IPOPP Implementation at the USDA Forest Service

Brad Quayle
USDA Forest Service
Remote Sensing Applications Center (RSAC)

Direct Readout Land/Vegetation Workshop

Mexico City, Mexico
October 10 & 11, 2007

USDA Forest Service Organization

- National Headquarters in Washington, DC
- 9 Regional Offices
- National Forest System
  - 155 National Forests and 20 National Grasslands
    - 600 Ranger Districts
  - 78 million hectares in CONUS, AK and PR

- Research
  - 7 stations
  - 50 field offices
- State and Private Forestry
  - Fire & Aviation
  - Forest Health Protection
- International Programs

Remote Sensing Applications Center (RSAC)

- National Technical Center
- Detached Washington Office unit of Engineering staff
- Located in Salt Lake City, Utah
- *Mission:* Provide national assistance to agency field units in applying the most advanced geospatial technology toward improved monitoring and mapping of natural resources

Forest Service MODIS Active Fire Mapping Program

- Operational wildland fire detection & monitoring
- Direct readout-based
- United States & Canada
- Near real-time maps, data and imagery

Rapid Response

http://activefiremaps.fs.fed.us

Forest Service Direct Readout Issues

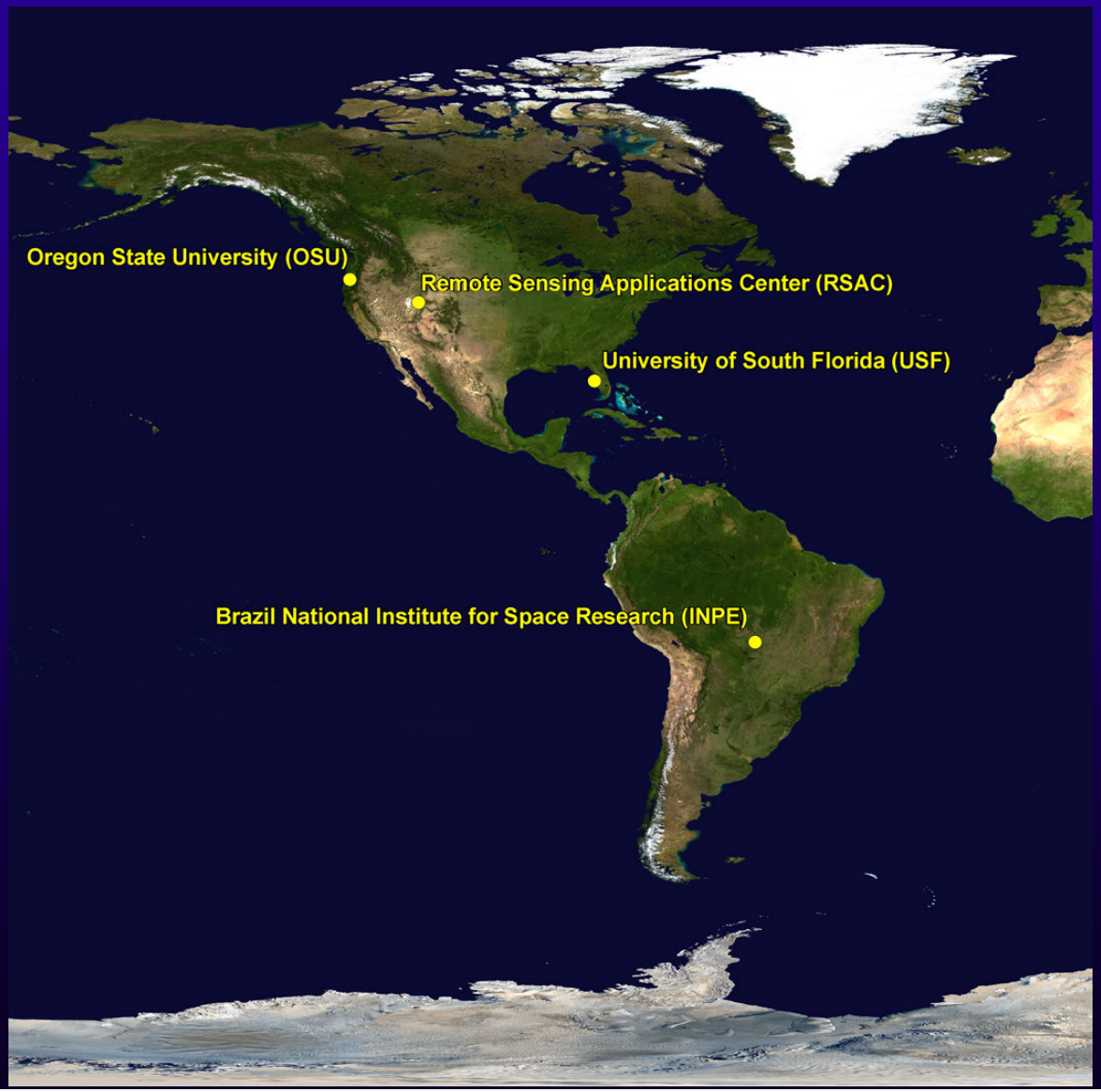
- Maintenance of existing direct readout algorithms/products
- Integration of new direct readout algorithms/products
- EOS to NPP transition

International Polar Orbiter Processing Package

- Direct readout processing environment
  - Process, visualize and evaluate:
    - NPP/NPOESS SDRs & EDRs
    - Terra/Aqua L1A/B & L2 products
- Built on the NISGS framework
  - Modular components; scaleable
- Algorithms
  - Latest land, ocean & atmosphere algorithms for direct readout environment
- IPOPP Development
  - NASA Direct Readout Laboratory
  - NOAA Integrated Program Office
  - University of Wisconsin - Cooperative Institute of Meteorological Satellite Studies

IPOPP Alpha Test Program

- RSAC is one of 4 Alpha Testers for IPOPP



IPOPP Alpha Test - Roles/Responsibilities

NASA Direct Readout Lab (DRL)

- Alpha release version of IPOPP
  - Core NISGS/IPOPP modules and associated technologies
  - MODIS land, atmosphere and ocean direct readout algorithms
- Implement feedback into IPOPP development

RSAC

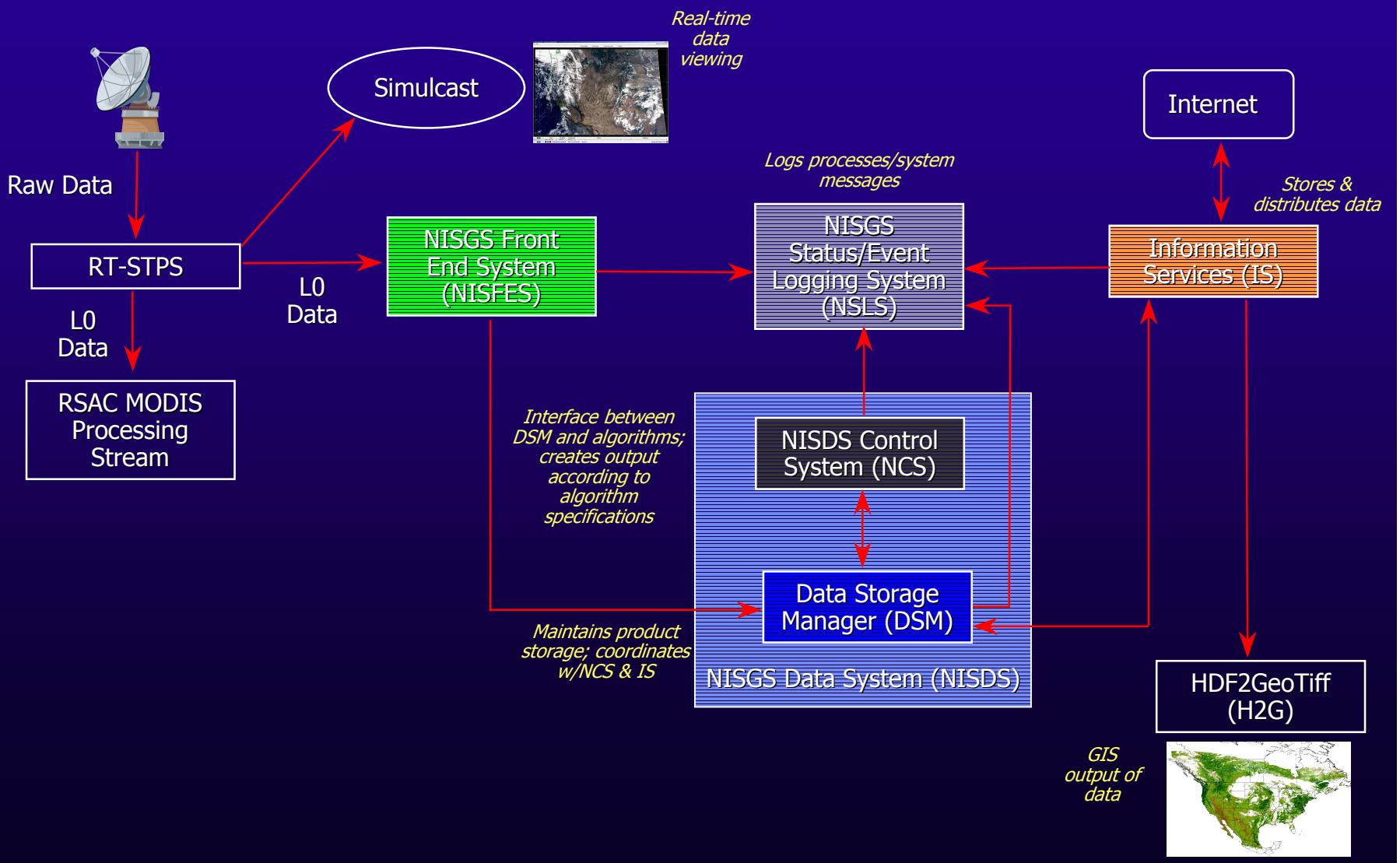
- Test/evaluate IPOPP in live direct readout environment
  - Generate products for use and distribution
  - Provide feedback to DRL
    - Software
    - System performance
    - Products
    - Documentation

RSAC IPOPP Alpha Test - Server

- Rack-Mounted 4U Server
  - 2.2GHz dual AMD Opteron processors, dual core
  - 8 GB RAM
  - Linux OS; FC 6
  - Implemented at RSAC on June 19, 2007

IPOPP Alpha Test - Processing Configuration

Based on NISGS framework...

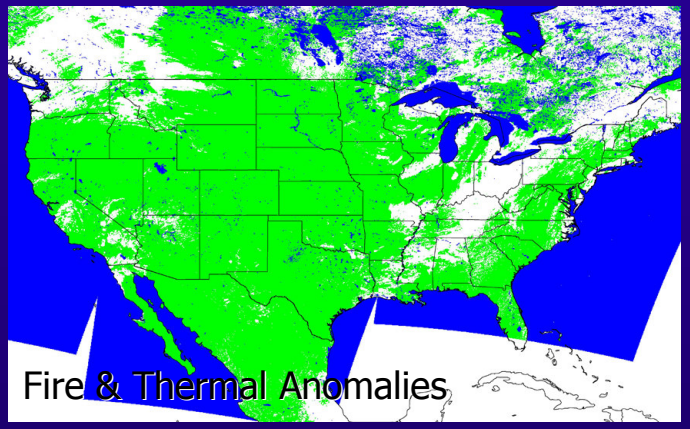


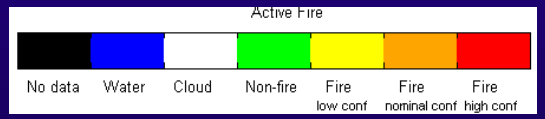
IPOPP Alpha Test - Science Processing Algorithms

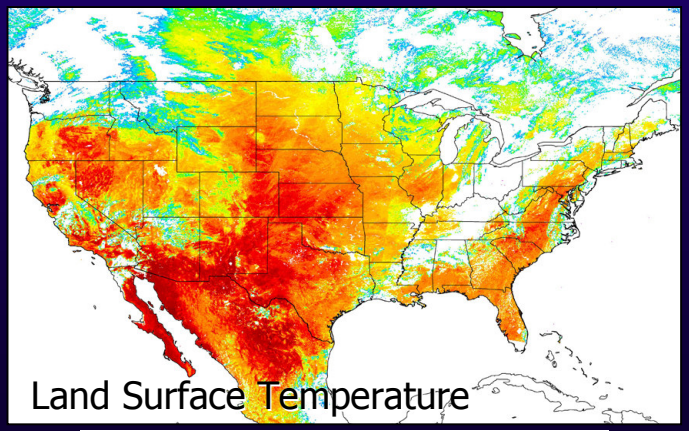
- Using latest Collection 5 (C5) MODIS science algorithms for direct readout environment
  - Land (4) – MODIS Rapid Response System
  - Atmosphere (5) – International MODIS/AIRS Processing Package (IMAPP)
  - Ocean (2) – SeaWiFS Data Analysis System (SeaDAS)
- Science Processing Algorithm (SPA) wrappers
  - Common command and execution interface
  - Algorithm customization
  - Standardization for algorithm updates; prototyping
- Ancillary/auxiliary data dependencies are maintained by NISGS/IPOPP

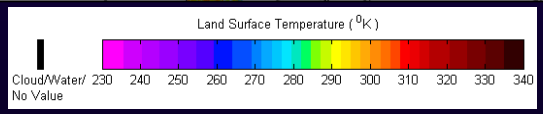
IPOPP Alpha Test – SPA Products

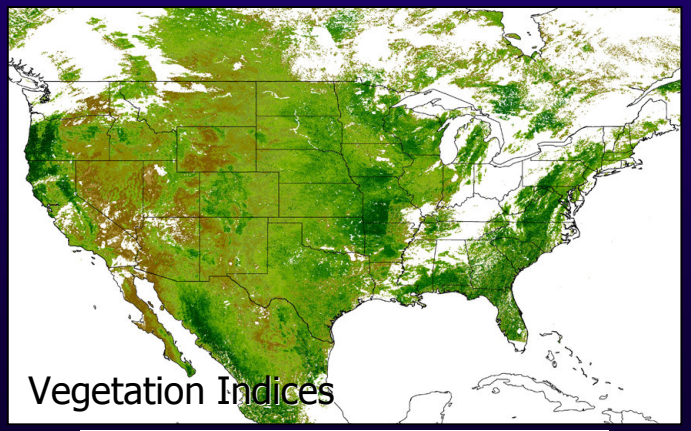
Land Discipline

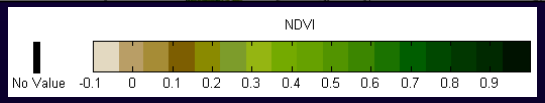








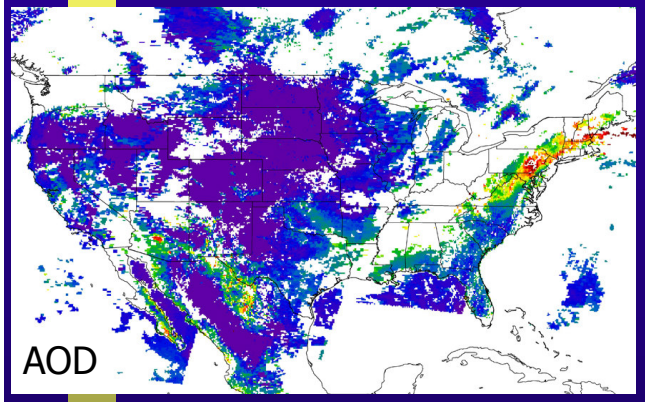


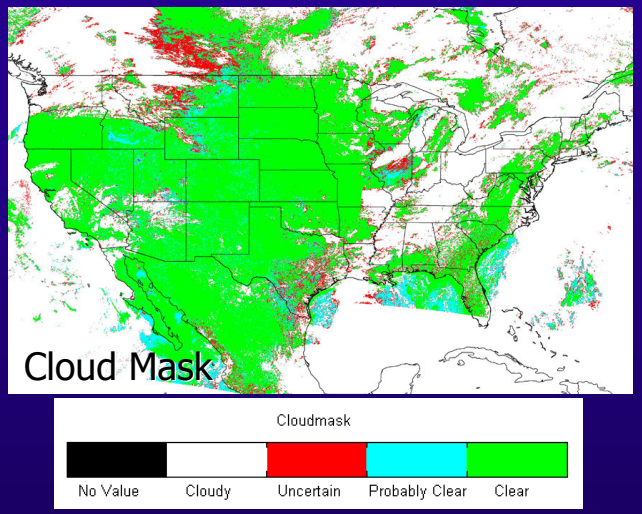


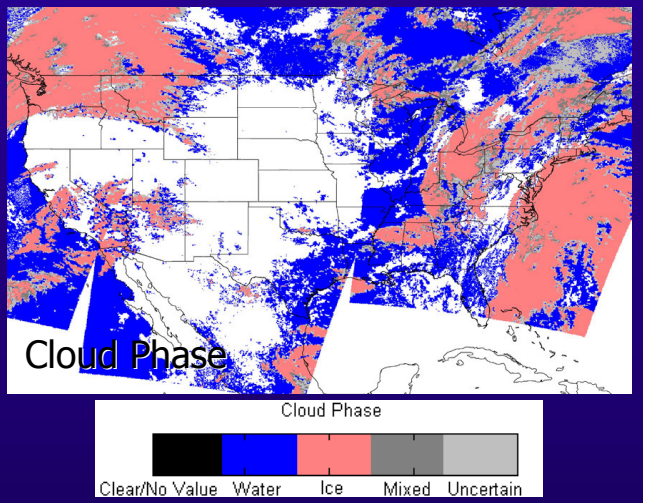
Snow/Ice product coming soon…

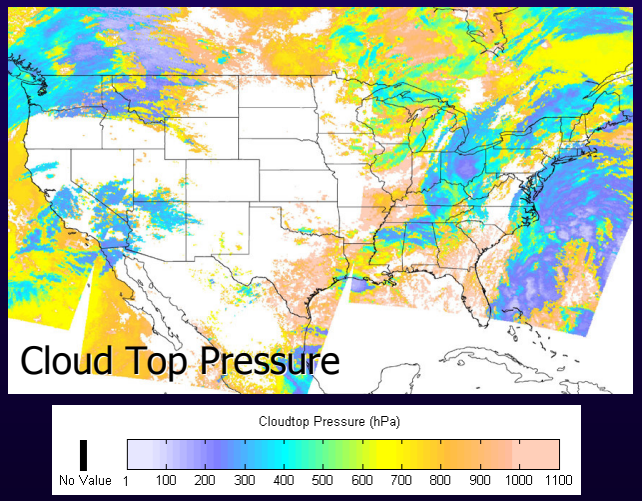
IPOPP Alpha Test - SPA Products

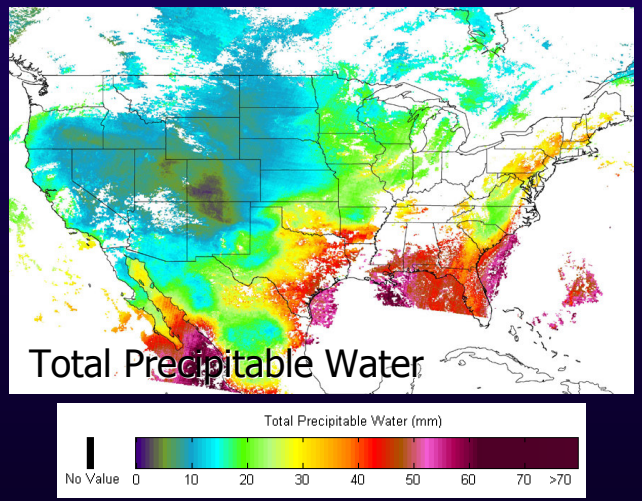
Atmosphere Discipline





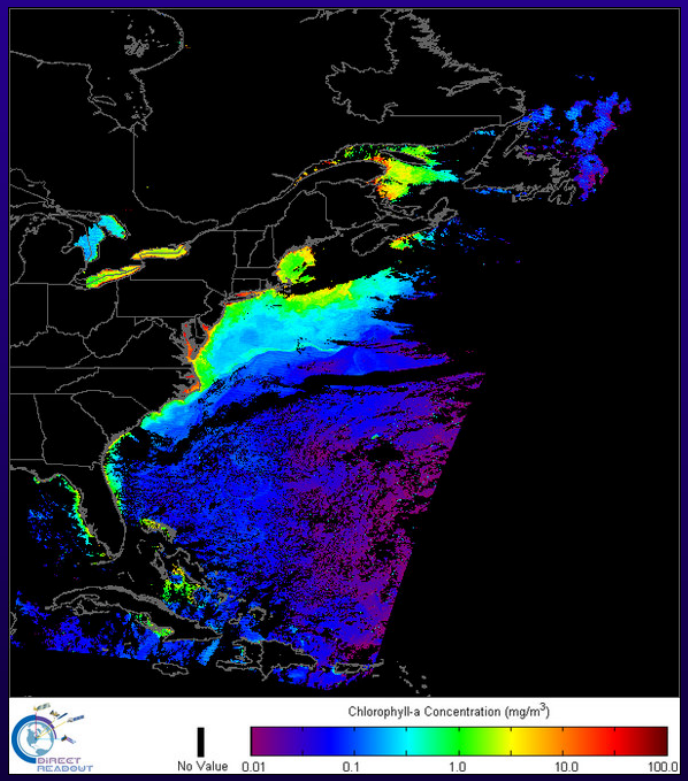




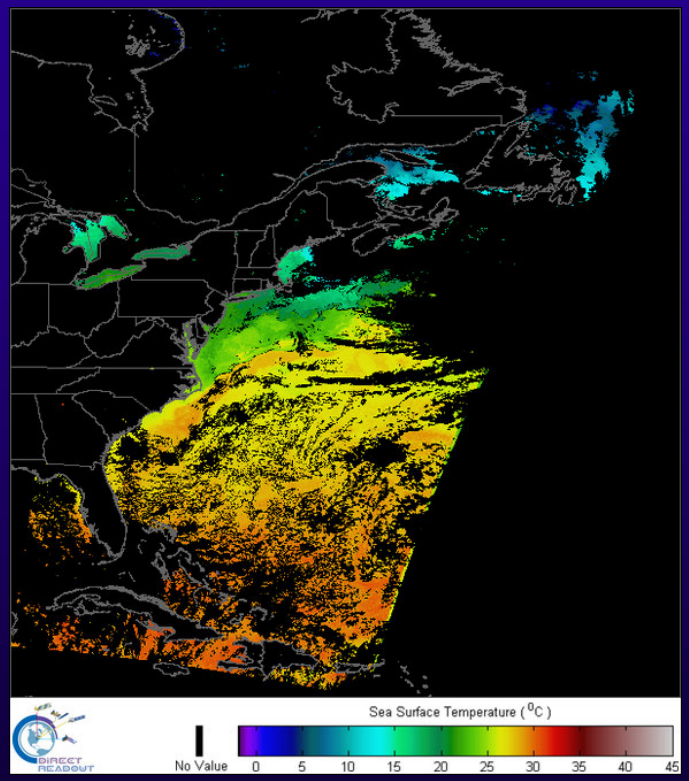


IPOPP Alpha Test - SPA Products

Ocean Discipline



Chlorophyll-a Concentration



Sea Surface Temperature

Not tested by RSAC…

IPOPP Alpha Test - Product Output

- Products generated for entire L0 swath
- Output formats
  - HDF4
    - Standard output format for L2 products
    - Science data sets (SDS) layers for each L2 product
  - GeoTiff
    - Output using HDF2GeoTiff utility (H2G)
    - Single SDS for each GeoTiff (multi-band output is possible)
    - Geolocated with color map and metadata
    - Projection: Geographic decimal degrees; WGS84 datum/spheroid
- Compatibility
  - GeoTiff format imports readily or can be used directly in Forest Service enterprise geospatial applications
    - Leica Geosystems Imagine 9.x
    - ESRI ArcGIS 9.x

IPOPP Alpha Test - Product Output

- Metadata
  - Generated for each product; XML format
  - Generated at each level of processing
    - Processing lineage for each level is captured
    - Aggregate with supplementary metadata information to generate FGDC compliant metadata to meet Forest Service requirements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```


L2 product metadata

MOD14.07269050038.tif

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Metadata_Reference_Information

FGDC metadata

Identification_Information:
Citation:
Citation_Information:
Originator: USDA Forest Service
Publication_Date: 9/26/2007
Title:
MOD14.07269050038.tif
Geospatial_Data_Presentation_Form: remote-sensing image
Online_Linkage: \\PCIBAM84FRFC$\mod014.07269050038.tif
Description:
Abstract:
Terra MODIS MOD14 Fire and Thermal Anomalies data
Purpose:
General Use
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 9/26/2007
Time of Day: 0500 UTC
Currentness_Reference:
ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -134.523270
East_Bounding_Coordinate: -89.746626
North_Bounding_Coordinate: 62.850410
South_Bounding_Coordinate: 18.923893
Keywords:
Theme:
Theme_Keyword: Fire
Theme_Keyword: Thermal Anomaly
Theme_Keyword: MODIS

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Fire Mask
Attribute:
Attribute_Label: ObjectID
Attribute_Definition:
Internal feature number.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition:
Not Processed (missing data)
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition:
Not Processed (obselete)
Enumerated_Domain:
Enumerated_Domain_Value: 2
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Fire (low confidence)
Enumerated_Domain:

RSAC IPOPP Alpha Test - System Performance

Testing Time Period

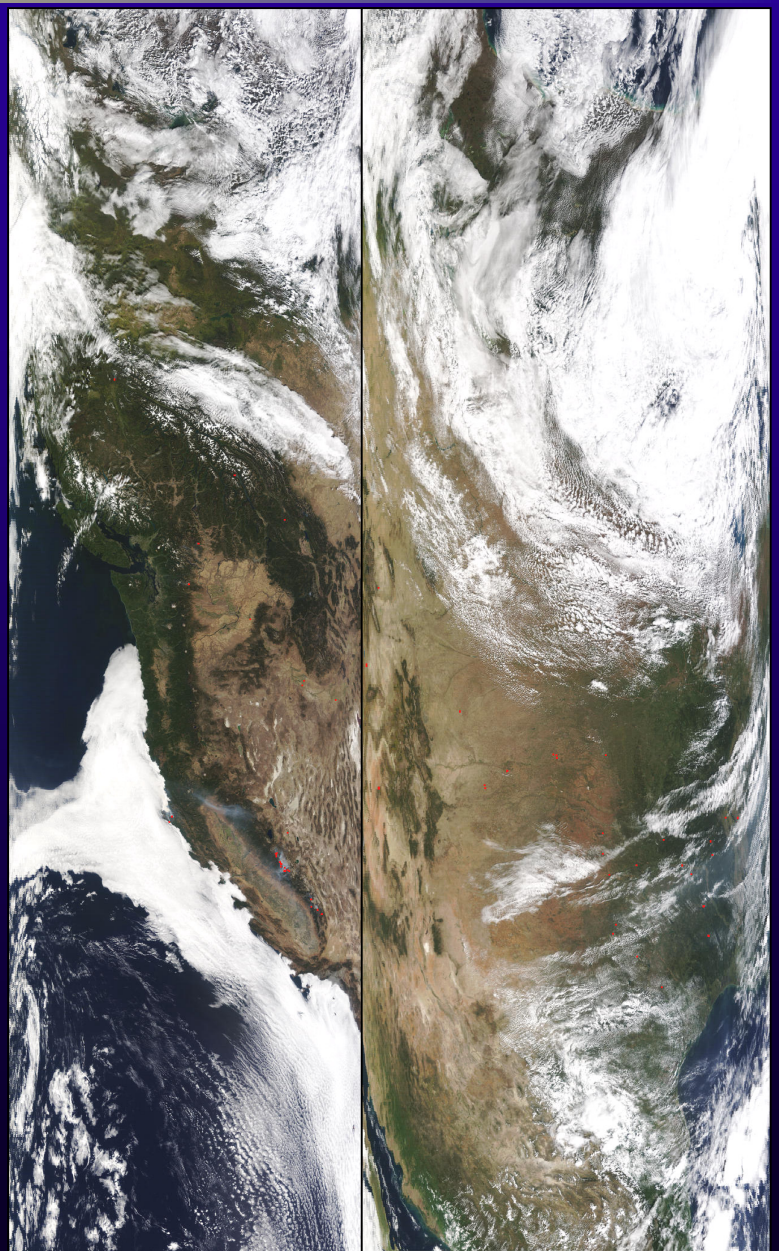
- Processed data on 91 days between June 19, 2007 – October 5, 2007

Data Ingest

- 695 Terra/Aqua L0 swath granules

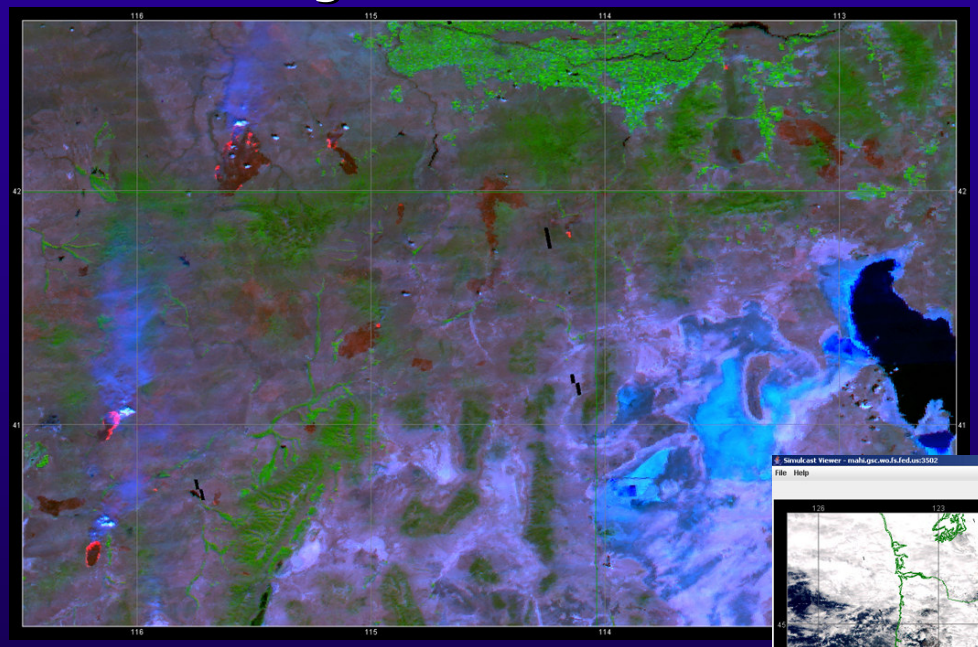
Product Generation Rate

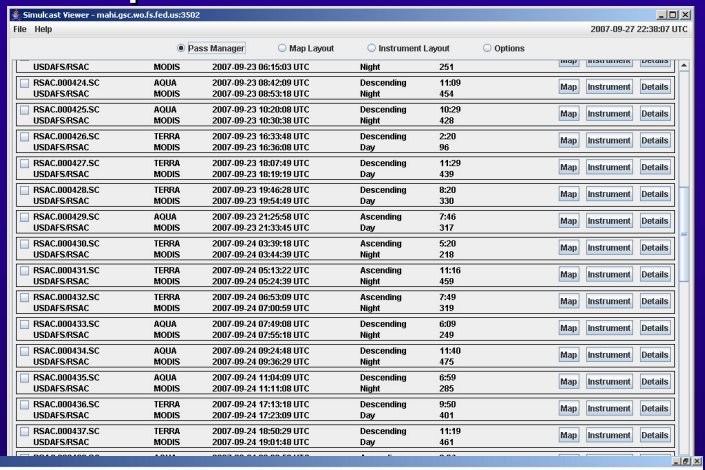
- <1 hour to generate all L2 products from an ~1GB L0 swath (~12-14 minute swath)

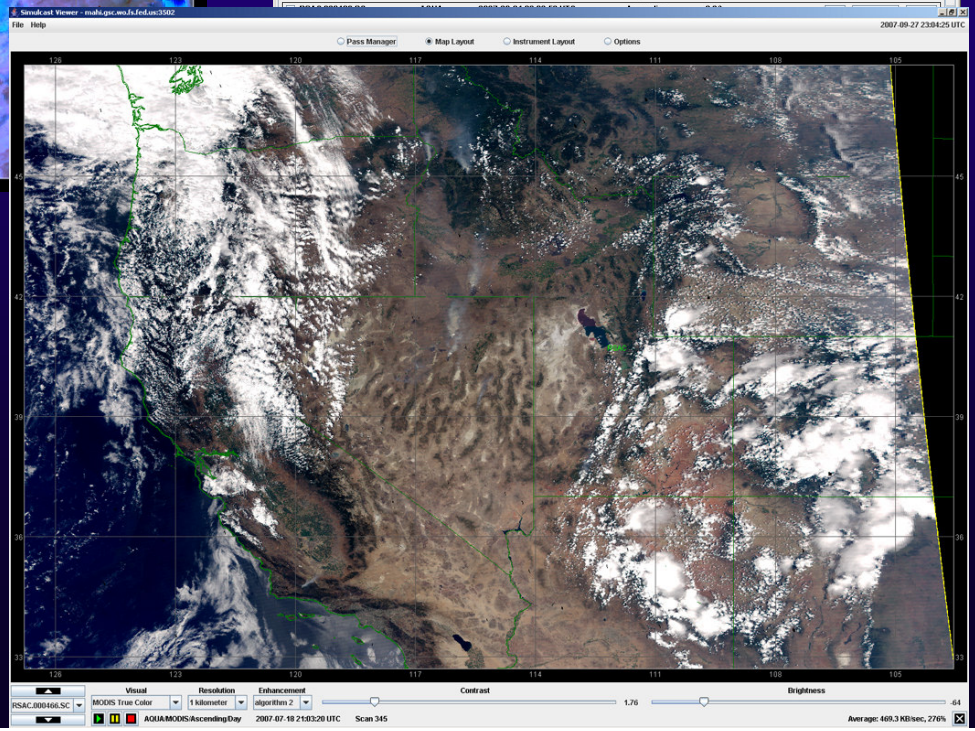


RSAC IPOPP Alpha Test - Simulcast

NRT viewing of direct readout data on a map base







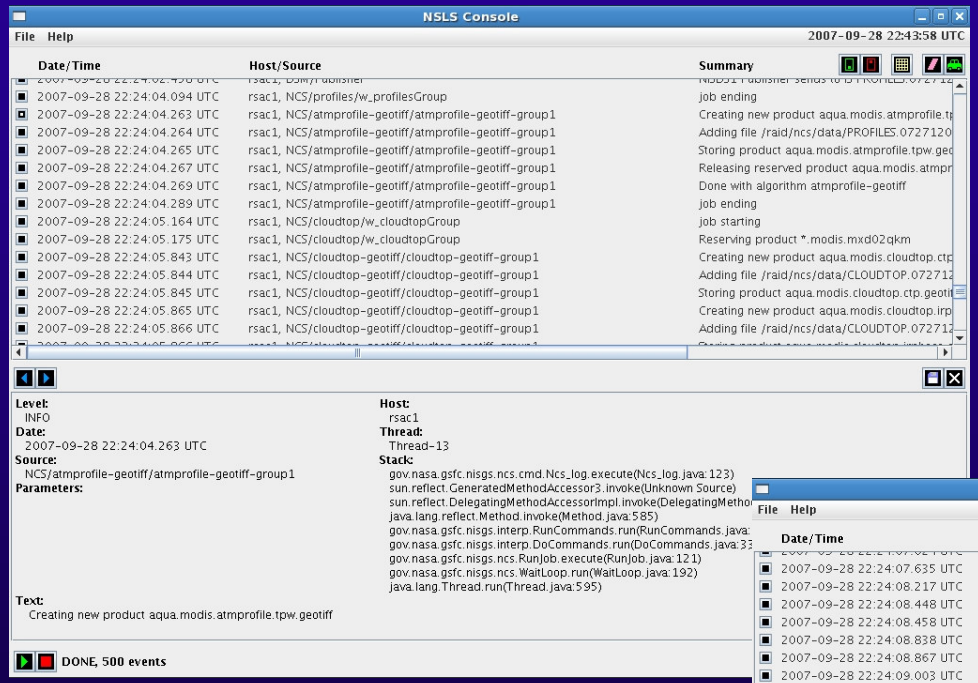
Simulcast server hosted by RSAC; available to USFS and BLM users.

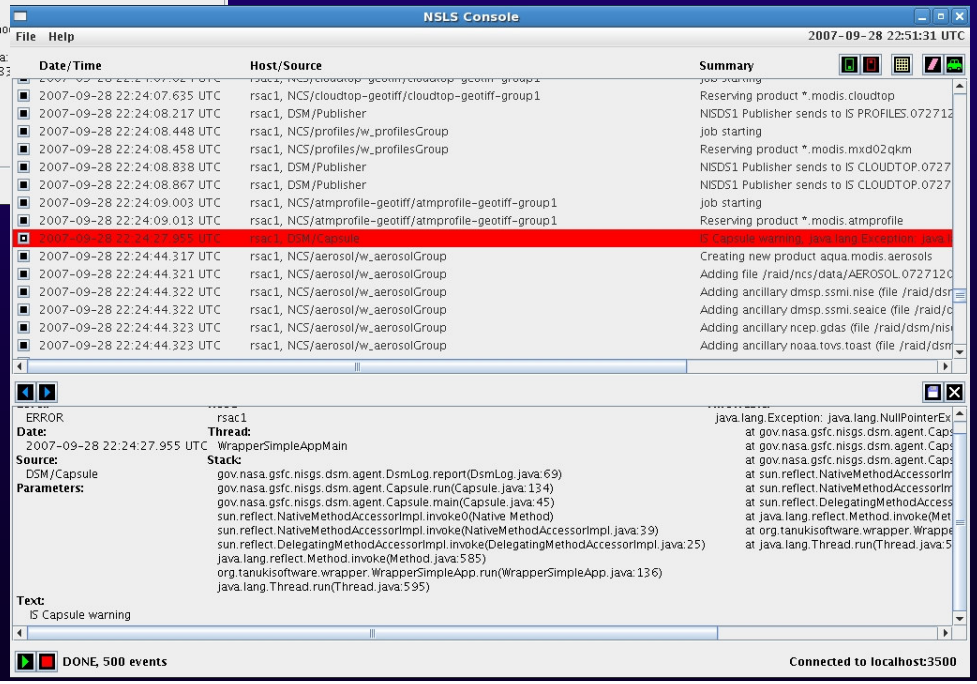
Used at RSAC to review acquisitions in NRT.

Also used by fire managers; air quality specialists.

RSAC IPOPP Alpha Test - NSLS

NISGS Status/Event Logging System (NSLS)



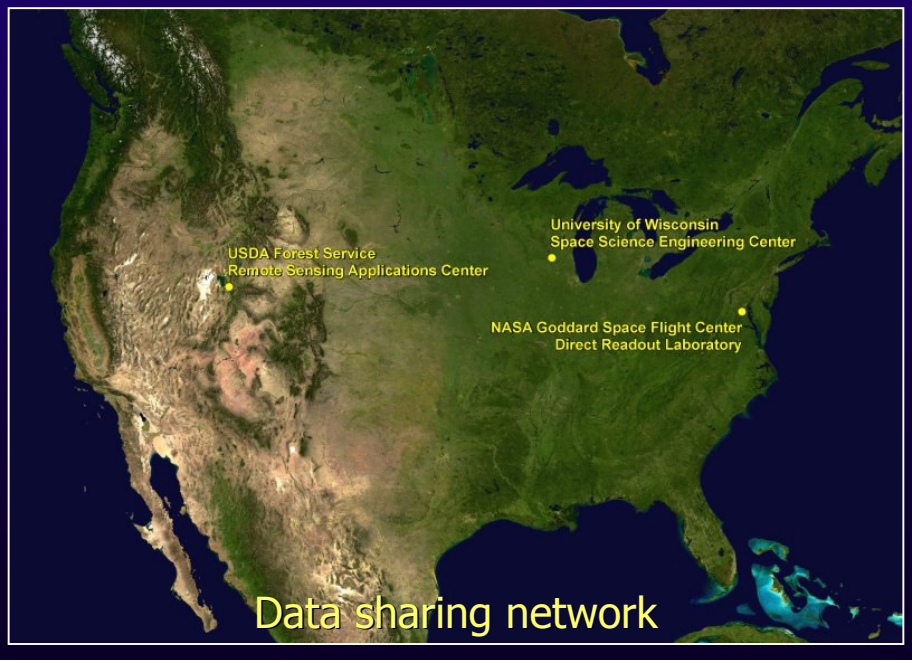


Logs all status and event messages from processing system

Used during Alpha testing to monitor all system processes; troubleshooting

RSAC IPOPP Alpha Test – Looking Forward

- Additional testing/feedback
- Increase data processing volume
  - CONUS coverage with additional ground station data
- Evaluate integration of new algorithms of utility to Forest Service
- Data product distribution
- Data integration into relevant Forest Service applications



IPOPP Product Distribution By RSAC

Product Website – Unrestricted Access

Products

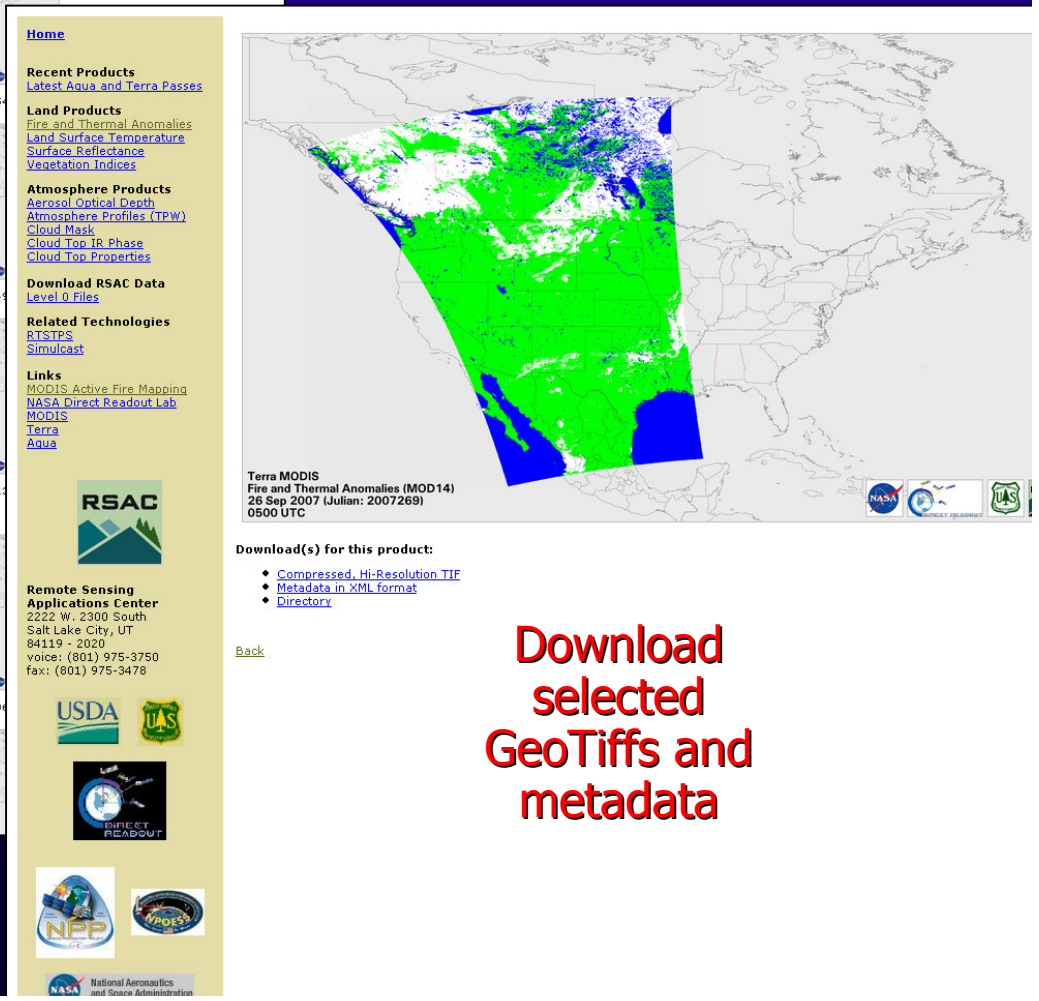
RSAC Level 0 data

http://svinetfc6.fs.fed.us/directreadout

IPOPP Product Distribution By RSAC

Product Website – Unrestricted Access

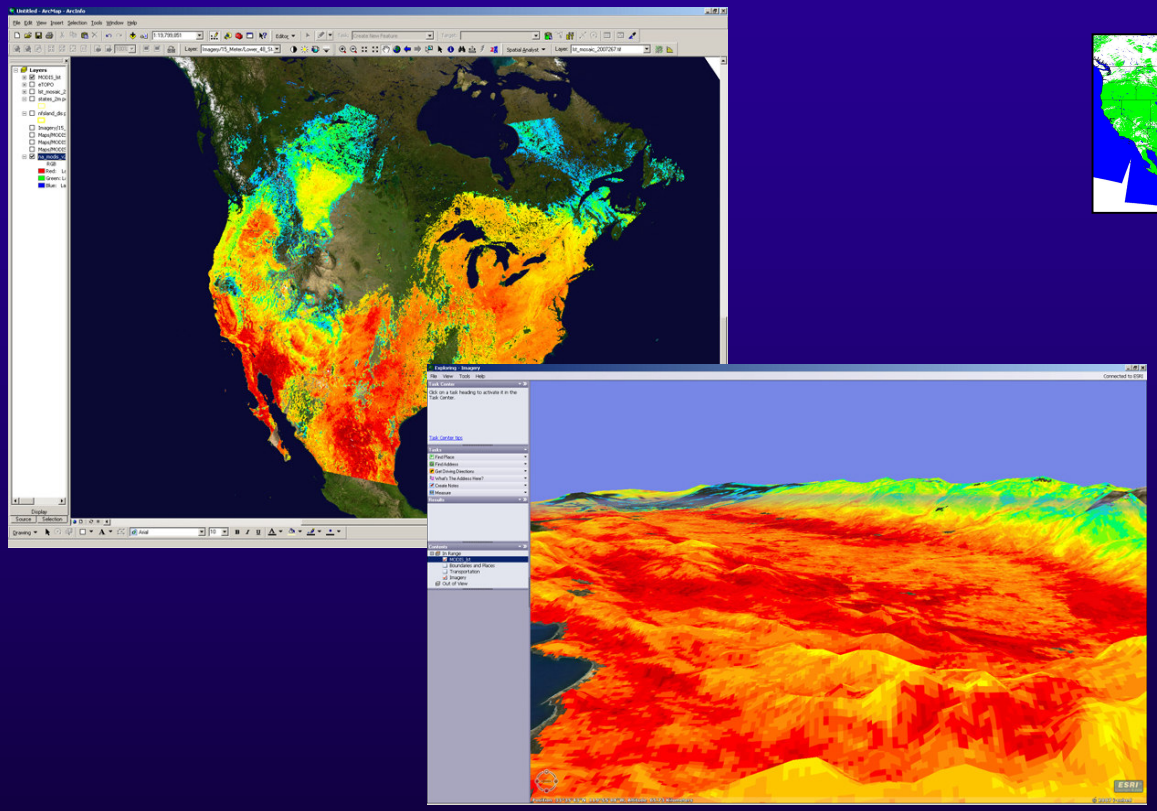
Browse Daily Products

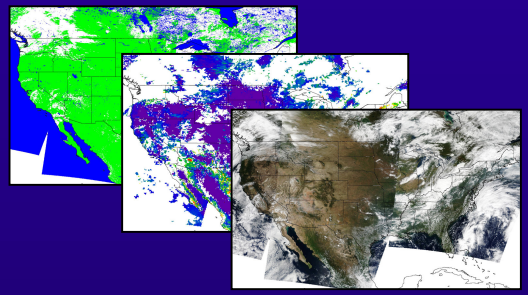


Download selected GeoTiffs and metadata

IPOPP Product Distribution By RSAC

Enterprise Data Services – USFS access only





Daily MODIS IPOPP Products

MODIS Blue Marble

15 meter pan-sharpened Landsat

1-2 meter digital ortho photos

USFS corporate image datasets

Instant access to local/regional/national scale imagery for CONUS via GIS client

No need to download data

Integrate with other geospatial data

2D/3D visualization

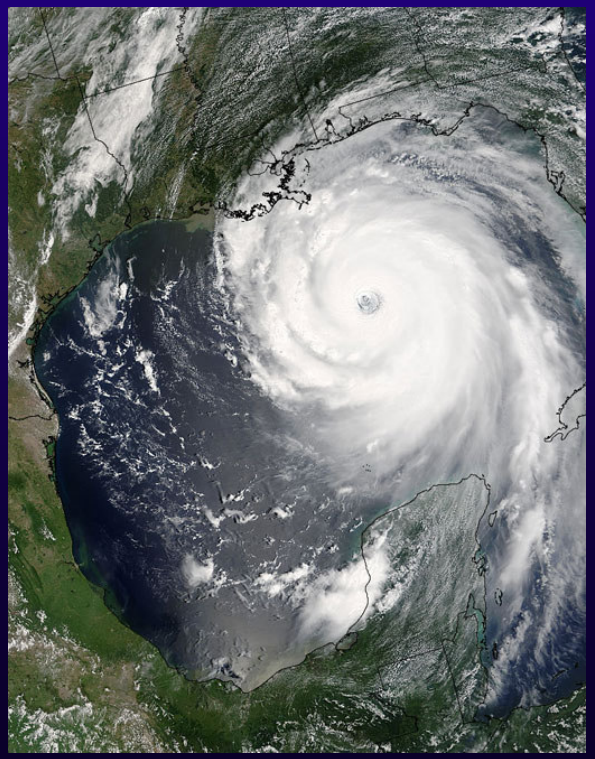
Example USFS Applications of IPOPP Products

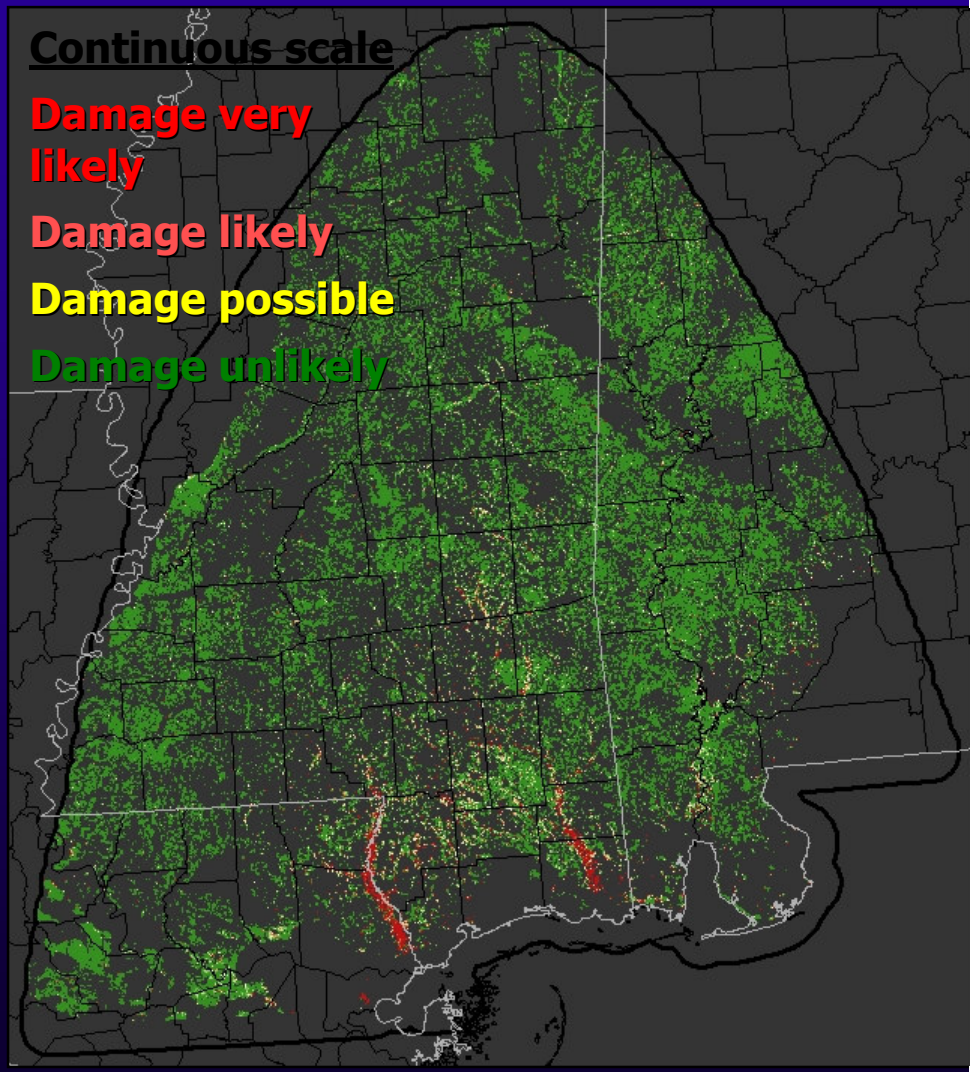
Both time-sensitive & routine applications…

- Wildland Fire
  - Fire detection and monitoring
  - Burn area mapping/assessment
  - Fire risk/forecasting assessments
- Monitoring
  - Ecosystem disturbance/Post-catastrophic event damage assessment
  - Vegetation recovery
  - Air quality
  - Range management
- Enterprise Data Services/Applications
  - USFS data server/data visualization services
  - USDA/USFS decision support applications

Example - Post Catastrophic Event Rapid Assessment

- Forest Service "rapid response toolkit"
- Approximate estimates of forest damage and its costs within days of a catastrophic event

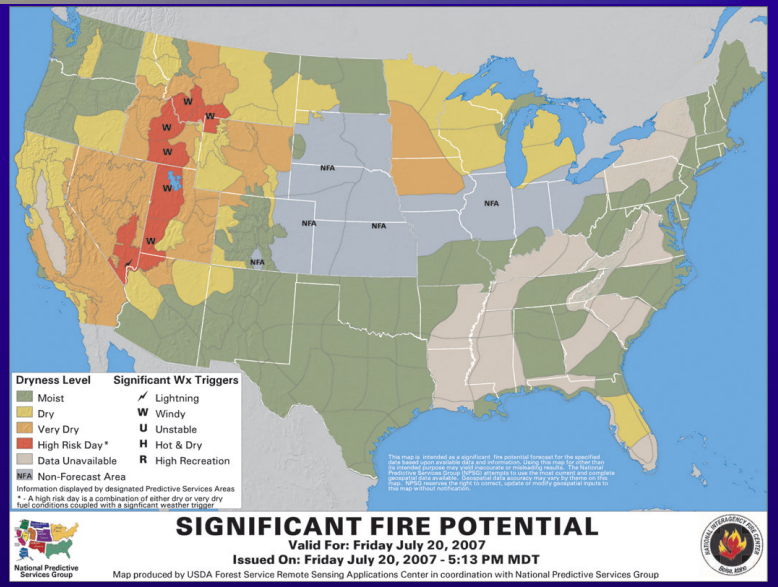




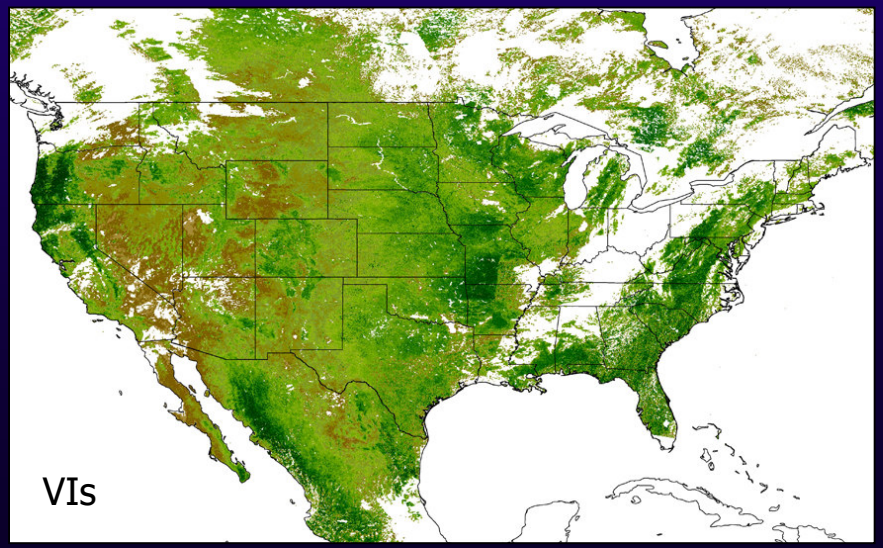
Damage likelihood of forested areas produced using data available 3 days after hurricane Katrina.

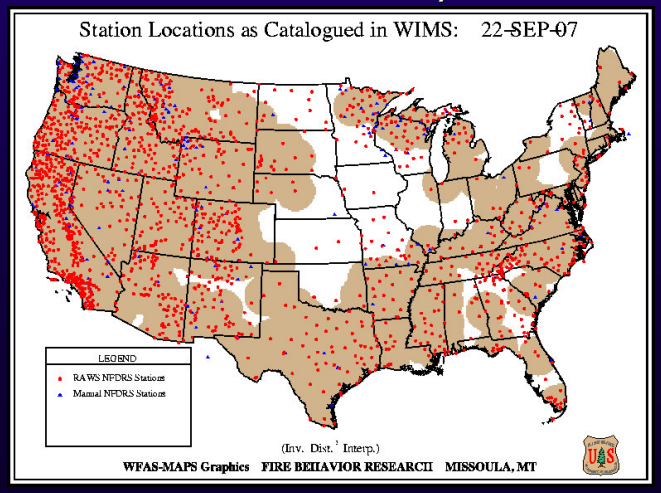
Example – Predictive Services Fire Forecasting

- Forecast nationwide, daily probability of large fire occurrence within PSAs over a 7-day period
- Variables:
  - Fuel moisture
  - Ignition triggers
  - Resource availability
- Fuel moisture currently based on Wx station indices



July 20, 2007 Significant Fire Forecast – Day 1

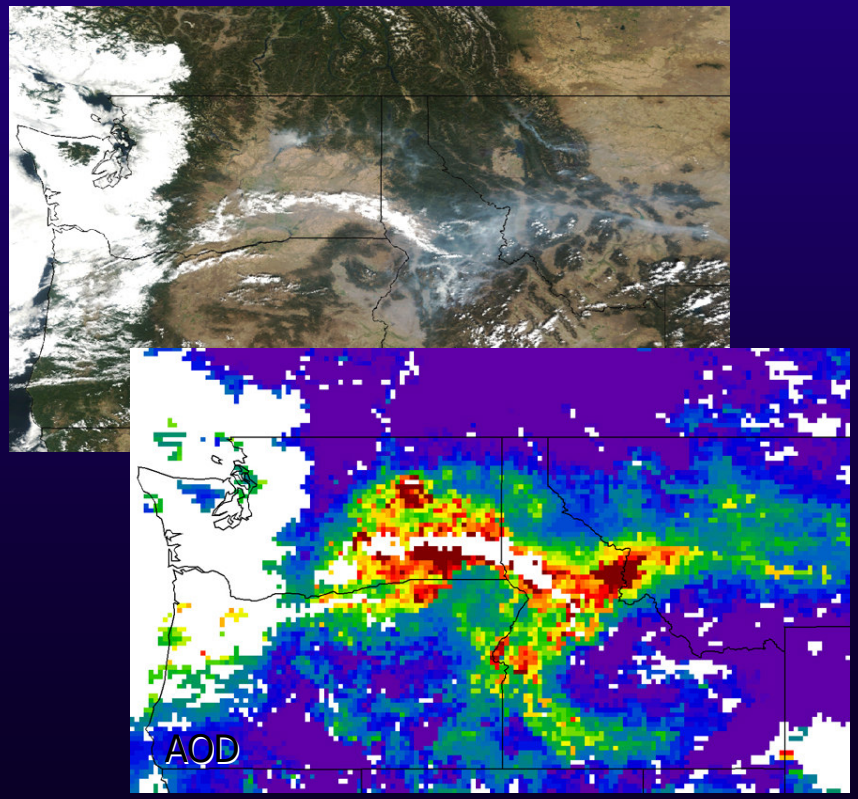


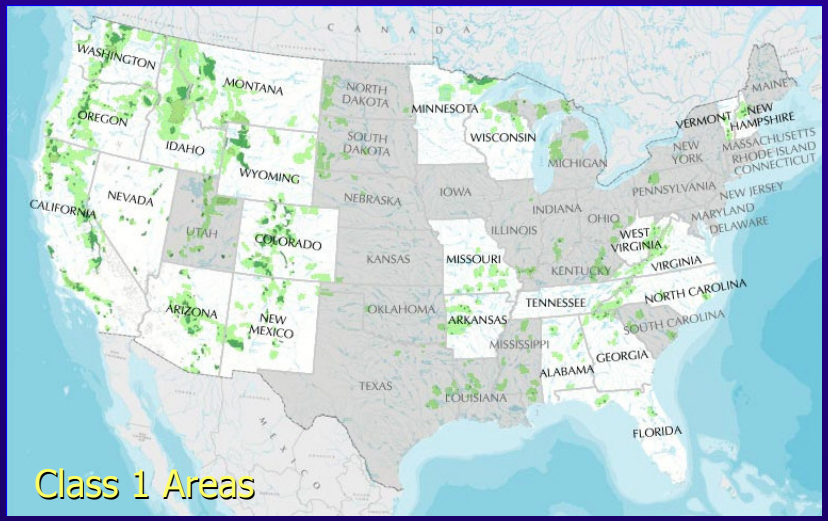


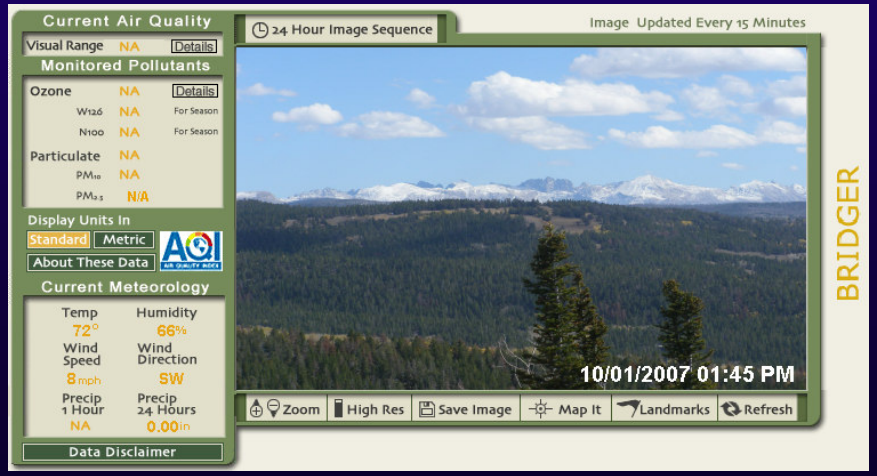
National Fire Danger Rating System Wx Stations

Example – Air Quality Monitoring

- Forest Service closely monitors air quality for Class 1 areas, population centers, etc.
- Real time air quality data (visibility, particulate matter) is collected at Forest Service monitoring sites







USFS real time air quality monitor site

IPOPP Alpha Test - Conclusion/Summary

- Modular, scaleable processing framework
  - Direct readout processing "a la carte"
- Facilitates implementation of algorithms in the DR environment
  - Provides standardized framework for updating existing algorithms and implementation of new algorithms
    - EOS and NPP
- Access to suite of latest DR products will facilitate multi-disciplinary needs/applications within the Forest Service
- "GIS ready" output with metadata
  - Facilitate use by users
  - Compatible with Forest Service applications and data services
- Ancillary tools for monitoring system/processes and visualizing data

Additional Information

USDA Forest Service Remote Sensing Applications Center

http://www.fs.fed.us/eng/rsac

USDA Forest Service RSAC Direct Readout Product Portal

http://svinetfc6.fs.fed.us/directreadout

NASA GSFC IPOPP and Alpha Test Program

http://directreadout.gsfc.nasa.gov/index.cfm?section=technology&page=IPOPP