NASA Wrangler

Automated Cloud-Based Data Assembly in the RECOVER Wildfire Decision Support System

John Schnase, Mark Carroll, Roger Gill, and Maggie Wooten

NASA Goddard Space Flight Center

Keith Weber, Kindra Blair, Jeffrey May, and William Toombs

Idaho State University GIS Training and Research Center

Is it just me?

January 24, 1984
Apple commercial
announcing Macintosh

July 28, 2017
IGARSS conference
announcing Wrangler

NASA Wrangler

NASA Wrangler is a loosely-coupled, highly parallel data aggregation service designed to take advantage of the eleastic reource capabilities of cloud computing …

- Automatically collects Earth observational data, climate model outputs, derived remote sensing data products, and historical biophsical data
- Supports pre-, active-, and post-wildfire decision making *(and much more …)*
- Core service of the NASA RECOVER DSS, a rapid-resposne GIS analytic capability for federal, state, and local governments
- Reduces to minutes the time needed to assemble and deliver crucial wildfire-related information …

It is estimated that scientists land managers spend 50–80% of their time gathering and preparing data for further analysis … (Lohr, 2014)

Challenge Being Addressed

Data assembly, analysis, and decision-making must happen quickly to meet the statuatory requirements for post-fire response plans …

- Two important post-fire products have 7- and 21- day deadlines:

  => US Forest Service (USFS) Emergency Stabilization and Rehabilitation (ESR) plans

  => Bureau of Land Management Burned Area Emergency Response (BAER)

- Currently, data gathering is a manuel effort that depends on the availablility of staff, time, and data for a particular region
- The NASA RECOVER decision support system addresses this challenge …

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The RECOVER Project

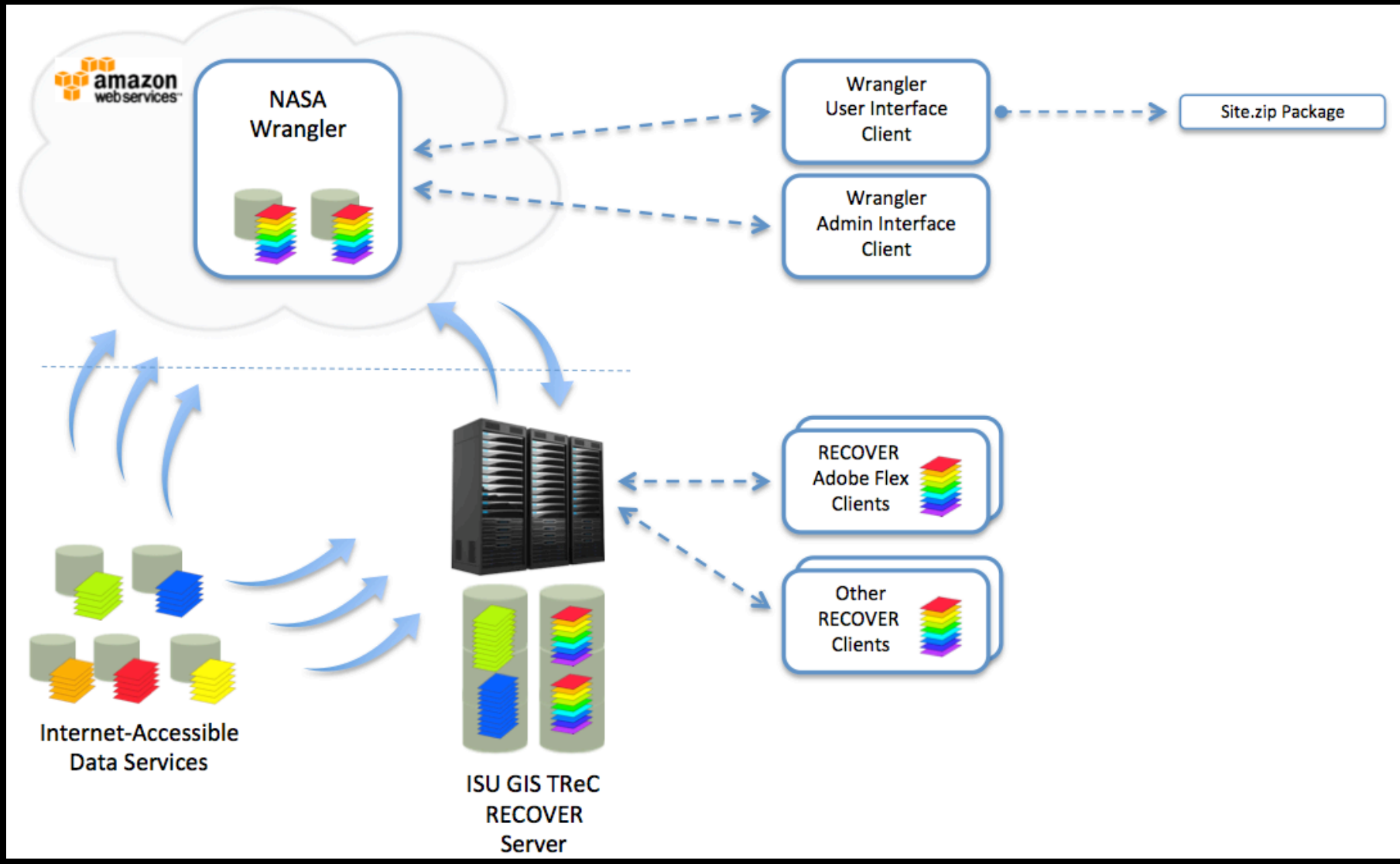
Rehabilitation Capability Convergence for Ecosystem Recovery (RECOVER) is an automated decision support system that quickly compiles all the necessary data sets and provides them in an easy-to-use web map analysis tool …

- Four-year capability development project funded by the NASA Applied Sciences Disasters Program
- Idaho State University's GIS Training and Research Center (GIS TReC) is the lead institution
- NASA Goddard Space Flight Center developing cloud-based Wrangler capability
- Partner agencies include BLM, USFS, NPS, USGS, and NIFC …

RECOVER

NASA Idaho State University U.S. Department of the Interior Bureau of Land Management Forest Service USDA
National Interagency Fire Center Boise, Idaho USGS science for a changing world National Park Service USDA

Architecture



Data Sources

Wrangler acquires, packages, and delivers data from any source with a web service exposure …

Vegetation dataset services

- BPS_BioPhysicalSetting
- ESP_EnvironmentalSitePotential
- EVC_ExistingVegetationCover
- EVT_ExistingVegetationType
- fPAR
- NDVI

Fire dataset services

- FRG_FireRegimeGroup
- HistoricFires
- HistoricFires_PastDecade

Plus MERRA, GEOS 5 climate model data and MODIS, Landsat time series …

Topographic dataset services

- TopographyElevation
- TopographyAspect
- TopographySlopeDEG

Other dataset services

- Geology
- Habitat
- LandslidePotential
- NHD
- ROADS
- SMA_SurfaceManagementAgency
- Wetlands
- Watersheds

Implementation

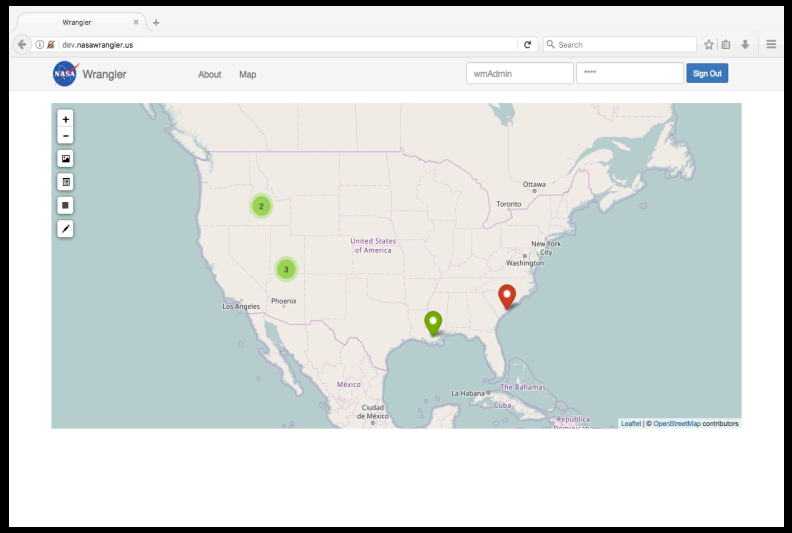
Wrangler was built using open-source software and deployed as an easily conveyable cloud image ….

- Django – A popular web framework for Python particularly well suited for data-driven applications
- Boostrap – A popular multi-platform web-based user interface development environment
- Leaflet – A popular environment for building map-based web applications
- Amazon Web Services (AWS) – Amazon's FedRAMP-compliant cloud computing service

Advantages

Wrangler/RECOVER performance and cost effectiveness have been demonstrated across three fire seasons …

- Time reduction benefits – Two orders-of-magnitude time reducation in the data assembly task
- CapEx => OpEx benefits – Cloud-based implementation and licensing simpicity of Wrangler's open-source software base makes deployment and technology transfer easier and less costly

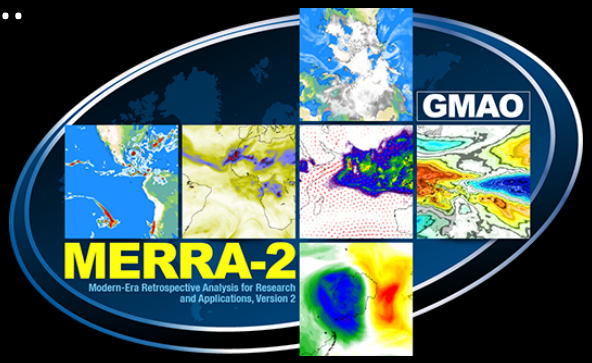


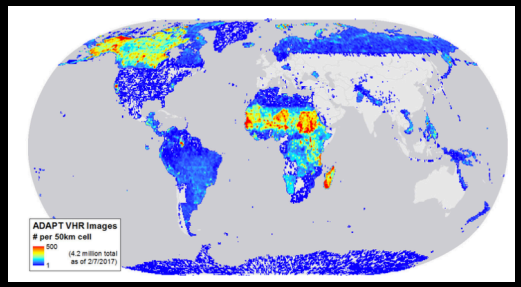
- Socioeconomic benefits – Reduces cost, but most important, it frees up time for more important tasks …

Other Applications

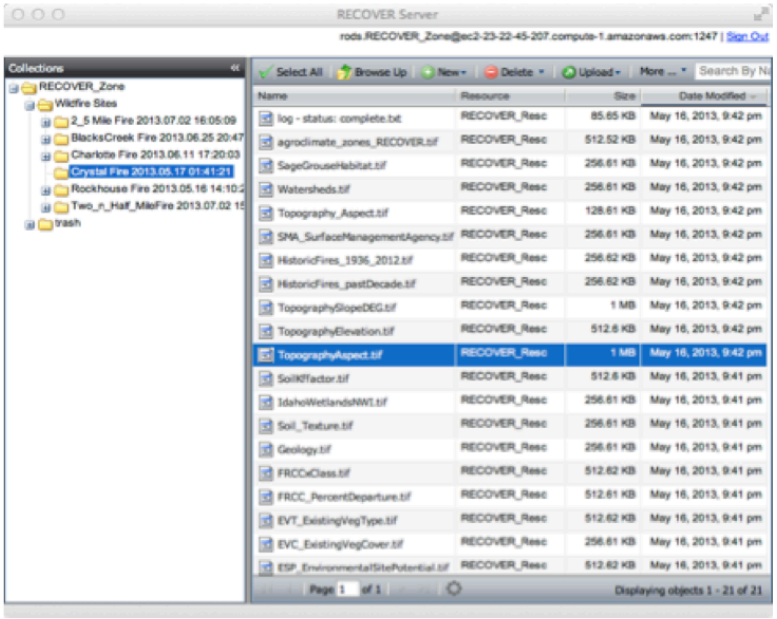
Wrangler's capabilities are general, widely applicable, and proving useful in several other NASA projects. We are also always looking for new applications and new partnerships …

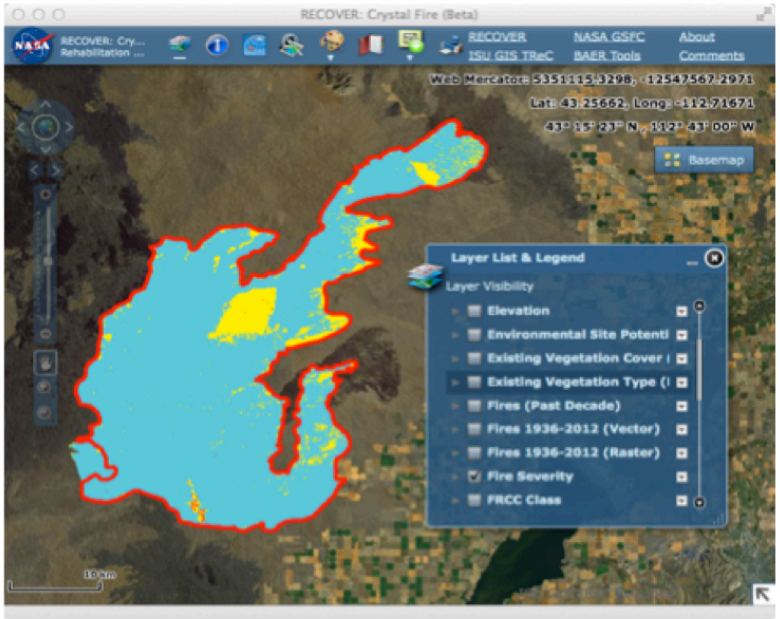
- MERRA Analytic Service (MERRA/AS) – High-performance data analytics for climate model outputs
- Advanced Data Analytics Platform (ADAPT) Science Cloud – High-end compute/storage for a wide range of NASA activities.
- Arctic Boreal Vulnerability Experiment (ABoVE) – Diverse data assembly for the ABoVE science team





Demos





Version 1.0 YouTube demos – Wrangler Server / RECOVER Client Interfaces

http://www.youtube.com/watch?v=LQKi3Ac7yNU Wrangler V1.0 Server
http://www.youtube.com/watch?v=SGhPpiSYpVE RECOVER V1.0 Client

For more RECOVER information …

Idaho State University — GIS Training and Research Center

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RECOVER

- Objectives
- Overview
- Results
- RECOVER DSS webmaps

What is RECOVER

NASA RECOVER story map

RECOVER TRACKER

Objectives

Objective In partnership with the Department of Interior's Bureau of Land Management (BLM) and Idaho Department of Lands (IDL), we will build and evaluate a prototype RECOVER decision support system. RECOVER will be an automatically deployable, site-specific multi-criteria decision aid that brings together in a single application the information necessary for Burned Area Emergency Response (BAER) teams to plan reseeding strategies and monitor ecosystem recovery in the aftermath of savanna wildfires.

RECOVER will use state-of-the-art cloud-based data management technologies to improve performance, reduce cost, and provide site-specific flexibility for each fire. Customized RECOVER instances will be automatically deployed in the Amazon EC2 Cloud when a fire is detected. RECOVER's decision products will be dynamically assembled from an existing network of data resources. RECOVER will automatically generate and refresh derived fire severity, fire intensity, and other products throughout the burn so that when the fire is contained, BAER teams will have at hand a complete and ready-to-use RECOVER system customized for the target wildfire. Since BAER remediation plans must be completed within 14 days of a wildfire's containment, RECOVER has the potential to significantly improve the decision-making process.

-Additional links and disclosures-

- Nondiscrimination and Equal Opportunity in NASA Assisted Programs
- Equal Opportunity in NASA Assisted Programs
- Title IX and STEM: Promising Practices
- Title IX and STEM: A Guide for Conducting Title IX Self-Evaluations
- NASA and STEM

Investigators

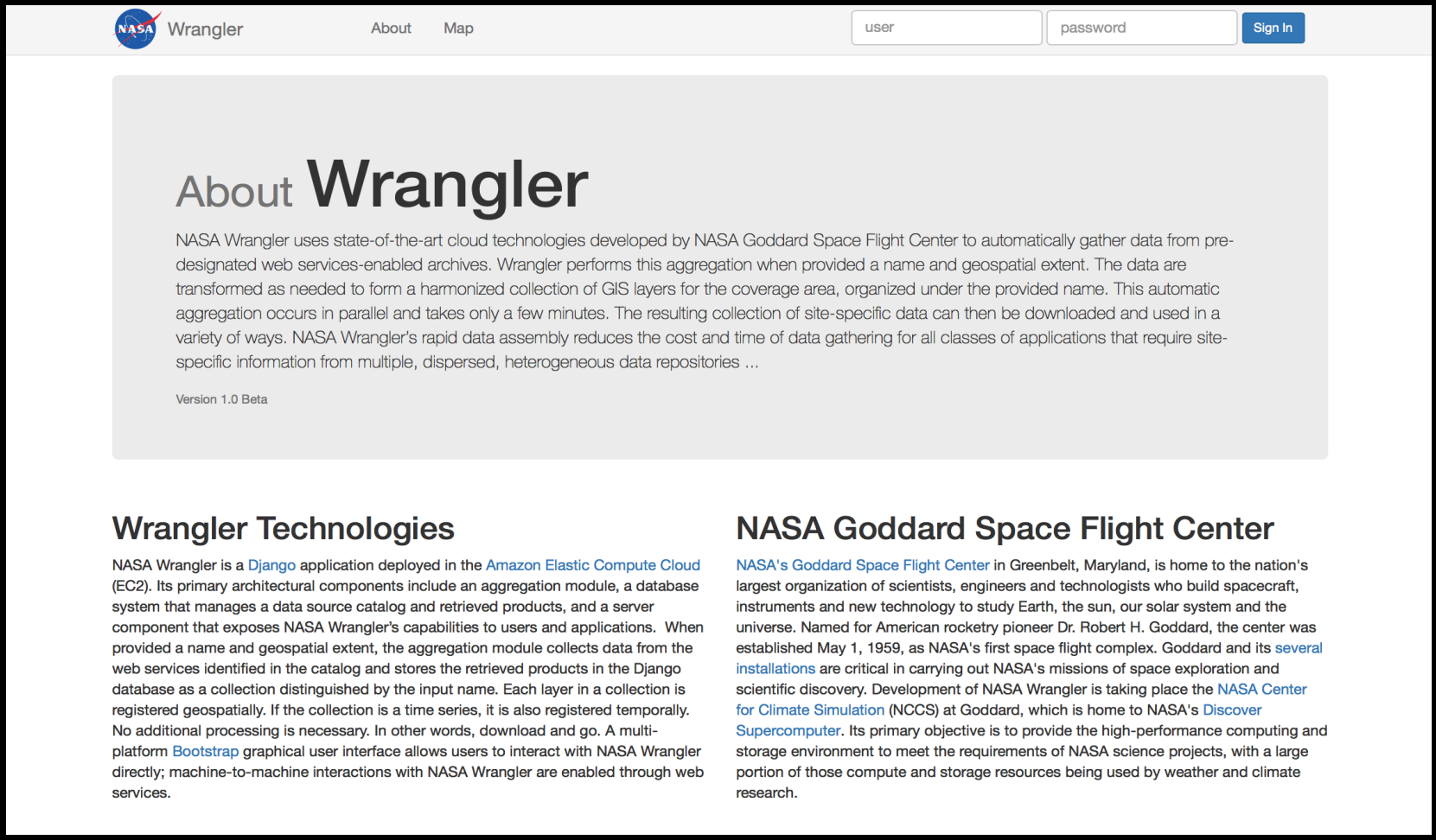
- Keith T. Weber (PI)
- John Schnase (Co-PI)
- Mark Carroll (Co-PI)

Related links

- NASA's wildfire program
- NASA Goddard Space Flight Center
- NASA DEVELOP
- Press release
- Landslide Hazards following wildfire
- Inciweb
- National Geospatial subcommittee
- BAER Tools website
- BAER Tools VAR worksheet

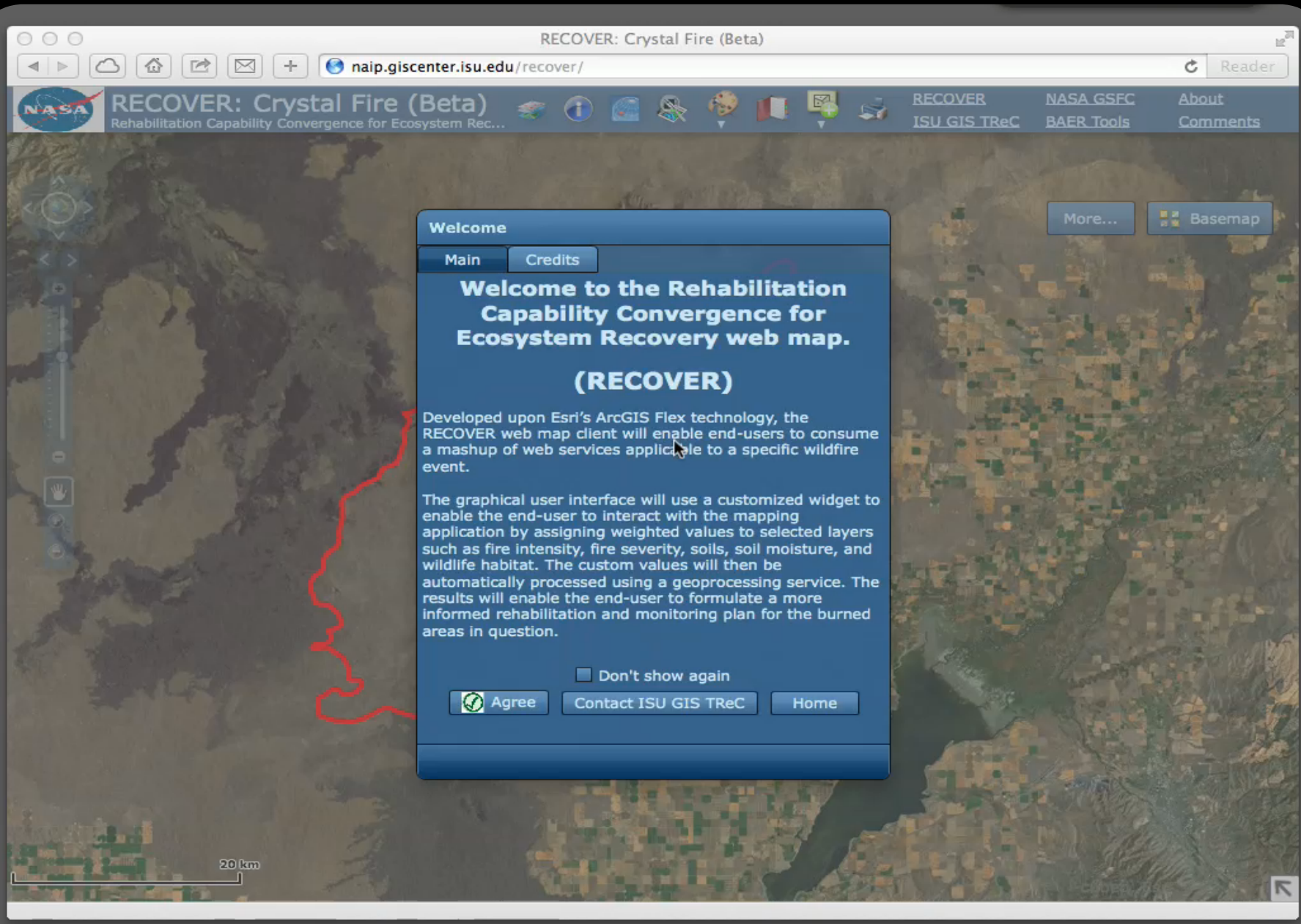
http://giscenter.isu.edu/research/Techpg/nasa_RECOVER

For more Wrangler information …



http://NASAWrangler.us

nasawrangler.us
Wrangler
Sign In
About Wrangler
NASA Wrangler uses state-of-the-art cloud technologies developed by NASA Goddard Space Flight Center to automatically gather data from pre-designated web services-enabled archives. Wrangler performs this aggregation when provided a name and geospatial extent. The data are transformed as needed to form a harmonized collection of GIS layers for the coverage area, organized under the provided name. This automatic aggregation occurs in parallel and takes only a few minutes. The resulting collection of site-specific data can then be downloaded and used in a variety of ways. NASA Wrangler's rapid data assembly reduces the cost and time of data gathering for all classes of applications that require site-specific information from multiple, dispersed, heterogeneous data repositories ...
Wrangler Technologies
NASA Wrangler is a Django application deployed in the Amazon Elastic Compute Cloud (EC2). Its primary architectural components include an aggregation module, a database system that manages a data source catalog and retrieved products, and a server component that exposes NASA Wrangler's capabilities to users and applications. When provided a name and geospatial extent, the aggregation module collects data from the web services identified in the catalog and stores the retrieved products in the Django database as a collection distinguished by the input name. Each layer in a collection is registered geospatially. If the collection is a time series, it is also registered temporally. No additional processing is necessary. In other words, download and go. A multi-platform Bootstrap graphical user interface allows users to interact with NASA Wrangler directly; machine-to-machine interactions with NASA Wrangler are enabled through web services.
NASA Goddard Space Flight Center
NASA's Goddard Space Flight Center in Greenbelt, Maryland, is home to the nation's largest organization of scientists, engineers and technologists who build spacecraft, instruments and new technology to study Earth, the sun, our solar system and the universe. Named for American rocketry pioneer Dr. Robert H. Goddard, the center was established May 1, 1959, as NASA's first space flight complex. Goddard and its several installations are critical in carrying out NASA's missions of space exploration and scientific discovery. Development of NASA Wrangler is taking place the NASA Center for Climate Simulation (NCCS) at Goddard, which is home to NASA's Discover Supercomputer. Its primary objective is to provide the high-performance computing and storage environment to meet the requirements of NASA science projects, with a large portion of those compute and storage resources being used by weather and climate research.
Version 1.0 Beta | NASA Goddard Space Flight Center


RECOVER: Crystal Fire (Beta)
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Reader
RECOVER: Crystal Fire (Beta)
Rehabilitation Capability Convergence for Ecosystem Rec...
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More...
Basemap
Welcome
Main
Credits
Welcome to the Rehabilitation Capability Convergence for Ecosystem Recovery web map.
(RECOVER)
Developed upon Esri's ArcGIS Flex technology, the RECOVER web map client will enable end-users to consume a mashup of web services applicable to a specific wildfire event.
The graphical user interface will use a customized widget to enable the end-user to interact with the mapping application by assigning weighted values to selected layers such as fire intensity, fire severity, soils, soil moisture, and wildlife habitat. The custom values will then be automatically processed using a geoprocessing service. The results will enable the end-user to formulate a more informed rehabilitation and monitoring plan for the burned areas in question.
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