SDCG-5 Session 2

Landsat 7/8 status and 2013 Implementation Plan (Element 1)

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Mission Landsat
Launch and commissioning

- *Landsat 7*
  - *Operational: since 15 April 1999*
  - *Expected life time:; anticipate decommissioning in **2017***
- *Landsat 8*
  - *First OLI image 18 March on WRS since 11 April 2013*
  - *Design Life: 5 years OLI and 3 years TIRS*
  - *Fuel: 12+ years*
- *Data policy: Free and open access*
- *8 day repeat cycle using both satellites; 30 meter pixel; 185 km swath*

Mission Landsat-7 and -8 Acquisition Strategy

- *Construct an objective Global Environmental Record using a long-term acquisition plan*
- We propose to focus the use of Landsat 7 on continental land masses
  - Reduce the use of Landsat 7 for acquisitions of island, night, ocean, and Antarctica scenes
  - Landsat 8's larger daily acquisition limit and sensor characteristics provide opportunities for increased extreme latitude, island, ocean and night acquisitions to complement a Landsat 7 LTAP focused on continental land masses

Long-Term Acquisition Plan Summary

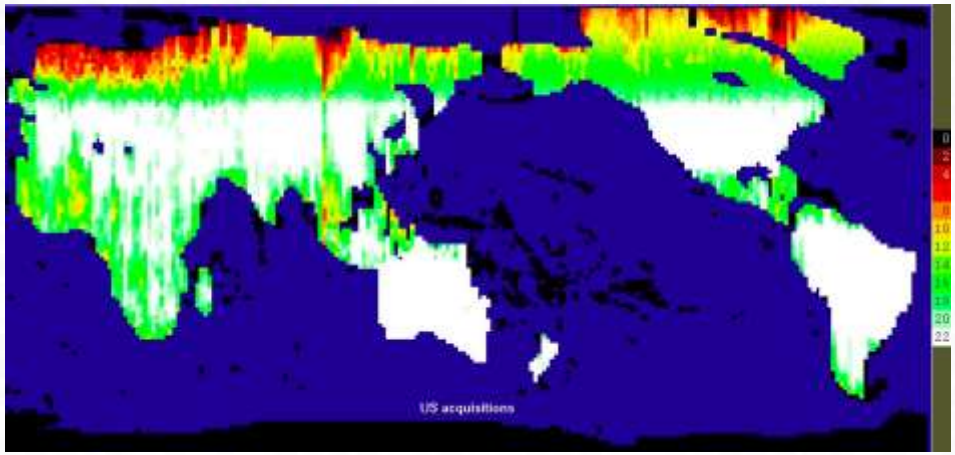
Prior

- Landsat 7
  - Images 350 – 450 images per day out of 540 - 630 sun-lit land opportunities
  - ETM+ has strict duty cycle constraints
  - Power cycling incurs warm up and data overhead penalties for short intervals equivalent to 4 scenes
  - Storage capacity constraints
  - Since the Scan Line Corrector failure, the LTAP pursues image pairs
  - Acquires oceanic islands at reduced priority and frequency
  - Acquires Arctic once per season
- Landsat 8
  - Currently acquiring 550 images per day
  - Acquires using a formal LTAP
  - Specified to acquire and distribute 400 images per day
  - Deep Blue Band for ocean monitoring
  - Better cloud detection with Cirrus Band
  - Improved dynamic range

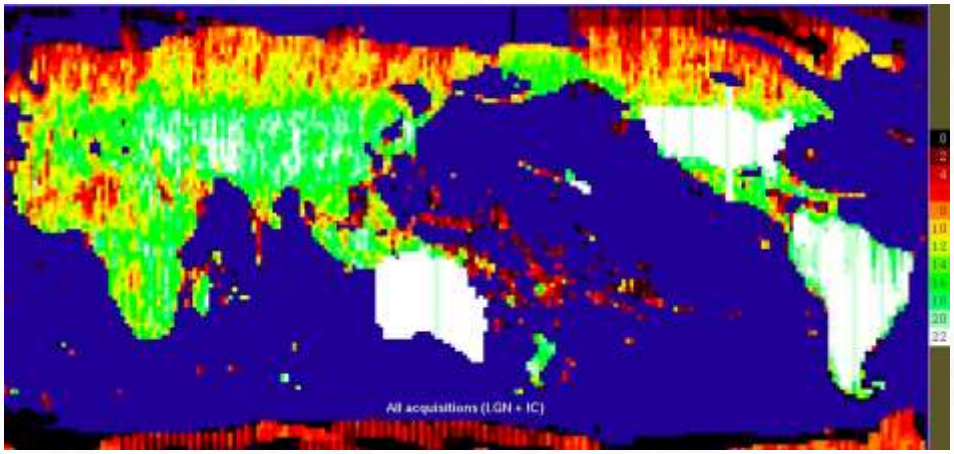
Current

- Landsat 7
  - Increased imaging of continental land masses improved coverage of persistently cloudy areas and better gap filling
  - Eliminate routine imaging of islands, water and Antarctica
  - Increase imaging from 369 images/day (69%) to approximately 438 images/day (91%)
  - Reduce ETM+ duty cycle from 15.1% to 14.4% and power cycles from 28.6 to 17.5 per day
- Landsat 8
  - Constrained by download costs/opportunities
  - Higher island priority
  - More frequent imaging for islands and Arctic
  - Lower sun elevation constraint from 15% to 5%
  - Increase Antarctica acquisitions
  - Support selected night campaigns (such as urban heat islands, fires, sea ice, and volcanoes)
  - Include selected near shore and interior water scenes
  - Support large water campaigns
  - Increase ascending node day acquisitions

Landsat 7 Continental versus Ops Model



Modeled one-year global coverage



Ops one-year global coverage

Daily Average Metrics	Continental Model	Operations
Qualifying Candidate Scenes	479 scenes/day	536 scenes/day
Acquisition Rate (LGN)	438 scenes/day (91% of candidates)	375 scenes/day (70% of candidates)
ETM+ duty cycle	14.4%	15.1%
ETM+ power cycles	17.5	28.6
Average ACCA	47.5	37.3
Clear scene acquisition rate (ACCA ≤10)	129 scenes/day (29% of acquisitions)	126 scenes/day (34% of acquisitions)
Marginal scene acquisition rate (ACCA ≤ 50)	230 scenes/day (53% of acquisitions)	238 scenes/day (64% of acquisitions)

Mission Landsat Data processing

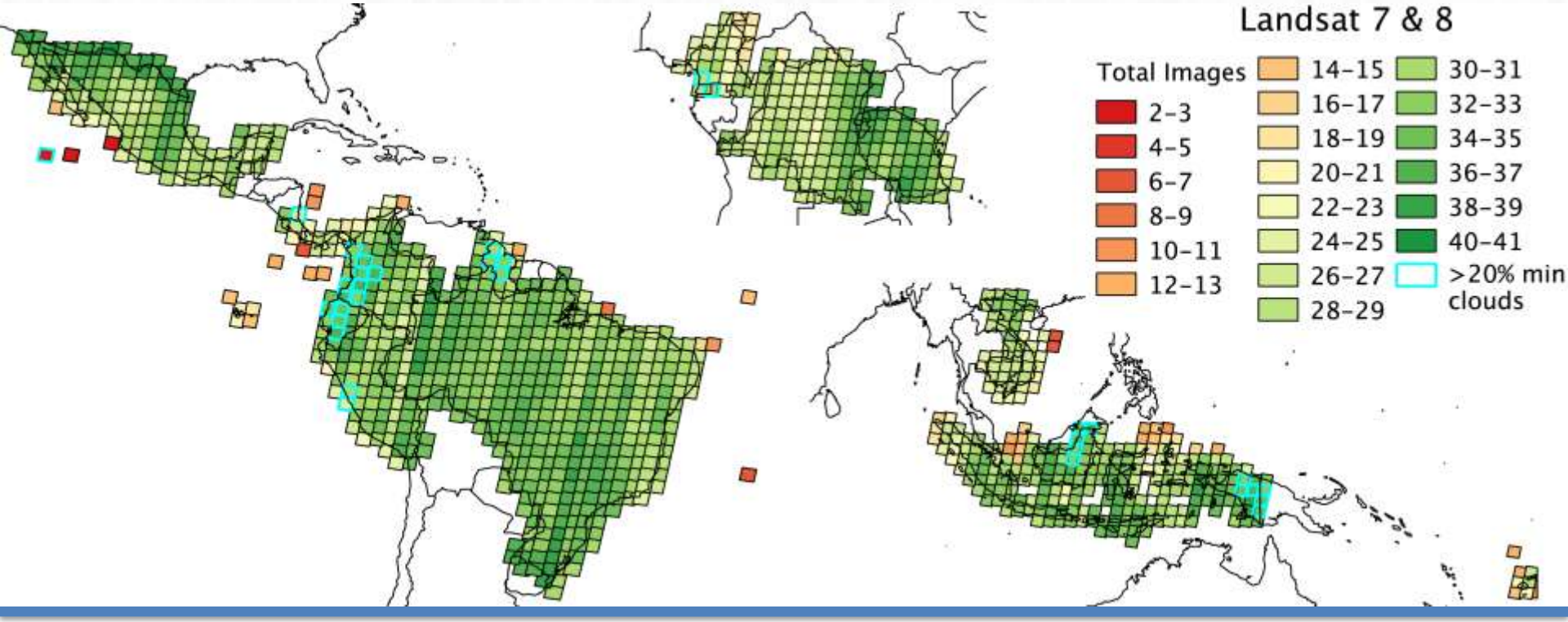
- *Processing levels:*
  - *Systematic-Corrected (L1G): Landsat 1-7*
  - *Systematic- and Terrain- Corrected (L1Gt): Landsat 7-8*
  - *Precision- and Terrain-Corrected (L1T): Landsat 1-8*
  - *If precision control is available, we attempt to create an L1T. If, for example due to cloud cover, enough control cannot be found, we fall back to a systematic product.*
- *Data formats:*
  - *GeoTIFF*
- *Means for data distribution*
  - *Download only*

Spatial Accuracy Assessment

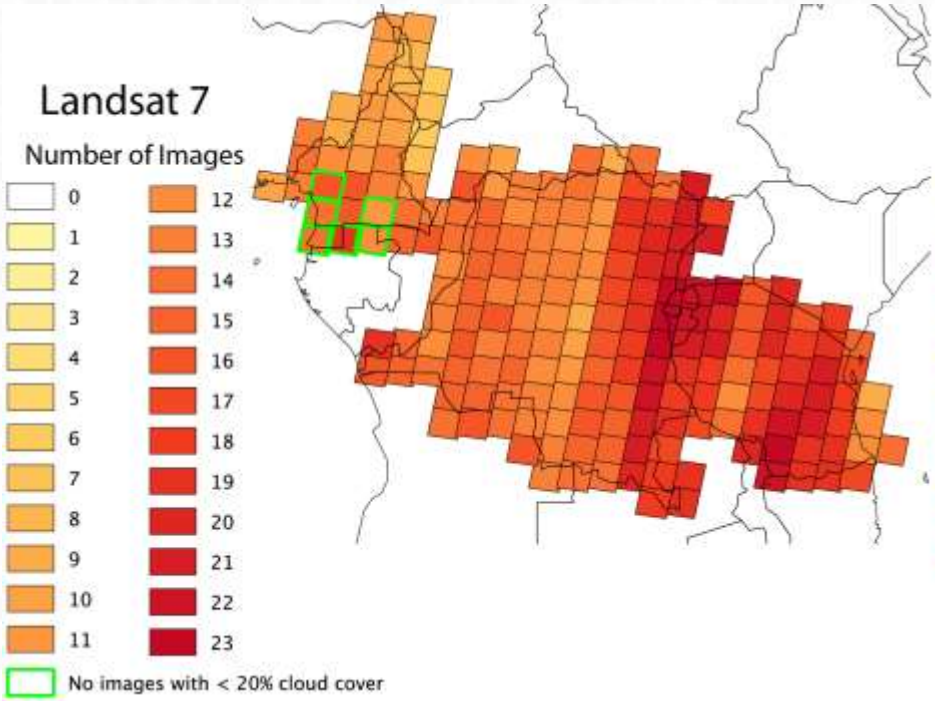
- *Percentage of L1T products with better than 1 pixel accuracy*
  - *MSS: 89.91% Precision RMSE;*
    - *93.72% Independent RMSE (if RMSE>10 pixels, auto fallback to L1G*
  - *TM:99.48% Precision RMSE;*
    - *88.04% Independent RMSE (No fallback threshold)*
  - *ETM+: 99.05% Precision RMSE*
  - *OLI: 100% Precision RMSE (over 30 meters will fall back to L1Gt)*
    - *OLI: L1Gt RMSE better than 30 meters*
- *Rules of thumb*
  - *To automatically stack images, the RMSE should be less than 1 pixel*
  - *MSS data cannot be auto-stacked*
  - *TM & ETM+ L1T can be auto-stacked with caution*
  - *TM & ETM+ L1G and L1Gt cannot be auto-stacked*
  - *OLI/TIRS can be auto-stacked*
  - *When in doubt inspect image and use information in metadata*

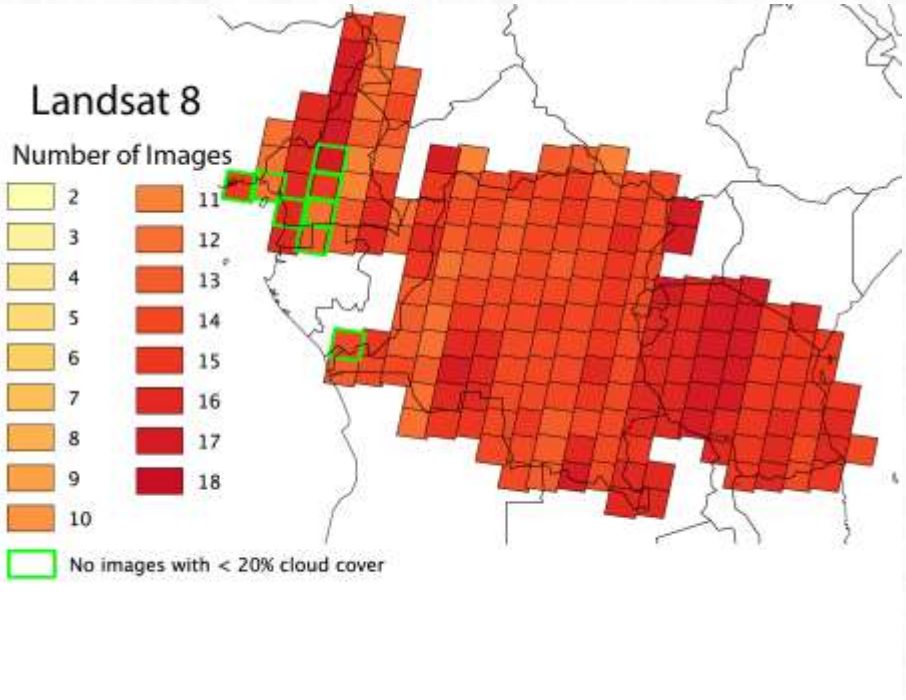
Total GFOI Landsat ETM+ and OLI Images in 2013

- Landsat 7 & 8 acquired up to 41 images for each scene
- Landsat 8 only imaged during the last three quarters
- Scenes (34) highlighted in cyan have no image with better than 20% cloud

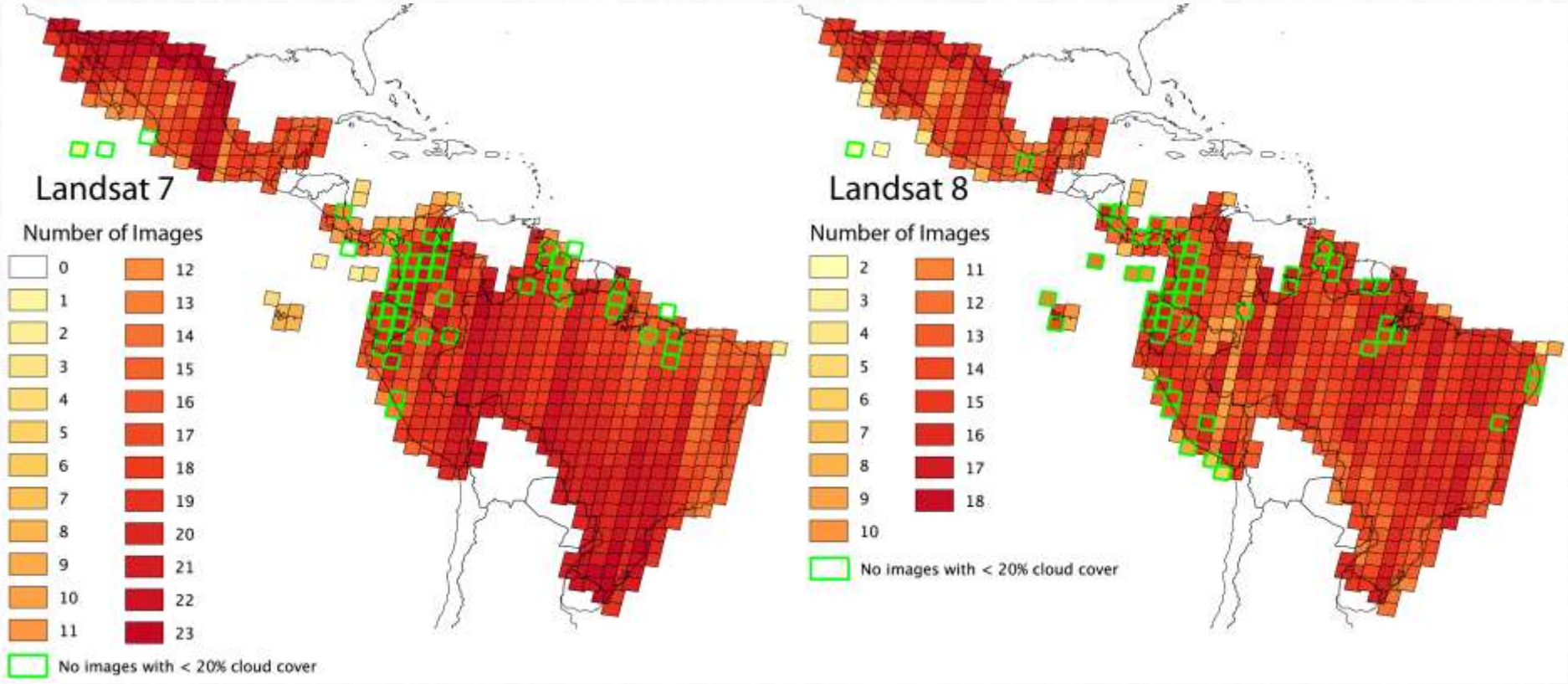


Landsat 7 & 8
2013 - Africa

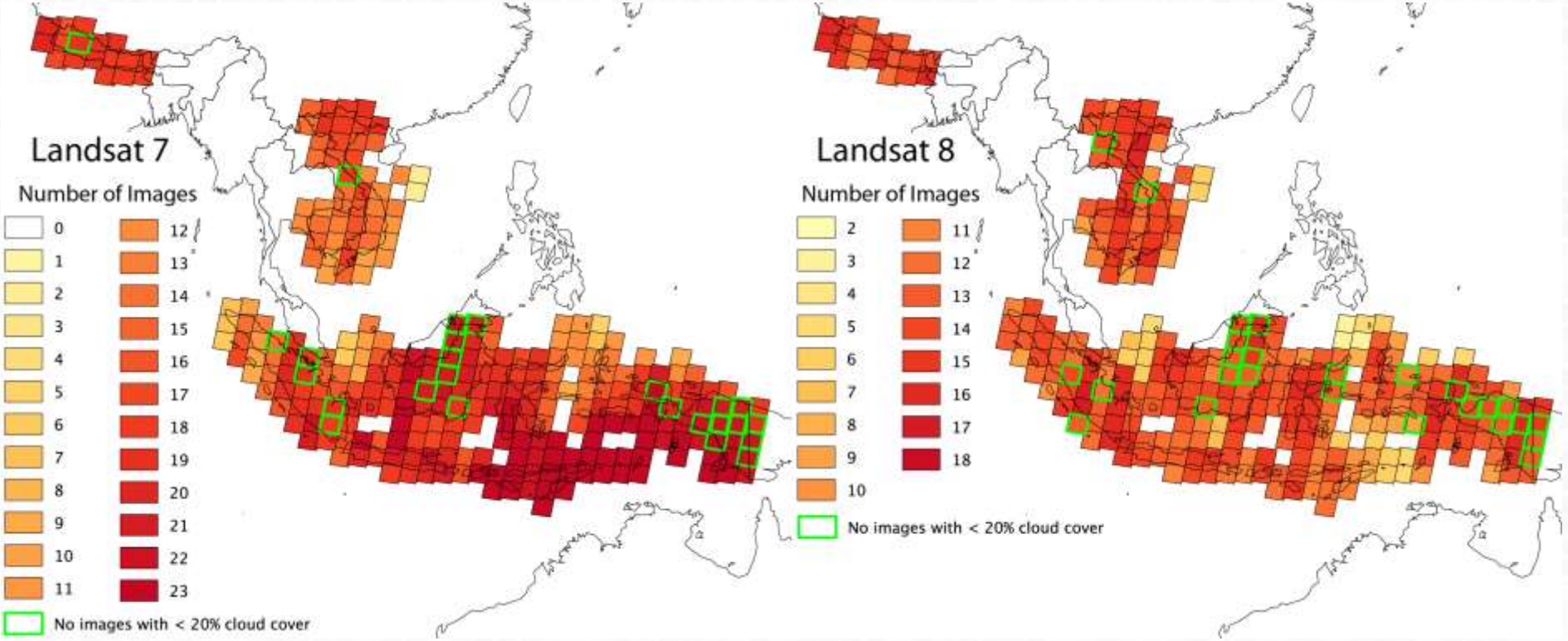




Landsat 7 & 8
2013 - Americas

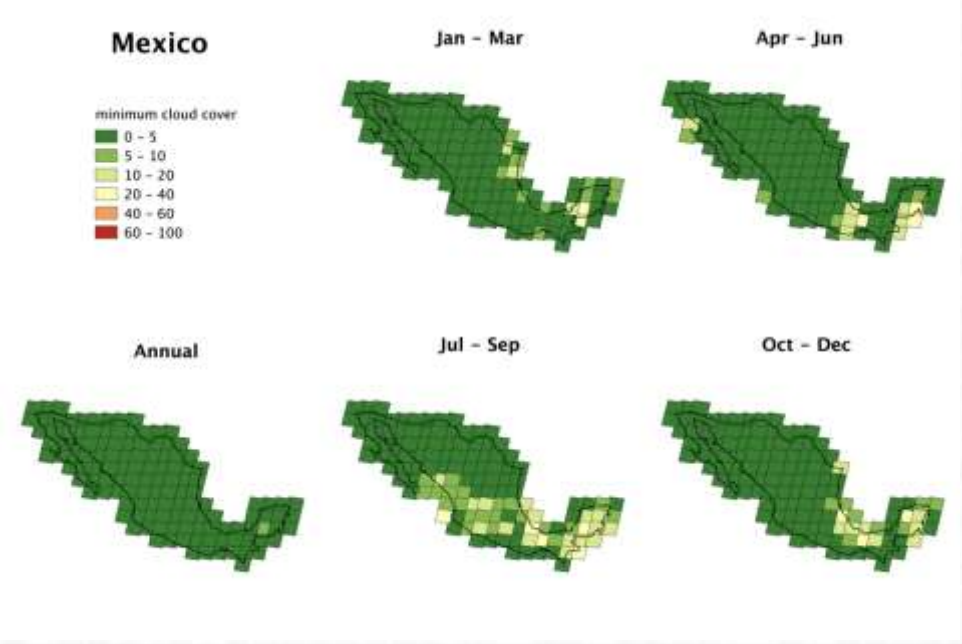


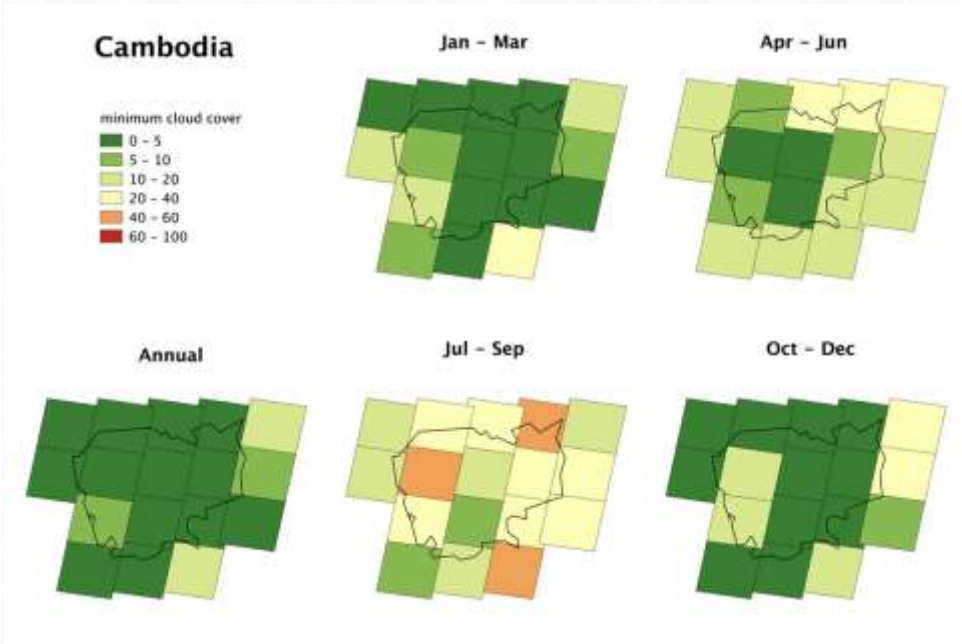
Landsat 7 & 8
2013- Asia



Landsat 7 & 8 2013
Best Cloud Cover by Season

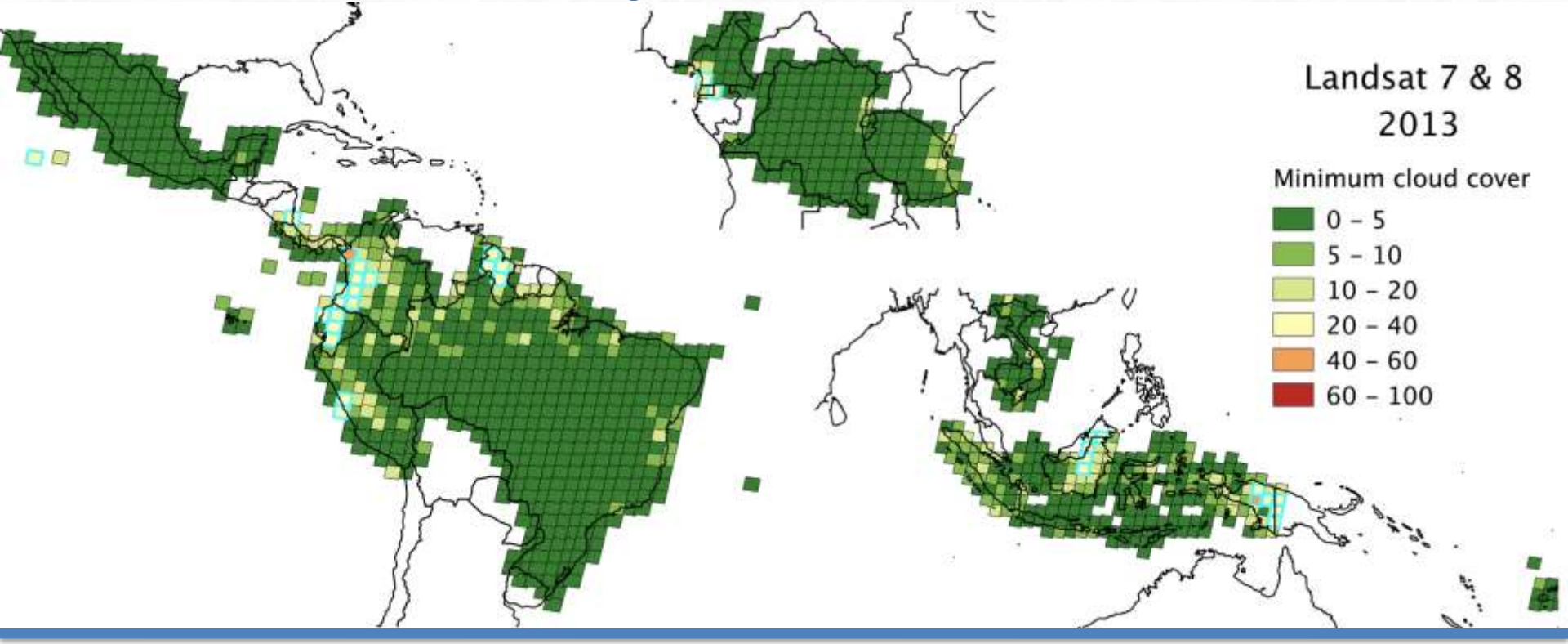
- The 2013 implementation report includes annual and seasonal maps for each country





Total GFOI Landsat ETM+ and OLI Images in 2013

- 30% of the scenes had cloud free images
- 70% of the scenes had images with better than 3% cloud cover
- 90% of the scenes had images with better than 10% cloud cover



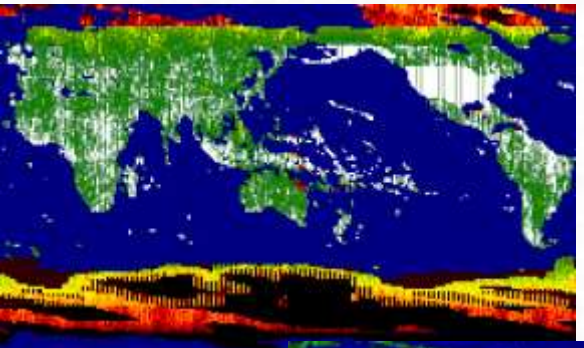
Landsat 7 & 8 2013 Best Cloud Cover by Season

- With Landsat 7 only the best cloud cover for 90% of the scenes is 15.62%.
- With Landsat 8 only the best cloud cover for 90% of the scenes is 16.83%.
- However using both Landsat 7 & 8 the best cloud cover for 90% of the scenes drops to 9.79%.
- Landsat 8 statistics are worse than Landsat 7, presumably due to the lack of 1st quarter data.
- Landsat 7 end of life will be no later than early 2018!

Landsat 7 & 8 2014 and beyond

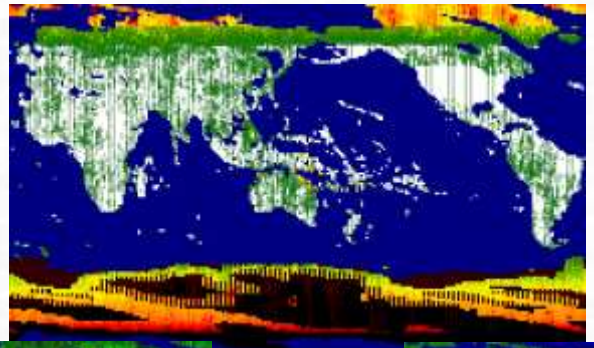
- Acquisitions will continue at the current 550 images per day or greater
- We currently acquire using cloud avoidance, so there are diminishing returns on additional acquisitions.
- To do better requires more frequent coverage: Sentinel-2, CBERS-4
- Radar and Airborne platforms provide the best opportunities for cloud avoidance…

Looking forward to 2014



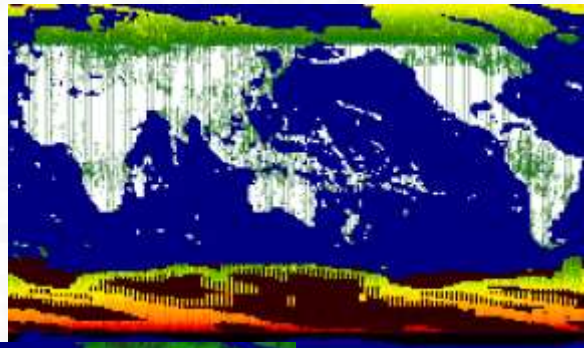
550

current



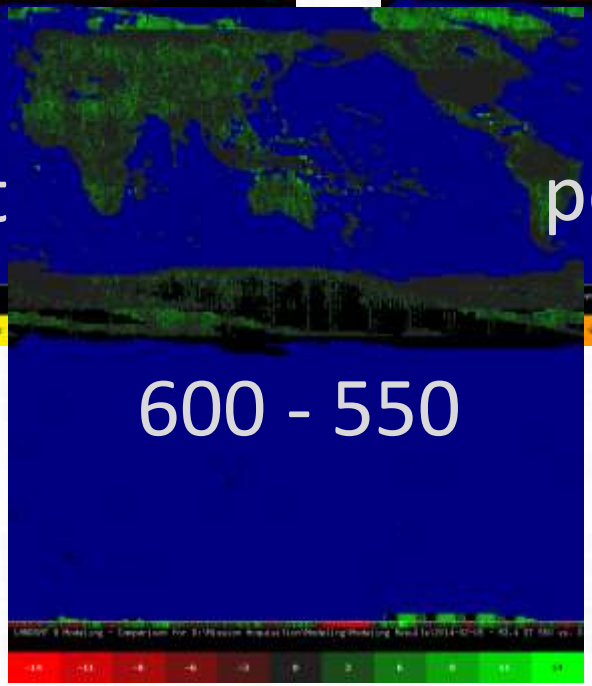
600

possible

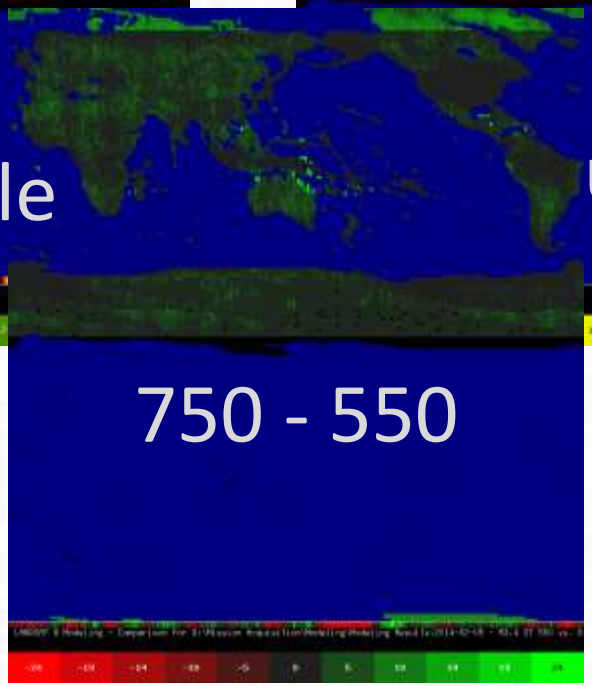


750

unlikely



600 - 550



750 - 550

Hopes and expectations

- Good chance we'll increase to 600 images/day at least for the northern hemisphere summer
- Download costs and shutter use are limiting constraints
- Will add selected "interior" water bodies
- Will create a smooth priority ramp at poles to shift additional resources to vegetated regions
- Will not be able to add more night imaging
- **Data distribution continues to be a challenge**

	SDCG (FCT/GFOI)	Silva Carbon	FAO	GEOGLAM (shape file areas)	delivered	2014 delivery	notes
Algeria				Y		2009-2013, SRTM3,GLS	
Argentina	Y(eaf?)			Y		2009-2013, SRTM3,GLS	
Australia	Y(Tasmania)			Y			No media delivery (Tasmania GFOI)
Belize	Y(eaf?)	Y				2009-2013, SRTM3,GLS	In silvaCarbon, but not in GFOI
Bolivia	Y(eaf?)	Y				2009-2013, SRTM3,GLS	
Brazil	Y				2009-2012, SRTM2,GLS		No media delivery
Burma		Y				2009-2013, SRTM3,GLS	
Cambodia	Y				2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Cameroon	Y				2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Colombia	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Costa Rica	Y					2009-2013, SRTM3,GLS	
DRC	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Ecuador	Y		Y			2009-2013, SRTM3,GLS	
Ethiopia				Y		2009-2013, SRTM3,GLS	
Fiji						2013, SRTM3,GLS	in LSI explorer, but not elsewhere
Guatemala		Y				2009-2013, SRTM3,GLS	
Guyana	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Honduras		Y				2009-2013, SRTM3,GLS	
Indonesia	Y				2009-2012, SRTM2,GLS		no media delivery (2013)
Laos		Y				2009-2013, SRTM3,GLS	
Malawi		Y				2009-2013, SRTM3,GLS	
Malaysia				Y(eaf?)			Selangor State - no delivery
Mexico	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Nepal	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Nicaragua		Y	Y			2009-2013, SRTM3,GLS	
Pakistan				Y?		2009-2013, SRTM3,GLS	
Panama	Y					2009-2013, SRTM3,GLS	
Paraguay			Y				no media delivery ?
Peru	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Philipines		Y				2009-2013, SRTM3,GLS	
Papua New Guinea				Y(eaf?)			Madang Province - no delivery
Russia				Y		2009-2013, SRTM3,GLS	
Tanzania	Y		Y		2009-2012, SRTM2,GLS	2013, SRTM3,GLS	
Thailand		Y			2009-2012, SRTM2,GLS	2013 (delivered)	
Uganda			Y	Y		2009-2013, SRTM3,GLS	
Ukraine				Y		2009-2013, SRTM3,GLS	
Vietnam	Y	Y	Y			2009-2013, SRTM3,GLS	
Zambia		Y	Y			2009-2013, SRTM3,GLS	

Color Legend

GFOI	completed	
GFOI	John added	29,075 direct for EE, LSI and Landsat-8 updates + Ivanpah Playa
GFOI	Doug Muchoney supported	29,800 direct for EE and LSI
GEOGLAM	GEOGLAM supported	for EE and LSI

Levels of POC - country, mailing distribution, within CEOS GFOI/GEOGLAM community

Assumptions Inge for FAO, Sylvia for SilvaCarbon, Simon for GFOI, Michel for GEOGLAM

Assumption 2: if SilvaCarbon then also GFOI

FAO countries from Inge's SDMS presentation at EROS. The old list included Argentina, Cambodia, Laos. The old list did not include Paraguay.

Thank You!

Questions?