RECOVER

Using GIS for Wildfire Decision Support with NASA RECOVER

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What is the RECOVER DSS

- Context
  - *The mission of the GIS TReC is to facilitate sound decision making through the use and application of geospatial technologies*
  - Since 1998, ISU's GIS TReC has advanced an active research program focusing on land cover change across the Intermountain West
  - Wildfire is one of the most significant agents of land cover change

The A-ha Moment

- Fall 2011

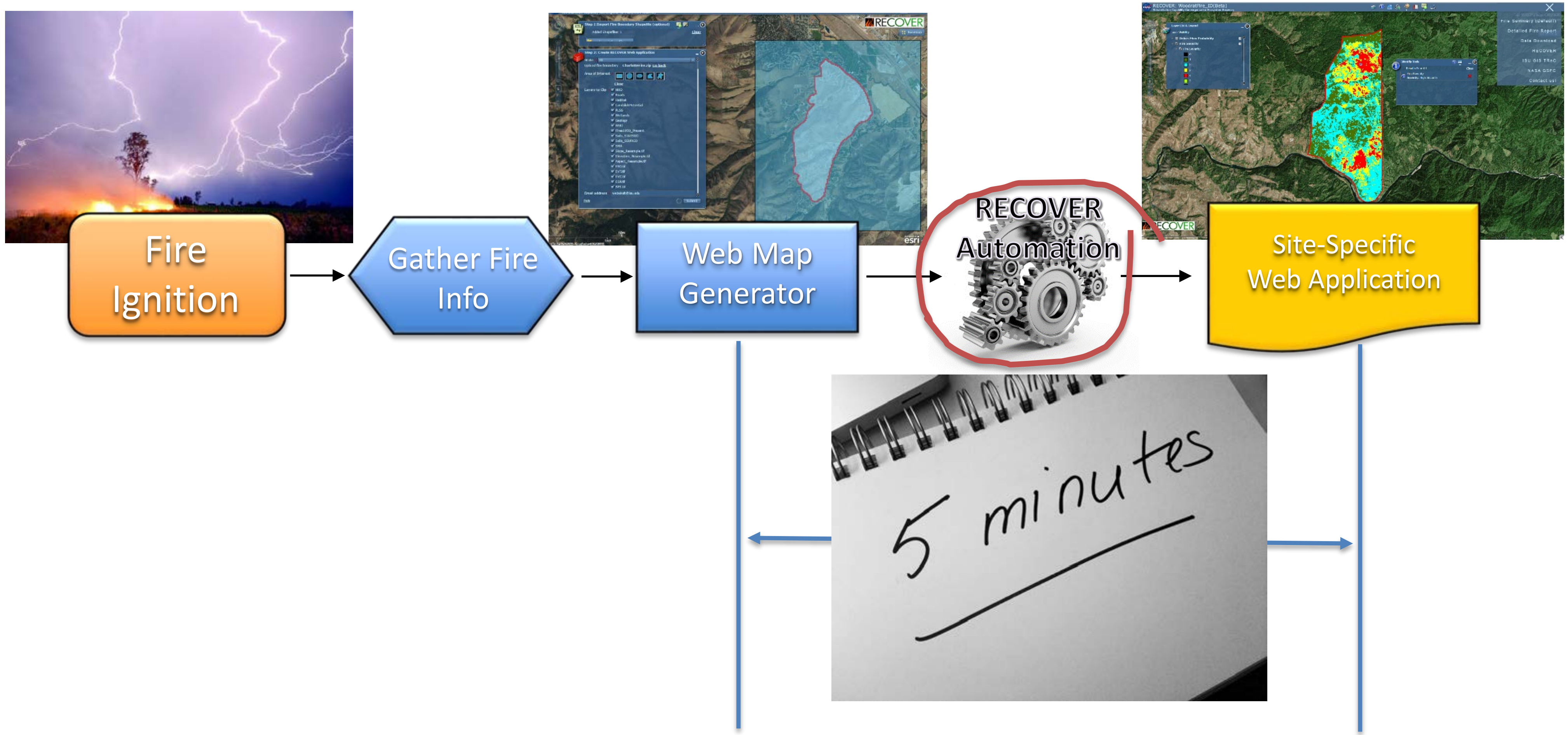
Team Building and Collaboration

- ISU’s GIS Center
- NASA’s Goddard Space Flight Center
- NASA Applied Sciences ROSES, wildfire applications program

Since 2012

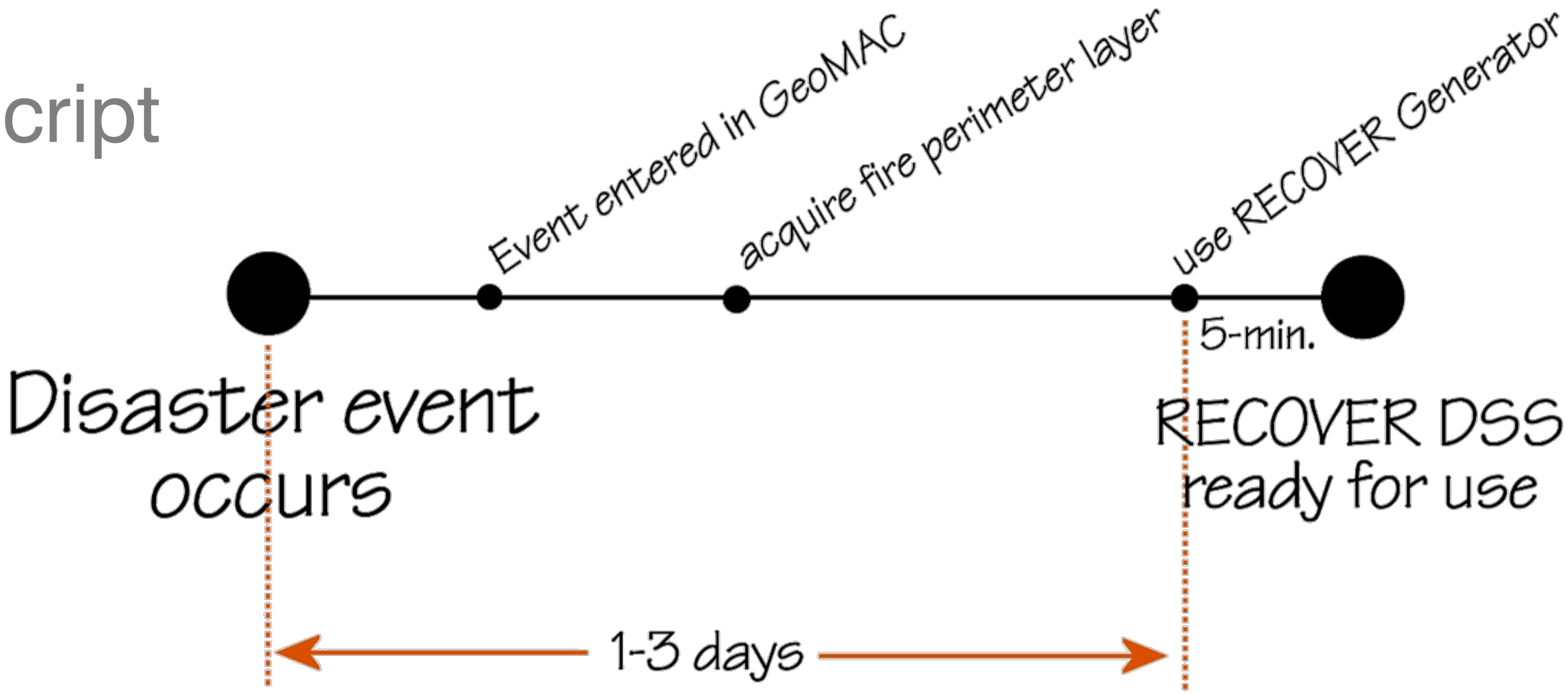
- RECOVER has been deployed
  - On over 100 wildfires
  - Burning 6.5 M acres of land
  - And many of the largest fires each year

How Does it Work?



Let's Make it Even Faster!

- Our Large Fire Trigger (LFT) script



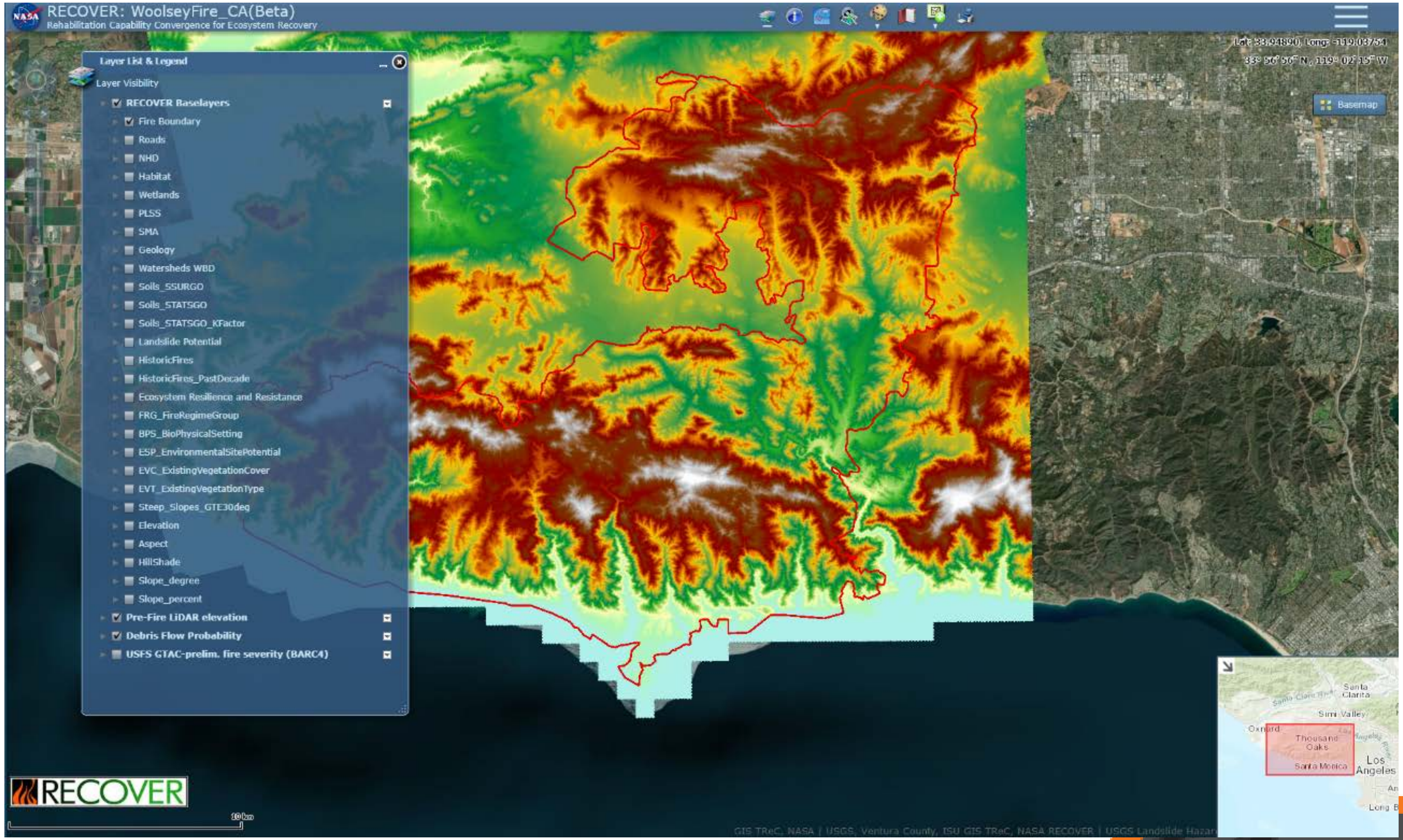
RECOVER Automation

Table 1. General description of the base layers used in the RECOVER DSS

Base Layer name	Data Structure	Authoritative Source
Fires1950_Present	Geodatabase polygon feature class	USGS GeoMac
Geology	Geodatabase polygon feature class	USGS
Habitat	Geodatabase polygon feature class	USDI BLM
LandslidePotential	Geodatabase polygon feature class	USGS
NHD	Geodatabase line feature class	USGS
PLSS	Geodatabase polygon feature class	USDI BLM
Roads	Geodatabase line feature class	Composite (Esri and individual state DOT)
SMA	Geodatabase polygon feature class	USDI BLM
Soils_SSURGO	Geodatabase polygon feature class	NRCS
Soils_STATSGO	Geodatabase polygon feature class	NRCS
WatershedsWBD	Geodatabase polygon feature class	USGS
Wetlands	Geodatabase polygon feature class	US FWS, National Wetlands Inventory (NWI)
Ecological Resilience/Resistance	GeoTIFF	USDI BLM and NRCS
BPS_BiophysicalSetting	GeoTIFF	Landfire
ESP_EnvironmentalSitePotential	GeoTIFF	Landfire
EVC_ExistingVegetationCover	GeoTIFF	Landfire
EVT_ExistingVegetationType	GeoTIFF	Landfire
FRG_FireRegimeGroup	GeoTIFF	Landfire
HistoricFires_PastDecade	GeoTIFF	USGS GeoMac
Soils_STATSGO_Kfactor	GeoTIFF	NRCS
Elevation	GeoTIFF	USGS, National Elevation Dataset (NED)
Aspect	GeoTIFF	USGS, National Elevation Dataset (NED)
Slope_degree	GeoTIFF	USGS, National Elevation Dataset (NED)
Slope_percent	GeoTIFF	USGS, National Elevation Dataset (NED)
Slopes_GTE30d	GeoTIFF	USGS, National Elevation Dataset (NED)
Hillshade	GeoTIFF	USGS, National Elevation Dataset (NED)

- **Talented team**
- Acquire and maintain current data using **authoritative sources**
- **Web optimize** data ensuring high performance over the web
- **Invest** in/maintain good IT infrastructure (servers and network)

Self-Service and Highly Automated

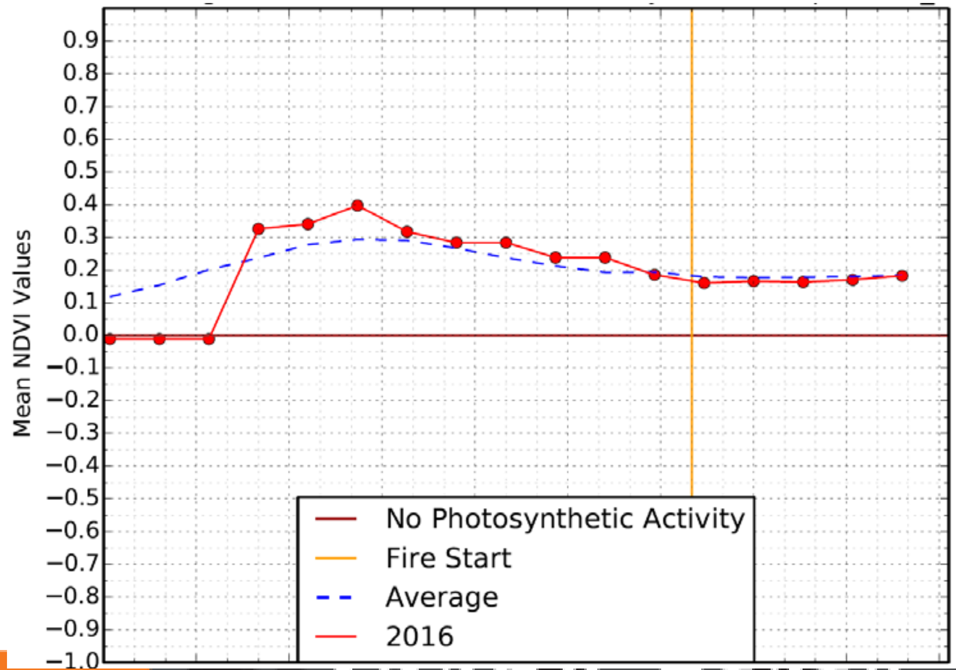


Automated Reports

- Reports
- Additional data requests
  - Fire Severity
  - Long term vegetation trend (NDVI)
  - Debris-flow probability
  - LiDAR
- **Actionable Information**

WoolseyFire_CA - Summary Report

Administration Agency	Acres
BLM	0
NPS	21,632
ST	9,405
Undetermined	69,190
Total Acres	*100,227*



Scripted Reports

Summary of Ecological Resilience and Resistance

RR_class	Acres
Wetlands/riparian	2,761
High resiliency	42,239
Moderate resiliency	162,245
Low resiliency	27,361
Total (acres)	234,606

dNBR Statistics

MIN	MAX	MEAN	STD	RANGE
-0.23	1.3	0.34	0.2	1.6

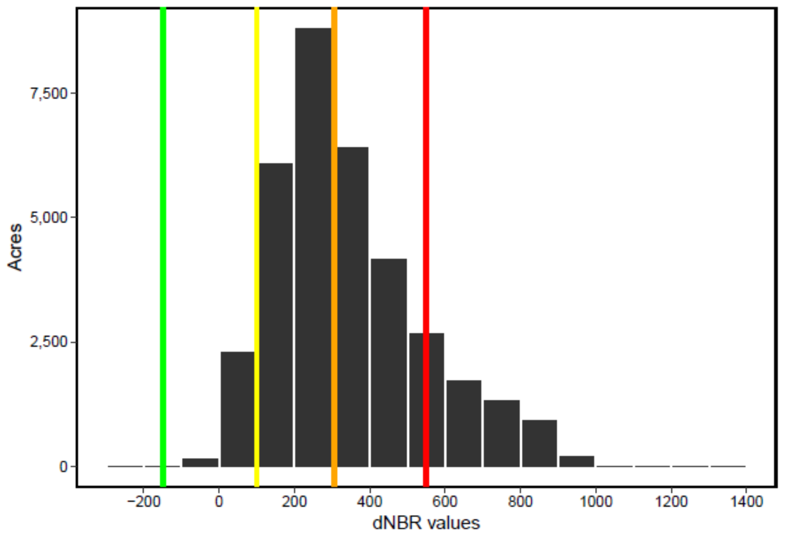


Figure 1. Binned histogram of the Fire-affected vegetation (dNBR) layer. Prior to field validation, dNBR values exceeding 550 (indicated by the vertical red line) are often used as a starting point to identify high severity burn areas. Similarly, the threshold for moderate severity burns is indicated by the vertical orange line, low severity burns by the yellow line, and unburned areas by the green line. The percent of each severity level found within the fire perimeter is given in the table below. Bear in mind these data and thresholds do not reflect field validated observations but represent a starting point for any subsequent field work.

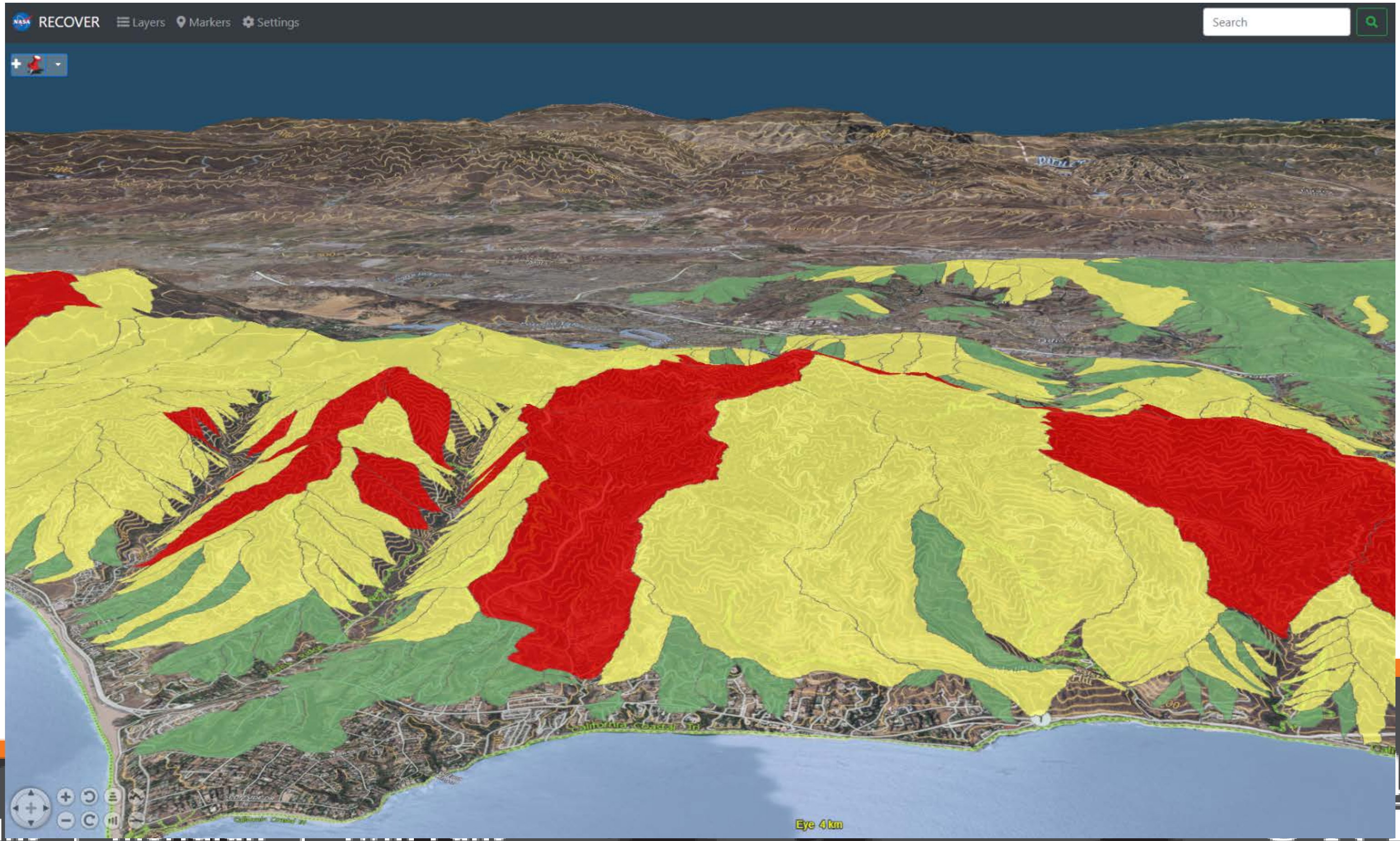
Severity Level	dNBR Range	Percent	Acres
Increased Greenness	-LOW - -149	0.0	1.6
Unburned	-148 - 100	7.1	2,461.2
Low Severity	101 - 305	44.2	15,325.9
Moderate Severity	306 - 550	33.5	11,606.8
High Severity	551 - HIGH	15.3	5,304.1

The Software

- Esri ArcGIS
- Python
- R

Listen and Deliver

- Data visualization with NASA Worldwind



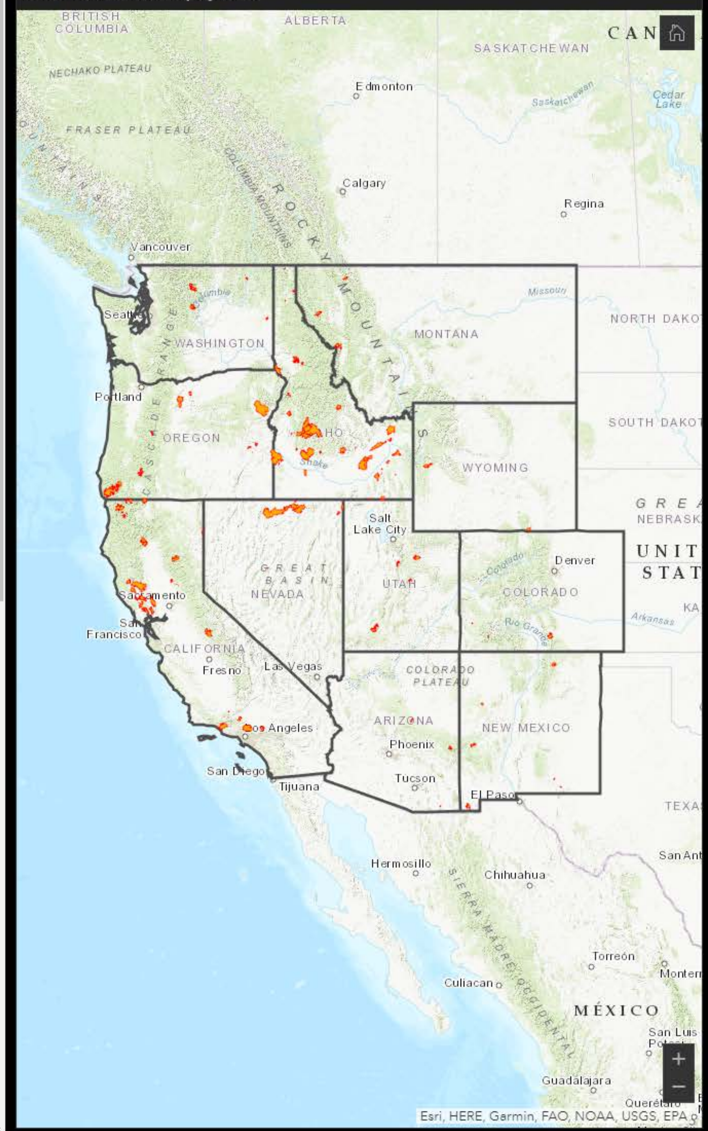
RECOVER's Tracker Dashboard

RECOVER

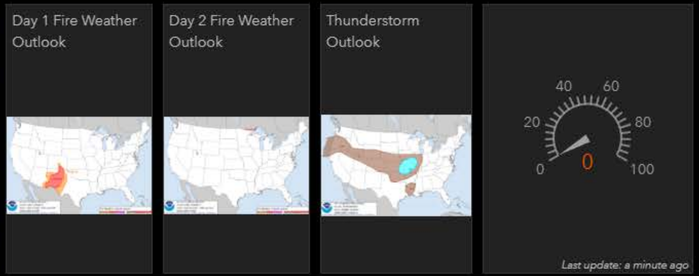
Generate a new DSS

NAME	STATE	YEAR	ACRES
416	CO	2018	32,934
Badger Creek	WY	2018	20,367
Box Car	OR	2018	100,227
Boyds	WA	2018	4,655
Buzzard	NM	2018	45,069
Carr	CA	2018	214,500
Columbus	OR	2018	9,770
Cougar	ID	2018	7,867
Cougar Creek	WA	2018	35,274
County	CA	2018	89,874
Crescent Mountain	WA	2018	49,247
Crooked Creek	NM	2018	6,899
Diener Canyon	NM	2018	9,329
Dollar Ridge	UT	2018	52,112
EXERCISE: Tapa de Tabla	ID	2018	524,868
Ferguson	CA	2018	96,229
Goose Creek	NV	2018	18,304
Grassy Ridge	ID	2018	99,199
Horse Park	CO	2018	1,236
Howe Rdge	MT	2018	13,032
Jackknife	OR	2018	15,591
Jim Sage	ID	2018	1,937
Judd	AZ	2018	4,096
Kellar	NM	2018	5,767
Klamathon	CA	2018	38,254
Kllondike Complex	OR	2018	228,219
Klondike	OR	2018	68,233
Martin	NV	2018	435,306
Mendocino complex 2018	CA	2018	272,427
Mesa	ID	2018	34,688
Miles	OR	2018	33,224
OK Bar	NM	2018	43,984
Owyhee	NV	2018	5,353
Pawnee	CA	2018	13,815
Pole Creek	UT	2018	18,603
Rabbit Foot	ID	2018	34,586
Rattlesnake	AZ	2018	26,080
Rattlesnake Creek	ID	2018	5,285
Roosevelt	WY	2018	48,385
Santa Cruz Island	CA	2018	246
Sharps	ID	2018	64,797
South Sugarloaf	NV	2018	234,611
Spring Creek	CO	2018	53,987
Stewart	ID	2018	5,271
Substation	OR	2018	78,419
Taylor Creek	OR	2018	52,217
Terwilliger	OR	2018	9,552
Tinder	AZ	2018	11,744
Trail Mountain	UT	2018	10,632
Ute Park	NM	2018	33,246
Woolsey	CA	2018	100,227
Adobe	CA	2017	41,507
Atlas	CA	2017	48,902
Brianhead	UT	2017	71,688
Chetco	OR	2017	186,184
Clear Lake	CA	2017	1,734
Deer Park	ID	2017	17,598
Delano	NV	2017	15,074
Eclipse Complex	CA	2017	130,103

NASA RECOVER DSS Deployments

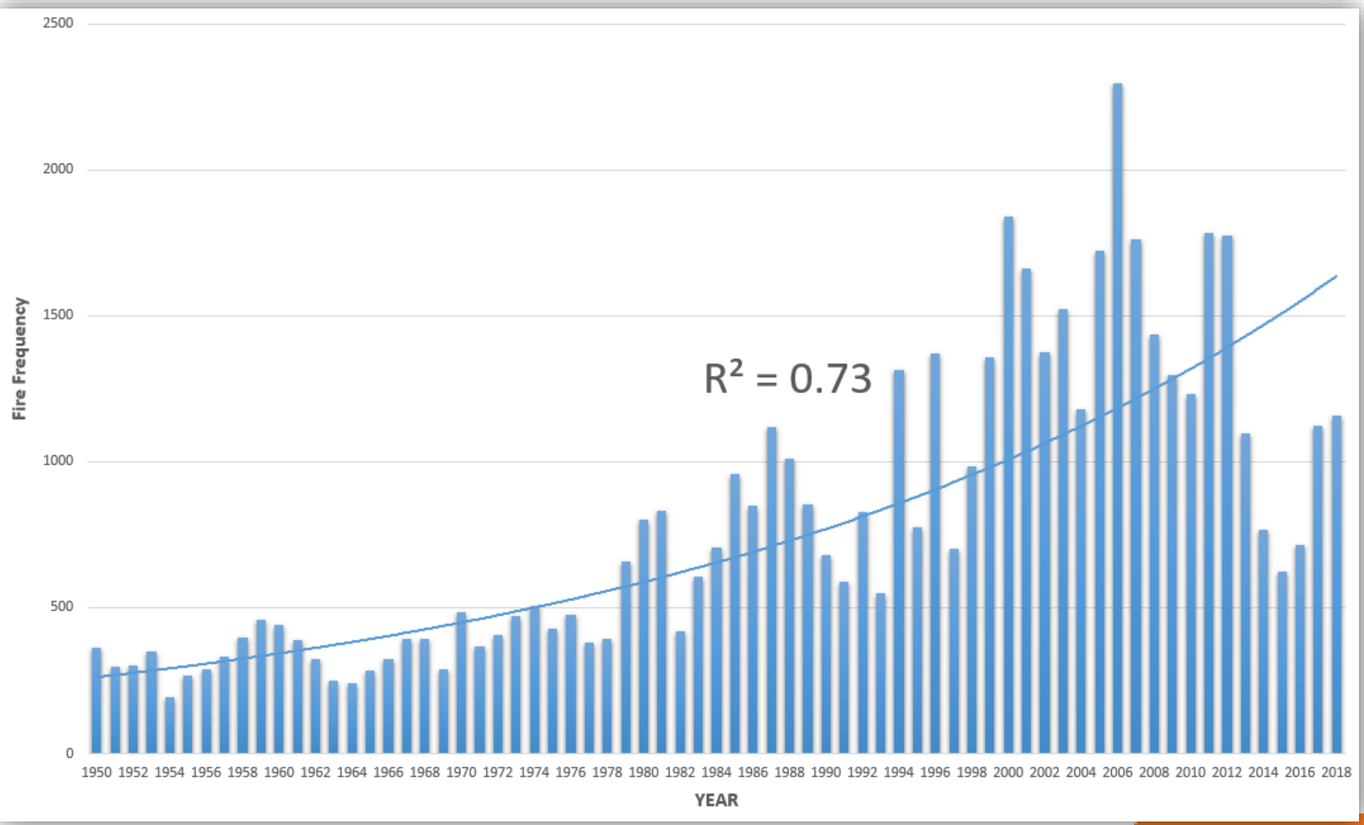


USGS GeoMac Active Wildfires



Why? Is it Really Necessary?

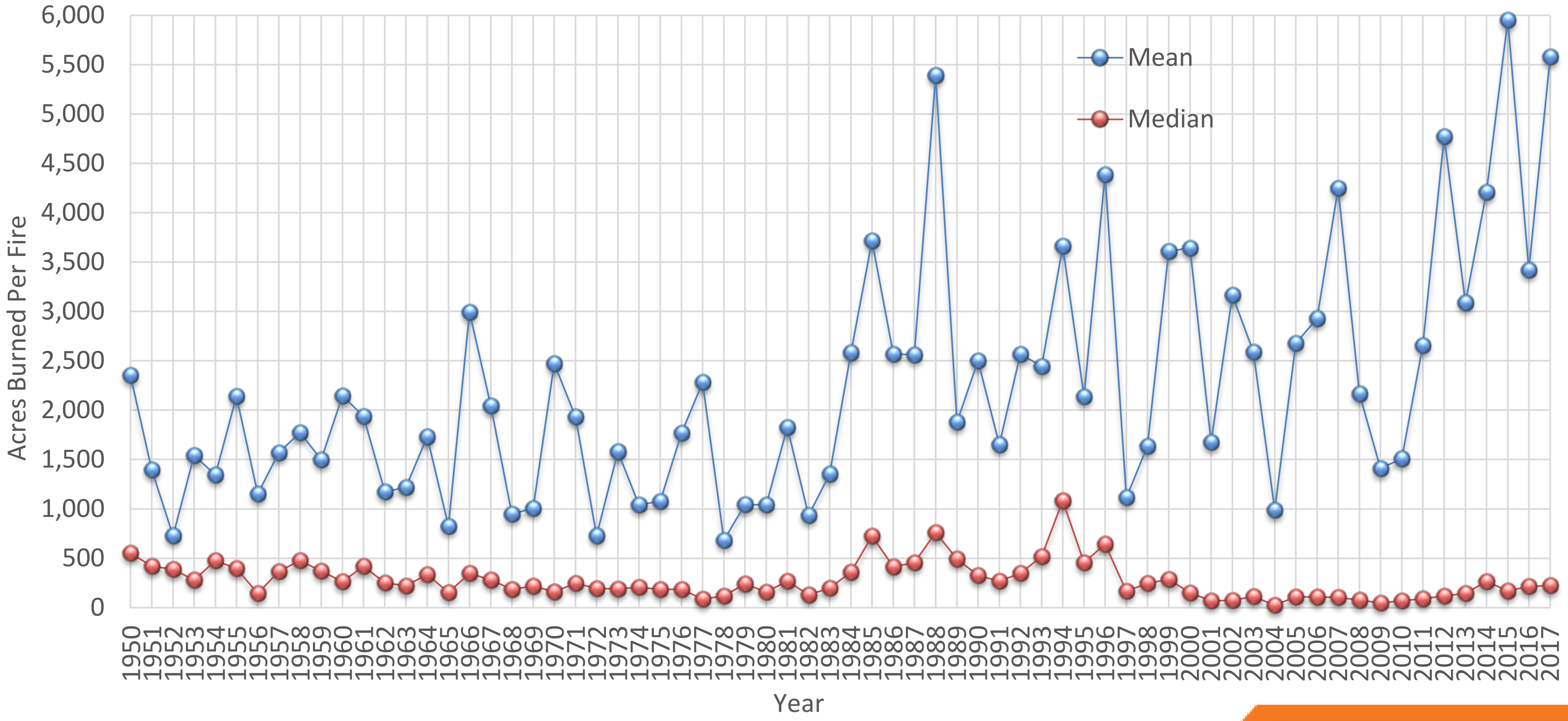
- There are more fires



Source: Historic Wildfires Database (1950-present), ISU GIS Center

There are More Mega-Fires

- Mega-fire (a fire burning >100,000 acres)



Source: Historic Wildfires Database (1950-present), ISU GIS Center

Spatial Analysis across the West

Workflow

- Overlay fire polygons on the USGS LANDFIRE *Biophysical setting* raster layer
- Run zonal Statistics as Table
- Analyze results

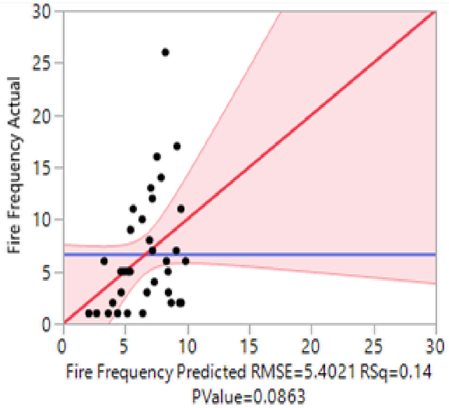
All Fires 1950-2017	
Majority	**PCT**
Conifer	38%
Shrubland	44%
Grassland	12%
Riparian	0%
Hardwood	6%
Hardwood-Conifer	1%
Sparse	0%
	100%

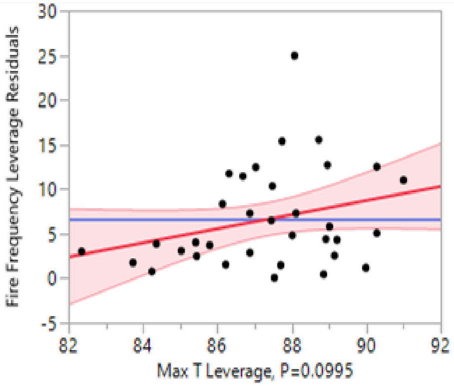
Fires after 2000	
Majority	**PCT**
Conifer	42%
Shrubland	39%
Grassland	13%
Riparian	0%
Hardwoord	5%
Hardwood-Conifer	1%
Sparse	0%
	100%

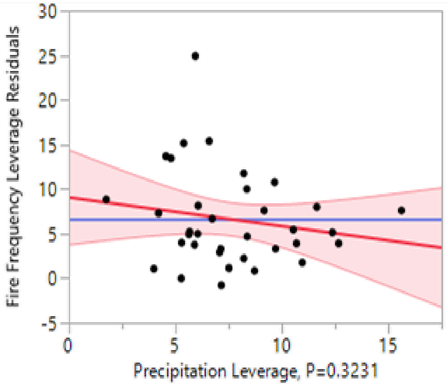
Notice the recent increase in coniferous forest fires

Cause of our Changing Fire Regime

- Climate, weather, and land management





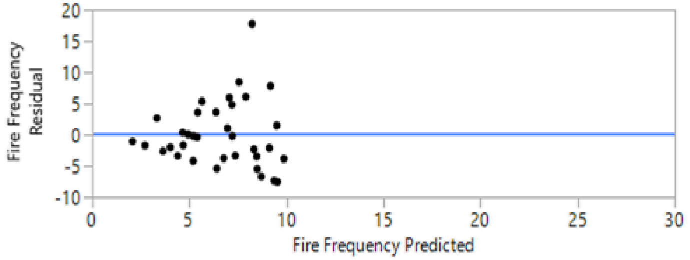


Effect Summary

Source	LogWorth		PValue
Max T	1.002		0.09950
Precipitation	0.491		0.32310

Remove Add Edit ☐ FDR

Residual by Predicted Plot



Summary of Fit

RSquare	0.141998
RSquare Adj	0.088372
Root Mean Square Error	5.402111
Mean of Response	6.6
Observations (or Sum Wgts)	35

Land Management

Source TED talks:
https://www.ted.com/talks/paul_hessburg_why_wildfires_have_gotten_worse_and_what_we_can_do_about_it?language=en#t-525707

Conditions Required for a Wildfire

SUSCEPTIBILITY

Fuel (load, continuity)
Soil moisture
Topography (aspect)
Other intrinsic factors
Past fire history

HAZARD

Winter snow pack/SWE
Precipitation
Temperature
RH (approx. thresholds
<15% day and <40% night)

IGNITION SOURCE

Lightning
Anthropic

GIS and Wildfire

- RECOVER was designed as a *post-wildfire* decision support system
  - **Helps answer questions** regarding re-seeding, mulching, debris flow probability, and long-term recovery.
  - For these types of questions, **geospatial data are critical** to affect a well-informed decision
  - Under the changing fire regime, it is unreasonable to think management and well-informed decisions can happen without GIS and satellite remote sensing

Impact of RECOVER

- Socioeconomic impact study 2016-18
  - $1.2 M of positive economic impact
  - Improved cross-organizational communication
  - 95%+ adoption rate
  - Better informed decision making

Questions?

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

RECOVER is a NASA Applied Sciences sponsored project. K. T. Weber (PI), J. Schnase (Co-PI) and M. Carroll (Co-PI), Goddard Space Flight Center