



The RECOVER Cloud-Based Data Server

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Talk Outline

The RECOVER Project
The RECOVER System
The RECOVER Server
Next Steps
Demo / Q&A



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)

• Phase I - Feasibility Study.

• Phase II - Operational Deployment.

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Assessing the Success of Postfire Reseeding in Semiarid Rangelands Using Terra MODIS

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Abstract

Successful postfire reseeding efforts can aid rangeland ecosystem recovery by rapidly establishing a desired plant community and thereby reducing the likelihood of infestation by invasive plants. Although the success of postfire remediation is critical, few efforts have been made to leverage existing geospatial technologies to develop methodologies to assess reseeding success following a fire. In this study, Terra Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data were used to improve the capacity to assess postfire reseeding rehabilitation efforts, with particular emphasis on the semiarid rangelands of Idaho. Analysis of MODIS data demonstrated a positive effect of reseeding on rangeland ecosystem recovery, as well as differences in vegetation between reseeded areas and burned areas where no reseeding had occurred ($P < 0.05$). We conclude that MODIS provides useful data to assess the success of postfire reseeding.

Resumen

Esfuerzos exitosos de resembría post-fuego pueden ayudar a los ecosistemas de pastizales a recuperarse rápidamente, estableciendo una comunidad deseada de plantas y reduciendo la probabilidad de infestación de plantas invasoras. Mientras el éxito del mejoramiento post-fuego es crucial, pocos esfuerzos se han hecho para aprovechar las tecnologías geoespaciales existentes para desarrollar metodologías encaminadas a medir el éxito en la resembría después de la presencia de fuego. En este estudio, información de satélite Terra Moderate Resolution Imaging Spectroradiometer (MODIS) se usó para mejorar la capacidad de determinar los trabajos de rehabilitación de post-fuego, con un particular énfasis en los pastizales semiaridos de Idaho. Análisis de información de MODIS demostraron un efecto positivo en la recuperación de los pastizales tras el fuego, así como diferencias en la vegetación entre áreas resembradas ($P < 0.05$). Se concluyó que MODIS provee información útil para

Key Words: IPAR, Idaho, rehabilitation, remote sensing, wildfire

INTRODUCTION

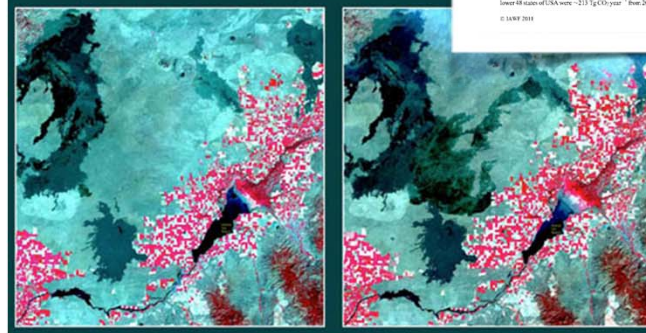
Wildfire is a common hazard in the semiarid rangelands of southeast Idaho. Following wildfire, ground vegetation typically is changed and can leave the landscape devoid of vegetative cover. These communities frequently undergo a series of adverse ecological changes, such as soil erosion, invasion by introduced annual grasses (e.g., cheatgrass [*Bromus tectorum*] and medusahead [*Taenatherum caput-medusae*]), and long-term native species decline (Peterson et al. 2002; Hilly et al. 2004). Rehabilitation is often necessary after fire, particularly in areas with high variation of the terrain. Monitoring how ecological systems respond to rehabilitation efforts is a critical step for determining long-term sustainability of the communities affected and for planning future land management practices.

Over the years, increasing resources have been devoted to fire rehabilitation efforts through various federal agencies such as the US Department of Agriculture (USDA), Forest Service (USFS), and Bureau of Land Management (BLM) (Peterson et al. 2002; Hilly et al. 2004). This study was made possible by grants from the National Aeronautics and Space Administration (NASA) Space Grant Consortium of Idaho (NSG 58-04-01-01), National Aeronautics and Space Administration Goddard Space Flight Center (NSG04-0290), and Idaho State University (ISU). Corresponding author: Fang Chen, GIS Training and Research Center, Idaho State University, 197 S 8th Ave, Stop #114, Pocatello ID 83209, USA. Email: chenfang@isu.edu

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GIS in Remote Sensing and Decision Support Systems

The Crystal Fire – Atomic City, Idaho



2009 (Slaughter 1962; Woodruff and Neff 2001; EPA 2001). Furthermore, following a fire, vegetation communities may transition to a very different community type due to invasion by non-native species, including the variety of introduced insect herbivores (Thomas and Davis 1985; Hilly et al. 2004). Satellite remote sensing and geographic information system (GIS) mapping have been used for many wildfire studies (Friedman et al. 1997; Miller and Nease 2002; Wessner et al. 2005; Lesica et al. 2006; Weber et al. 2006). These studies used both commercial and modified data sets that have been collected in active fires and for detecting post-fire recovery (Weber et al. 2006). However, few studies have been conducted on active fires and for detecting post-fire recovery (Weber et al. 2006). The National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) and Idaho State University (ISU) have been using a direct and fast method to assess the success of post-fire reseeding efforts (Chen et al. 2006; Chen et al. 2007; Chen et al. 2008; Chen et al. 2009). In addition, various burning is recognized as an important source of major gases in the atmosphere, such as carbon dioxide, methane, carbon monoxide, nitrogen dioxide, and particulate matter (Carter et al. 1978; Crutzen et al. 1994). These trace gas compounds may have been released by the fire and contribute to the greenhouse effect by trapping atmospheric CO₂ emissions from fires by the lower 6 km of the atmosphere (213 K. Brown 2002).

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RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery

An Automated Burned Area Emergency Response Decision Support System for Post-fire Rehabilitation Management of Savanna Ecosystems in the Western US

Keith T. Weber
GIS Training and Research Center
Idaho State University

John L. Schnase^{1,2}, Molly E. Brown¹, and Mark Carroll³
¹Office of Computational and Information Science and Technology,
²NASA Center for Climate Simulation, and ³Biospheric Sciences Branch
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of Interior's Bureau of Land Management (BLM), we propose to build a decision support system, RECOVER, will be an automatically decision aid that brings together in a single application the Area Emergency Response (BAER) teams to plan reseeding strategies in the aftermath of savanna wildfires.

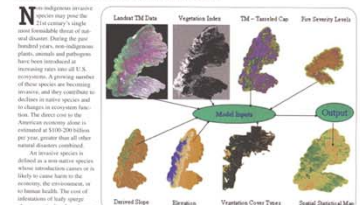
of-the-art cloud-based data management technologies to improve site-specific flexibility for each fire. Customized RECOVER is played in the Amazon EC2 Cloud when a fire is detected. RECOVER's all-derived from the existing network of data resources. RECOVER's fresh denved fire severity, fire intensity, and other products throughout BAER teams will have a hard a complete and ready-to-use target wildfire. Since BAER remediation plans must be completed quickly, RECOVER has the potential to significantly improve the

use on forest wildfires. RECOVER adds an important new dimension on ecosystem rehabilitation in semiarid savannas. A novel tool using the use of soil moisture estimates, which are an important but fire rehabilitation planning. We will use downscaled soil moisture data sources currently available to begin evaluating the use of soil

The National Invasive Species Forecasting System:

A Strategic NASA/USGS Partnership to Manage Biological Invasions

By John L. Schnase, Thomas A. Stohlgren and James A. Smith



Recently issued data plays a critical role in dealing with the problem of invasive species. NASA currently provides measurements from Terra, Landsat-7, QuikSCAT, Jason and other missions that can be used to forecast the distribution of invasive species. Future missions will expand these measurements to include critical three-dimensional structure that supports a wide range of species. The National Biological Service's Committee on Global Change in Environmental Science has identified increased understanding of biodiversity and ecosystem functioning as one of the most important environmental science research priorities for the next decade and the world today. The committee also emphasized the need to develop improved management techniques and an early warning capability for non-indigenous invasive species. NASA and the U.S. Geological Survey (USGS) are currently working together to develop a National Invasive Species Forecasting System to manage and control of an invasive species.



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 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:

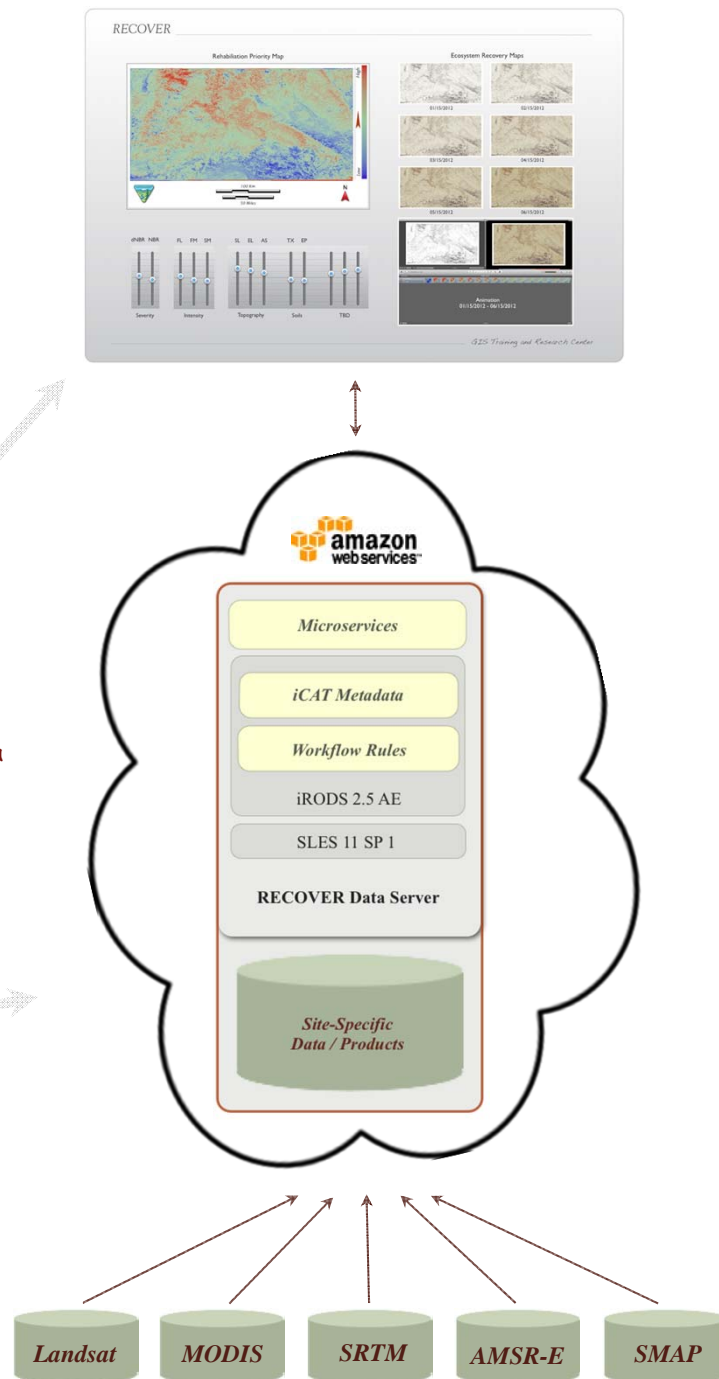
- 1.RECOVER Clients - Desktop and mobile interfaces that are able to connect to the RECOVER Server.

- 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:

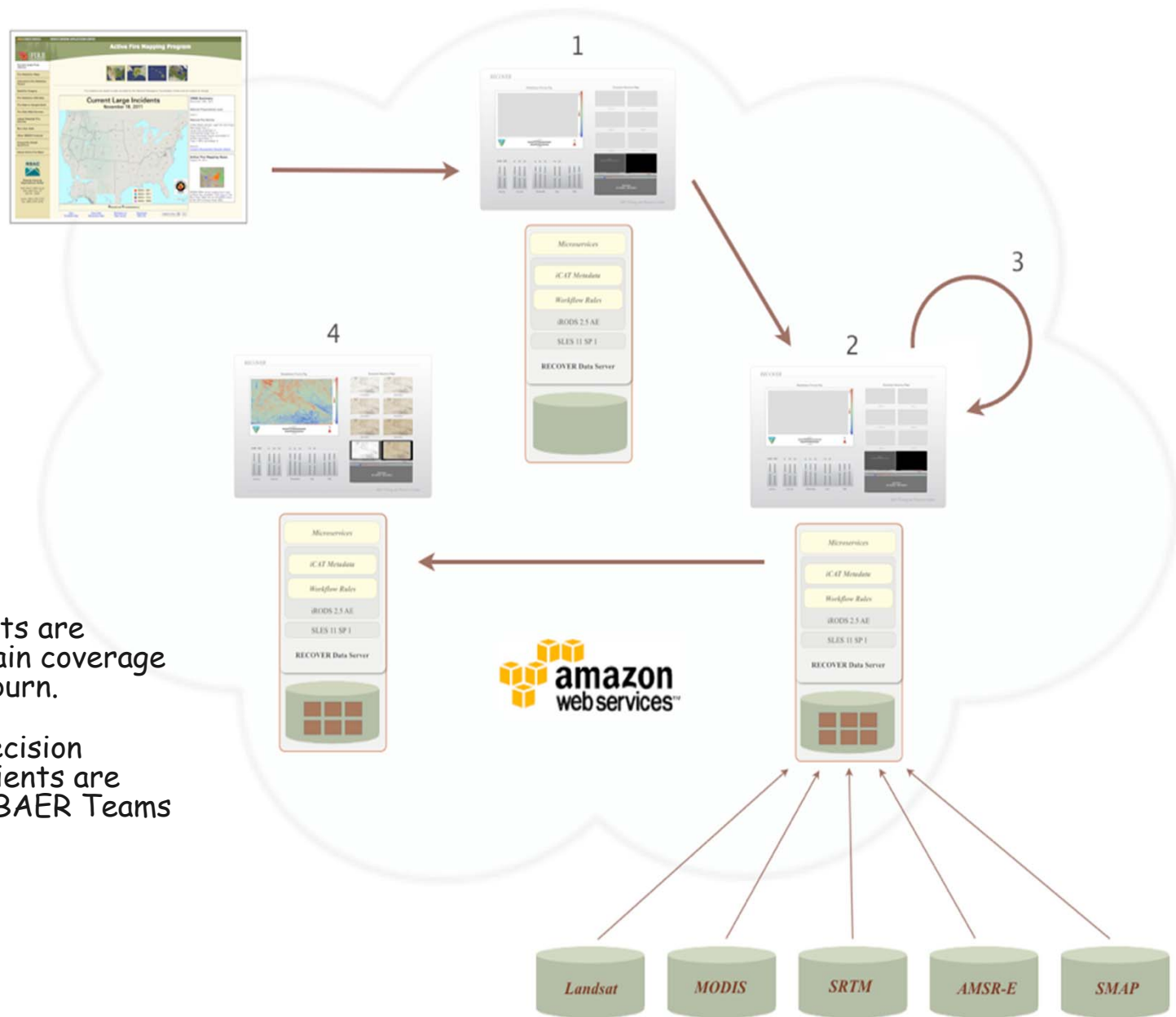
1. A request containing the wildfire name and spatial extent is sent to the RECOVER Server.

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, mash-up products are refreshed as needed to maintain coverage and currency throughout the burn.

4. When the fire is contained, decision products 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 = Integrate 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

The screenshot shows the iRODS website homepage. The main content area features a large image of a globe with a red and yellow band across it, and text that reads "IRODS Independent Evaluations" and "INDEPENDENT EVALUATIONS OF IRODS". Below this, there is a section titled "IRODS WORKSHOP" and another titled "About DICE". The right sidebar contains several sections: "What is iRODS?", "IRODS 2.0.1 Released", "Documentation", "IRODS Development Information", "Performance and Testing", and "Contact us". The footer includes logos for The University of North Carolina at Chapel Hill, UCSD, and the National Science Foundation, along with a "This page has been accessed 18,869 times" counter.

www.irods.org

The RECOVER Server

- Is deployed in the Amazon Elastic Compute Cloud (EC2).

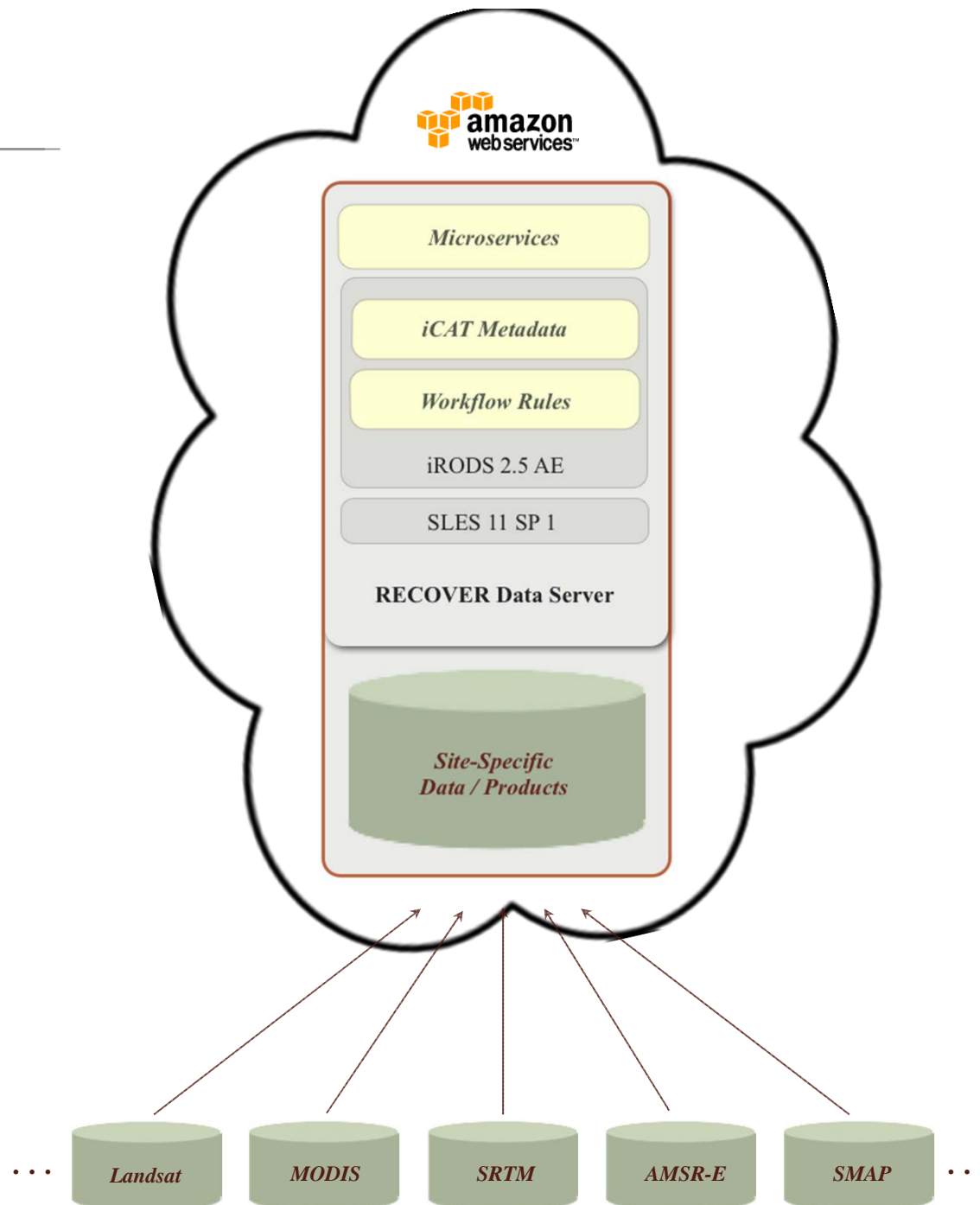
- Assembles and manages a variety of data:

Stage 1 Collection - Core

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)

Stage 2 Collection - Derived / Ancillary

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:

Stage 3 Collection - Short-Term DSS Products

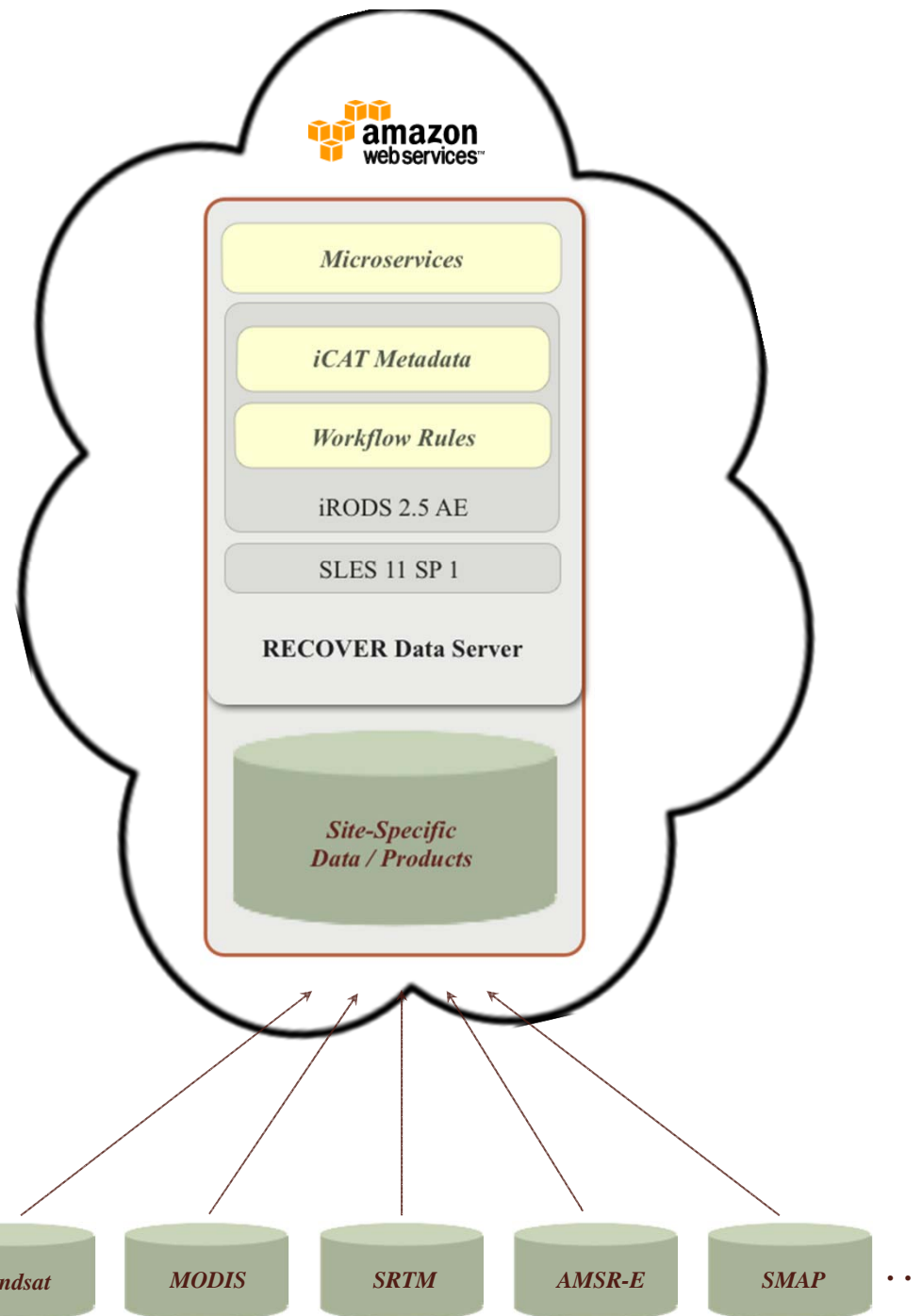
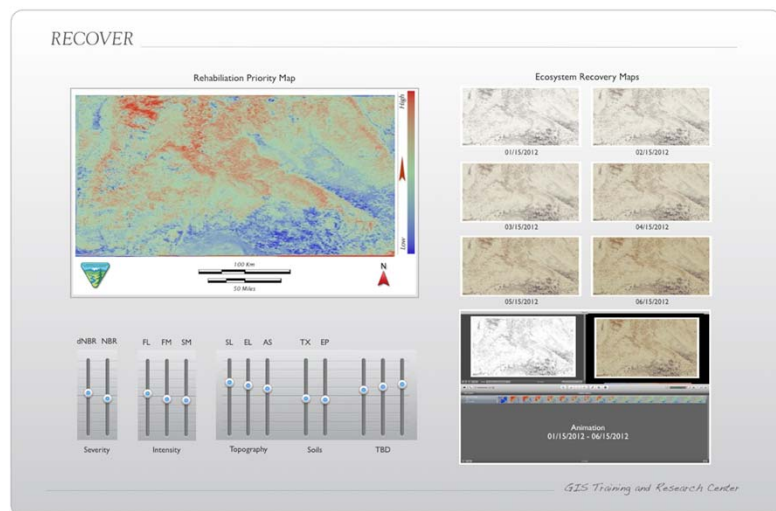
Rehabilitation Priority Maps (RPMs)

[Derived product composed of Stage 1 and Stage 2 inputs.]

Stage 4 Collection - Long-Term DSS Products

Ecosystem Recovery Maps (ERMs)

[Derived product composed of periodic fPAR measurements.]



The RECOVER Server

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Stage 3 Collection - Short-Term DSS Products

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Stage 4 Collection - Long-Term DSS Products

Ecosystem Recovery Maps (ERMs)

[Derived product composed of periodic fPAR measurements.]

Stage 1 Collection - Experimental

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)

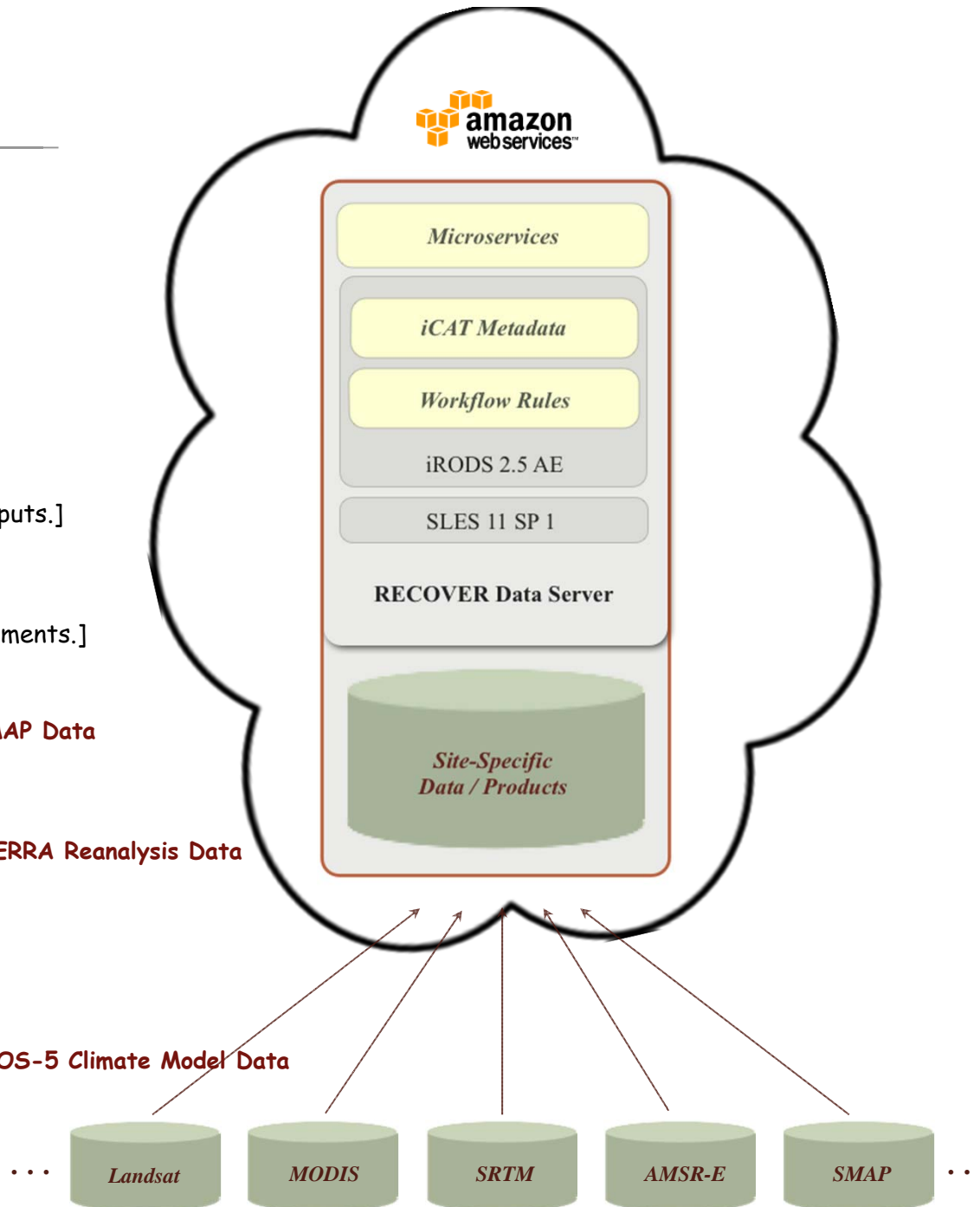
Future Temperature (goes5FT)

<= Placeholder for GEOS-5 Climate Model Data

Future Precipitation (goes5FP)

Future Temperature (modeleFT)

Future Precipitation (modeleFP)



Next Steps ...

•Phase I - Feasibility Study

-1 Year (FY13) Prototype development and evaluation activity.

-Idaho / Crystal Fire are being used for prototype development.

-Want to "shadow" work on at least one fire this season to evaluate.

-Evaluate with partners and develop proposal / teaming arrangement to develop production system.

•Phase II - Operational Deployment

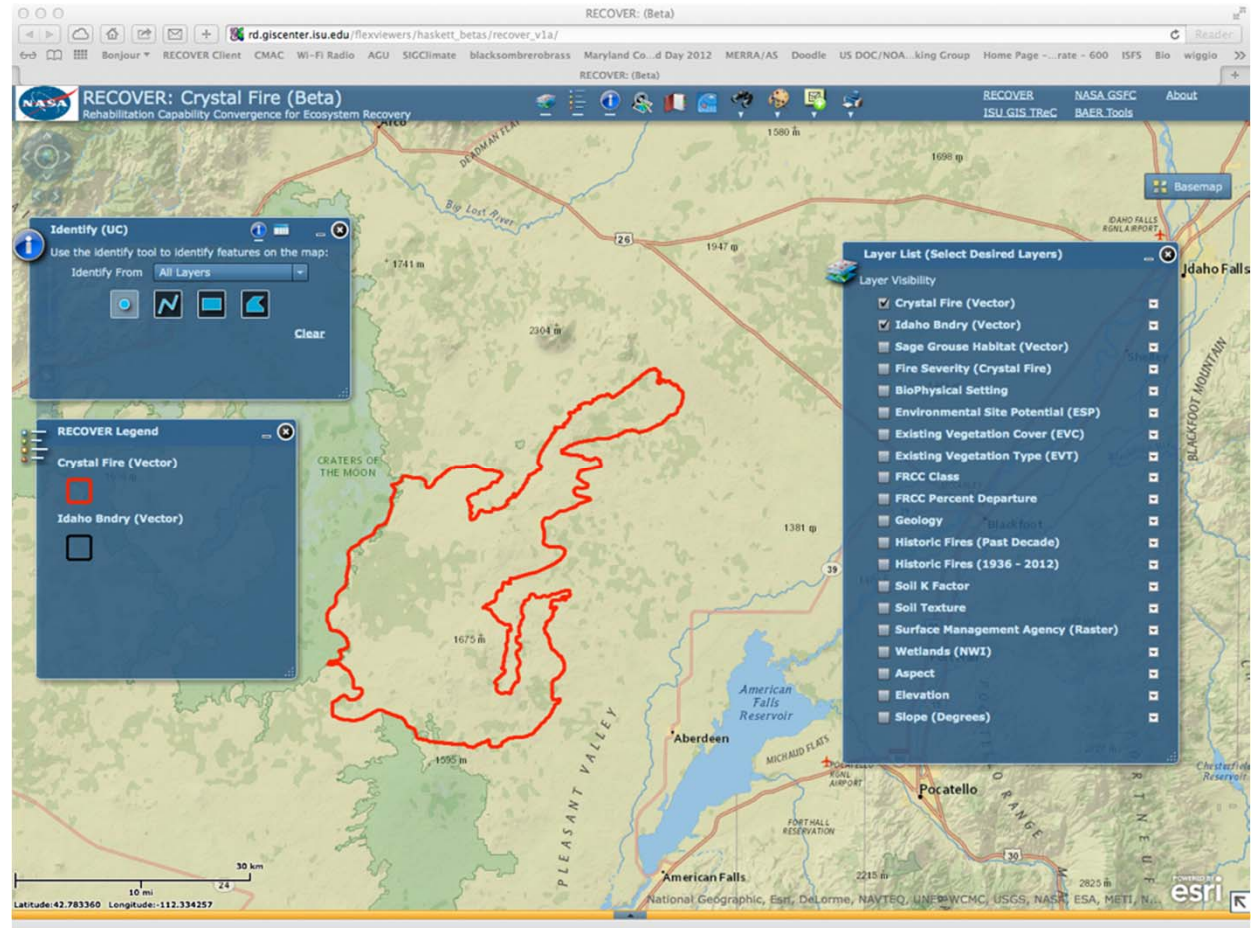
-2 Year (FY14-15) activity to develop full-scale system for Western US regions of interest.

-(NB: There's a Phase I down-select!)

-Develop mobile tablet/smartphone capabilities to complement desktop interfaces.

-Enable the RECOVER platform to consume SMAP, LDCM, Suomi NPP, Reanalysis, and Climate Model data.

- Create a modern wildfire DSS optimized to for the current suite of GIS technologies and Earth observing missions ...



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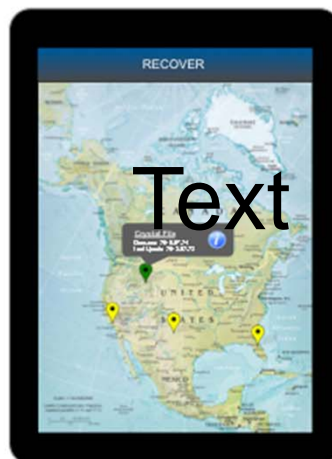
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RECOVER iPad Prototype

App Definition Statement:

The RECOVER iPad Prototype application provides ecologists a tool to analyze burn site recovery imagery.



Initial State

Pins indicate fire sites, green pins indicate recent updates.

Click the information button, 'i', to view the site.



Site View

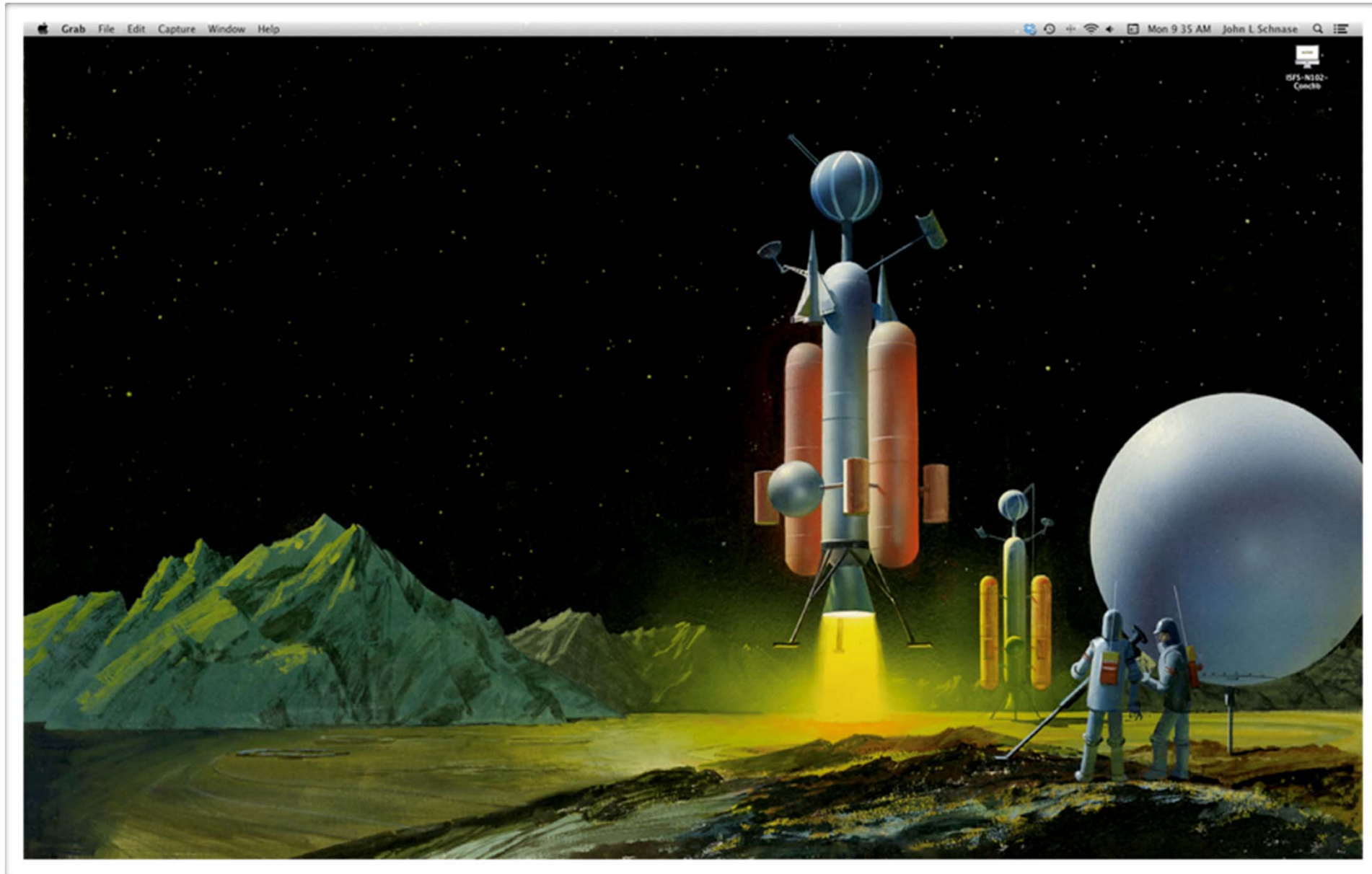
The site view shows the fire boundary and a mosaic of all layers.



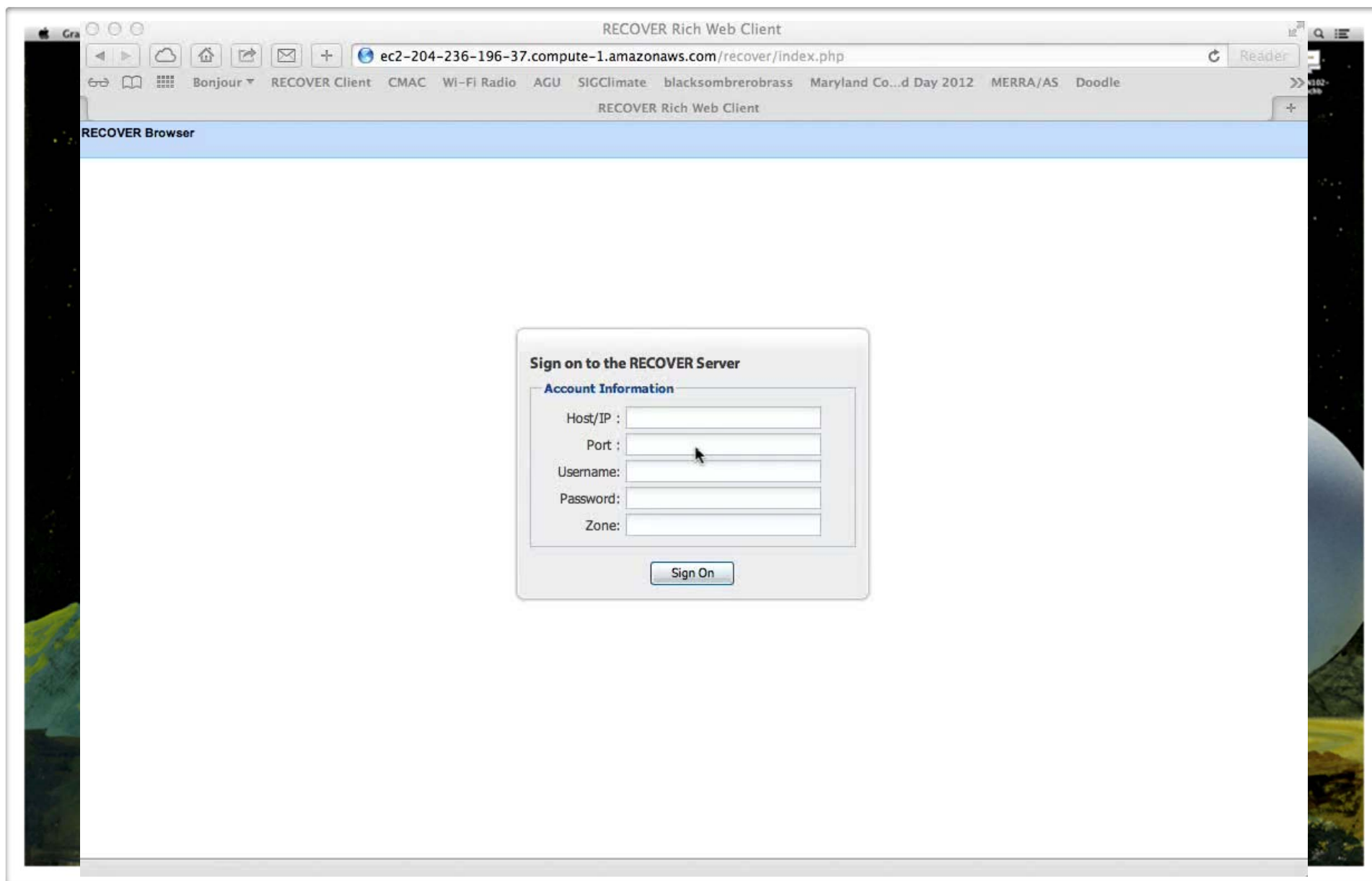
Layer Selection

Choose layers for the mosaic. For the prototype, all layers contribute equally. Slider bars will be added later.

The RECOVER Server - Demo



The RECOVER Server - Demo





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