Contains information about all L0Rp files**
 - **Parameters such as: file names, file version, file sizes, checksum**
 - **Interval**
 - **Contains information about the entire interval collection**
 - **Parameters such as: interval ID, collection type, start and stop times (and WRS-2 path and row), number of scenes, corner points**
 - **Scene**
 - **Contains information about the WRS-2 scenes identified in the interval (nominal earth imagery only)**
 - **Parameters such as: scene ID, scene start and stop times (and WRS-2 path and row), scene corner points and centers**



Bias Parameter Files

- The pre- and post-imaging shutter (dark) data for each orbit will be processed to construct a set of bias parameters for the imaging intervals in that orbit
 - Collected for each detector for each band in each SCA
 - Bias parameters could be constants for VNIR bands but may be time varying for the SWIR bands
 - Exact form of “bias model” is to be determined once more is known about actual OLI behavior
 - Bias Parameter File (BPF) is time-stamped with the effective date range of imaging for which it is applicable
- The BPF content will be provided as ASCII text using Object Description Language (ODL) syntax



Calibration Parameter Files

- The remainder of the OLI radiometric and geometric calibration parameters will be stored in a Calibration Parameter File (CPF)
- The CPF will be updated periodically (once per WRS cycle to once per quarter) similar to Landsat 5 and Landsat 7
- The CPF is time-stamped with the effective date range of imaging for which it is applicable
- The CPF content will be provided as ASCII text using Object Description Language (ODL) syntax

