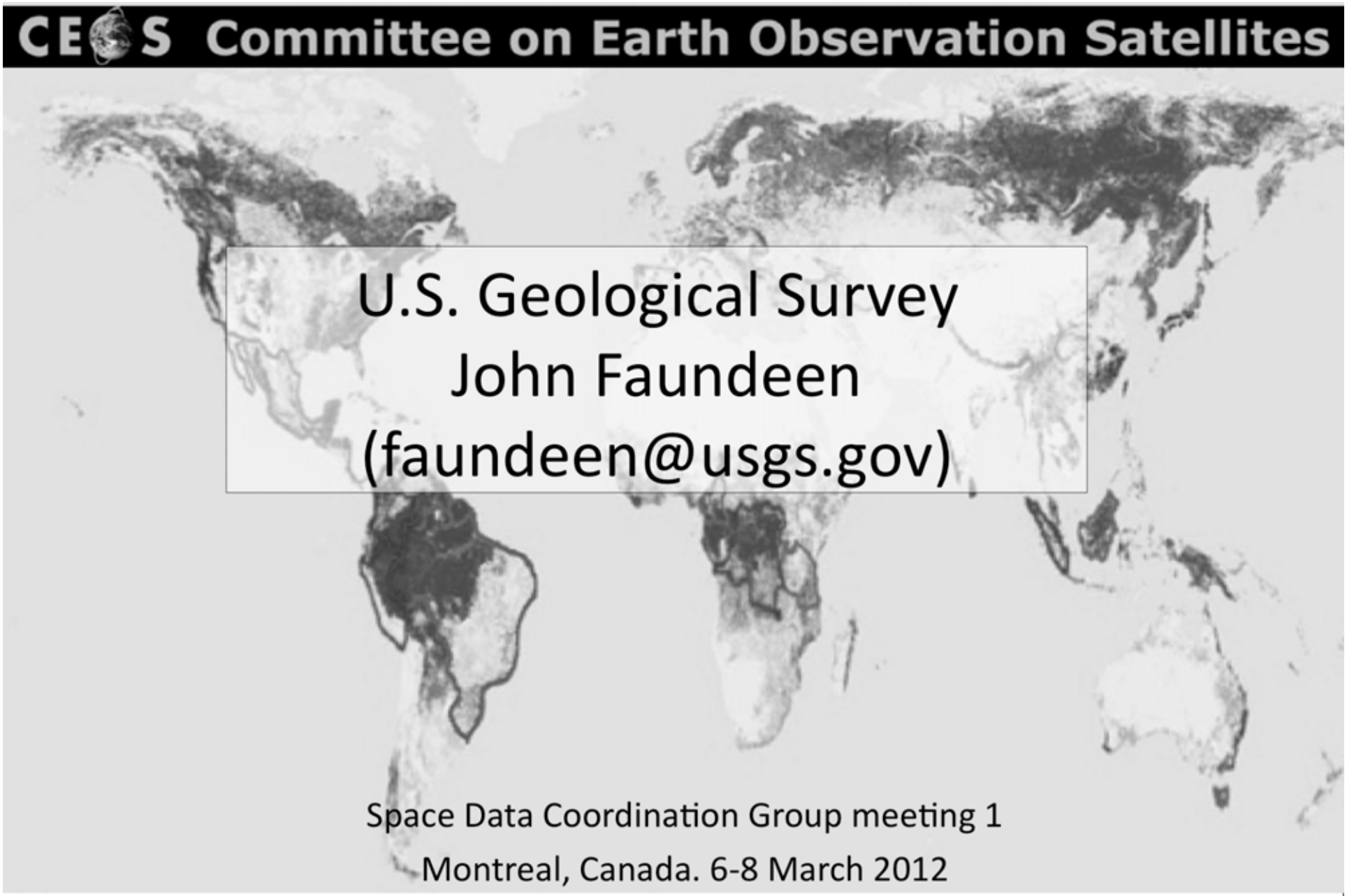
CEOS Committee on Earth Observation Satellites



U.S. Geological Survey

John Faundeen
(faundeen@usgs.gov)

Space Data Coordination Group meeting 1

Montreal, Canada. 6-8 March 2012

Forest Carbon Tracking
Global Forest Observations Initiative

GEO GROUP ON EARTH OBSERVATIONS

Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

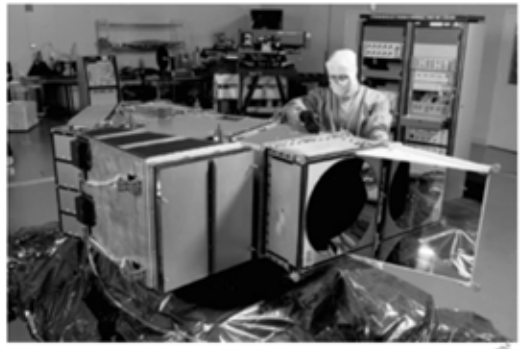
- Landsat 7 (Launched April 15, 1999)
- Sensor – Enhanced Thematic Mapper Plus (optical)
- 16-Day Revisit Frequency (233 Orbits)

Band	Spectral Range	Ground Res.
1	.45 to .52	30 meters
2	.52 to .60	30 meters
3	.63 to .69	30 meters
4	.75 to .90	30 meters
5	1.55 to 1.75	30 meters
6	10.40 to 12.5	60 meters
7	2.08 to 2.35	30 meters
Pan	.52 to .90	15 meters

Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

Landsat 7

- 185 Kilometers Swath
- 705 Kilometers Altitude
- 8-bit Quantization
- 375 Gigabytes Solid State On-board Recorders
- Sun-Synchronous 98.2 Degrees Inclination
- 10:00 AM Descending Node Equatorial Crossing
- Current Duty Cycle 380 Images/Day (was 300)
- Circles Earth Every 98.9 Minutes
- 170 Km x 185 KM Scene Size
- 270 Pounds Hydrazine
- 5 Year Design Life



Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

Landsat 7 Acquisition Strategy

- Driven by the requirement to create a long-term environmental record guided by the Long-Term Acquisition Plan (LTAP)
- Individual user requests and science campaigns are accepted, but only so far as they do not perturb the Long-Term Acquisition Plan
- Individual user requests are most likely to be accepted if they have associated field campaigns or are for emergency response.
    - Night acquisitions are only acquired by special request.
- Science campaigns tend to target areas associated with large mapping projects for which the temporal period is well defined, occasionally repeating, and tend to have a low priority boost leading to a moderated increase in the probability of acquisition.
- To meet these goals the Landsat Long-Term Acquisition Plan continues to evolve through lessons learned in response to new inputs, aging satellites, and new satellite capabilities

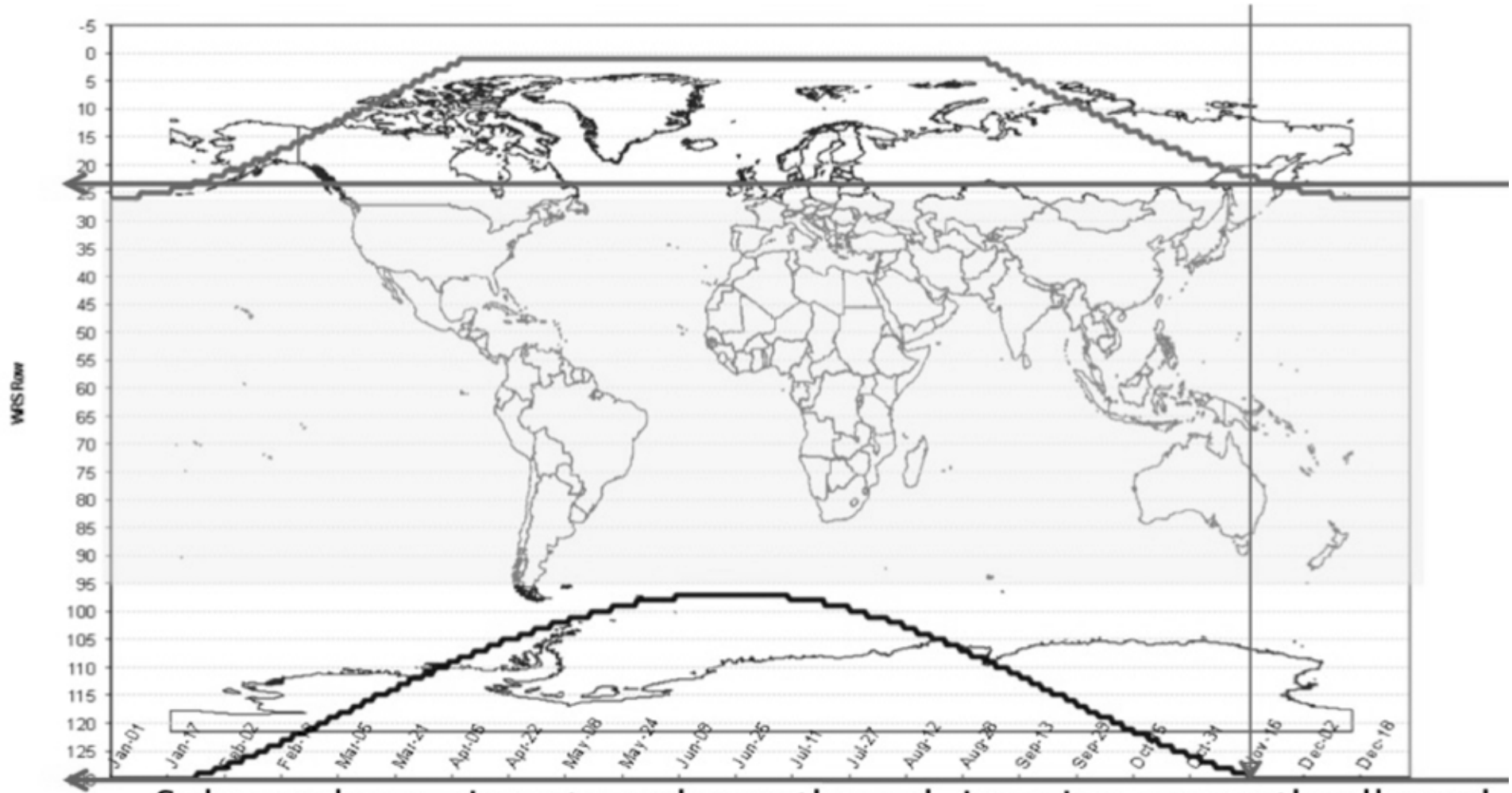
Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

Landsat 7 Long-Term Acquisition Plan (LTAP)

- Vegetation phenology quantified by seasonality files or NDVI
- Cloud predictions avoid acquisitions of “relatively” cloudy data
  - Cloud climatology quantify “relatively” cloudy data
- Automatic Cloud Cover Assessments of acquired images identify successful acquisitions
- Missed opportunity boost
- Thematic Campaigns – requirements not well represented by seasonality: reefs, agriculture, volcanoes, glaciers,…

Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

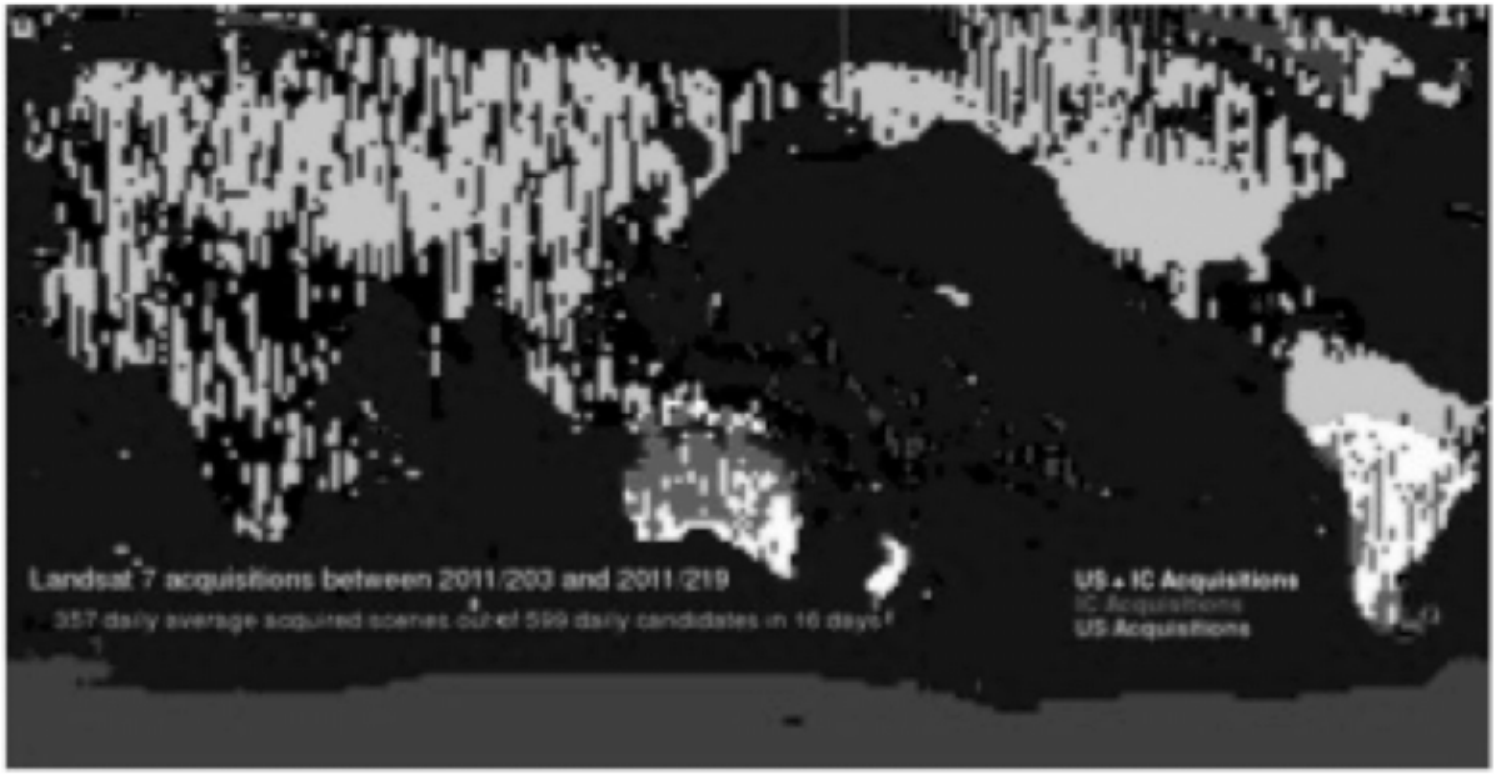
Landsat 7 Sun Angle Constrained Coverage



Solar cycle moving strongly southward. Imaging presently allowed (sun angle constraint) between the red horizontal lines

Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

Landsat 7 Coverage



- ND Coverage Can be Accomplished With International Cooperators

Summary of Mission Capacity to meet FCT/GFOI needs Missions currently in operation

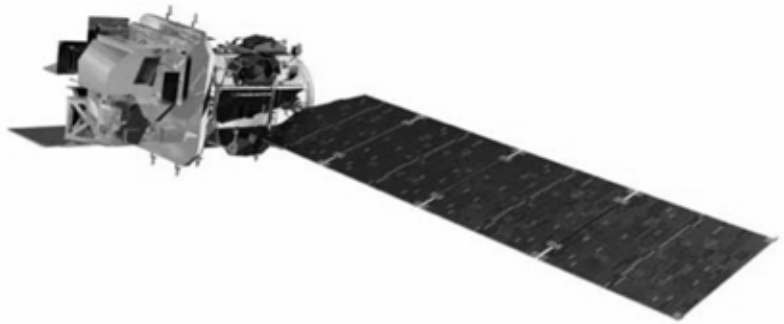
Landsat 7

- Processing Level
  - All Landsat data will be processed to the following Level-1 terrain correction parameters:
- Pixel size:
  - 15m (panchromatic: - Band 8)
  - 30m (Bands 1-5 and Band 7)
  - 60m (thermal - Bands 6 (High Gain and 6 Low Gain)
- Media type: Download (no cost) / Hard Disks
- Product type: L1T (precision & terrain corrected)
  - Output format: GeoTIFF
  - Map projection: UTM
  - Datum: WGS84
  - Orientation: North up
  - Resampling: Cubic convolution
  - DEM data used for terrain correction SRTM
    - GTOPO 30, if SRTM unavailable.

Summary of Mission Capacity to meet FCT/GFOI needs Near-future missions of relevance

Landsat Data Continuity Mission (LDCM)

- 25 January 2013 Launch
- April 2013 Expected Start of Operations
- 705 km Altitude
- 5 Year Mission Life
  - Fuel for 10 Years
- 16-Day Revisit
- 185 KM x 180 km Scene Size
- System Capacity
  - 400 Scenes / Day
- LTAP for Acquisition Planning
  - Should Support NDs
    - With International Cooperators



Summary of Mission Capacity to meet FCT/GFOI needs Near-future missions of relevance

Landsat Data Continuity Mission (LDCM)

- Processing: Level 1 T- Terrain Corrected
- Pixel Size:
  - OLI multispectral bands: 30-meters
  - OLI panchromatic band: 15-meters
  - TIRS bands: resampled from 30 meters to match OLI multispectral bands
    - From 100 meters
- Data Characteristics: GeoTIFF data format
- Cubic Convolution (CC) resampling
- North Up (MAP) orientation
- Universal Transverse Mercator (UTM) map projection
  - Polar Stereographic for Antarctica
- World Geodetic System (WGS) 84 datum
- 12 meter circular error, 90% confidence global accuracy for OLI
- 41 meter circular error, 90% confidence global accuracy for TIRS
- 12-bit quantization / data products

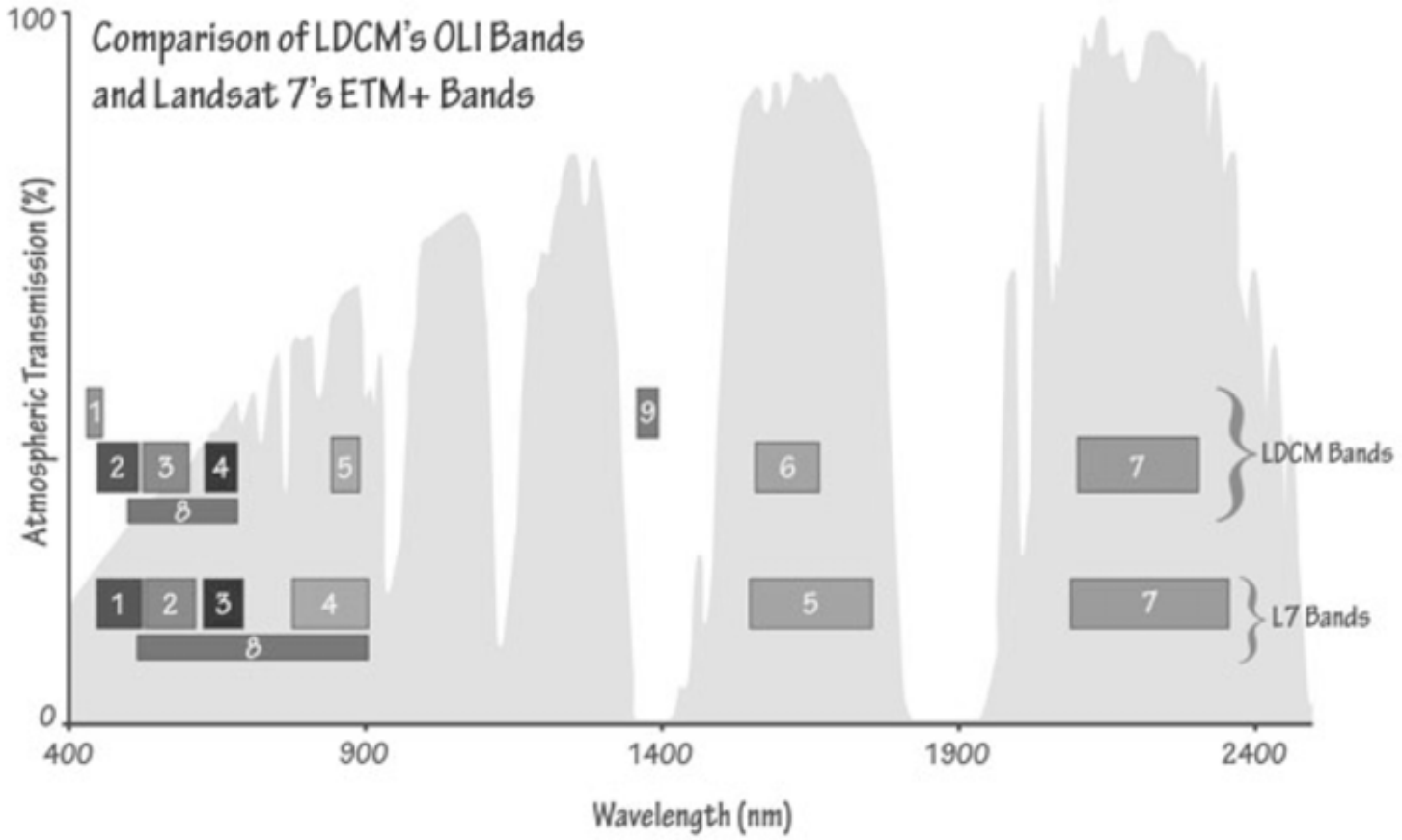
Summary of Mission Capacity to meet FCT/GFOI needs Near-future missions of relevance

Landsat Data Continuity Mission (LDCM)

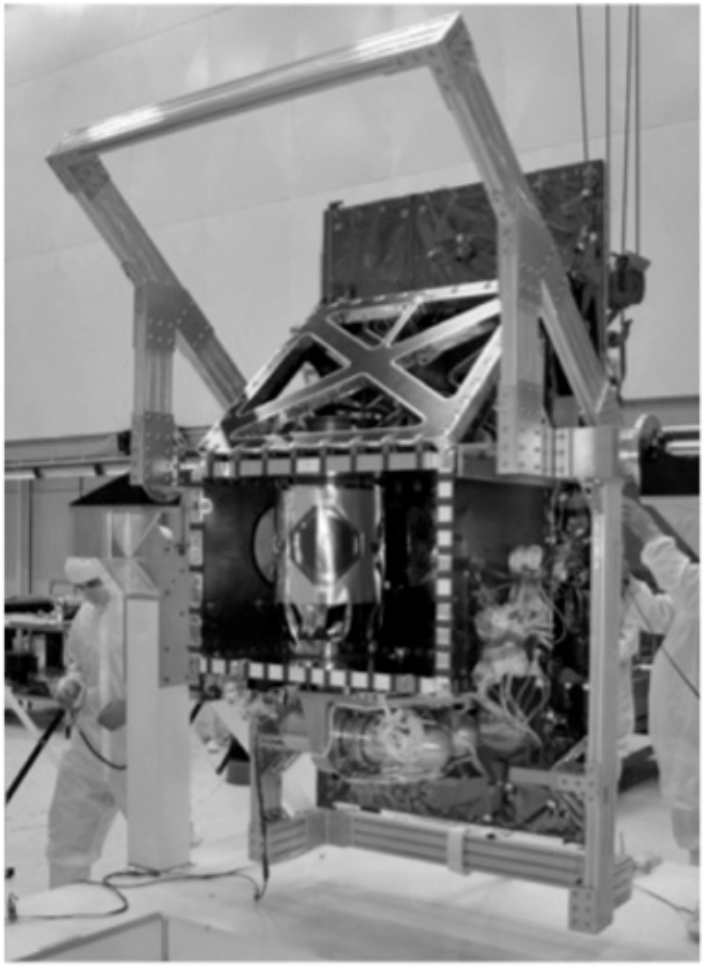
Band	Spectral Range	Ground Res.
1 Coastal Aerosal	.433 - .453	30 meters
2 Blue	.450 - .515	30 meters
3 Green	.525 - .600	30 meters
4 Red	.630 - .680	30 meters
5 NIR	.845 - .885	30 meters
6 SWIR 1	1.56 – 1.66	30 meters
7 SWIR 2	2.10 – 2.30	30 meters
8 Pan	.500 - .680	15 meters
9 Cirrus	1.36 – 1.39	30 meters
10 Thermal 1	10.3 – 11.3	100 meters
11 Thermal 2	11.5 – 12.5	100 meters

Summary of Mission Capacity to meet FCT/GFOI needs Near-future missions of relevance

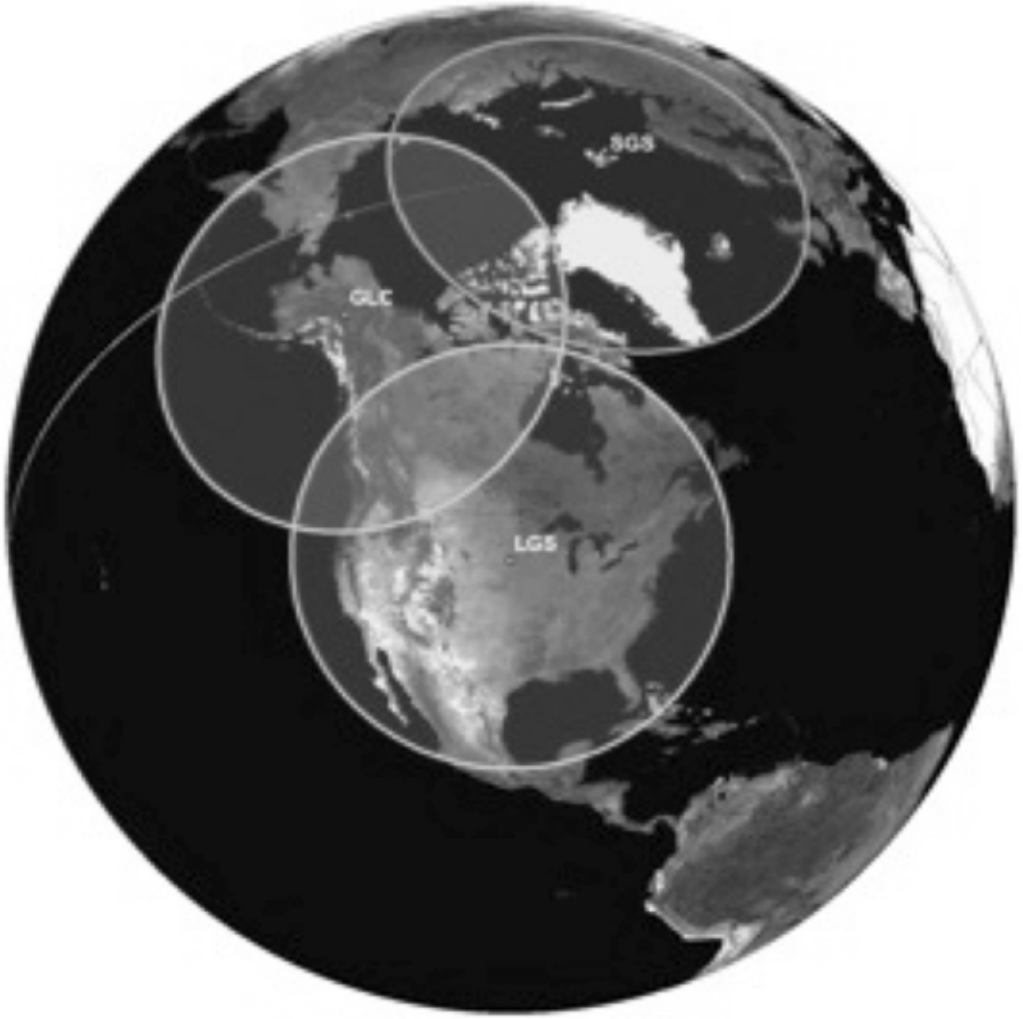
Landsat Data Continuity Mission (LDCM)



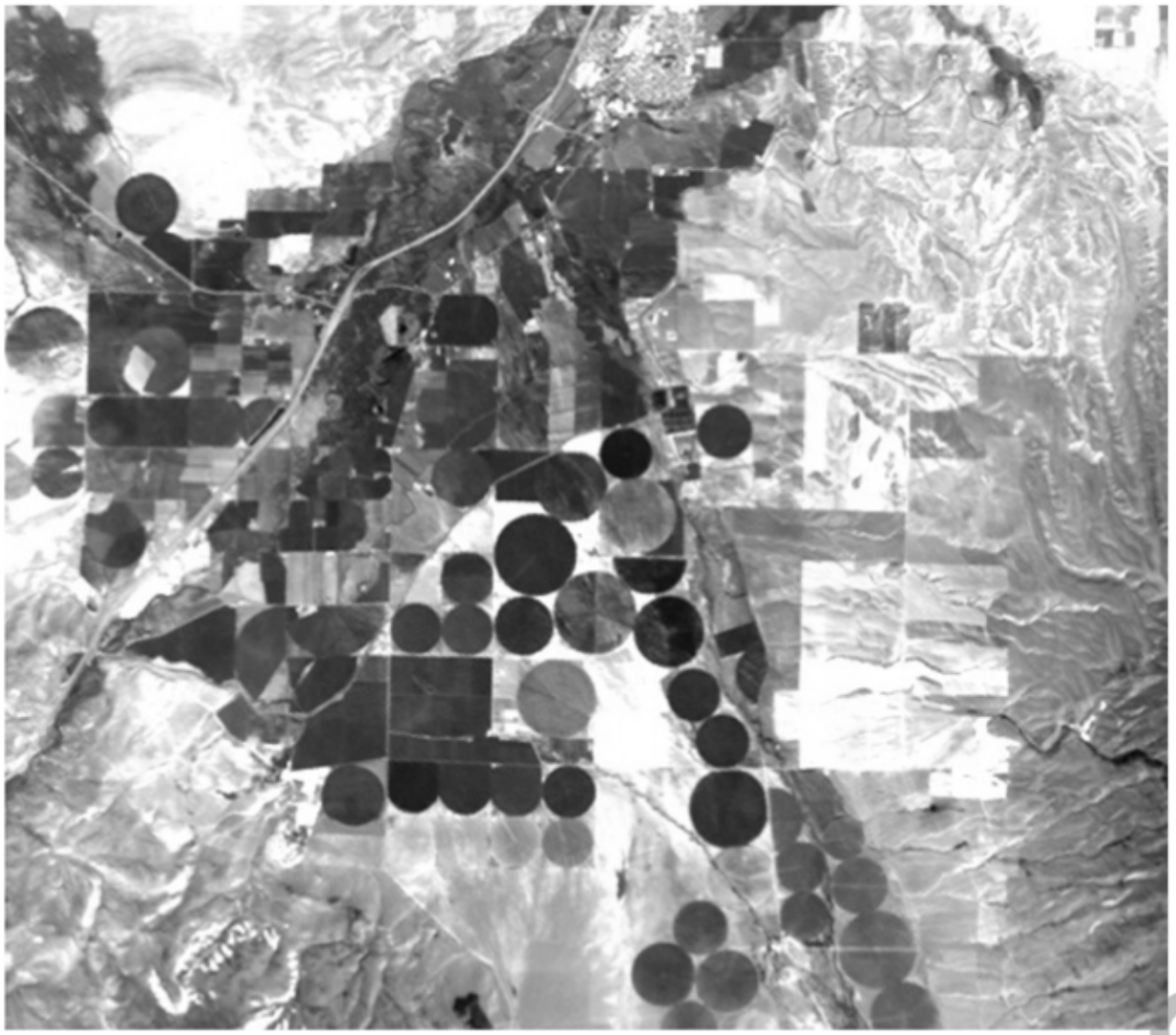
OLI & TIRS



Current LDCM Ground Stations

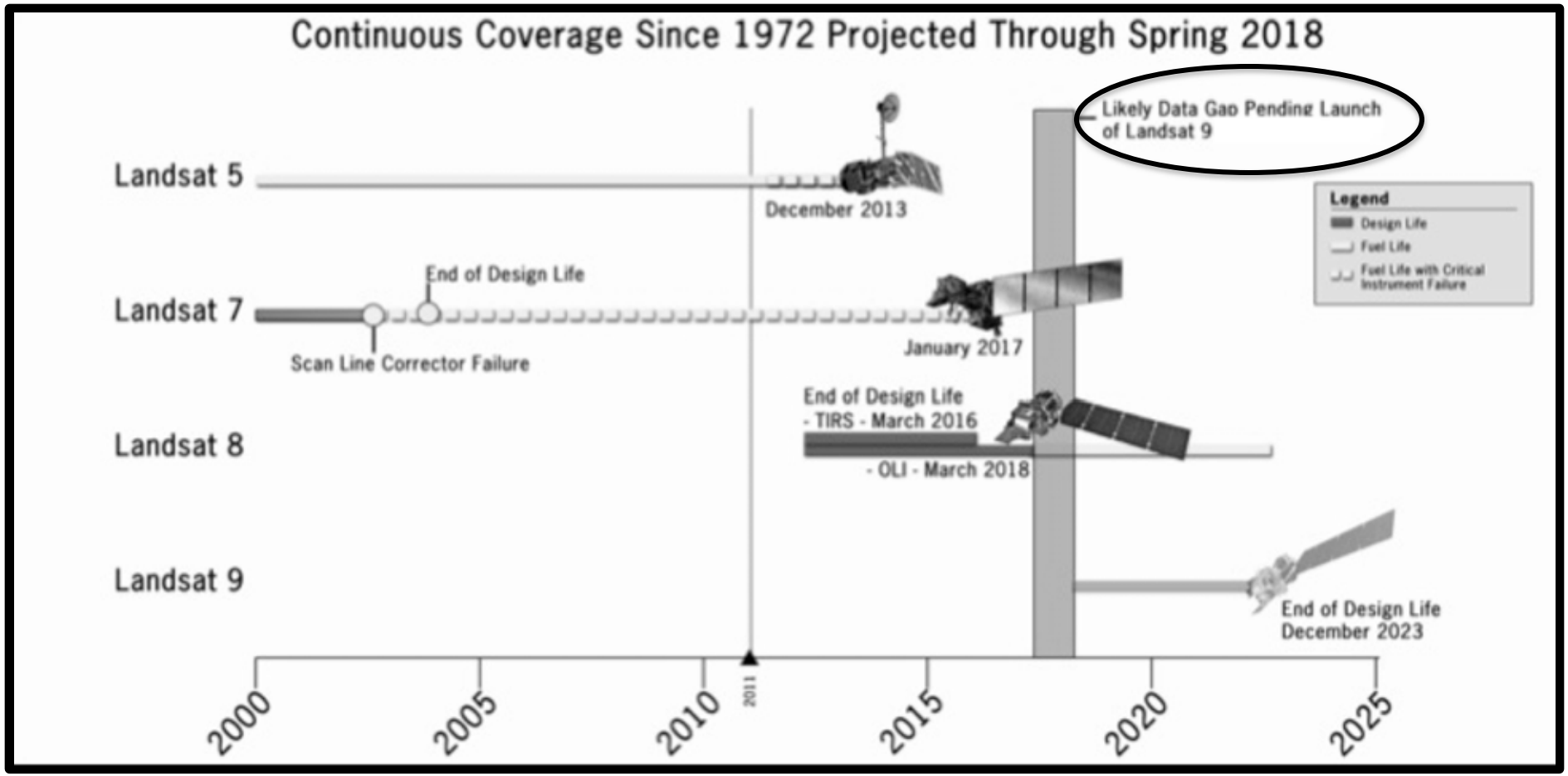


Simulated LDCM Data



Meeting the FCT/GFOI Data Requirements

- LDCM
  - Record entire global land surface, every season, every year.
- Geographical Priorities - Land Areas - LTAP



Meeting the FCT/GFOI Data Requirements

- Possible Verification Site Support
  - GeoEye OrbView-3 (2003-2007)

Meeting the FCT/GFOI Data Requirements

- GeoEye OrbView-3 (1 meter Pan and 4 meter XS Resolution

All	PANCHROMATIC	% PAN	MULTISPECTRAL	%MS	total
530,424	442,646	83.45	87,778	16.55	530,424

Year	All	PANCHROMATIC	% PAN	MULTISPECTRAL	%MS	total
2003	6,756	6,284	93.01	472	6.99	6,756
2004	53,865	39,330	73.02	14,535	26.98	53,865
2005	181,453	151,636	83.57	29,817	16.43	181,453
2006	241,931	208,555	86.20	33,376	13.80	241,931
2007	46,419	36,841	79.37	9,578	20.63	46,419
total	530,424	442,646	83.45	87,778	16.55	530,424

Cloud Cover							
	All	PANCHROMATIC	PAN % - Clouds	MULTISPECTRAL	MS % - Clouds	total	total % - Clouds
<=10%	249,817	216,793	48.98	33,024	37.62	249,817	47.10
11-20%	40,296	32,183	7.27	8,113	9.24	40,296	7.60
21-30%	21,621	17,371	3.92	4,250	4.84	21,621	4.08
31-40%	15,370	12,396	2.80	2,974	3.39	15,370	2.90
41-50%	21,733	17,466	3.95	4,267	4.86	21,733	4.10
51-60%	10,630	8,593	1.94	2,037	2.32	10,630	2.00
61-70%	10,825	8,706	1.97	2,129	2.43	10,835	2.04
71-80%	24,979	20,108	4.54	4,871	5.55	24,979	4.71
81-90%	28,037	22,663	5.12	5,374	6.12	28,037	5.29
91-100%	107,116	86,367	19.51	20,749	23.64	107,116	20.19
total	530,424	442,646	100.00	87,788	100.00	530,434	100.00