Deriving biophysical products from LANDSAT

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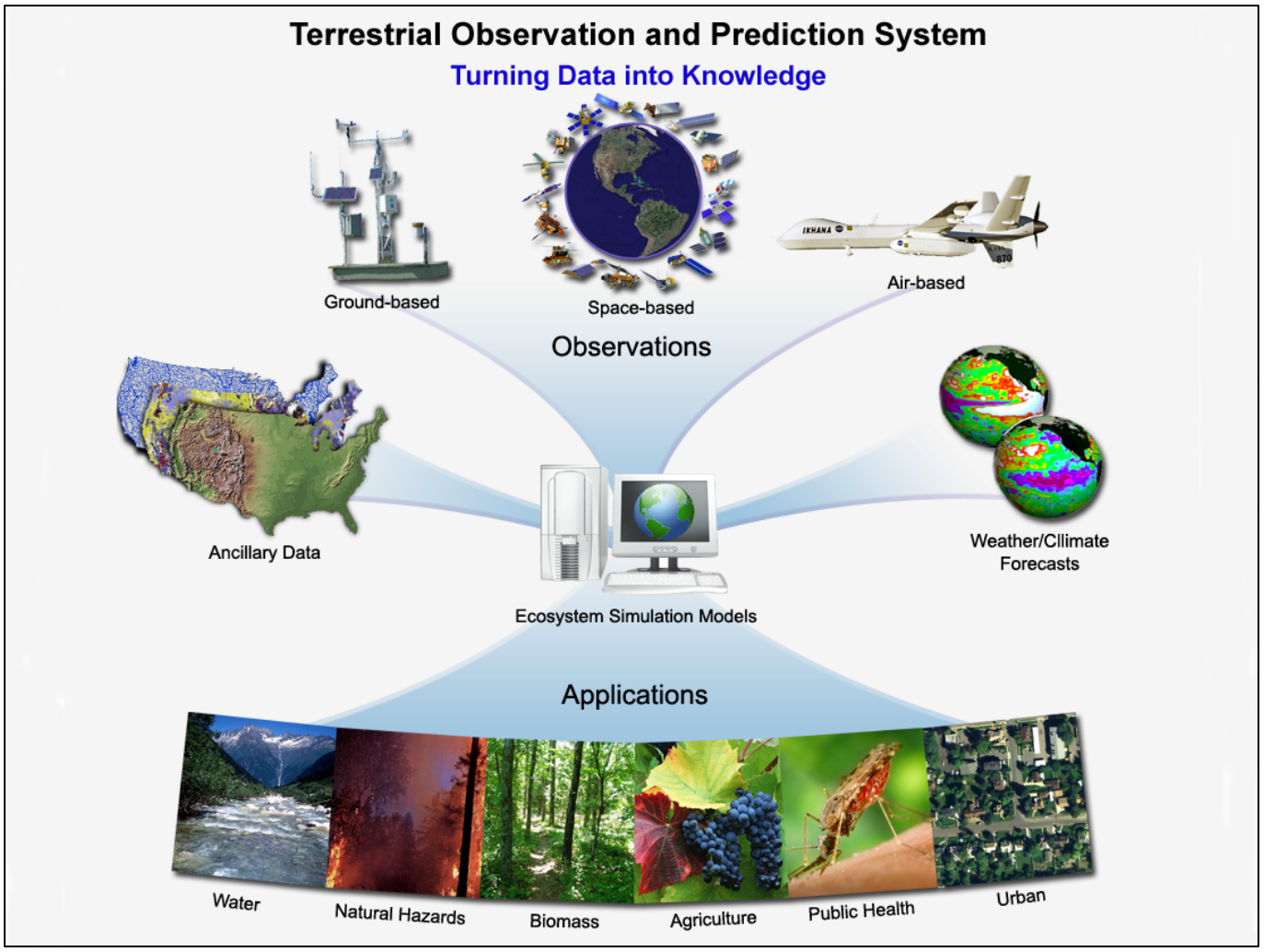
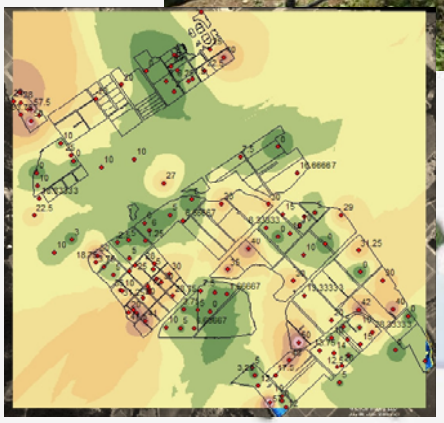
Presentation Outline

- Modisizing Landsat
- Community collaborative
- Prototyping Landsat Biophysical Products
- Leaf Area Index
- Landsat processing pipeline
- Technical challenges
- Potential benefits to LST

Need for MODISizing LANDSAT



- ✓ Monitoring
- ✓ Modeling
- ✓ Forecasting
- ✓ Local to global scales
- ✓ Emphasis on biogeochemical cycles



Ancillary Data

VSIM Model

Inputs
Climate: ETo, PPt, T
LAI:NDVI
Soils: Geophys. Data

Vine ET
ETv = ETo * kv

Vine Water Stress = f(Soil Moisture)

Data

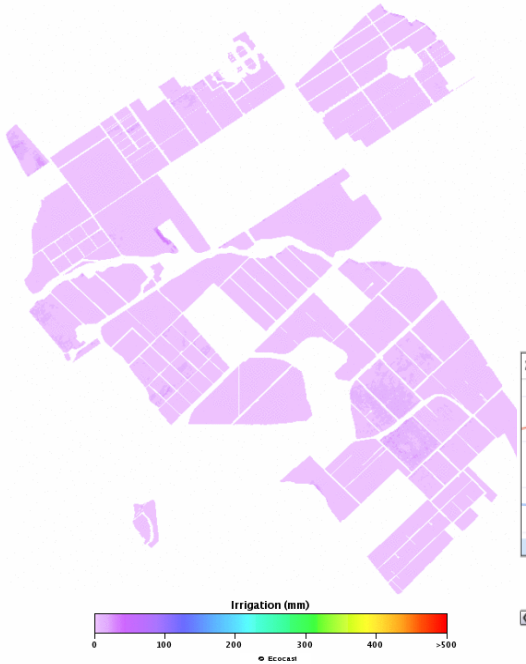
Water

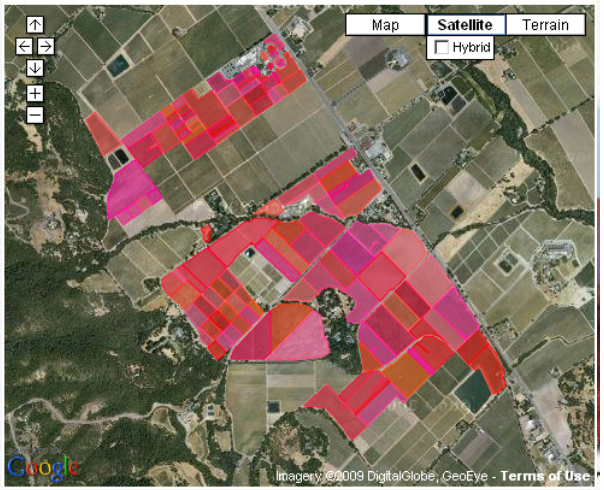
Cover Crop ET
ETc = ETo * kc

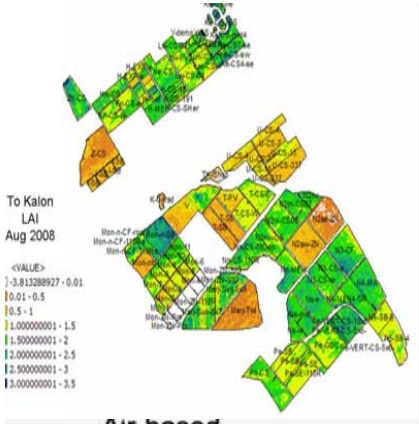
Soil Moisture = Precip + Irrig – ET - Runoff

Runoff = SM - SWHC

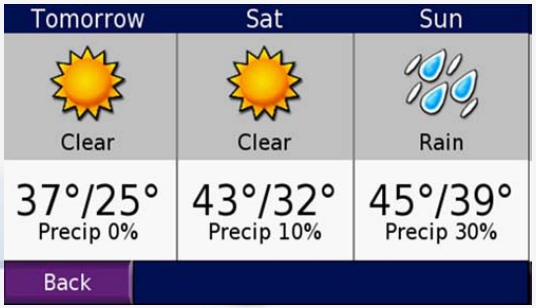
Cumulative Irrigation As Of July 01, 2007







Air-based

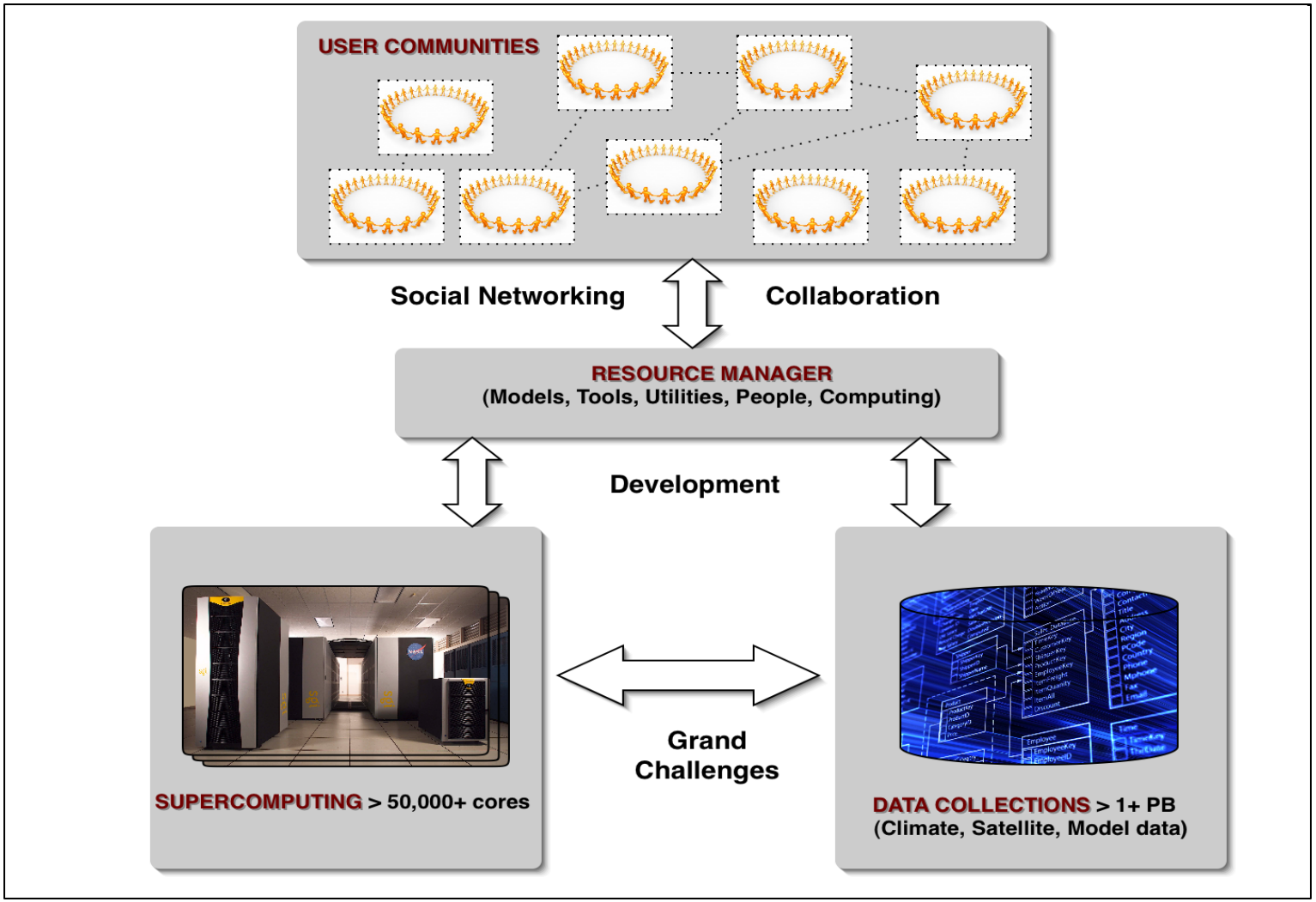


Weather/Cllimate Forecasts

TOPS Collaborative

- Project Goal:
  - *To improve availability of Earth Science data, models, analysis tools and scientific results through a platform that fosters knowledge sharing, collaboration, innovation and direct access to compute resources.*

TOPS Collaborative



TOPS Collaborative Resources

- **Computing**
  - Supercomputing and storage through NASA Advanced Supercomputing Division (NAS)
  - Almost 3PB storage, 512 - 8,000 CPU cores
- **Data**
  - MODIS, AVHRR, Landsat, GCM Scenarios, weather data, etc.
- **Models**
  - Publicly available models
- **Software Utilities**
  - Open source and commercial (pending licensing)
- **Web Portal**
  - Based on DASHlink social network site

Community Modeling Portal

- Social networking component based on NASA DASHlink system
- Users can search for related activities
  - Who is doing what where?
  - Map interface
    - Categorized by discipline
    - Categorized by geographic region
- Users can create projects and link to other projects
- Users can control the visibility of their project
- Users can control access to the project and the level of sharing
- Users can share algorithms, data, knowledge

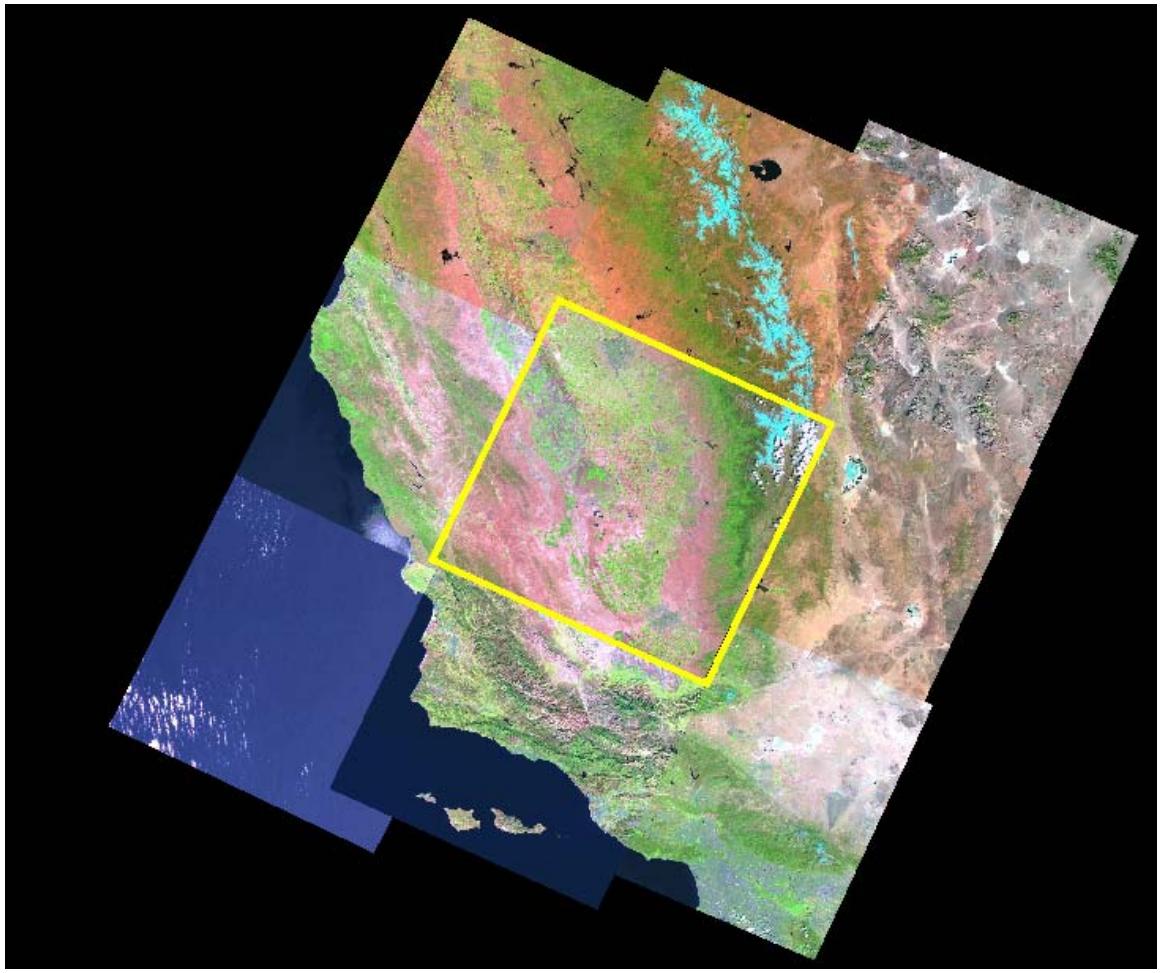
Example Usage

- User registers and specifies resource requirements:
  - Data, tools, models and computing resources
- A custom environment is created containing the requested resources
  - Within this environment user can:
    - Run existing models
    - Bring in new data, models, and algorithms
    - Extend existing models
    - Share models and data with community
    - Provide access to the results and the environment
- When work is completed resources are recycled
  - The specific environment (including models, data, etc.) can be completely saved and reloaded and re-run in the future reproducing the results

Agency Benefits

- Significantly reduces costs associated with scientific efforts using NASA assets
- Increase in usage of NASA data and models will provide improved return on investment in both past and future research activities such as the Earth Observing System or the Decadal Survey missions
- Provides a lower barrier of entry especially among climate change impact modeling groups with significant societal benefits

Prototyping Landsat Biophysical Products



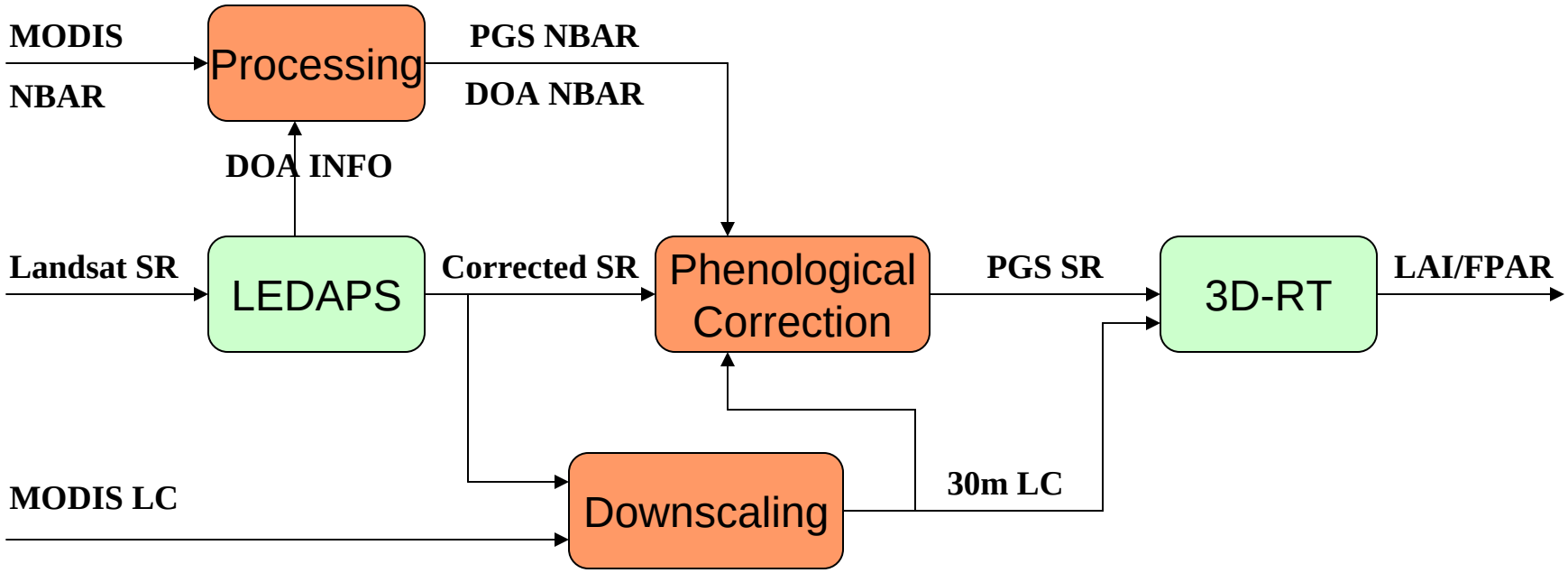
Leaf Area Index (area of leaves per
unit ground area)

Follow MODIS approach

- Surface Reflectances
- Land Cover
- LAI Look-Up-Tables

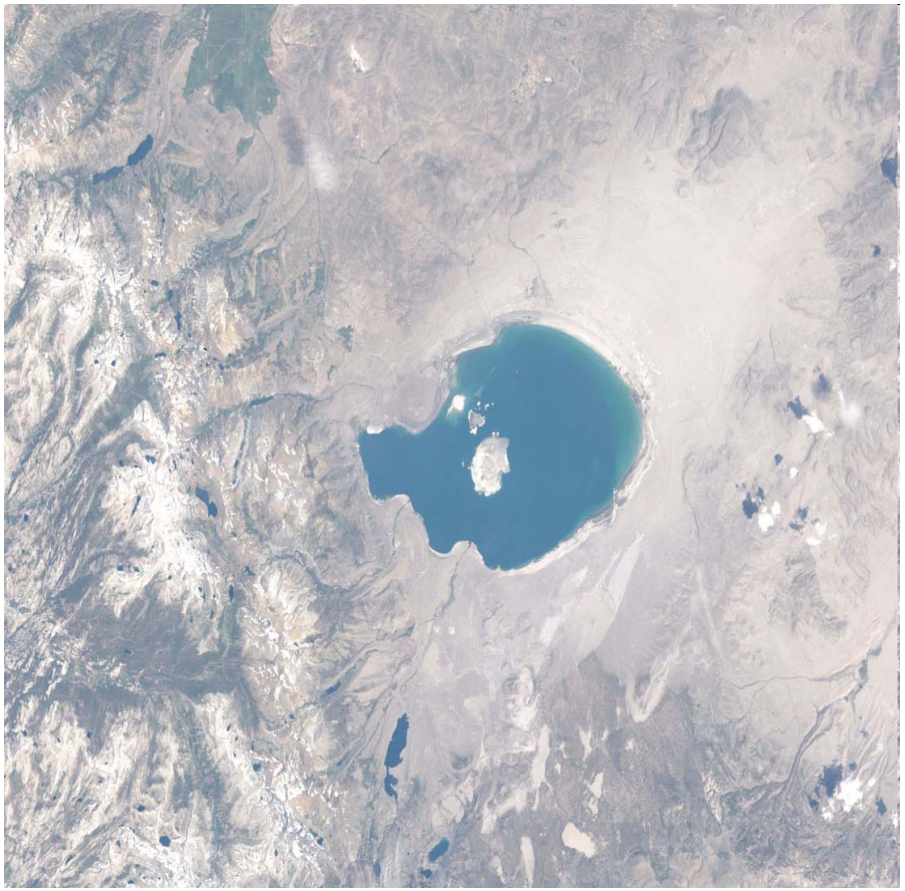
Conceptual processing pipeline, GLS 2000

- Adjusting DOA (date-of-acquisition) Landsat SR to its PGS (peak-growing-season) level by means of spectral mixing with MODIS NBAR data;
- Deriving 30m LC information based on MODIS LC map and Landsat SR characteristics.



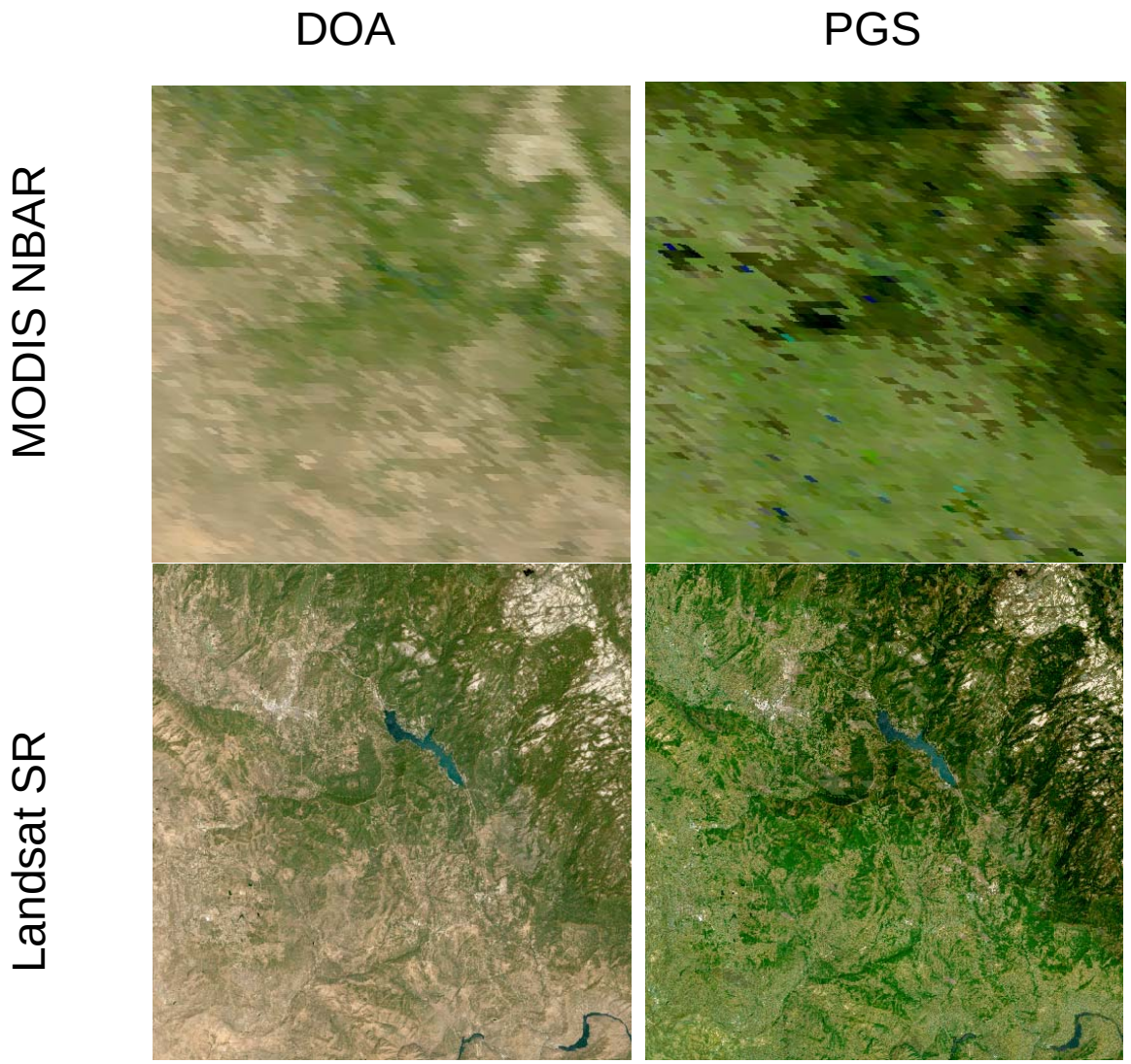
LEDAPS Atmospheric Corrections

Before

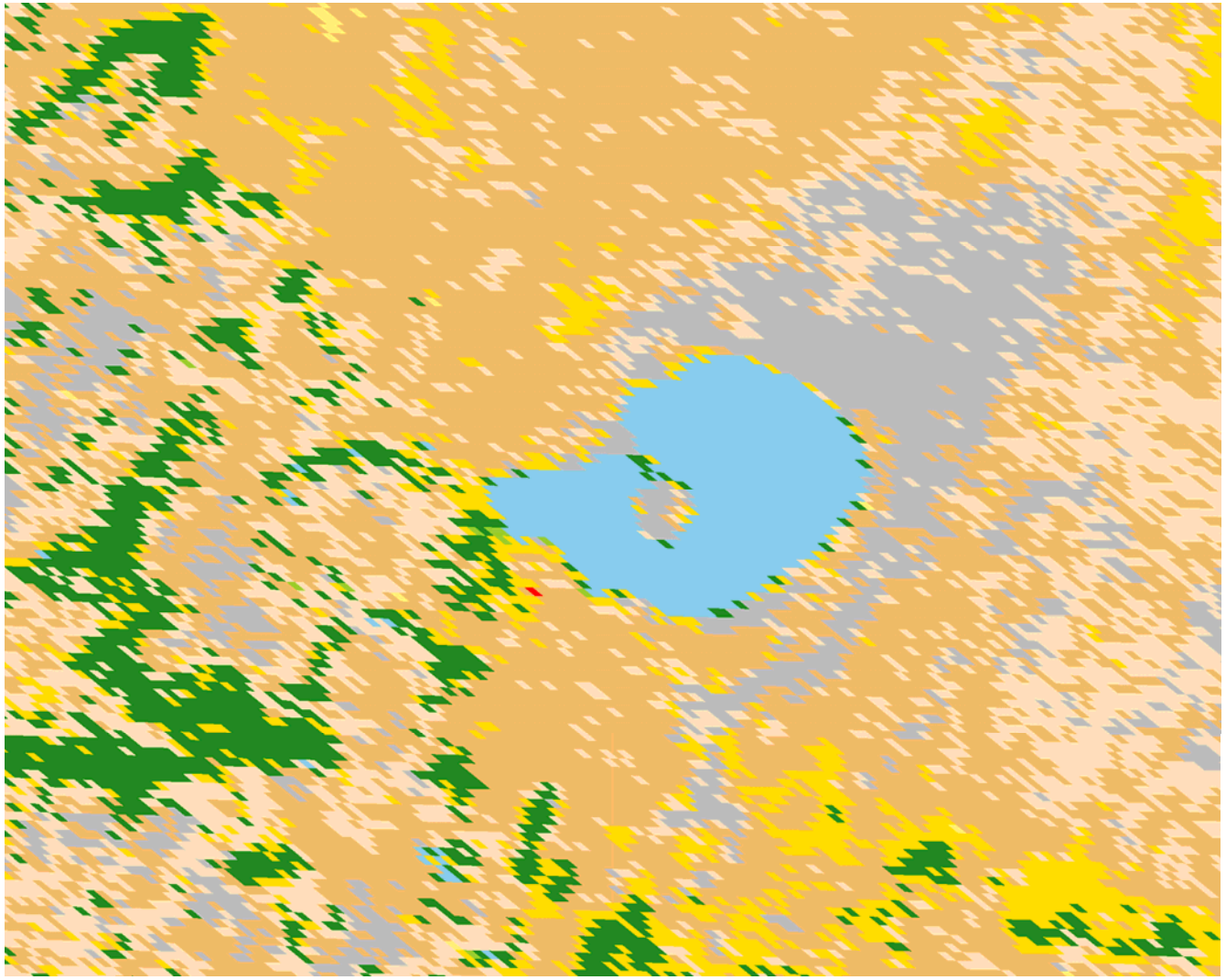


After

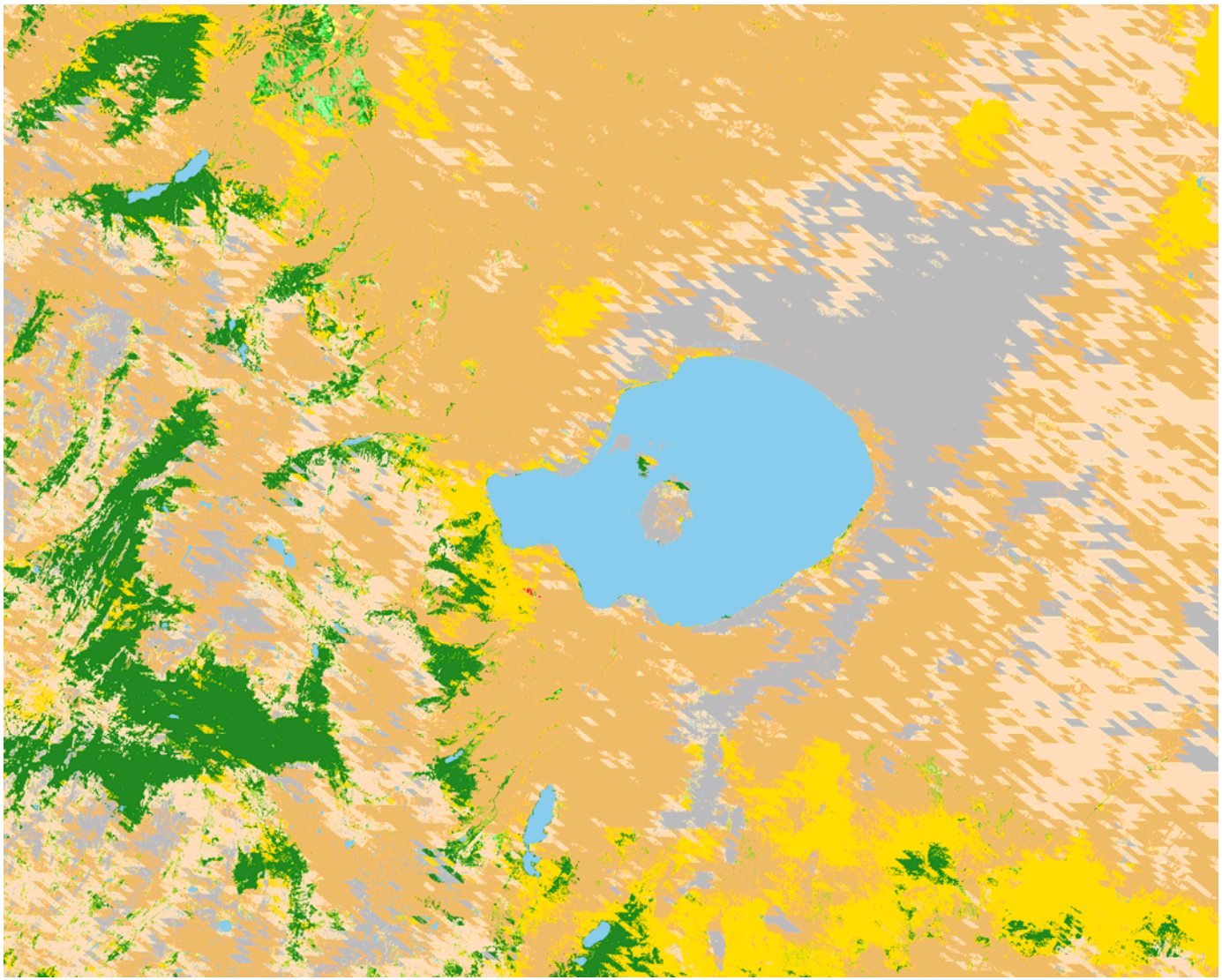
Phenological Adjustment of Landsat SR



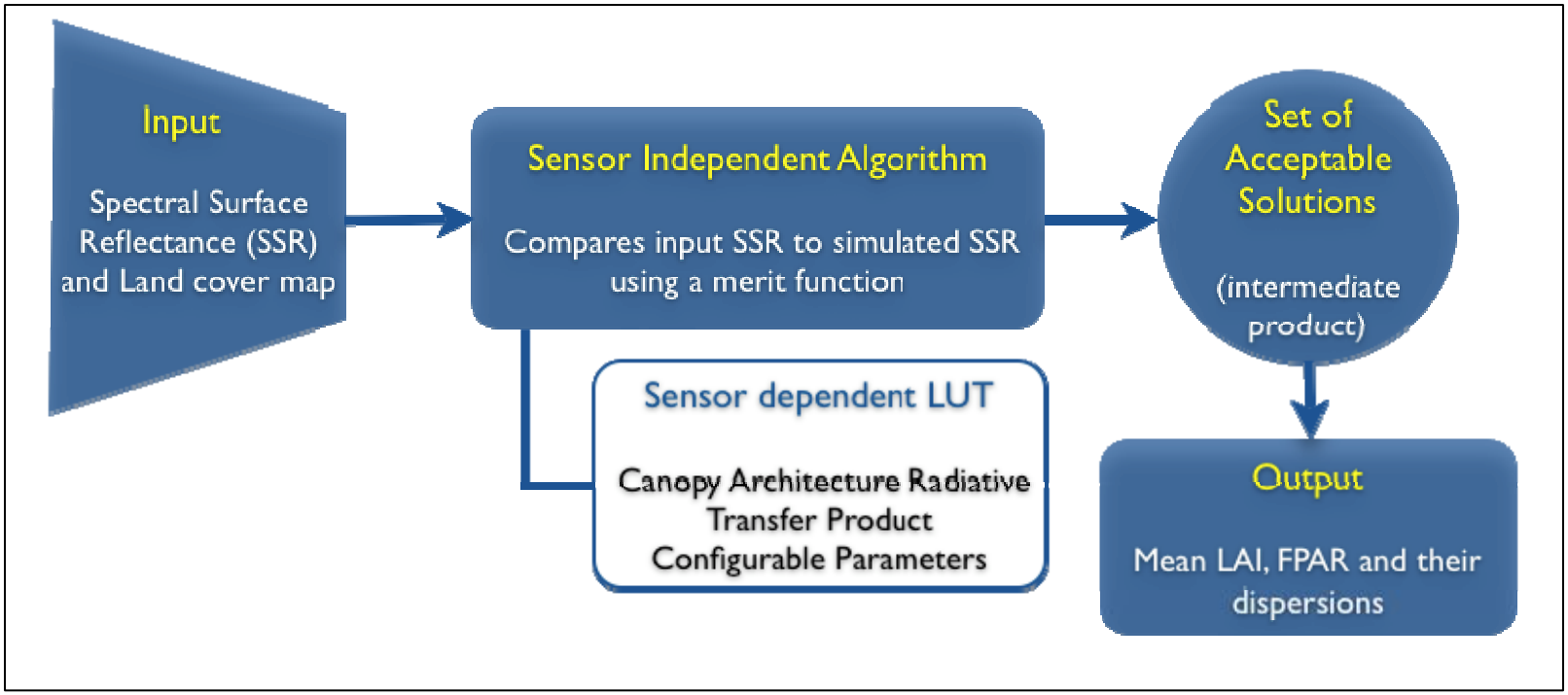
MODIS 500m Landcover



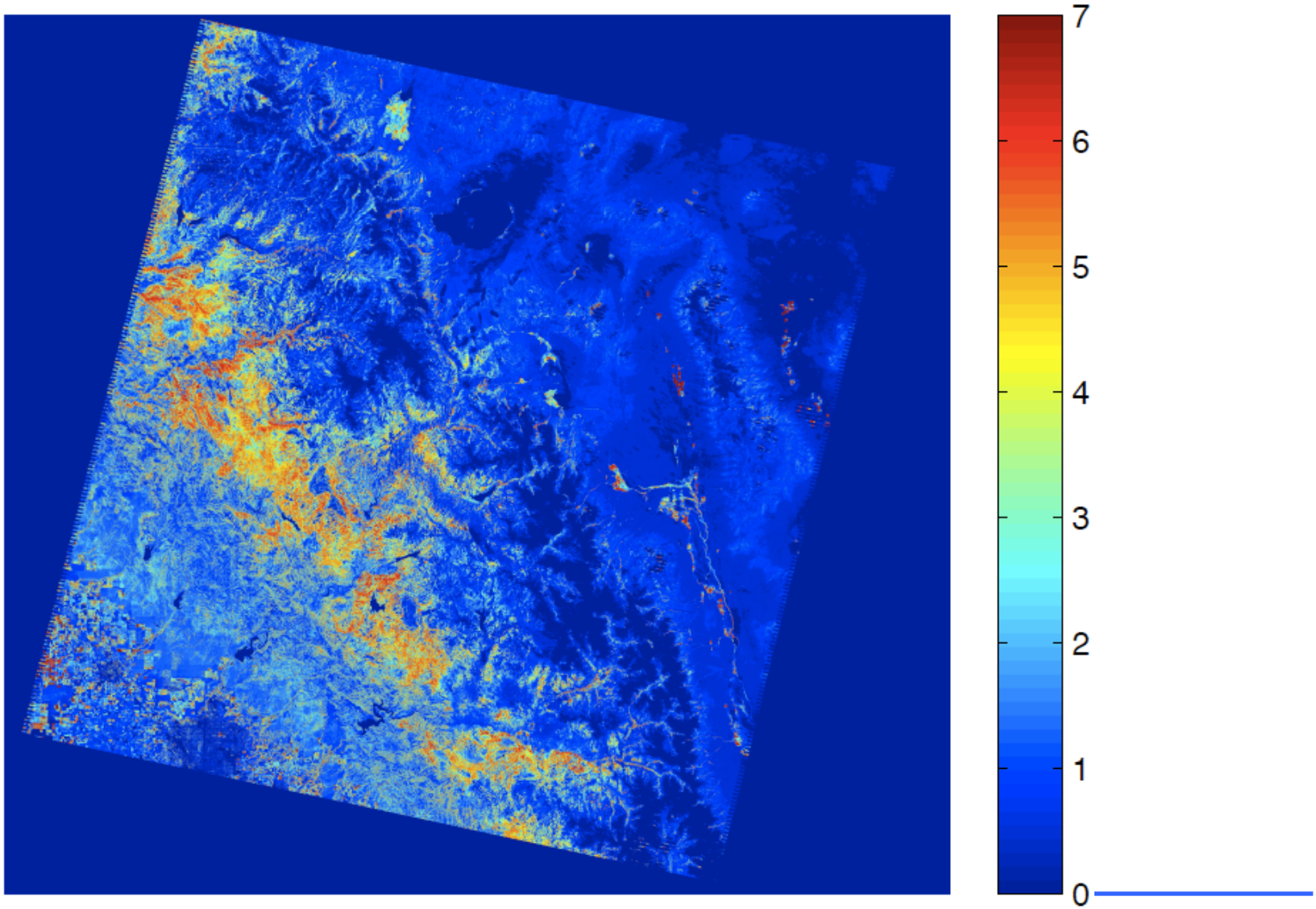
30m Land Cover downscaled from MODIS 500m



LAI Process Overview

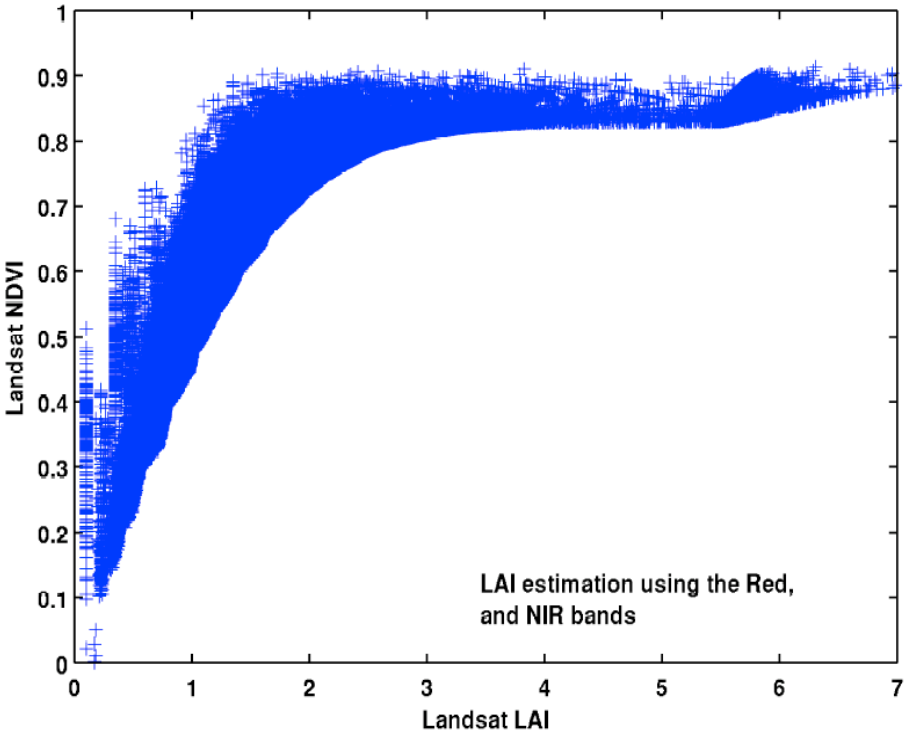


Landsat 30m LAI using MODIS LAI LUT

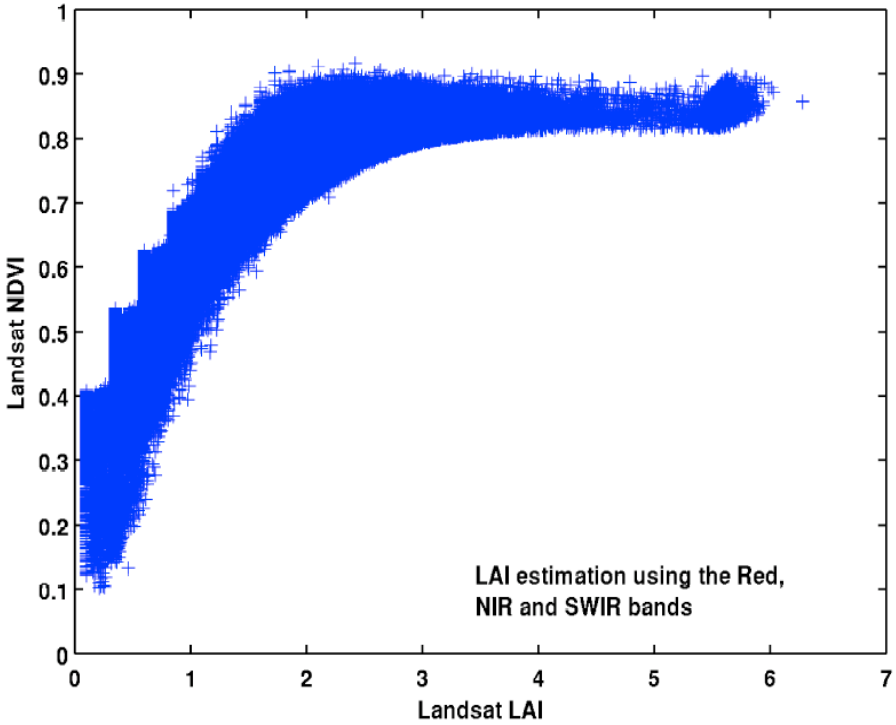


NDVI vs. Retrieved LAI

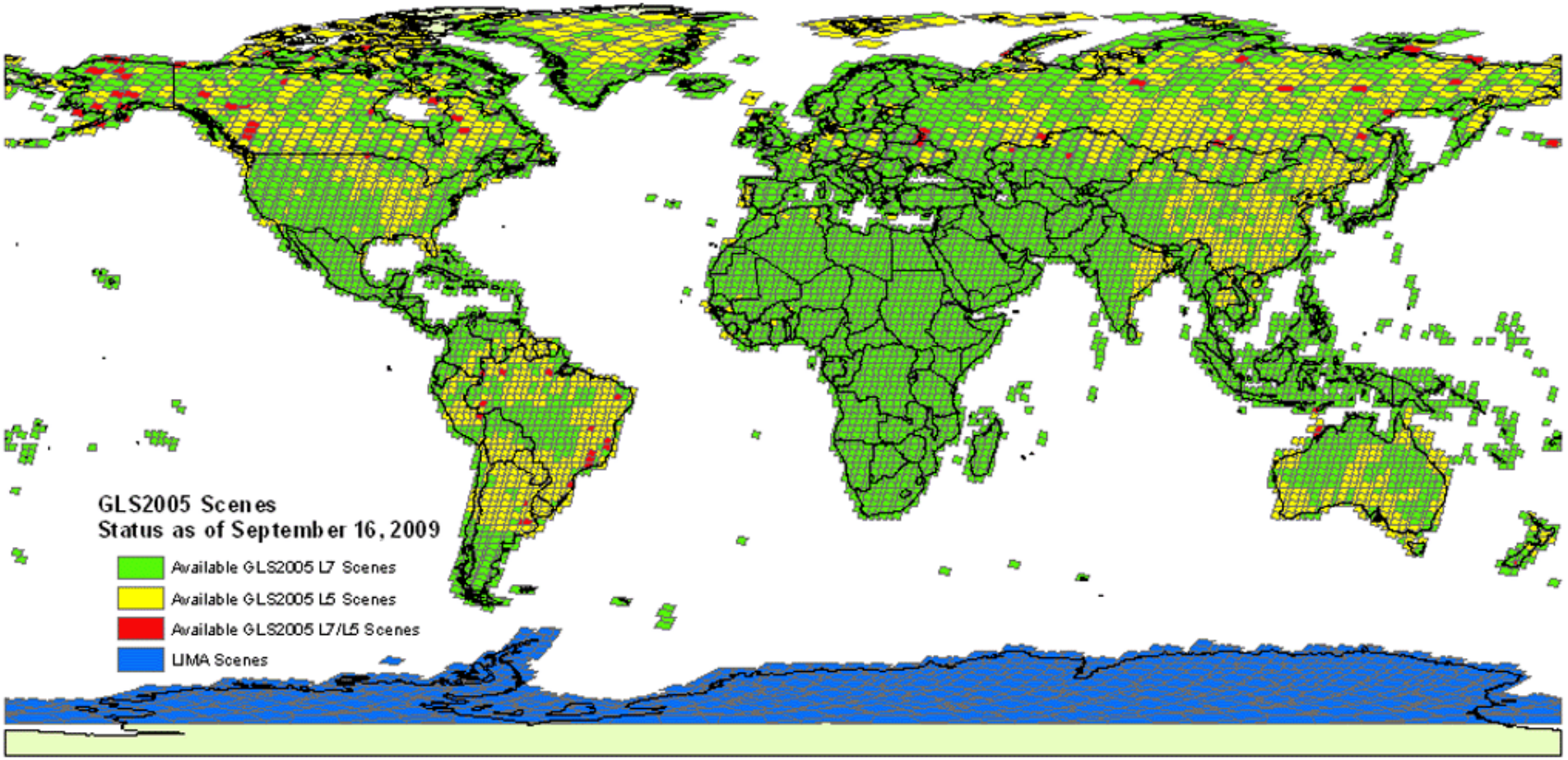
Red, NIR



Red, NIR and SWIR



Global LAI Mapping with GLS 2005



Landsat Processing Pipeline

- A workflow that integrates Landsat processing steps from Data Acquisition to LAI production
- Automated from LEDAPS execution to LAI
- Not automated:
  - Landsat Data Acquisition - especially bulk orders

Status

- Processed about 9,000 GLS scenes
  - GLS2005
  - Global LEDAPS run
- Tested end-to-end pipeline on subset of the dataset
  - After tests are completed, run the entire process globally

Technical Challenges

- HDF file-size limits prevents creation of larger MODIS mosaics which causes some inconvenience
  - In the future possibly re-work the components to use HDF5
- No direct implementation of HDF-EOS in Python
  - Must use additional metadata to produce HDF-EOS files required for the processing - done!
- Discovered bug in MODIS Reprojection Tool when used on float64 datasets
  - Fixed and patch submitted to the MRT team.
- Slow network for large data transfers from EDC
  - Currently shipping entire disks

Community Input

- QA strategy
- Process components refinements/improvements
- Validation
- Distribution

Potential Benefits of the Collaborative to LST

- A valuable resource for LDCM algorithm development and testing
- Can support experimental global processing/product generation
- Facilitates community participation
- Rapid turn around in support of efforts such as the LandCarbon project