

Landsat Science Team

Landsat Product Updates

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Agenda

- **Product Updates**
- **File Format Discussion**
- **QA Band / Cloud Mask Discussion**
- **Landsat 8 Reprocessing Plans**

Product Updates

Improvement	Instrument Data Affected	Description	Anticipated Release	Implications to End User	Current Status / Expected Date
Quality Band	OLI/TIRS	Updates to include fmask Output	L8 LPGS 2.6	Quality band now filled out for cloud shadow	Oct-2015 - pending approach and validation of Cfmask
	TM/ETM+	Quality band similar to Landsat 8; utilize fmask for cloud detection	L1-7 LPGS 12.7	Quality band now included with L1 product	Oct-2015 - pending approach and validation of Cfmask
	MSS	Quality band similar to Landsat 8; utilize cubist (existing) algorithm for cloud detection	TBD	Quality band now included with L1 product	Need to analyze other alternatives and perform validation
Land-based cloud cover score	OLI/TIRS	Calculate CCA on land-only using output from fmask - provide in metadata / user search	LPGS 2.5	Modifications to mtl file; additional search parameter	Completed 4/23/2015
	TM/ETM+	Calculate CCA on land-only using output from fmask - provide in metadata / user search	L1-7 LPGS 12.7	Modifications to mtl file; additional search parameter	Oct-15 - pending approach and validation of Cfmask
	MSS	Calculate CCA on land-only using output from cubist - provide in metadata / user search	TBD	Modifications to mtl file; additional search parameter	Need to analyze other alternatives and perform validation
Ground Control Library Updates	TM/ETM+	Phase I - 177 Path/Row combinations improved; GCP water mask	LPGS 12.5	GCP Version update in MTL file	Completed - Fall 2014
	OLI/TIRS	Phase I - 177 Path/Row combinations improved; GCP water mask	LPGS 2.4	GCP Version update in MTL file	Completed - Fall 2014
	TM/ETM+, OLI/TIRS	Phase II - Low-latitude areas	Release Independent	GCP Version update in MTL file	Complete - Will be coordinated with TIRS stray light correction processing
	TM/ETM+, OLI/TIRS	Phase III - High-latitude areas	Release Independent	GCP Version update in MTL file	Starts Summer 2015



Denotes updates since winter 2015 LST

Product Updates

Improvement	Instrument Data Affected	Description	Anticipated Release	Implications to End User	Current Status / Expected Date
TOA Reflectance / Brightness Temperature Metadata	TM, ETM+	L1-7 consistency w/L8 - Reflectance scaling factors (multiplicative and additive) which are scene based coefficients in mtl file for L1-7 (no sun angle correction); Brightness temperature is also included	LPGS 12.6	includes metadata in .mtl file to allow the user to generate rho-prime TOA reflectance. Metadata includes the brightness temperature.	Completed - Spring 2015
TOA Reflectance Angle Coefficients File (Enhanced Metadata)	OLI/TIRS	Scene-specific per-pixel solar azimuth and sensor viewing angle coefficients (enhanced metadata) to allow users to convert to reflectance	L8 LPGS 2.5	Coefficients file is included with product. Tools will be made available to generate angle bands.	Capability released 4/23/2015 in L8 LPGS 2.5 but not currently enabled
	TM/ETM+	Scene-specific per-pixel solar azimuth and scan angle coefficients (enhanced metadata) to allow users to convert to reflectance	LPGS 12.7	Coefficients file is included with product. Tools will be made available to generate angle bands.	Oct-2015
TOA per-pixel product	TM/ETM+	Produce TM and ETM+ as per-pixel product using angle coefficients. Utilizes JPEG 2000 format and includes a "versioning" updates. Projection parameters same as existing L1T.	TBD	Generated as a separate product in new product format. Existing product remains the same and overlaps minimum of six months. Code available to go back to L1T.	Defer to ARD discussion
	OLI/TIRS	Update L8 to perpixel product using angle coefficients. Utilizes JPEG 2000 format and includes a "versioning" updates. Projection parameters same as existing L1T.	TBD	Generated as a separate product in new product format. Existing product remains the same and overlaps minimum of six months. Code available to go back to L1T.	Defer to ARD discussion



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Product Updates

Improvement	Instrument Data Affected	Description	Anticipated Release	Implications to End User	Current Satus / Expected Date
Level 1 data format study	All	More flexible alternatives to gzip'd L1T, more condusive to data delivery services such as opendap and OGC WCS	Phase I	First collection/version will be in JPEG 2000 format. GeoTiff format availability options are being investigated.	Spring 2016
			Phase II - L1T	Geotiff no longer available- in favor of JPEG2000	6 months after TOA-product
Product 'versioning' / Collection management	All	Improve data so users can more readily determine changes in the product	Phase I - TOA	[TBD] - Most likely a change to the file name and metadata.	Spring 2016
Level-1 Systematic Terrain Fallback	ETM+	Fall back to terrain corrected systematic when precision ground control can't be applied; Already do this for Antarctic.	LPGS 12.7	Need to get results of study and show examples	Oct-15
Automatically reprocessing to utilize definitive ephemeris	ETM+	Data that is processed as it is aquired utilizes predicted bumper mode parameters that may include slight pixel offsets	LPGS 12.6	Will take place automatically within hours.	Completed - Spring 2015
Automatically reprocessing to apply best bumper mode calibrations	ETM+	New acquisitions utilize predicted bumper mode parameters. Reprocess recent acquisitions once bumper mode calibrations are released (~21 days)	LPGS 12.7	Show example of scan offsets	Oct-15
Increase product distribution space	MSS, TM, ETM+	Increase distribution space by 2x!	N/A	More data on-line.	Completed 12/2015
	OLI/TIRS	Increase distribution space	N/A	More data on-line.	Completed Spring 2015



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Product Format Discussion – JPEG2000

- **Why change the file format?**
 - **More sophisticated delivery and interactive data analysis**
 - Band selection
 - Enable services (OpenDAP, WCS) such as spectral-subsetting
 - **Improved compression ratio over gzip resulting in less storage requirements and less volume downloaded**
 - **Evolving standards**
 - Supported by a vast majority of tools and services
 - Sentinel is using it

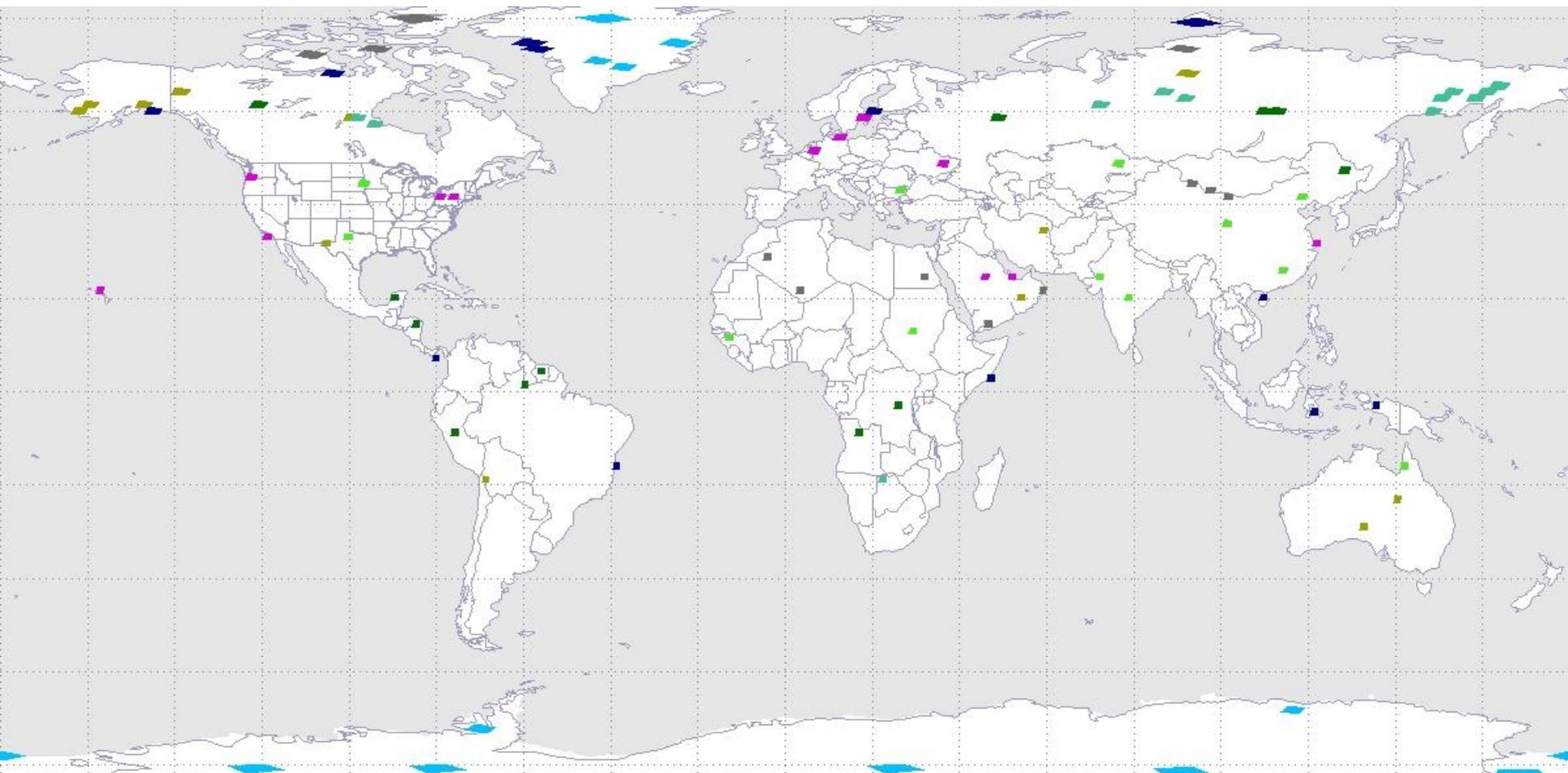
- **Samples Distributed**
 - **GeoTIFF as it is generated today**
 - **JPEG2000 with MTL (ODL) metadata**
 - **JPEG2000 with XML metadata (simply converted from ODL to XML)**

- **Questions / Comments**
 - **Any concerns with JPEG2000 format band files?**
 - **Metadata: ODL versus XML – What is your preferred format?**
 - **Plan to offer optional dynamic grouping of selected files for download**
 - E.g., create a tar file of all JPEG2000 bands / scene on the fly when downloaded

QA Band – CFMask Analysis / Approach

- **Alternatives considered**
 - **CFMask**
 - **CFMask with Confidence Levels**
 - **See5**
 - **ACCA**
 - **LEDAPS**
 - ♦ **Does not currently work on Landsat 8 OLI/TIRS products**
 - **L8SR**

L8 Cloud Validation Set Map



Barren

Grass/Crops

Snow/Ice

Water

Forest

Shrubland

Urban

Wetlands

Current QA Band Products

Bit	Description	Landsat 8 OLI/TIRS		Landsat 5-7 TM and ETM+	Landsat 1-4 MSS
0	Designated Fill	✓		✓	✓
1	Dropped Frame	✓		✓	✓
2	Terrain Occlusion	✓		✓	
3	Saturation				✓
4	Water	ACCA	CFMask	CFMask	
5					
6	Cloud Shadow	CFMask		CFMask	
7					
8	Vegetation				
9					
10	Snow/Ice	ACCA	CFMask	CFMask	
11					
12	Cirrus	Cirrus			
13					
14	Cloud	See5	CFMask	CFMask	MSS CCA
15					

 = One-bit output.

 = Two-bit output, but only yes or no reported.

 = Two-bit output, full confidence levels reported.

Landsat 8 Reprocessing Campaign Imagery Related

Process	Affects	System Changes	Range	Improves
TIRS Stray Light Correction	TIRS	Code and support data	All dates	Radiometric accuracy
OLI Relative Gains	All OLI Bands	CPF	All dates	Striping
OLI Absolute Gains	OLI VNIR Bands	CPF	Safe hold and short time after event	Radiometric accuracy <ul style="list-style-type: none"> • up to <0.2% change
	Costal Aerosol	CPF	All dates	Radiometric accuracy <ul style="list-style-type: none"> • up to a <1% change
SSM roll/TIRS alignment	TIRS	CPF	Pre TIRS Side-A Mode-0	Small improvement to TIRS alignment to OLI for nominal data
Changes to TIRS framing	TIRS LOR framing.	Code	All dates	Improves TIRS coverage with respect to OLI within a L8 product; small change, only few pixels at top/bottom
GCP Phase 2	Phase 2 Path/ Rows	Support data	All dates for path/rows	Improves absolute geodetic accuracy; 50-70 meter improvement
GCP UTM Zone Resampling	OLI/TIRS	Code	Pre LPGS 2.5	Regions where GCPs belong to multiple UTM zones. Possible that this could have a 0.5 pixel effect but that would be worse case.
UT1-UTC	OLI/TIRS	CPF	All dates from 1 st reprocessing campaign.	Improves accuracy of L1GT. 3-5 meter range.

Landsat 8 Reprocessing Campaign Metadata Related

Process	Affects	System Changes	Range	Improves
CFMask	MTL and QA band	Code	All dates	Improves cloud assessment
Angle coefficient file	New metadata	Code	All dates	Enhances users ability to use data
Cirrus Cloud Assessment	QA band	CPF and code	All dates	Improves cloud assessment
Land-Base Cloud Cover	MTL and QA band	Code	Pre LPGS2.5	Improves cloud assessment
Cloud Score for night scenes	MTL	Code	Pre LPGS2.5	CCA now -1 for night scenes.

Backup Slides

OLI Absolute Gain Changes

