Breakout Report Back:

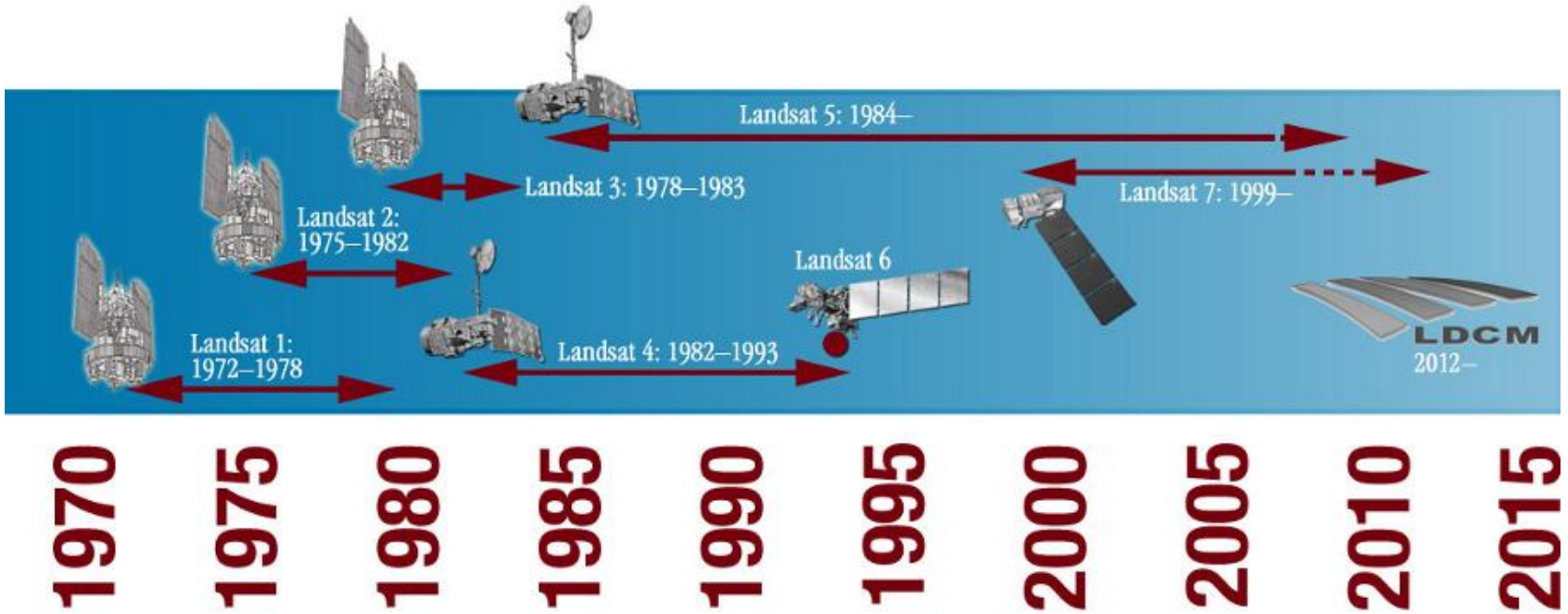
LCLUC Science Needs for higher order Landsat Products

(focusing on LDCM era)

Since January 2008, the USGS has been providing free Landsat data via the Internet

- Processed as Level 1 terrain corrected (L1T) data
  - standard GeoTiff format
  - Universal Transverse Mercator map projection with WGS84 datum
  - radiometric calibration
  - systematic geometric correction, precision correction using ground control chips, and the use of a digital elevation model to correct parallax error due to local topographic relief.
- This L1T systematic radiometric and geometric processing is important as it provides a consistent data set needed for reliable surface monitoring and to establish trends.

Want a long term Landsat data record of higher level products

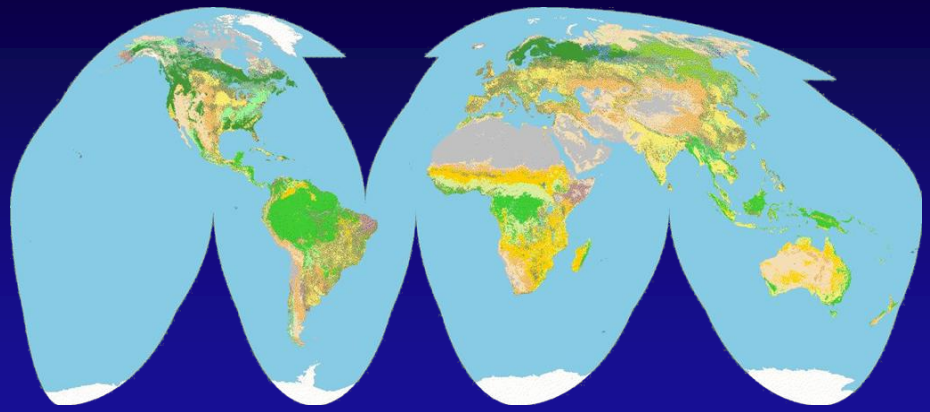


USGS Interests in Advanced Landsat Products

- There has been a change in USGS interest
- At the first Landsat Science Team meeting, USGS HQ presented a “single product” policy
- Increasing interest in higher-level Landsat products
  - ECV’s for climate research
  - applications
- Boston LST meeting: Oct, 2009

Terrestrial ECV's

Terrestrial ECV
River Discharge
Water Use
Ground Water
Lake Level
Snow Cover
Glaciers and Ice Caps
Permafrost
Albedo
Land Cover
fAPAR
LAI
Biomass
Fire Disturbance



Essential Climate Variables (ECVs) are variables that are currently feasible for global implementation for the global climate observing system, and have high impact on the UNFCCC and IPCC requirements.

USGS

Higher Level Product Processing Pre-requisite

- Systematic, consistent, community endorsed data processing needed in order to enable higher level bio/geophysical and LCLU product derivation
  - Calibration [L1T]
  - Geolocation [L1T]
  - atmospheric correction
  - BRDF correction
  - Cloud mask
  - Snow mask
  - (SLC-off gap filling for ETM+)
  - Per pixel QA for all
- Individual path/row acquisitions UTM+ projection
- Composited data product mosaics in global & continental projections
  - using all the Landsat data, not just select acquisitions
  - processed shortly after acquisition i.e. “near real time”
  - global coverage every month ? Every 16 days ?

What Higher Level Products ?(and what can be done with Landsat record ?)

- pan-sharpened multi-spectral band - E
- Surface Reflectance - E
- Cloud - E
- Cloud & Relief Shadow - E
- Water Mask - E
- NDVI / EVI - E
- LAI, fPar - E
- Snow/ Ice - E
- Burned Area - M
- Land Cover – discrete & percent – M, Q, A
- Land Cover Change – at least A
- Phenology (metrics) - A

What Higher Level Products ?(and what can be done with Landsat record ?)

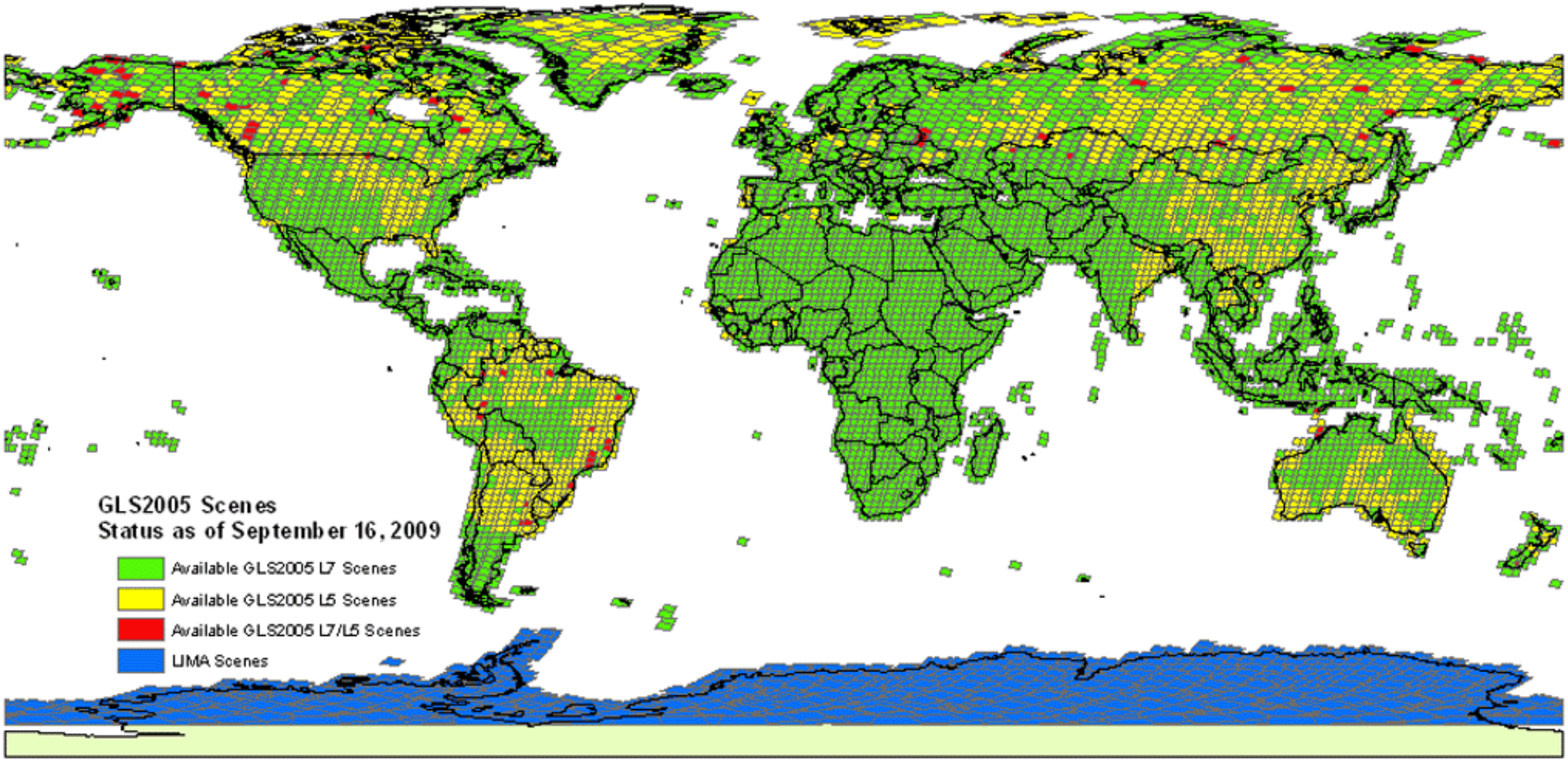
- Recognize that certain higher level products require other data (fusion/calibration/integration) to generate reliably
  - ET - E
  - Surface Temperature - E
  - Albedo/BRDF - E
  - Active Fire - E
  - Soil moisture – E
  - Live and dead veg. moisture - E
  - Crop type (M) & Crop health (E)
  - Biomass inc. cellousoic ethon biomass- E

What Higher Level Products ?(and what can be done with Landsat record ?)

- Must allow temporal comparison / change

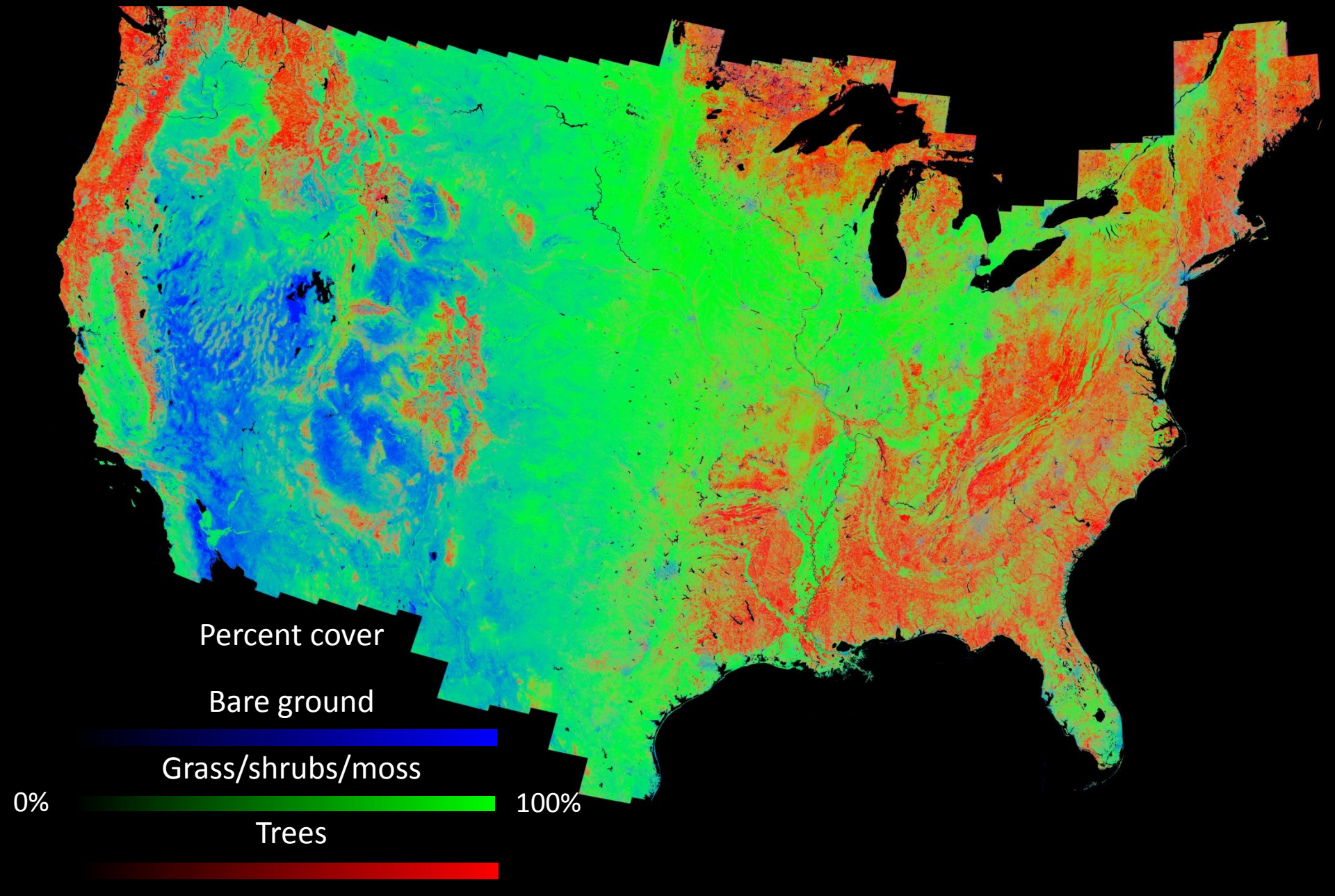
- Land Cover & Change
  - Post classification change detection != change product
  - Landsat resolution affords object-oriented classification improvement – e.g. urban
  - Hierarchy of temporal reporting intervals for higher level products

Implementing the LAI process globally with GLS 2005 data



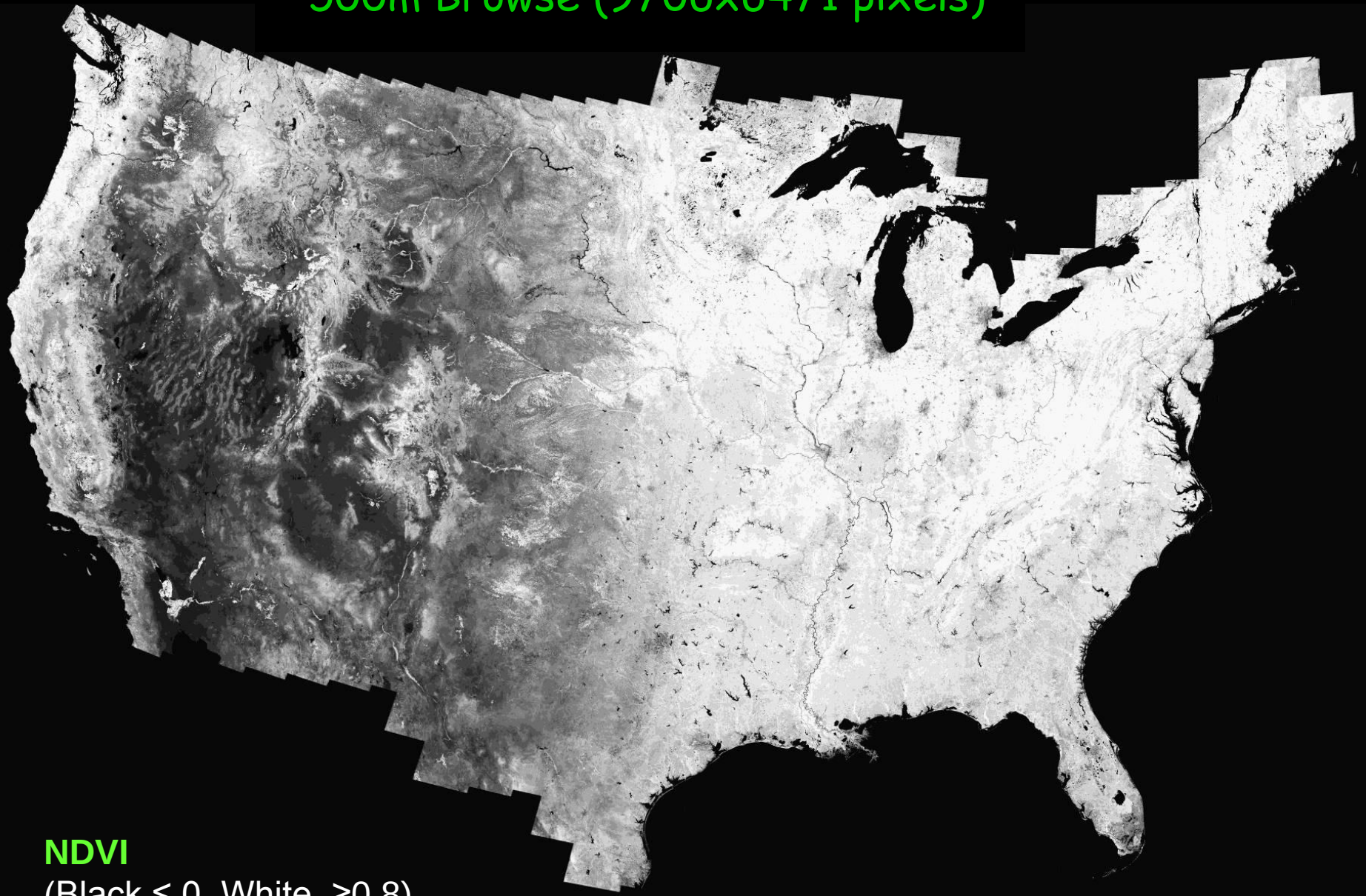
Rama Nemani

WELD 30m Vegetation Continuous Fields, 2008



Annual 2008

500m Browse (9706x6471 pixels)



NDVI

(Black ≤ 0, White ≥0.8)

USGS Meeting Expectations

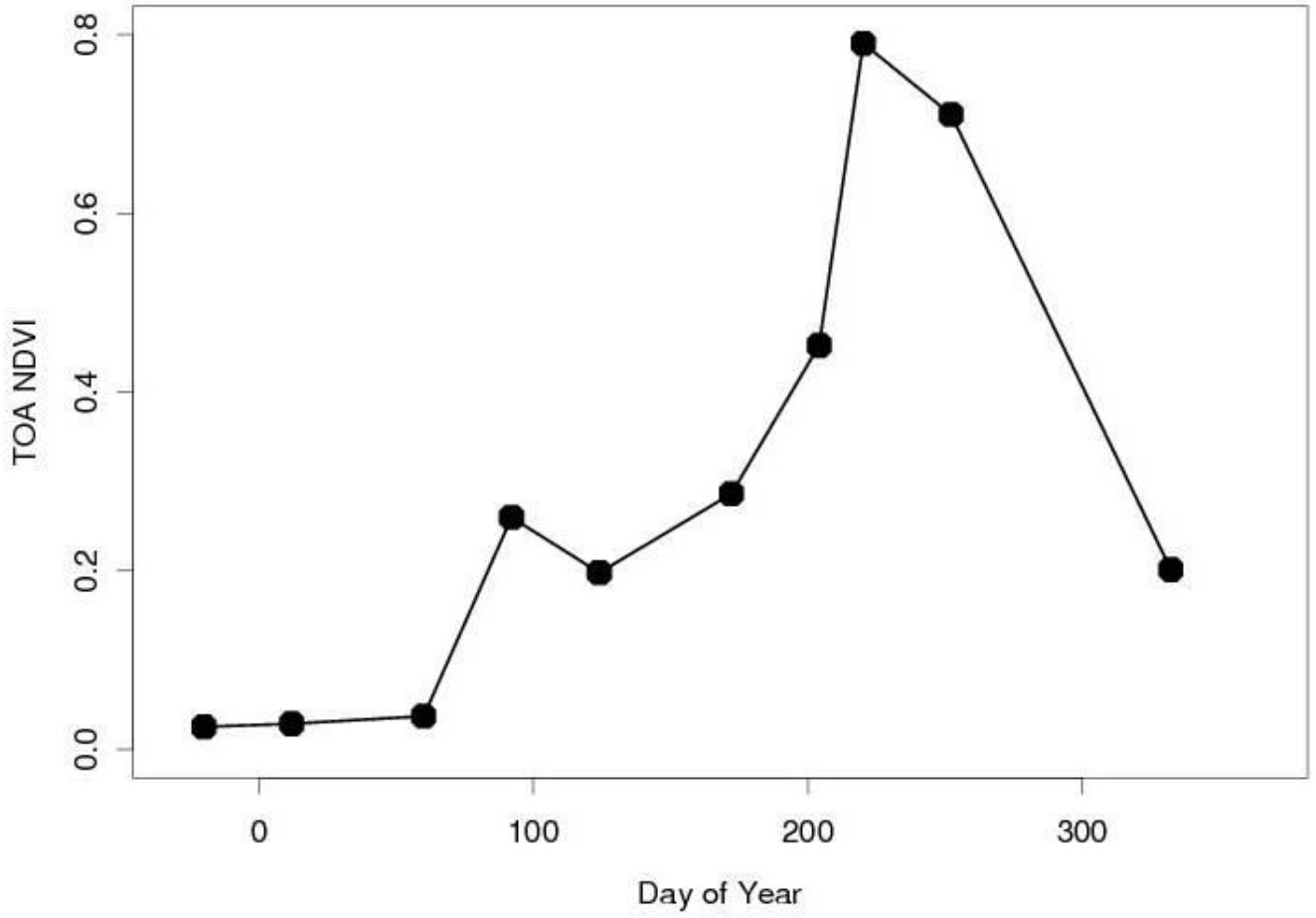
- Identify the state of the science for producing surface reflectance Landsat products
- Determine our readiness to produce prototype surface reflectance products
- Determine priorities for future ECV production

Slide: Tom Loveland

Landsat Phenology:

1 year NDVI for a single 30m WELD pixel extracted from 12 monthly composites

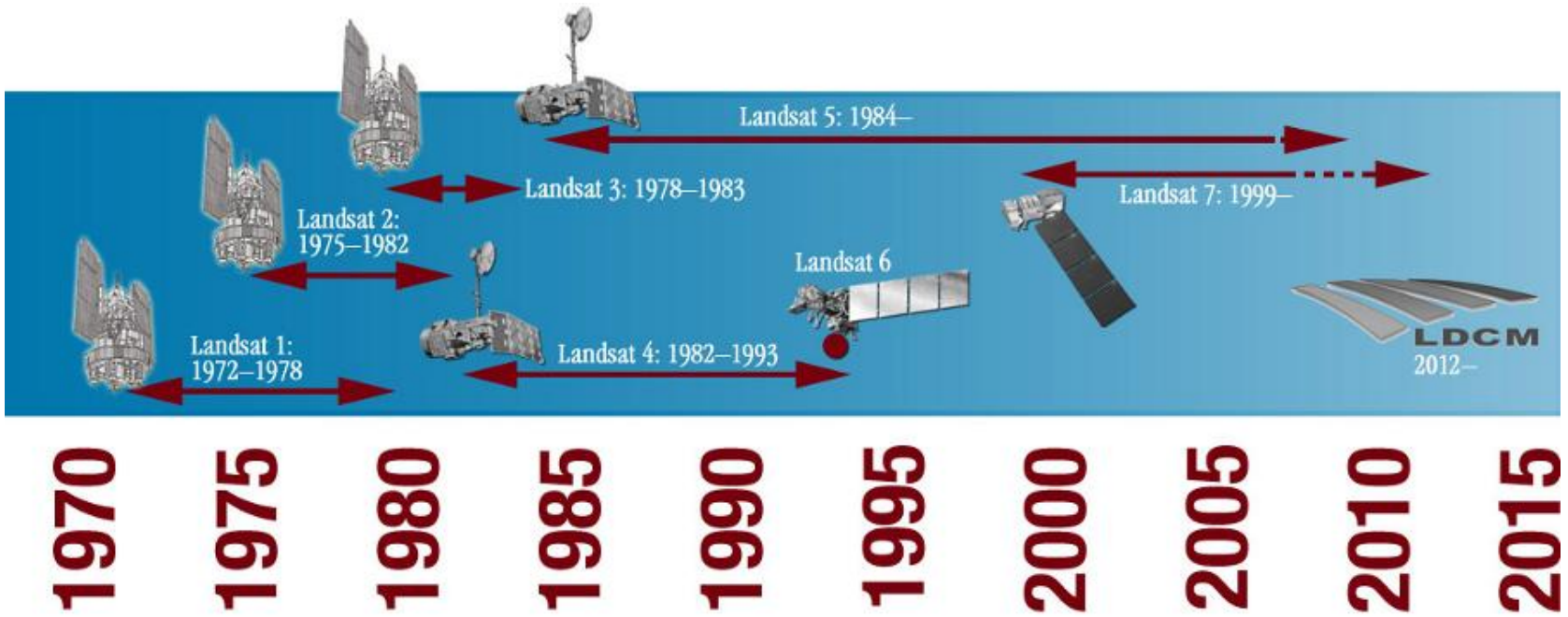
Brookings, Agricultural Field, SD



2006 NASA white paper describing the science needs for the *Land Cover/Land Cover Change ESDR*

- provision of a multi-temporal radiometrically and geometrically high quality data stream of surface reflectance measurements that capture landscape phenology
- reducing the cost of multi-temporal high spatial resolution satellite data
- access to consistent training/validation data
- an integrated suite of multi-resolution products that bridge sensor attributes and mission lifetimes.
- The Global Land Survey (GLS) datasets 1975, 1990, 2000, 2005 and 2010 only partly meet the above needs

Want a long term Landsat data product record of higher level products



Derived Higher Level Landsat data products for free

- available over the internet
- provision of data on media to support developing countries ?