RECOVER

Rehabilitation Capability Convergence for Ecosystem Recovery

A NASA/DOI National Wildland Fires Applied Sciences Project

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Wildfire Physics

Wildfire spread

- Ground - spread by subterranean roots
- Surface - spread by leaf and timber litter
- Ladder - spread by vines and shrubs
- Crown - spread by canopy vegetation

Wildfire front

- Wood is dried as water is vaporized (212 °F)
- Wood pyrolysis releases flammable gasses (450 °F)
- Wood **smolders**, burns without flame (590 °F)*
- Wood **ignites**, burns with flame (1000 °F)*
- Flame warms air on leading edge of front (>1500 °F)
- Process feeds forward ...

Wildfire forward rate of speed (FROS)

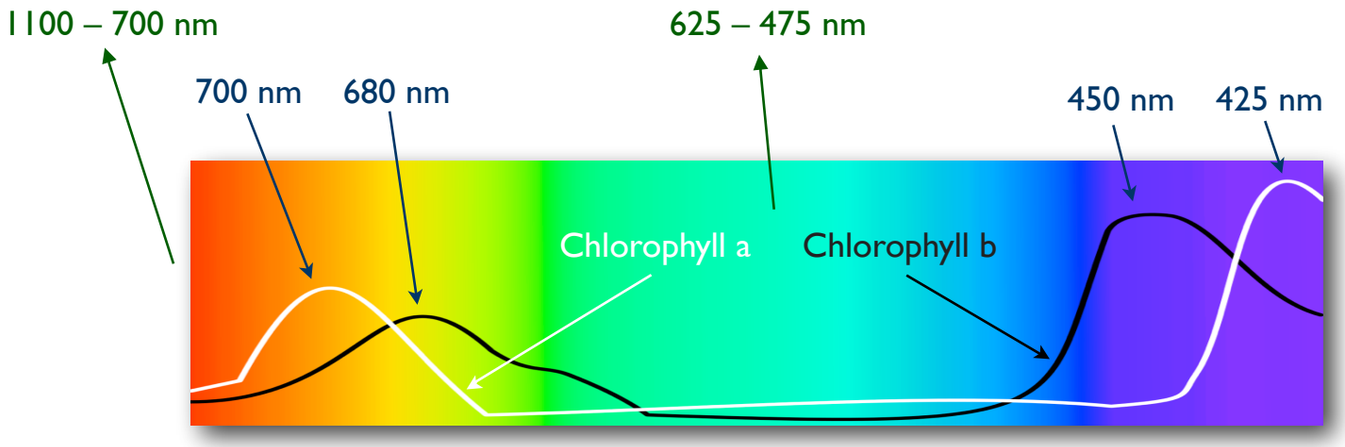
- ~6.7 mph in forests
- ~14 mph in grasslands
- with flaking, backing, jumping ...

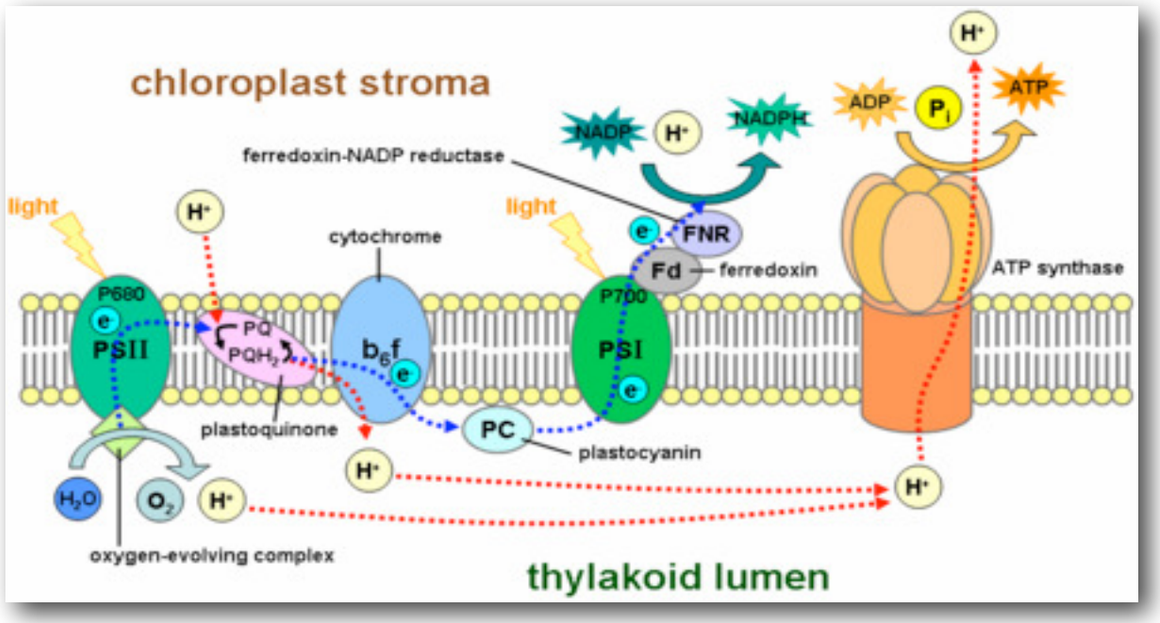

TEXAS
PARKS &

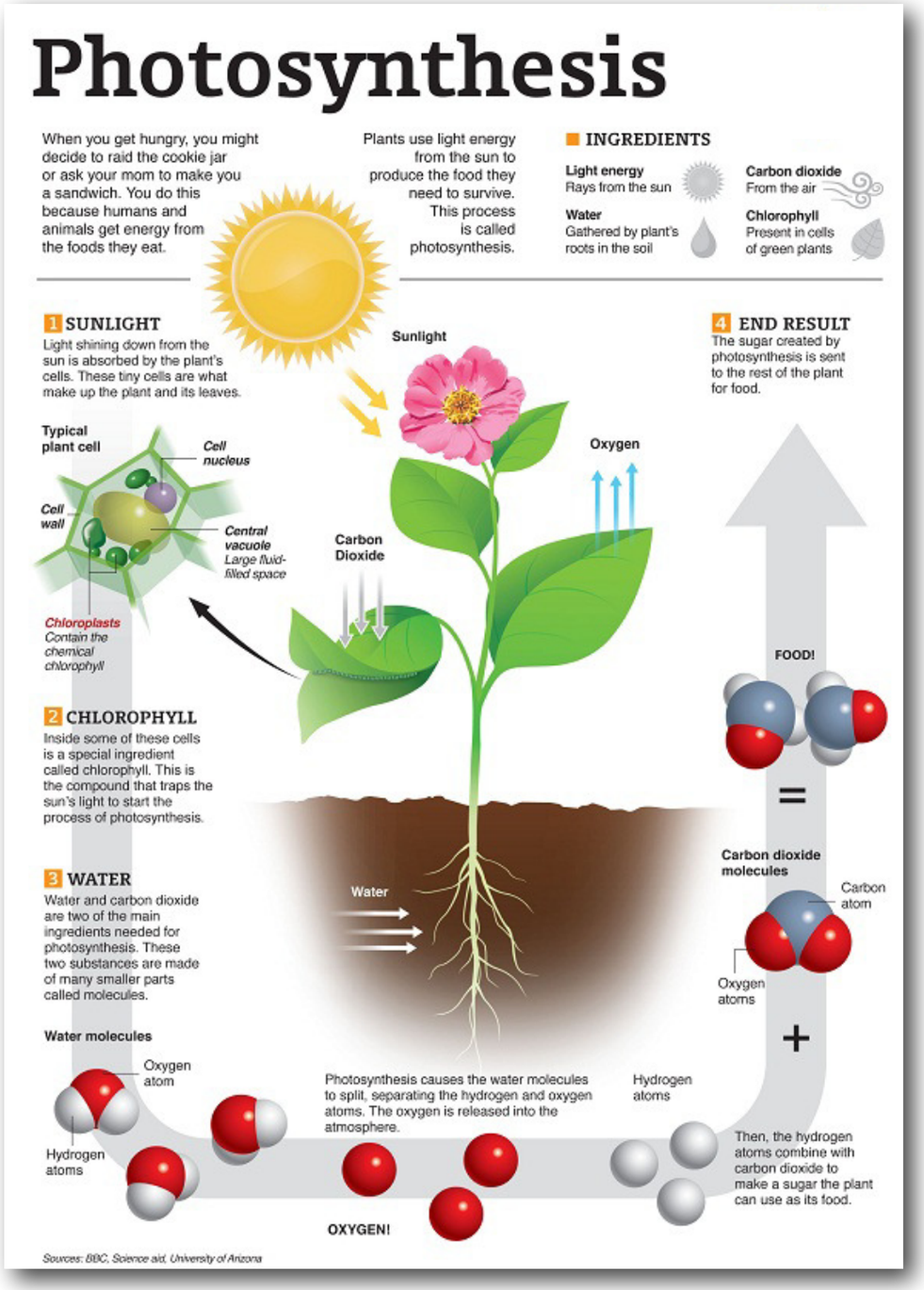
Plant Physiology

Chlorophyll ...

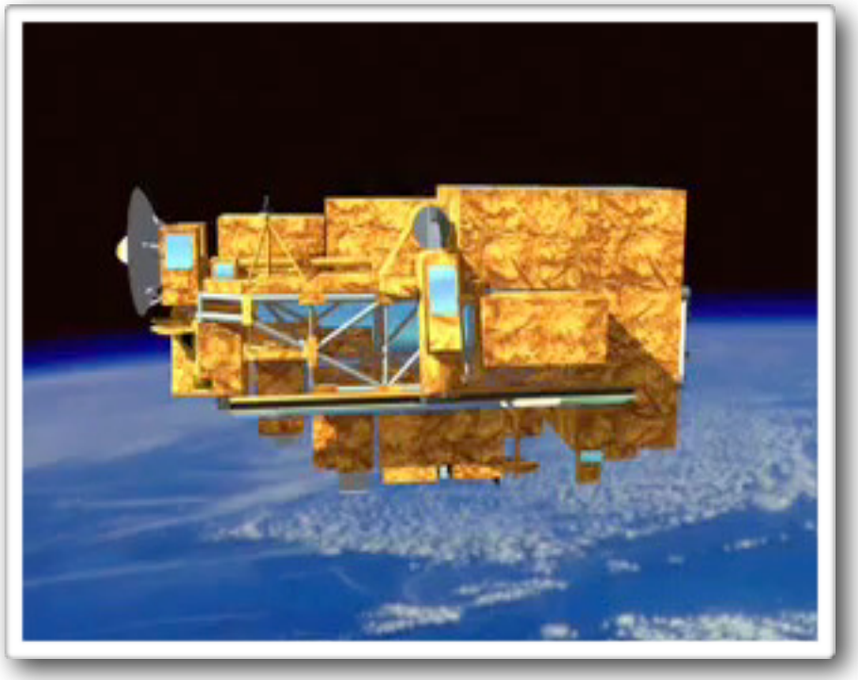
- **Absorption** – Yellow/red and blue/violet (visible)
- **Reflectance** – Green (visible) and near infrared (invisible)

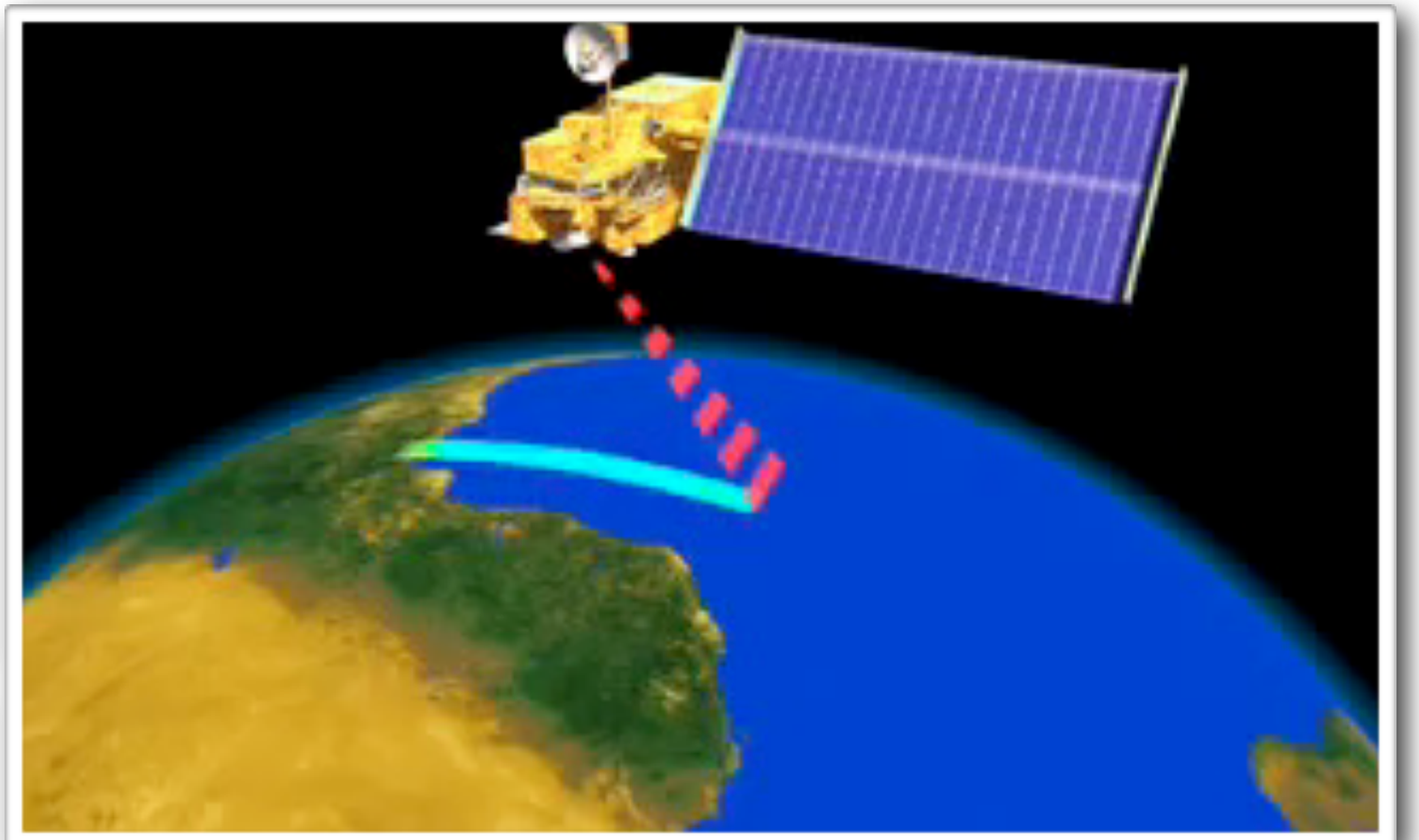






MODIS – A Spatiotemporal Technology for "Geotagging" Electromagnetic Radiation at a Global Scale ...

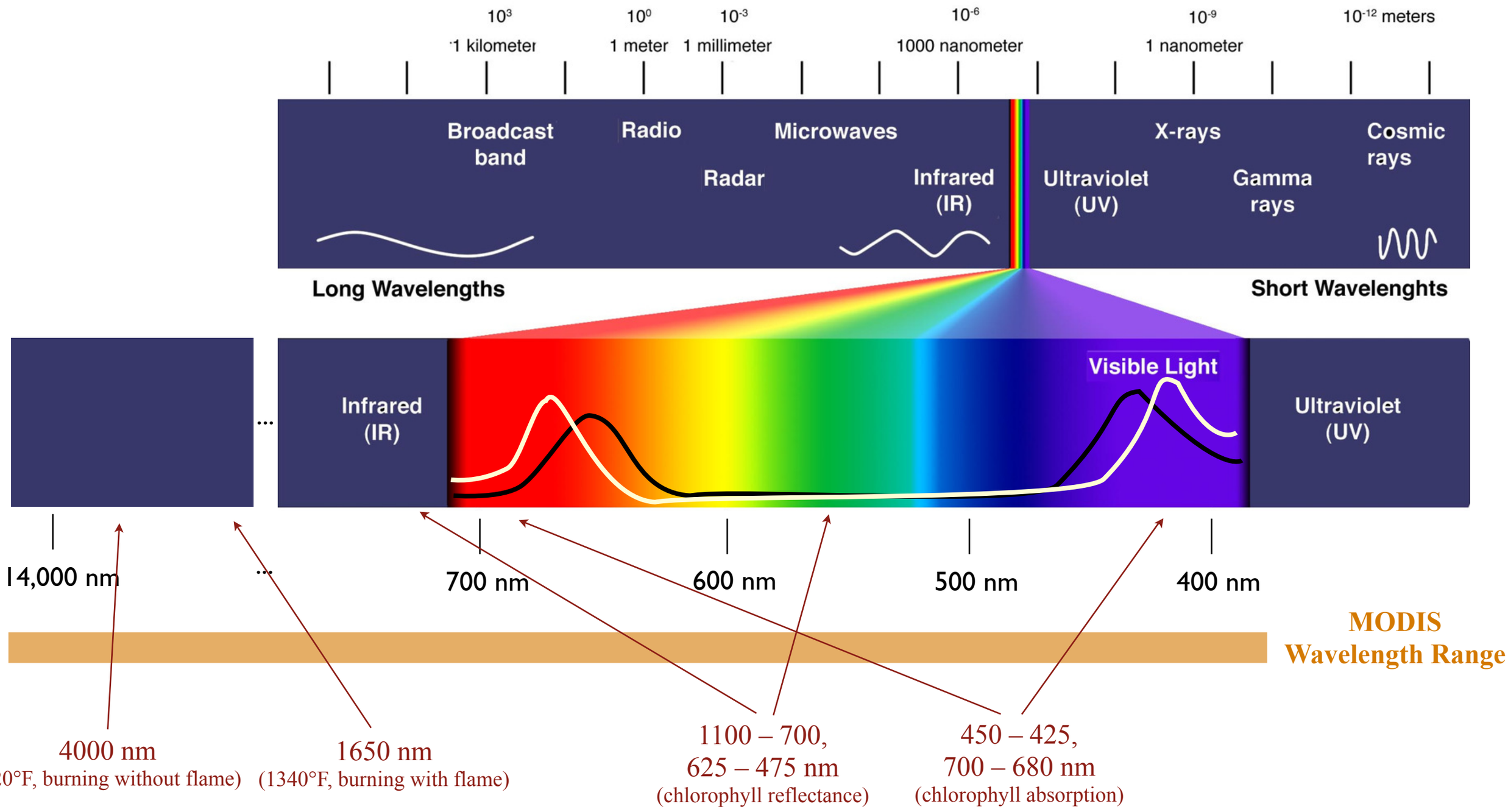




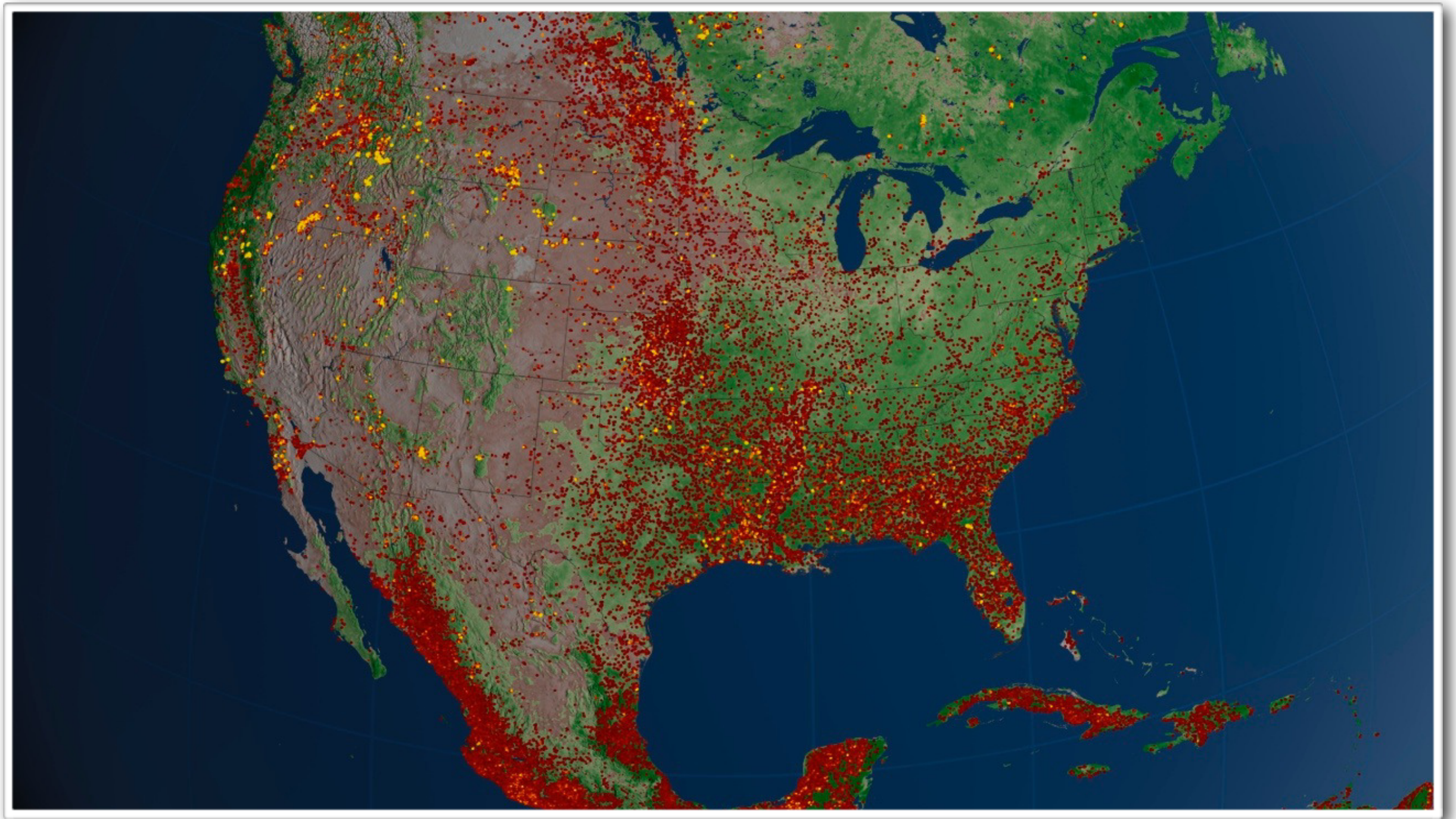
Moderate Resolution Imaging Spectroradiometer

- Key instrument on Terra and Aqua satellites.
- Launched in 1999 (Terra) and 2002 (Aqua), orbit at 705 km.
- Scans the earth every 1-2 days, swath width is 2330 km.
- 36 spectral bands, range in wavelengths from 400 nm to 14,400 nm.
- Resolution 250, 500, and 1000 m^2.
- In other words, a measurement of the electromagnetic radiation at each pixel location is geotagged at least every two days ...

MODIS – A Spatiotemporal Technology for "Geotagging" Electromagnetic Radiation at a Global Scale ...



MODIS – Fire Intensity and Vegetation – 2012



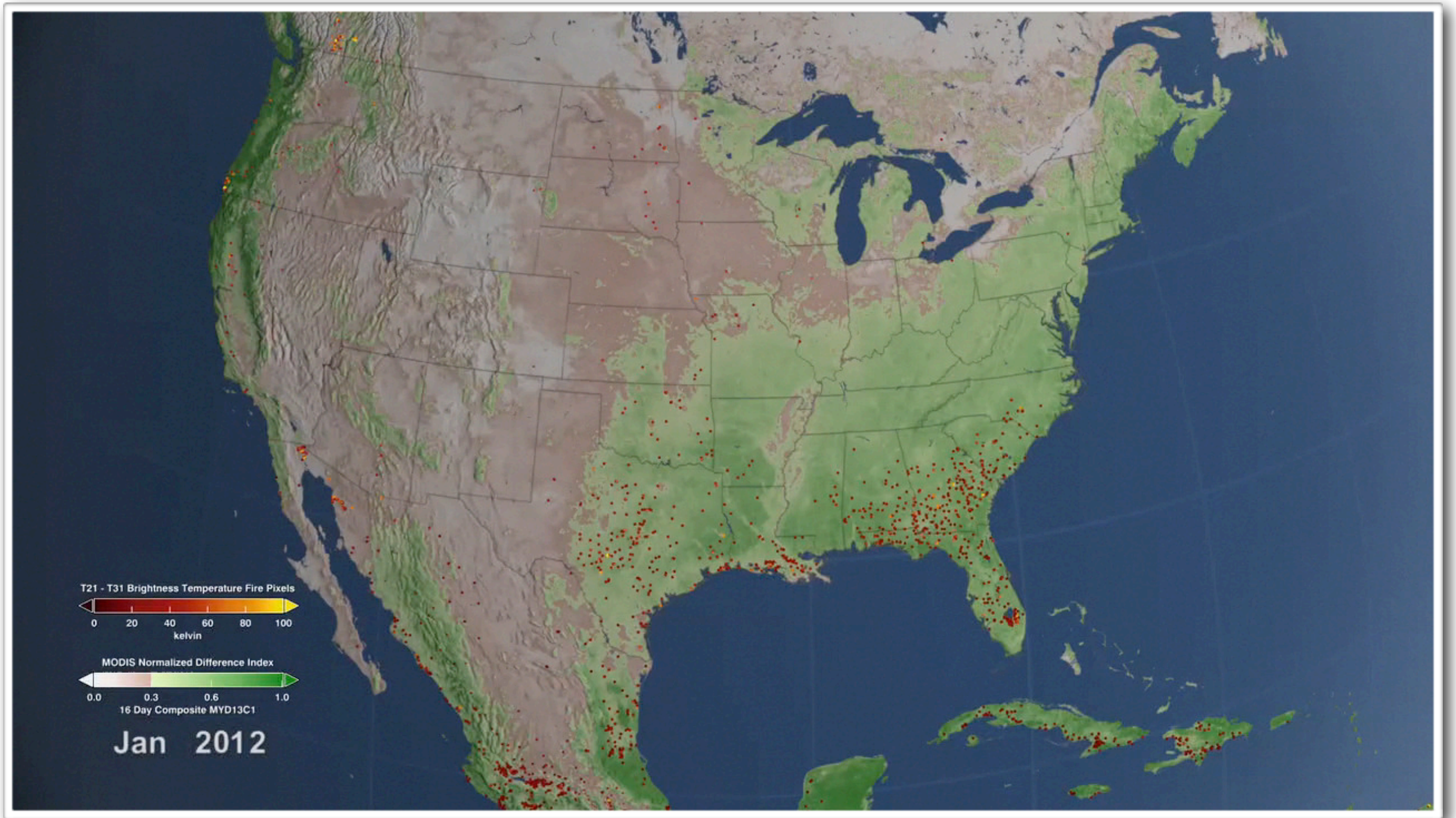
Vegetation (NDVI)

0.0 0.3 0.6 1.0

Fire Intensity

less more

MODIS – Fire Intensity and Vegetation – 2012



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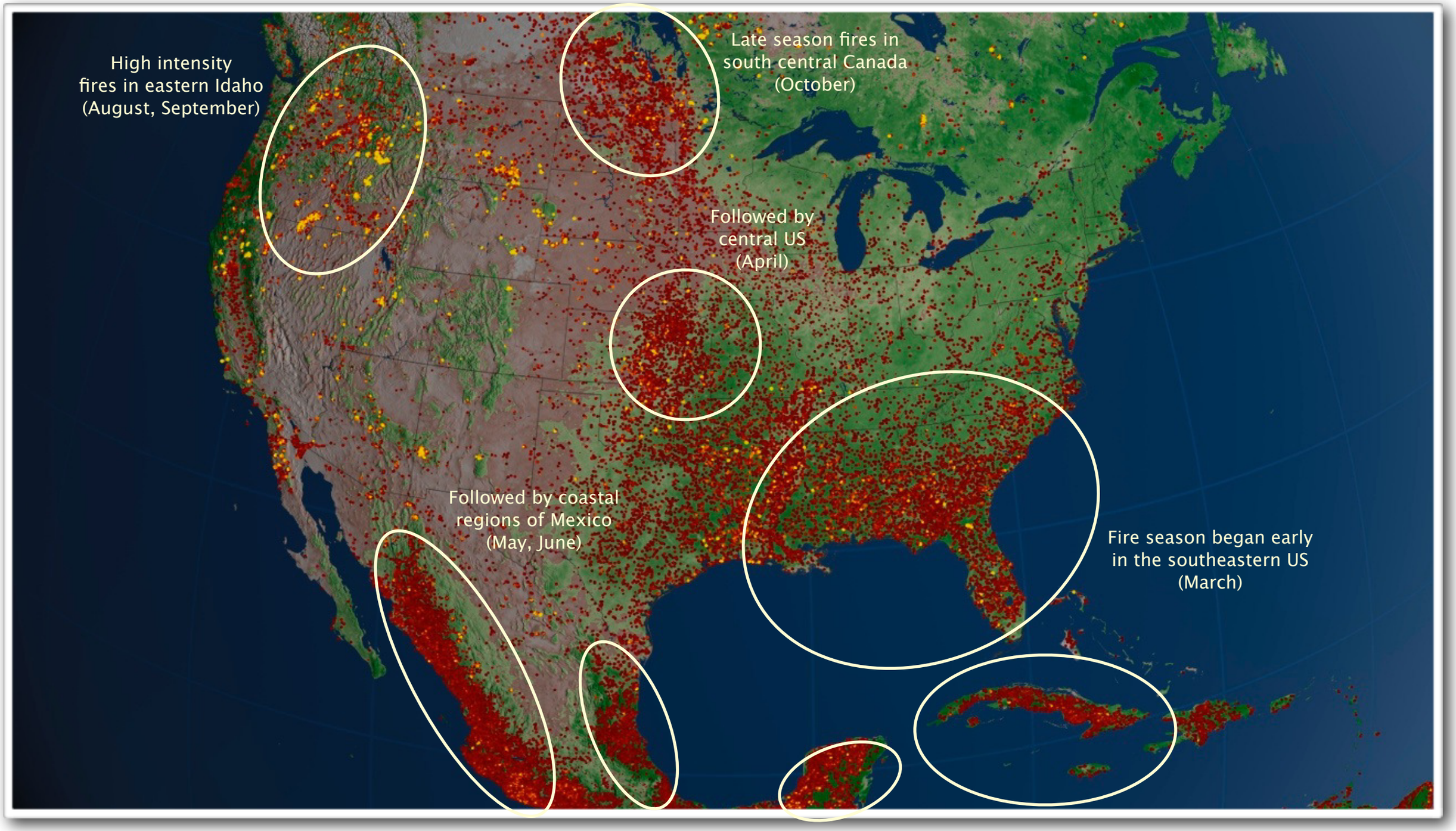

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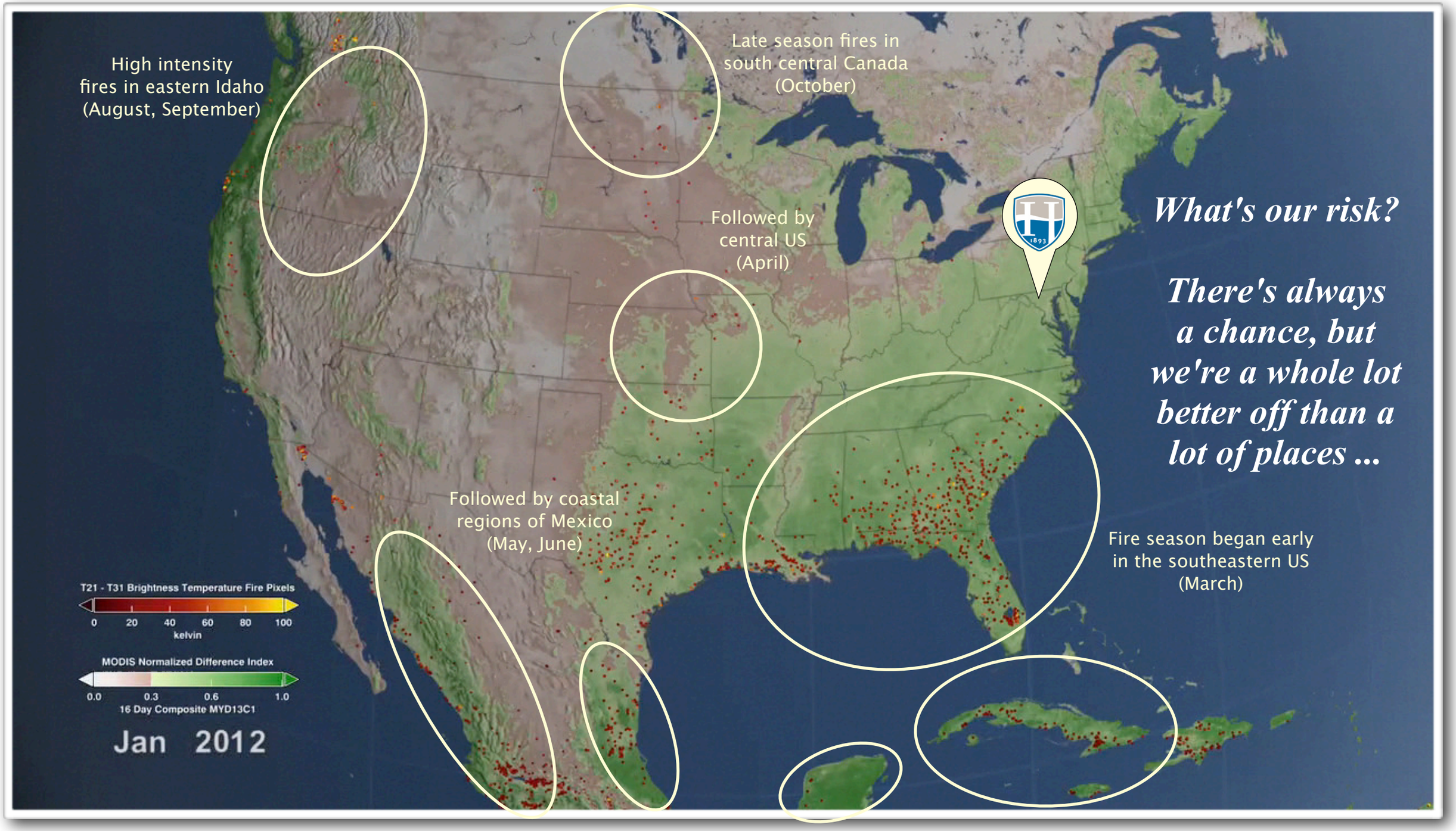


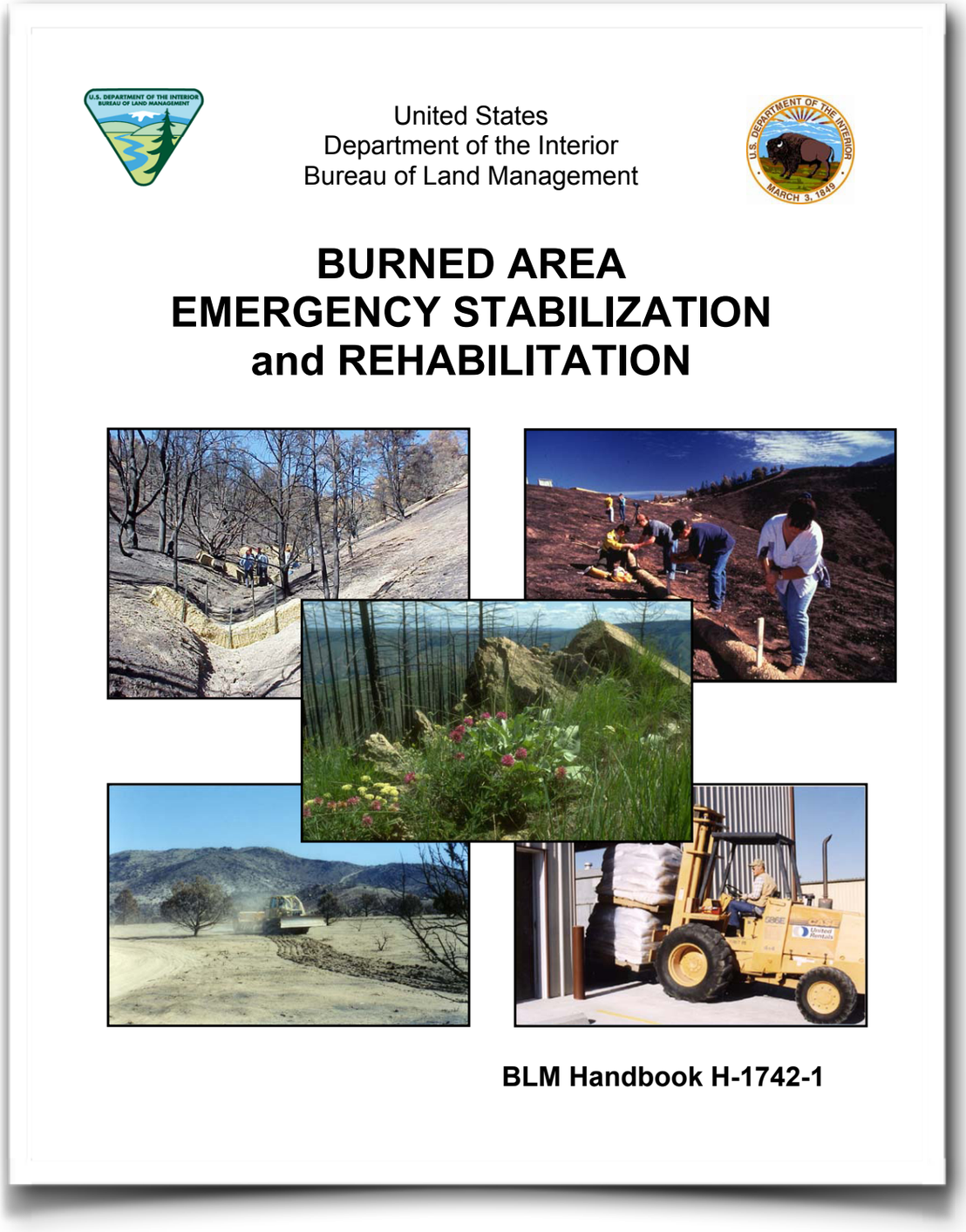
Wildfire Response

- The National Interagency Fire Center (NIFC), located in Boise, Idaho, is the nation's support center for wildland firefighting.
- Eight different agencies and organizations are part of NIFC: USFS, BLM, NWS, NPS, BIA, USFS, US Fire Administration, & FEMA.
- Decisions are made using the interagency cooperation concept because NIFC has no single director or manager.

Wildfire Response

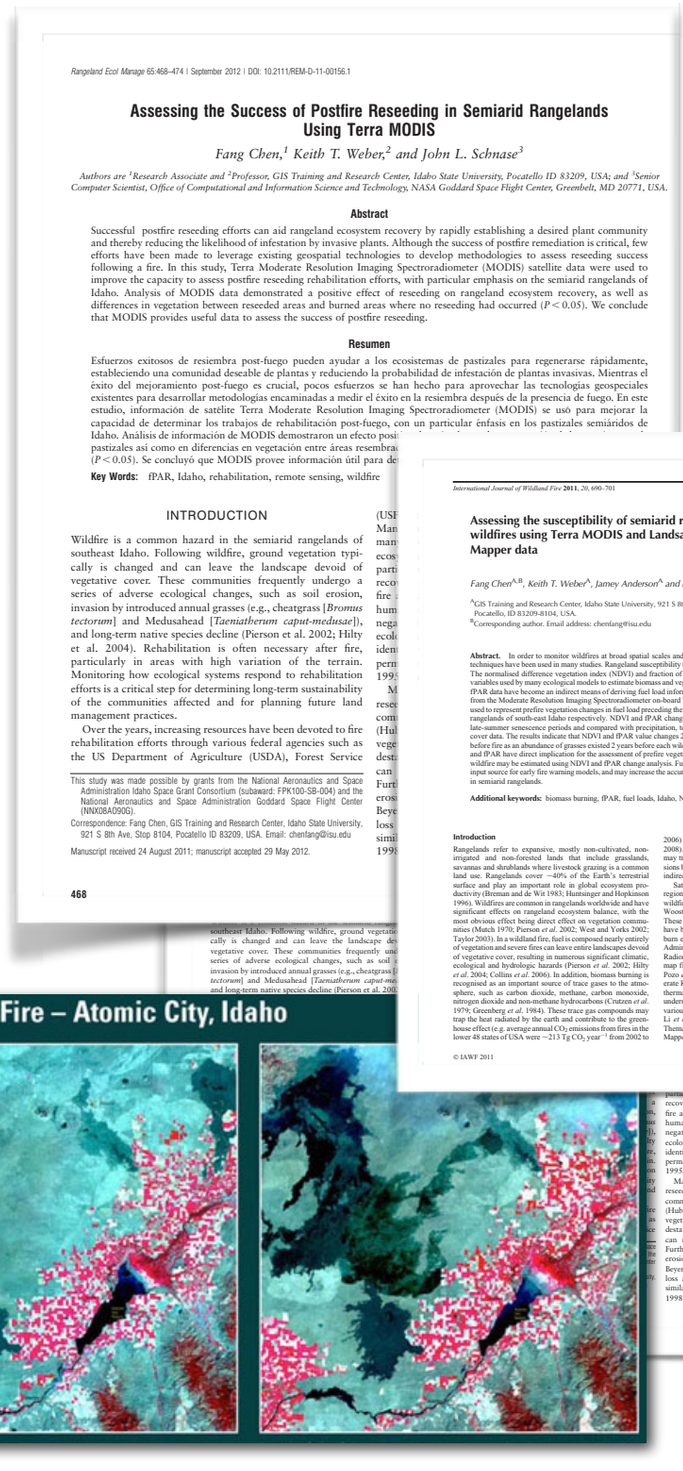
- After a major wildfire, law requires that the federal land management agencies certify a comprehensive plan for public safety, burned area stabilization, resource protection, and site recovery.
- These BAER plans are due within 14 days of containment of a major wildfire and become the guiding document for managing the activities and budgets for all subsequent remediation efforts.
- There are few instances in the federal government where plans of such wide-ranging scope are assembled on such short notice and translated into action more quickly.
- Post-fire rehabilitation planning is a data-intensive process and requires better access to new types of data products …

http://video.nationalgeographic.com/video/environment/environment-natural-disasters/landslides-and-more/wildfire-research/



The RECOVER Project

- Goal is to build an automated decision support system for post-fire rehabilitation planning.
- Focus is on savanna ecosystems of the Western US.
- Funded by NASA's Applied Sciences Program.
- Outgrowth of NASA-sponsored research on post-fire assessment and monitoring and decision support application development.
- Interagency Collaboration:
  - Idaho State University's GIS Training and Research Center (GIS TReC)
  - NASA Goddard Space Flight Center (GSFC)
  - DOI Bureau of Land Management (BLM)
  - Idaho Department of Lands (IDL).
- Stage 1 - Feasibility Study.
- Stage 2 - Operational Deployment.



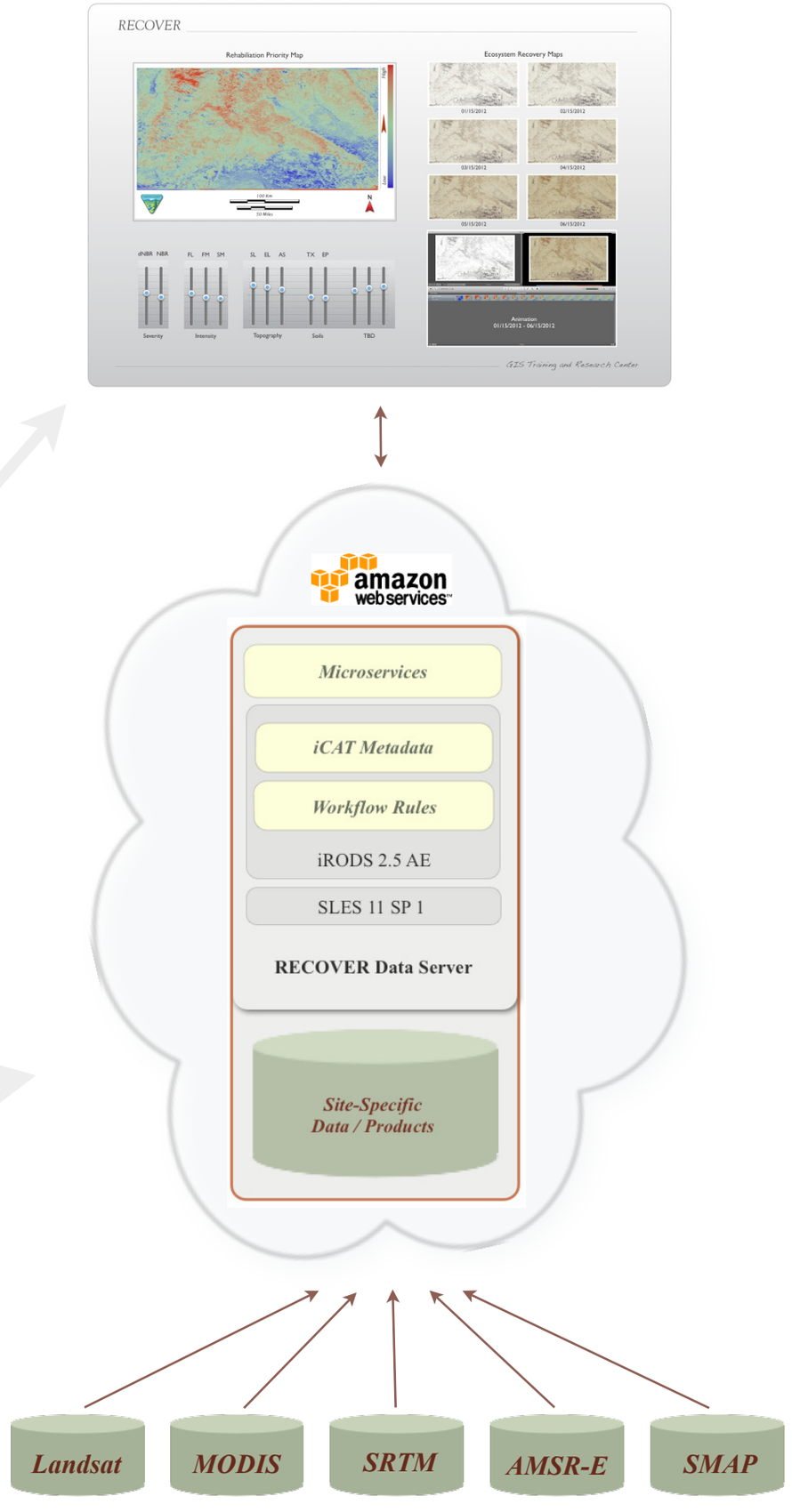
The RECOVER System

- RECOVER brings together in a single application the information necessary for BAER team post-fire rehabilitation decision-making and long-term ecosystem recovery monitoring.
- RECOVER is a web mapping application and multi-criteria decision aid that integrates information about fire severity and intensity with other types of data to help BAER teams plan reseeding strategies in the aftermath of savanna wildfires.
- Major system components:
  1. RECOVER Clients - Desktop and mobile interfaces that are able to connect to the RECOVER Server.
  2. RECOVER Server - A cloud-based data management system that automatically aggregates site-specific data from a distributed collection of relevant web-accessible resources.

GIS TReC leading client-side development

GIS TReC, BLM, IDL, and NASA together are identifying important data sets, workflows, and decision products ...

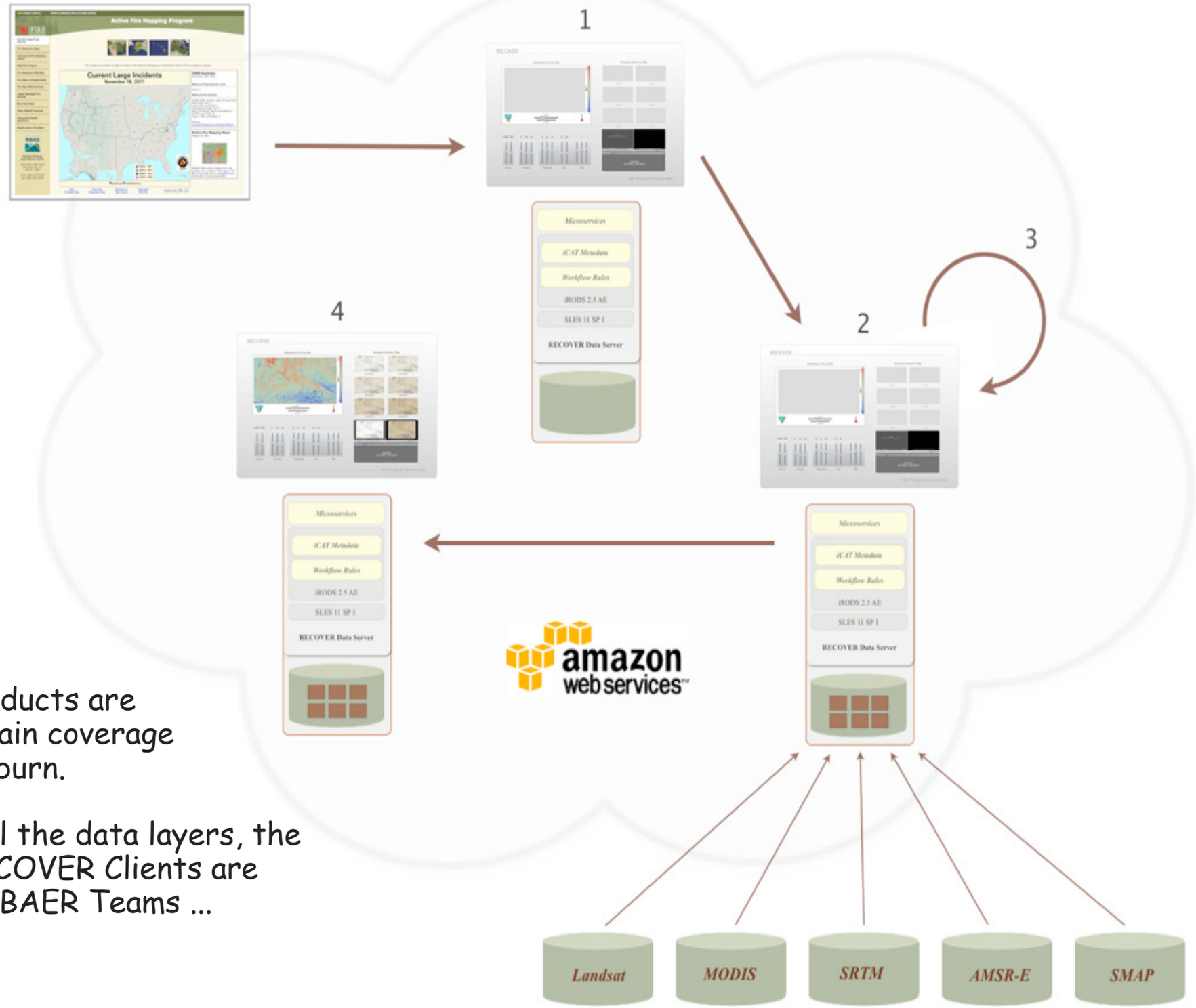
NASA leading server-side development



The RECOVER System

The typical RECOVER use scenario goes as follows:

1. A request containing the wildfire name and spatial extent is sent to the RECOVER Server.
2. The RECOVER server connects through web services to various data resources and automatically collects tailored, site-specific data and derived products.
3. These staged, aggregated products are refreshed as needed to maintain coverage and currency throughout the burn.
4. When the fire is contained, all the data layers, the RECOVER Server, and the RECOVER Clients are immediately ready for use by BAER Teams ...



The RECOVER Server

- Uses iRODS data grid software to manage site-specific data and metadata.

  iRODS = Integrated Rule-Oriented Data System

Background

- Open source data grid software system.
- Developed by the Data Intensive Cyber Environments (DICE) group, University of North Carolina.
- Historic roots in data grids, digital libraries, persistent archives, and real-time data systems R&D, and SRB.

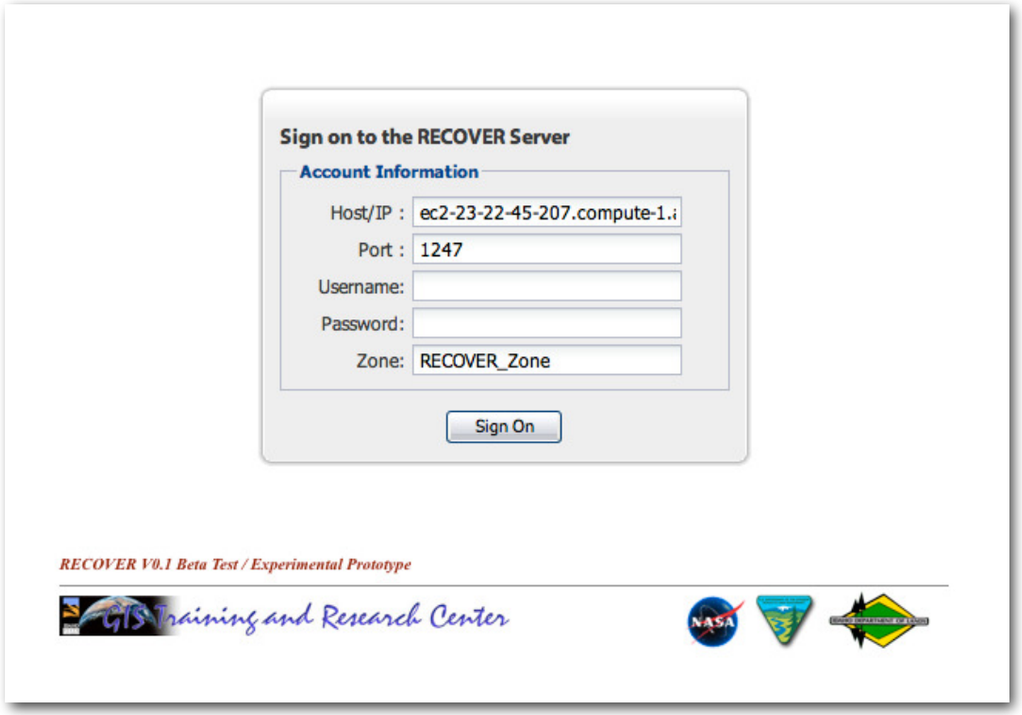
Features

- Targets large repositories, large data objects, digital preservation, and integrated complex processing.
- Supports server-side workflows implemented by chaining execution rules together based on data policies.
- Enables scalability and extensibility.

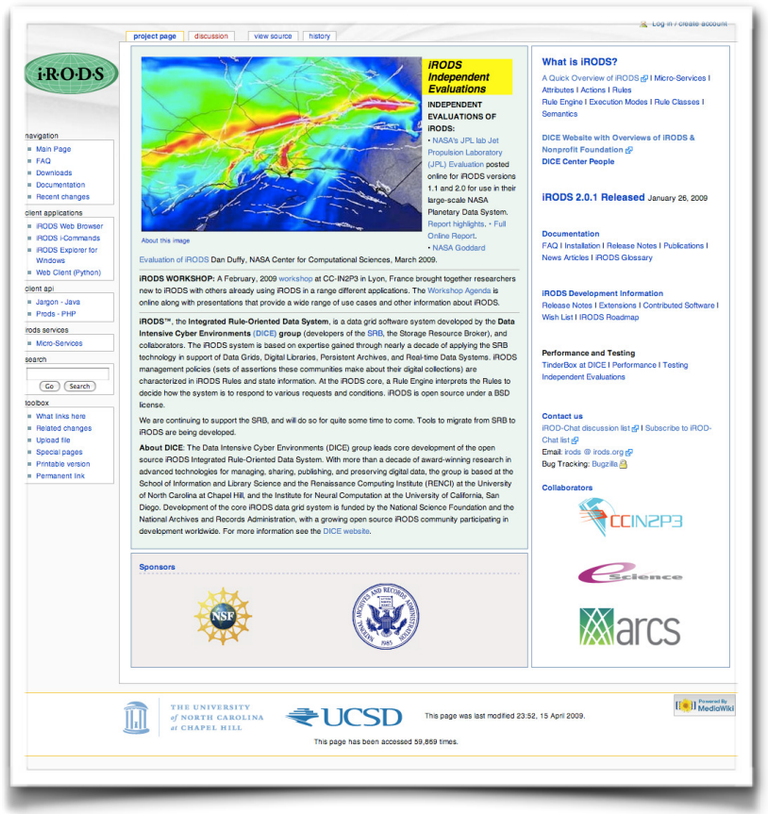
Major Concepts

- Policies => iRODS rules.
- Mechanisms => iRODS microservices.

With iRODS metadata providing the information necessary to perform these mappings ....



www.irods.org

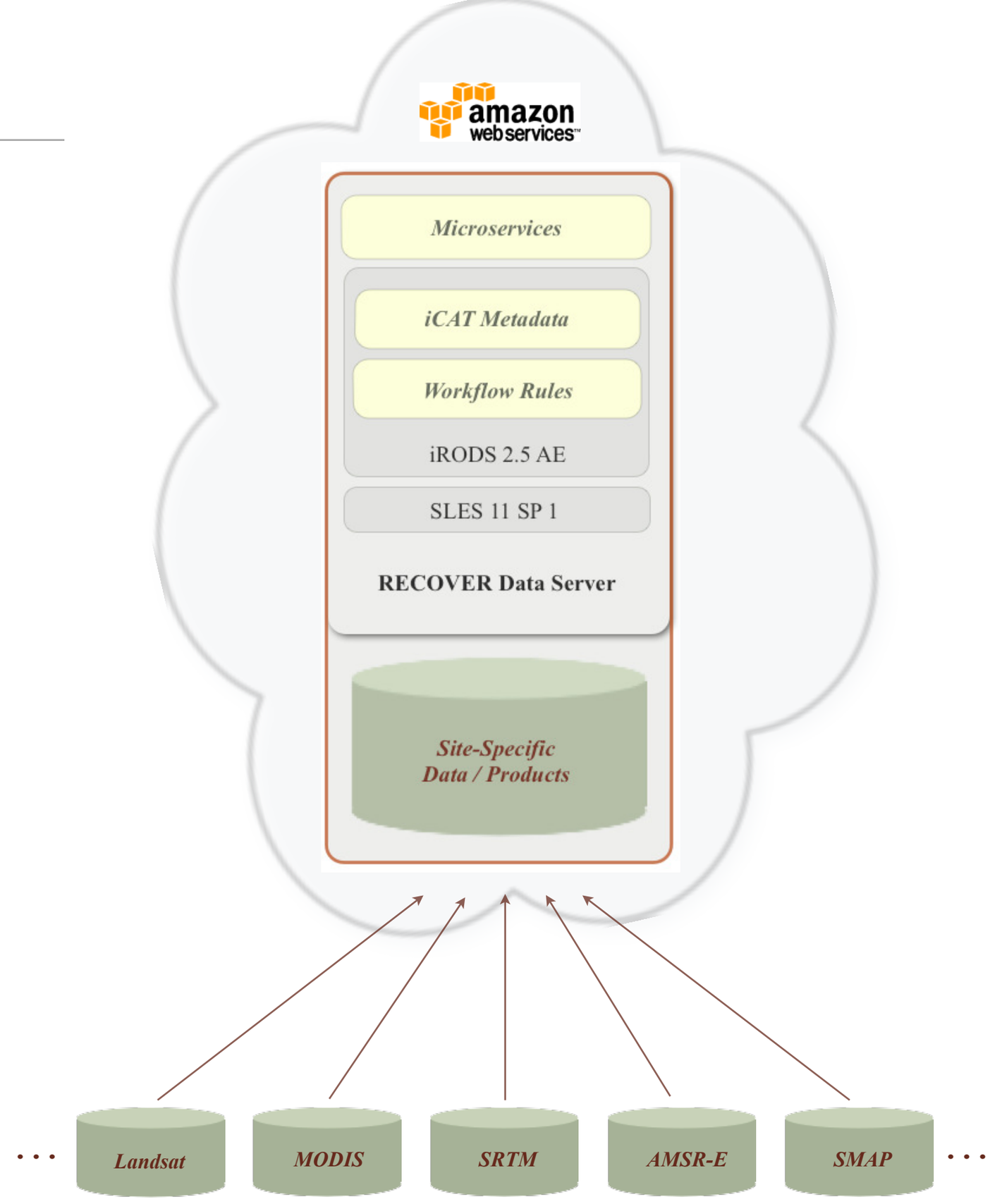


The RECOVER Server

- Is deployed in the Amazon Elastic Compute Cloud (EC2).
- Assembles and manages a variety of data:

Step 1: Core Data Sets (Automatically Assembled)
Normalized Burn Ratio (NBR)
Normalized Difference Vegetation Index (NDVI)
Fraction of Photosynthetically Active Radiation (fPAR)
Net Primary Production (NPP)
Topography Aspect (TA)
Topography Elevation (TE)
Topography Slope (TS)
Soil Texture (ST)
Soil K Factor (SKF)
Biophysical Setting (BPS)
Geology (GEO)
Existing Vegetation Cover (EVC)
Existing Vegetation Type (EVT)
Environmental Type Potential (ETP)

Step 2: Derived / Ancillary (Collected and Added Manually)
Difference in Normalized Burn Ratio (dNBR)
Fire Severity (FS)
Fire Intensity (FI)
Fire Regime Condition Class (FRCC)
FRCC Percent Departure (dFRCC)
Historic Fires 1936-2012 (H0)
Historic Fires 2002-2012 (H1)



The RECOVER Server

- Is deployed in the Amazon Elastic Compute Cloud (EC2).
- Assembles and manages a variety of data:

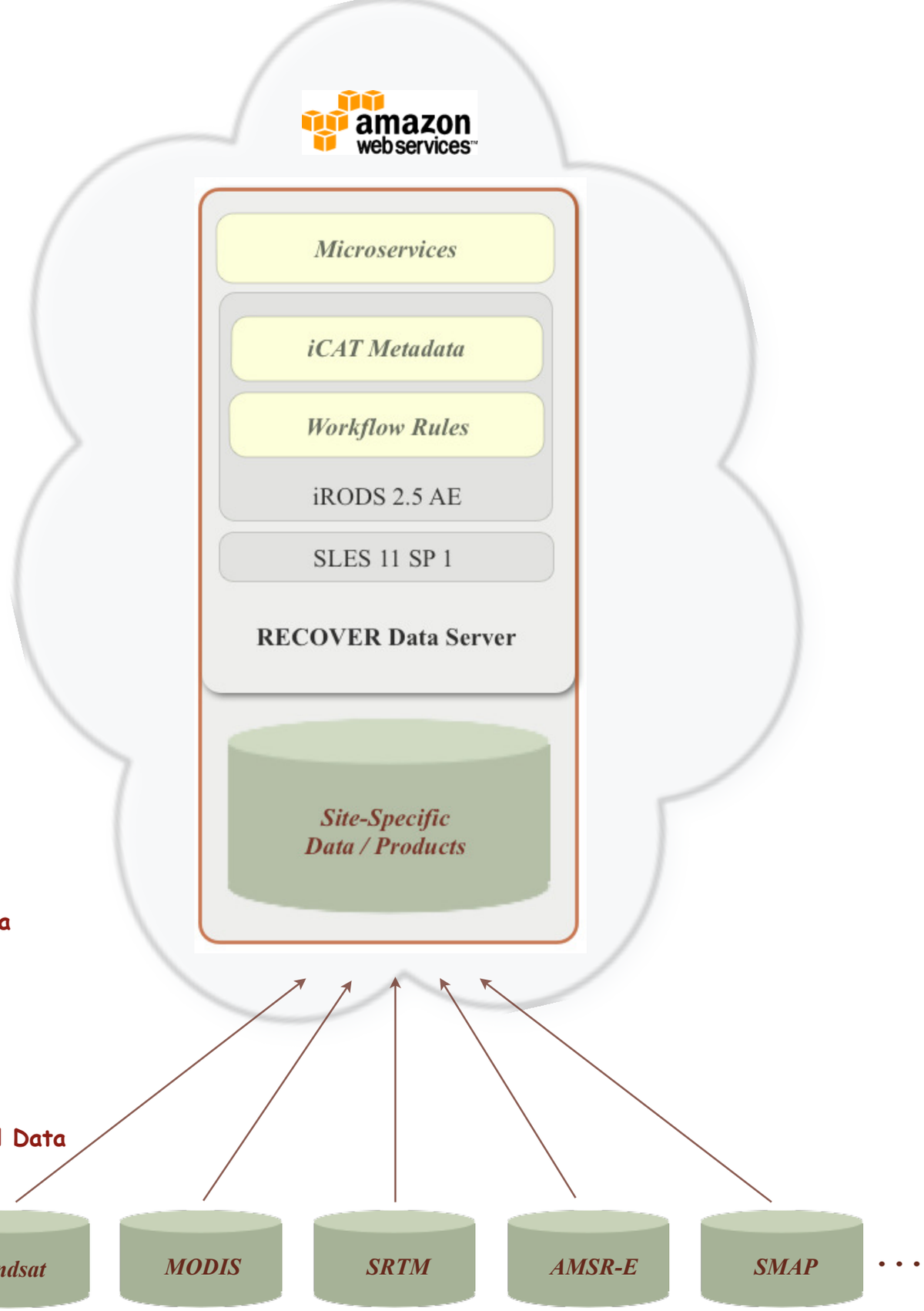
Step 3 Data - Short-Term DSS Products
Rehabilitation Priority Maps (RPMs)
[Derived product composed of Step 1 and Step 2 inputs.]

Step 4 Data - Long-Term DSS Products
Ecosystem Recovery Maps (ERMs)
[Derived product composed of periodic fPAR measurements.]

Experimental Data Sets
Evapotranspiration (modisET) **<= Placeholder for SMAP Data**
Soil Moisture (amsreSM)
Soil Moisture (smapSM)

Historic Temperature (merraHT) **<= Placeholder for MERRA Reanalysis Data**
Historic Precipitation (merraHP)
Historic Temperature (ecmwfHT)
Historic Precipitation (ecmwfHP)
Historic Temperature (ncepHT)
Historic Precipitation (ncepHP)

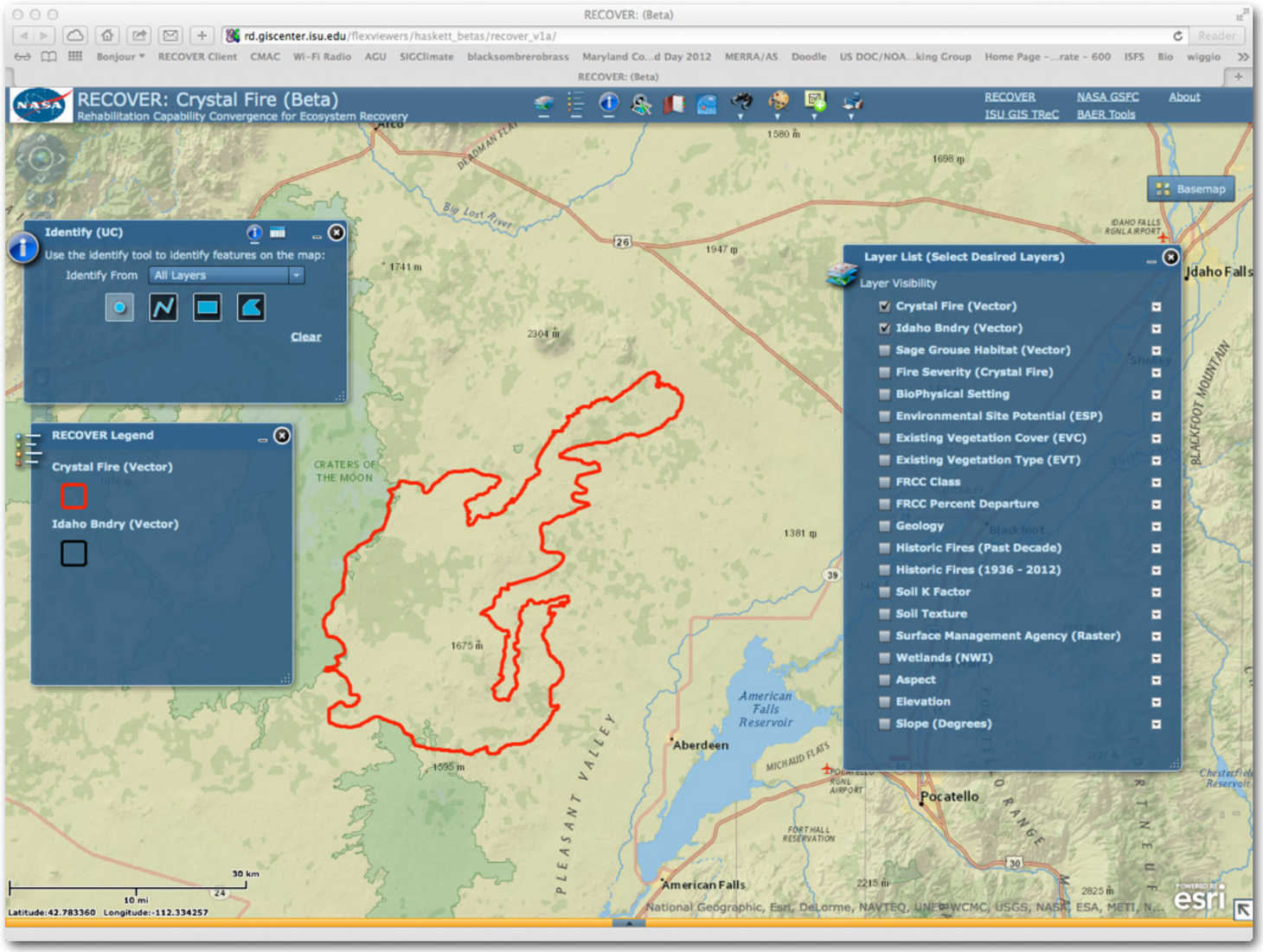
Future Temperature (goes5FT) **<= Placeholder for GEOS-5 Climate Model Data**
Future Precipitation (goes5FP)
Future Temperature (modeleFT)
Future Precipitation (modeleFP)

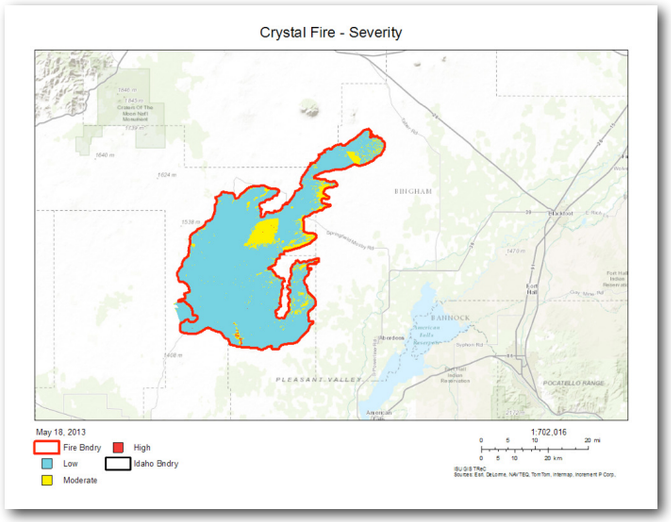


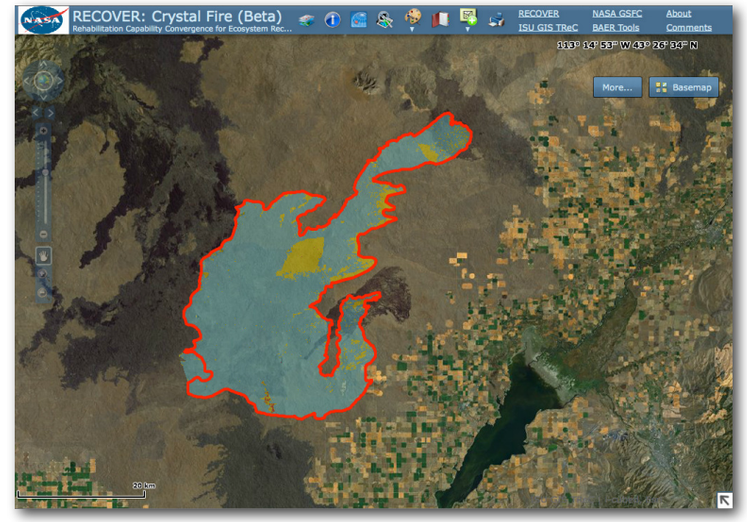
The RECOVER Client

- Adobe Flex Web Mapping Application
  - Connects to the RECOVER Server through a web services interface.
    (Eventually - right now we just use iDrop.)
  - Allows site-specific data layers to be viewed and interrogated in a variety of ways.
  - Accommodates a wide range of base layers.
  - Additional information to aid in analysis can be uploaded through the RECOVER Client.
  - Professional, high-quality, high-resolution maps can be easily generated.
- Mobile Clients
  - Prototype RECOVER Client designed for desktop and laptop use ...

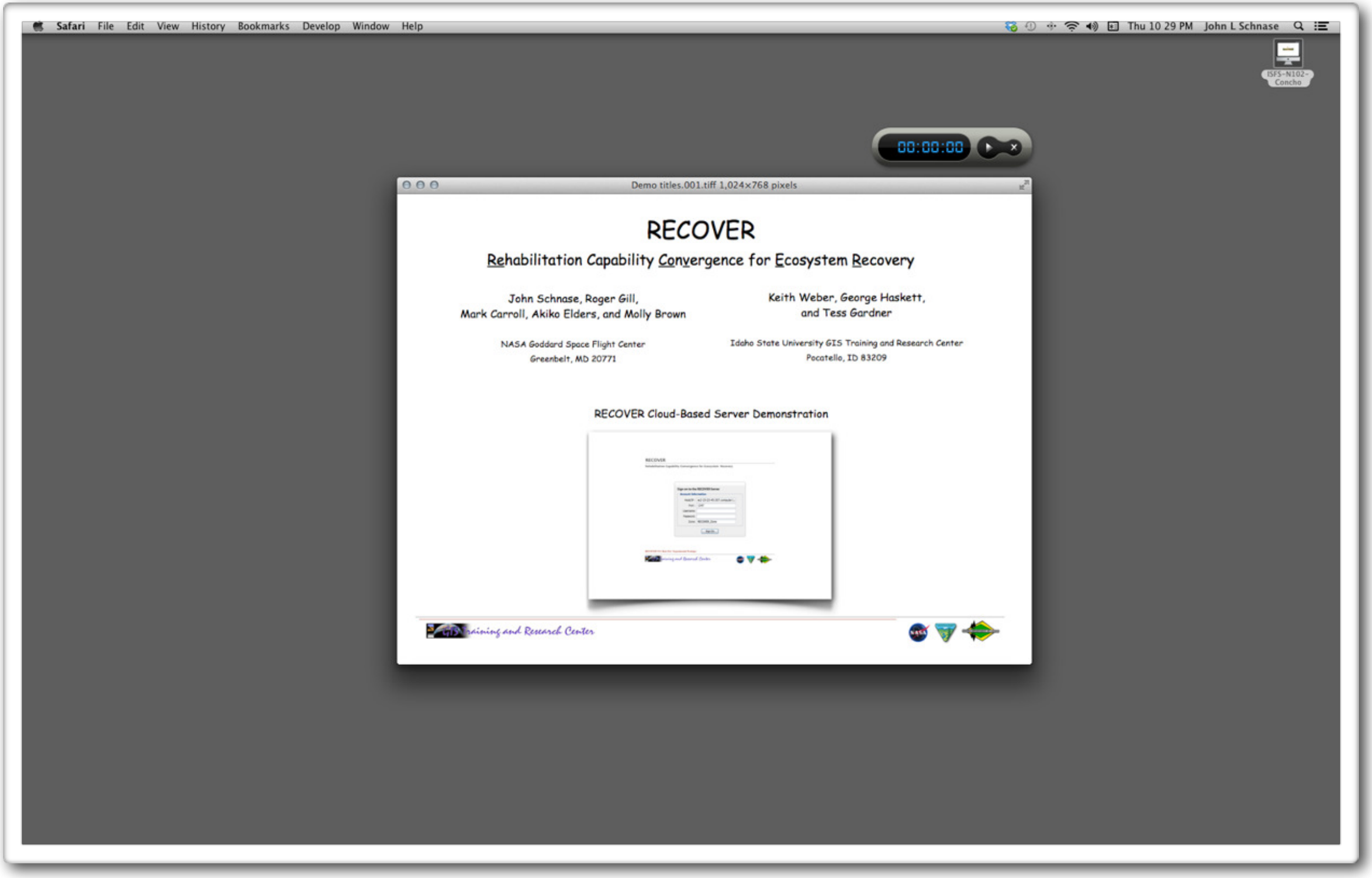
    ... but we are beginning to work on mobile clients.







RECOVER Server Demo



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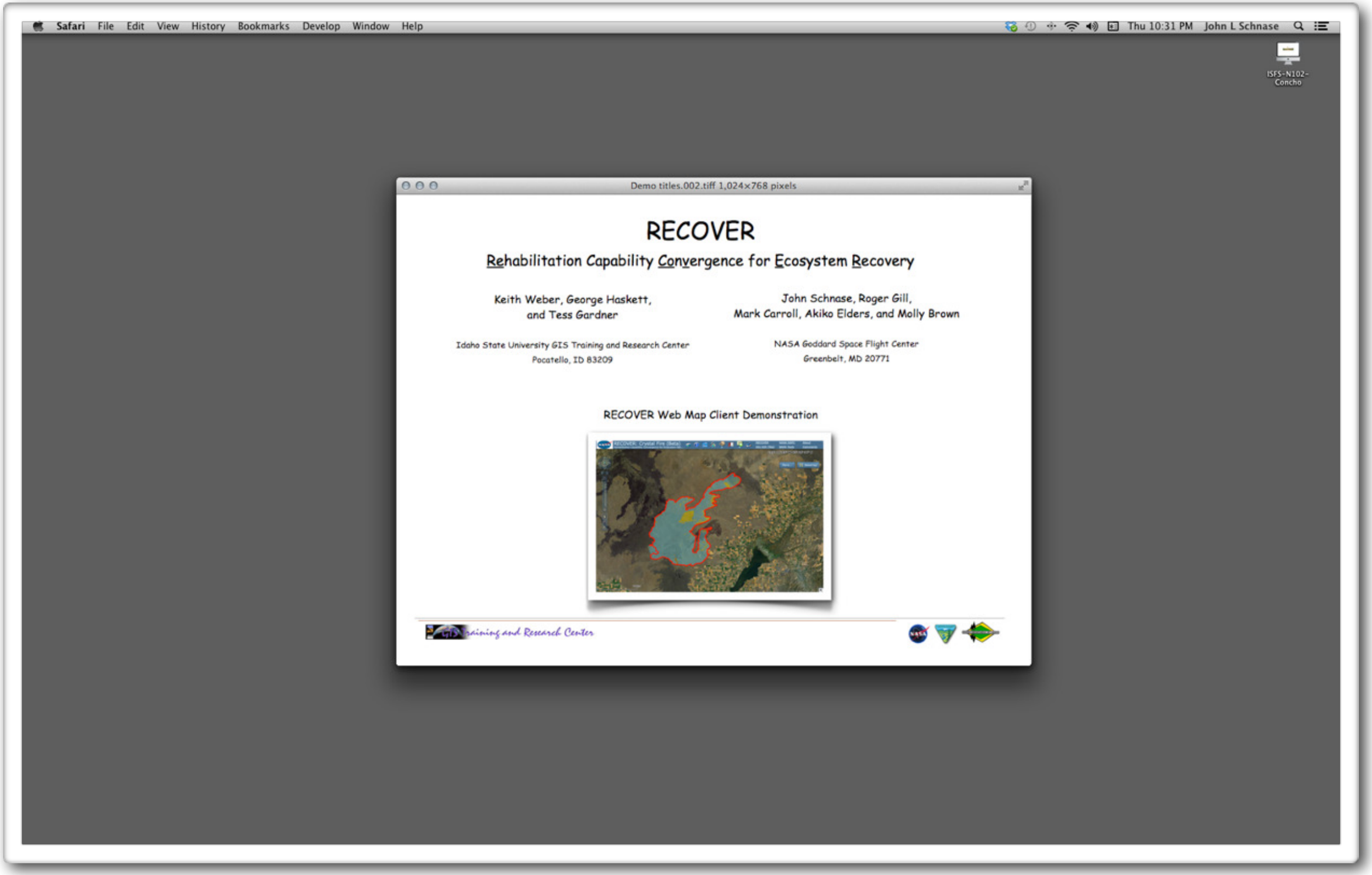
RECOVER Cloud-Based Server Demonstration

GIS Training and Research Center

RECOVER Client Demo



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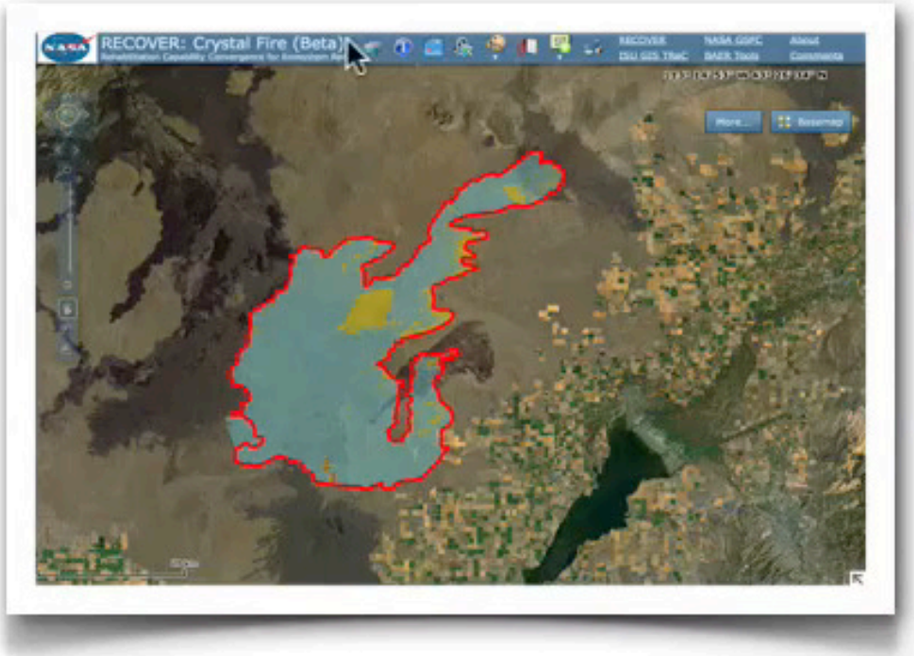
RECOVER Web Map Client Demonstration



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