



USGS Plans for Landsat Science Products

Landsat Science Team Meeting - March 3, 2011

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Synthesis of Boston Science Team Discussions on Products



General Product Priorities & Considerations

- **Surface Reflectance (foundational, endorsed, in progress)**
 - LEDAPS for scene-based
 - WELD for composites
 - Note: Hybrid approach is feasible as branch in algorithm when better (e.g. MODIS) ancillary data is available
- **Land Surface Temperature (foundational, endorsed, in progress)**
 - Scene-based
 - NASA FY11 support, USGS FY 12-13 support
- **Land Cover (foundational, endorsed, development TBD)**
 - Upstream dependencies on Surface Reflectance composites from WELD
 - Two needs – LCOV for end-user (more complex), LCOV for modeling/algorithm stratification (simpler)
- **LAI / fPAR (in progress)**
 - Would benefit from 30m Land Cover
 - Scene is building block, can consider composites, but be cognizant of phenology



Specific Near-Term Recommendations

- **Surface Reflectance**
 - **USGS should continue developing a Surface Reflectance production capability based on the LEDAPS atmospheric correction approach**
 - **USGS should stay in sync with LEDAPS algorithm refinements and code changes**
 - **USGS should establish a plan to generate and provide Surface Reflectance scenes for both internal and external validation and evaluation**
 - **Once validation and evaluation needs are met, USGS should bring the results together in a workshop**



Background

- USGS considers climate data records (CDRs) and essential climate variables (ECVs) necessary for terrestrial monitoring
- Advocacy and encouragement by Landsat Science Team
- USGS interests and efforts would be complementary to NOAA CDRs and useful in validating GOES-R advanced baseline imager (ABI) data products
- Geography Science Centers were directed to initiate a strategy for developing Landsat-based CDRs and ECVs
- CEOS Working Group on Climate considers Landsat important for the development and validation of terrestrial ECVs



USGS ECV Science Strategy

- Respond to requirements for quantitative information on land surface change
- Intended to inform USGS Programs and Projects and solicit feedback – eventually distributed for broader review and comment
- Address the needs of Federal science and land / resource management programs
- Responsive to international program needs (GCOS) for higher level satellite data products
- Leverage previously demonstrated capabilities from NASA research missions (e.g. MODIS) through collaborative partnerships
- Work with the Landsat Science Team to develop capabilities and perform product validation
- Conduct initial product evaluation through USGS and DOI projects



Status of USGS Landsat Science Data Processing

- EROS Science Processing Architecture (ESPA) framework development – modular design of science computing capabilities with scalable capacity
- Leverage existing EROS enterprise capabilities for data access (Landsat online cache), storage and distribution (LP DAAC and the Long Term Archive)
- LEDAPS software integration into ESPA – will use the new version of LEDAPS to establish baseline
- Implementation of WELD distribution system and Version 1.5 data for 2006 – 2010



Partnerships

- Web Enabling of Landsat Data (WELD) – David Roy, South Dakota State University
- Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) – Jeff Masek, Feng Gao (NASA GSFC), and Eric Vermote (UMD)
- Deriving Biophysical Products (LAI, fAPAR) from Landsat Data – Rama Nemani, NASA Ames Research Center
- Land Surface Temperature – John Schott (RIT) and Simon Hook (JPL)



Initial Focus

- Surface reflectance – LEDAPS and WELD
- Land Surface Temperature – funded by NASA LcPSO in FY11, USGS to assume funding support in FY12-13
- Land Cover – Global 30 meter initiative
- Strengthen role of Landsat Science Team collaboration



Near-term Plans

- Perform Initial Product Validation
 - Adopt methods and complement existing work (Vermote, Huang)
 - AOT retrievals vs. Aeronet
 - Surface reflectance retrievals vs. field data (vicarious calibration sites)
 - Up-scaled product comparisons to MODIS daily surface reflectance (MOD09)
 - NEON airborne observation platform
- Applications performance testing and evaluation
- Develop a “Quick Guide” to Products
 - WELD and LEDAPS product summaries
 - Links to WELD and LEDAPS data access and documentation



Near-term Plans

- Perform on-demand processing for evaluation by select users
 - EROS scientists
 - USGS Science Centers
 - Landsat Science Team
 - LP DAAC User Working Group
 - Existing users of LEDAPS software and products
- Solicit feedback on products
 - Fitness for use – extent to which products successfully meet the needs of end users
 - Benefits over standard L1T data
 - Description of methods used for validation / evaluation



Near-term Plans

- Characterize product quality and levels of service
 - Sufficiently free of error for needs? (e.g., accuracy, anomalies, artifacts...)
 - Sufficient specifications for needs? (e.g., file format, bands/parameters/processing level, precision/scaling/bit depth, temporal/geographic coverage)
 - Sufficiently documented for needs? (e.g., metadata expectation, easily interpretable documentation)
 - Sufficiency of access for needs? (e.g., ease of retrieval, timeliness)
- Instructions for placing orders for surface reflectance products
- User Workshop opportunity: Pecora 18, November 14-17

WELD WYSISWYG – Years 2006 - 2010

CONUS 2009

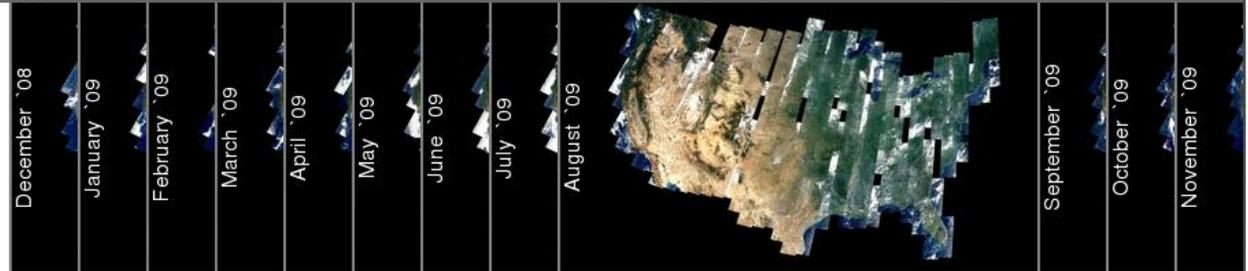
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155 users from 11 countries have placed >10,000 orders

Annual & Seasonal



Monthly



Weekly



| Maturity | Sensor Use | Algorithm stability | Metadata & QA | Documentation | Validation | Public Release | Science & Applications |
|-----------------|--|---|---|--|---|---|---|
| 1 | Research Mission | Significant changes likely | Incomplete | Draft ATBD | Minimal | Limited data availability to develop familiarity | Little or none |
| 2 | Research Mission | Some changes expected | Research grade (extensive) | ATBD Version 1+ | Uncertainty estimated for select locations/times | Data available but of unknown accuracy; caveats required for use. | Limited or ongoing |
| 3 | Research Missions | Minimal changes expected | Research grade (extensive); Meets international standards | Public ATBD; Peer-reviewed algorithm and product descriptions | Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood. | Data available but of unknown accuracy; caveats required for use. | Provisionally used in applications and assessments demonstrating positive value. |
| 4 | Operational Mission | Minimal changes expected | Stable, Allows provenance tracking and reproducibility; Meets international standards | Public ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed algorithm and product descriptions | Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood. | Data available but of unknown accuracy; caveats required for use. | Provisionally used in applications and assessments demonstrating positive value. |
| 5 | All relevant research and operational missions; unified and coherent record demonstrated across different sensors | Stable and reproducible | Stable, Allows provenance tracking and reproducibility; Meeting international standards | Public ATBD, Operational Algorithm Description (OAD) and Validation Plan; Peer-reviewed algorithm, product and validation articles | Consistent uncertainties estimated over most environmental conditions by multiple investigators | Multi-mission record is publicly available with associated uncertainty estimate | Used in various published applications and assessments by different investigators |
| 6 | All relevant research and operational missions; unified and coherent record over complete series; record is considered scientifically irrefutable following extensive scrutiny | Stable and reproducible; homogeneous and published error budget | Stable, Allows provenance tracking and reproducibility; Meeting international standards | Product, algorithm, validation, processing and metadata described in peer-reviewed literature | Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation | Multi-mission record is publicly available from Long-Term archive | Used in various published applications and assessments by different investigators |



Vision for the Future

- Provide on-demand processing of archive data to scene-based higher level products (surface reflectance, surface temperature) for all Landsat TM and ETM+ data by launch of Landsat 8
- Operational Processing of WELD composites – extend capability to process all TM and ETM+ data for the U.S. and the globe
- Global land cover – annual continuous fields and 5-year thematic classifications
- Incorporation of algorithms / software in ESPA framework for other products (LAI)



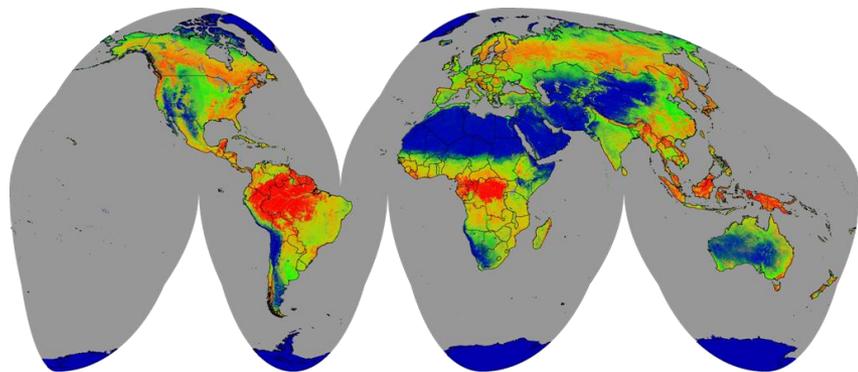
GEO Global Land Cover (GLC) Initiative

- Develop an initial global land cover baseline for the 2010 period
- Implement an ongoing monitoring system that provides annual land cover updates – including change.
- Establish capability and capacity to develop historical land change time series

- The products must:
 - Meet the needs and standards of the GEO community
 - Use the best available remote sensing science
 - Be implemented and sustained through an international network:
 - European Commission Joint Research Centre
 - National Geomatics Center of China
 - Brazil INPE
 - Geosciences Australia
 - Others to be determined

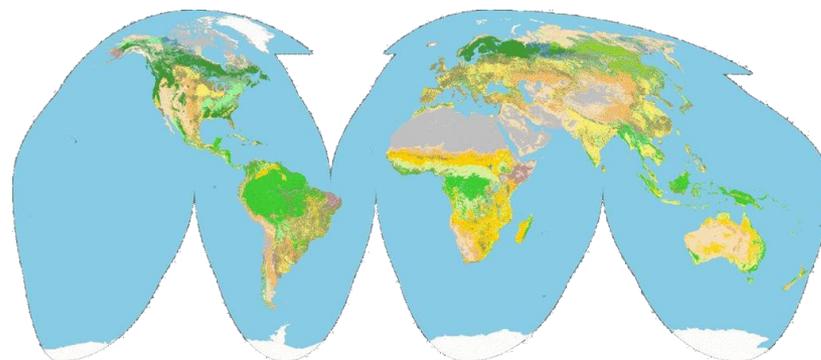


GEO Global 30m Land Cover Products



Annual land cover continuous variables

- Quantitative annual continuous measures of per pixel percent tree, shrub, herbaceous, water, snow/ice, and barren cover.
- Change products



Mid-decadal year land cover types

- Land cover categories (TBD) consistent with FAO Land Cover Classification System (LCCS)
- Maps and statistical estimates of major land cover types
- Complementary with other global land cover products (e.g., MODIS land cover, Globecover)