Evaluating the Socioeconomic Impacts of Rapid Assembly of Geospatial Data in Wildfire Emergency Response Planning:

A Case Study using the NASA RECOVER Decision Support System (DSS)

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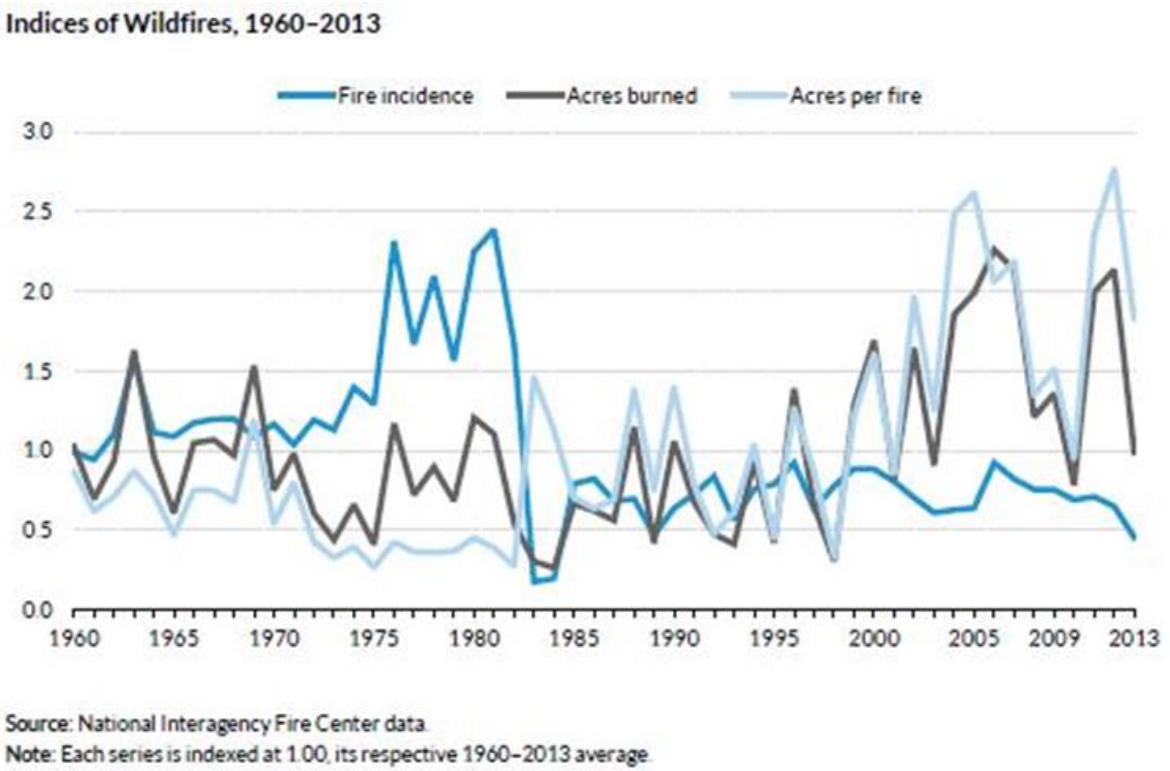
Increases in Wildfire Management Costs

- USFS and DOI have experienced a 400% increase in annual suppression costs between 1985 – 89 and 2009 – 13.
- Sources of Cost Increases
  - Inflation
  - Increases in Acres Burned
  - Changes in Land Use
  - Better Understanding of Role of Fires in Ecosystem
  - Change in Policy to include Damages

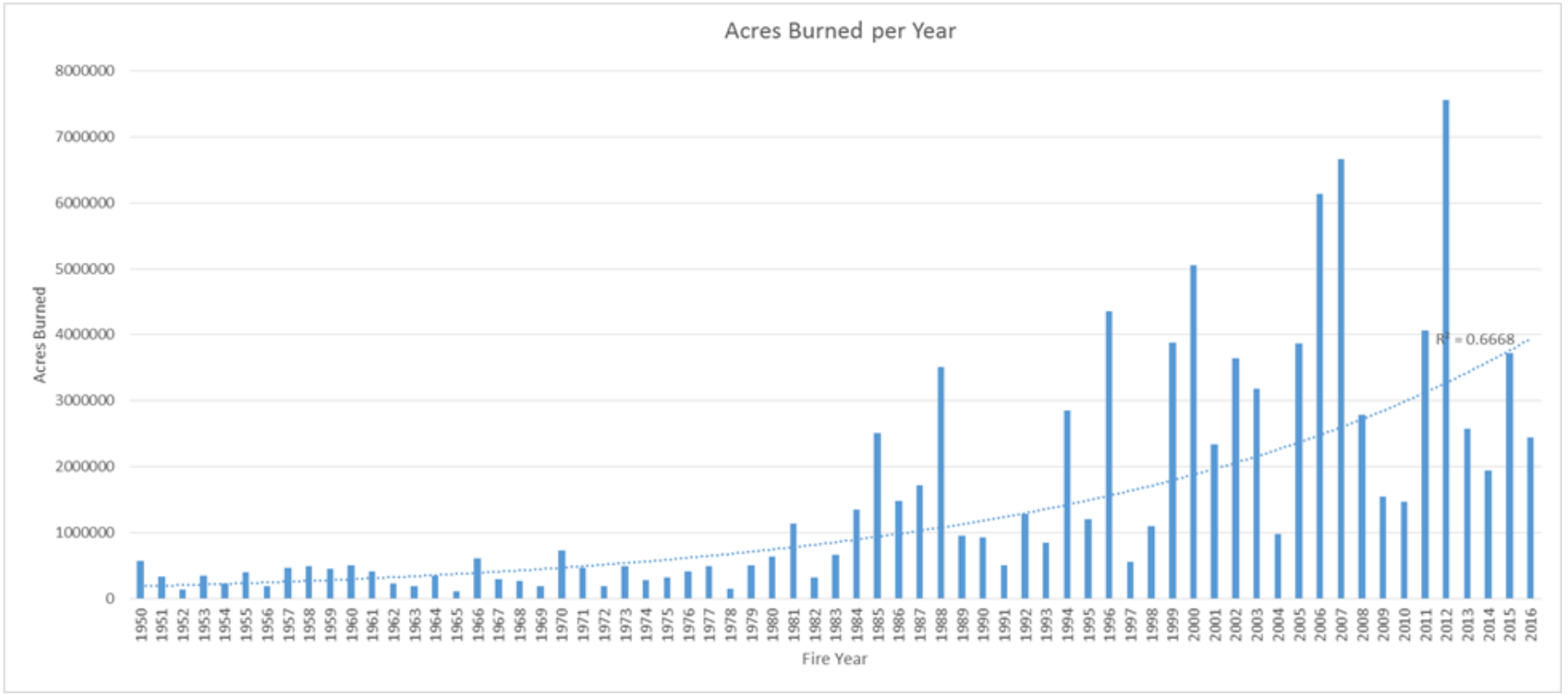
Changes in Acres Burned

- National Wildfire Incidence 1960 – 2013

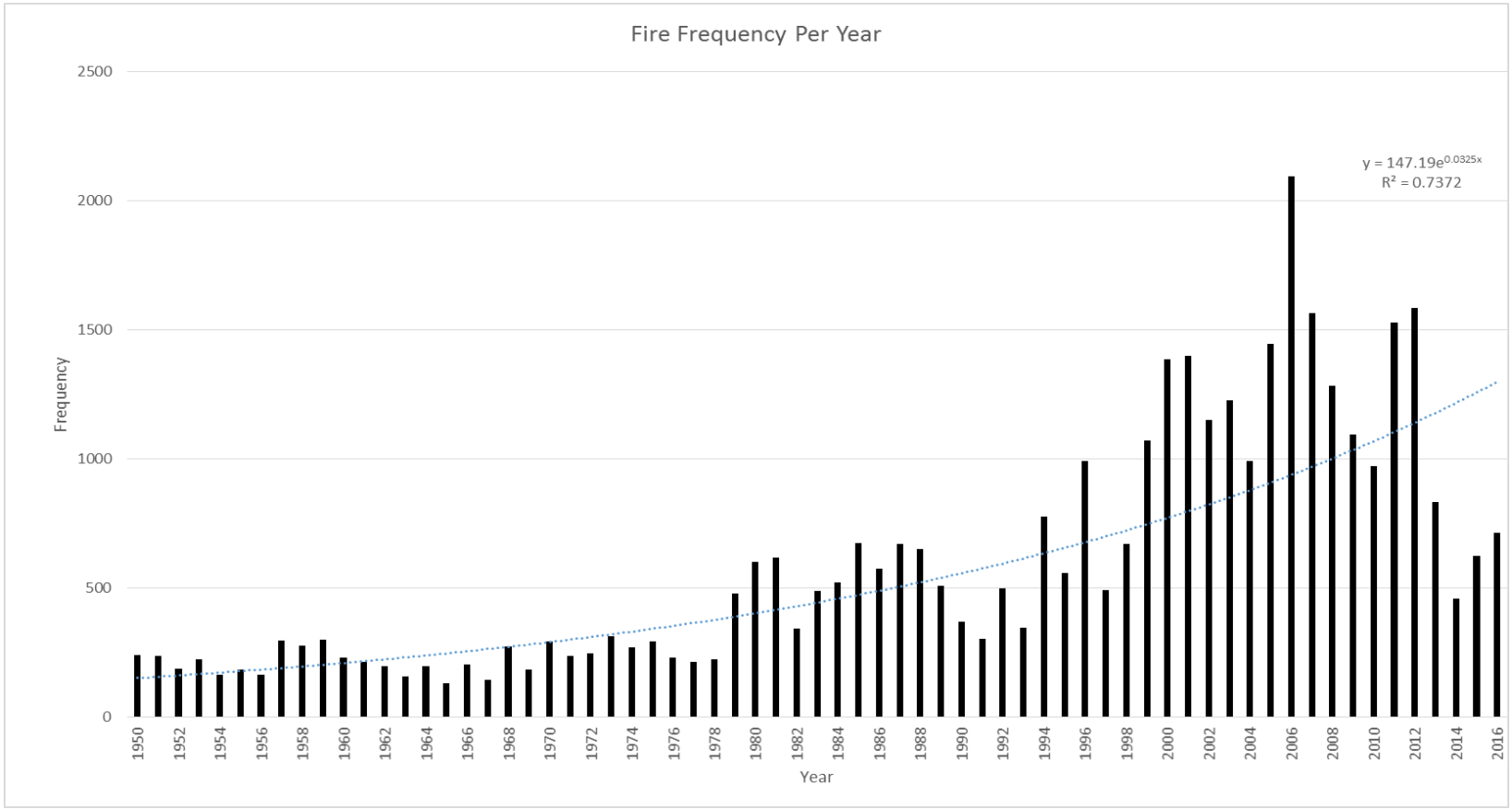


Brusentsev and Vroman (2016)

Acres Burned Western U.S. 1950 - 2016



Fire Frequency Western U.S. 1950 - 2016



USFS Cost Increases

- 2015 – battled over 36,000 fires
- 1 – 2% of fires not quickly suppressed accounted for 30% of annual costs
- Percentage of appropriated budget for wildfires
  - FY 1995: 16% FY 2015: 52%
  - Non-fire personnel decreased by 39% between 1998 & 2015

Wildland Urban Interface

- The increase in homes in WUI has increased costs to protect populace and property.

Fire Management Theory

- Earliest Theories – Sparhawk (1925)
- USFS Policy in 1935 – 10:00 a.m. policy
- USFS & BLM in 1979 – Natl. Fire Managment Analysis DOI in mid 1980s – FIREPRO
  - Cost plus loss (cost plus net value change) framework
    - Minimizes the sum of suppression costs and the damages associated with the wildfire.
- USDA & USDOI policy update: systemic approach

  Marginal $ suppression – 12 cents damage reduction

  Marginal $ pre-suppression -- $3.76 suppression expenditure reduction

  Lankoande & Yoder (2006)

True Cost of Wildfires

- Cost Categories
  - Direct: suppression costs, BAER rehabilitation
  - Rehabilitation: damages to landscape (flooding, landslides, invasive species, erosion)
  - Indirect: decrease in economic activity in area
  - Additional: mortality, morbidity, existence values
- Western Forestry Leadership Coalition (2009): survey of fires
  - Suppression costs ranged from 3 – 53% of total costs
- Dunn et al (2005): Old, Grand Prix, and Padua Wildfires in 2003
  - $1.3 BIL costs, 5% suppression
- Rahn (2009): San Diego County in 2003
  - $2.45 BIL costs, 1.8% suppression

Dynamic Component to Fire Management

- Passage of time and choices made as time progresses influences the value of non-direct costs. Value of assets are influenced by these choices.
  - Englin et al (2001): non-motorized recreational users in WY, ID and CO
  - Lynch (2004): forest watershed in Colorado
  - Kobayashi et al (2014): western rangelands and invasive grasses
  - Mueller et al (2009): hedonic housing study so Cal
- Putting out fires (SR) versus Breaking the cycle (LR)
  - Hazardous Fuels Reduction Program – 14% of USFS appropriated funds

Role of GIS-based Assessment and Planning

- O'Connor et al (2016)
  - "Used to inform short and long-term fire management strategies by identifying and quantifying specific risks to human assets, opportunities for fire-induced enhancement of natural resources, strategies to mitigate negative fire transmission from one land ownership to another, and pre-identification of landscape conditions hazardous to fire responders on the ground."
  - "constraints on time, resources, and expertise necessary to use spatial fire management tools effectively continue to limit the widespread adoption of spatial fire panning, even in the most advanced wildfire management organizations."
- NGAC – LAC (2014)
  - Annual cost savings from operational efficiency improvements, avoided alternative replacement costs, and opportunity costs related to economic and environmental decision support: $28 - $30 MIL

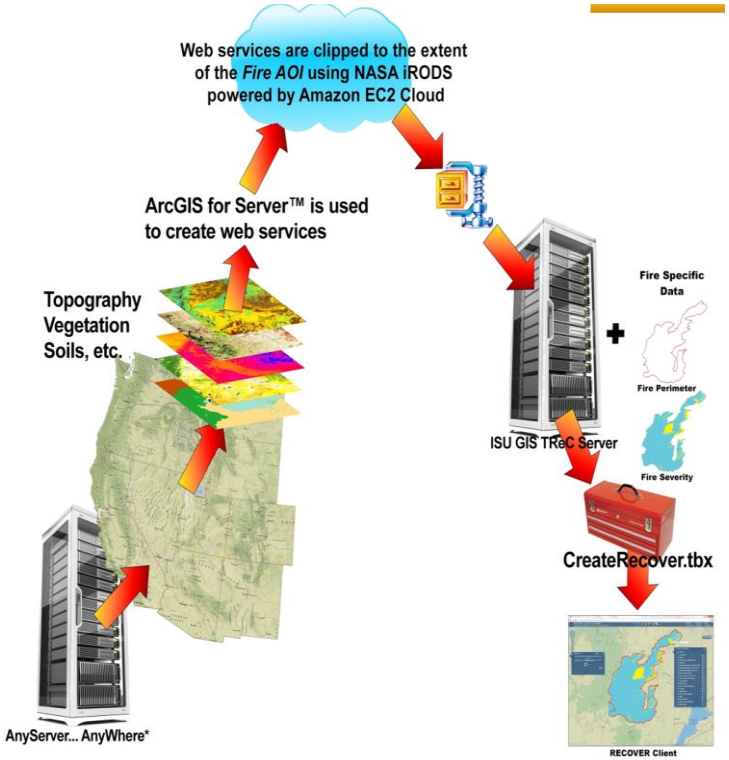
Purpose: NASA RECOVER DSS

Rehabilitation Capability Convergence for Ecosystem Recovery (RECOVER)

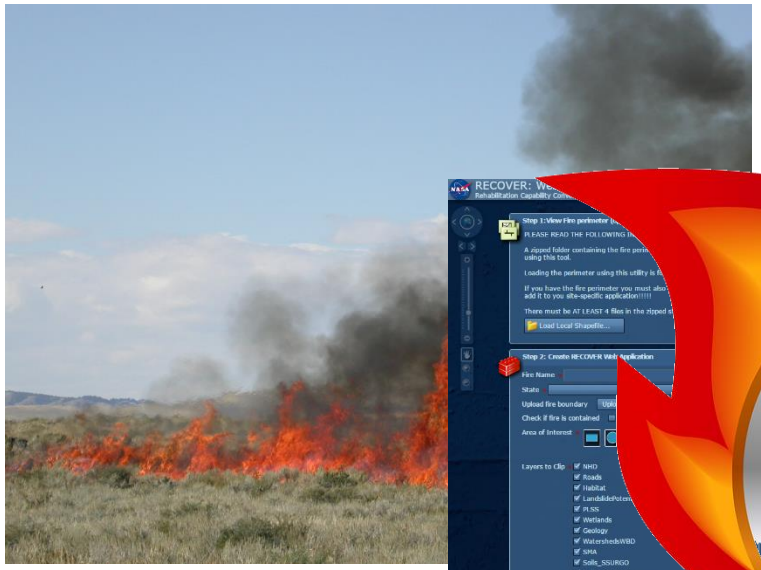
- Designed as post-wildfire DSS; aid rehabilitation planning
  - Rapid assembly of site-specific data
  - Web map delivery
  - For the entire western U.S.
    - Savanna ecosystems
- Extensive use of earth observing satellite system imagery & derived products (NDVI, dNBR, LANDFIRE, etc.)

Background: NASA RECOVER DSS

- 2013, Crystal Fire (2006) Demo:
  - 220,000 acres burned
  - Web maps produced in under 1 hour
- Illustrated a significant financial benefit to land management agencies



The Capability



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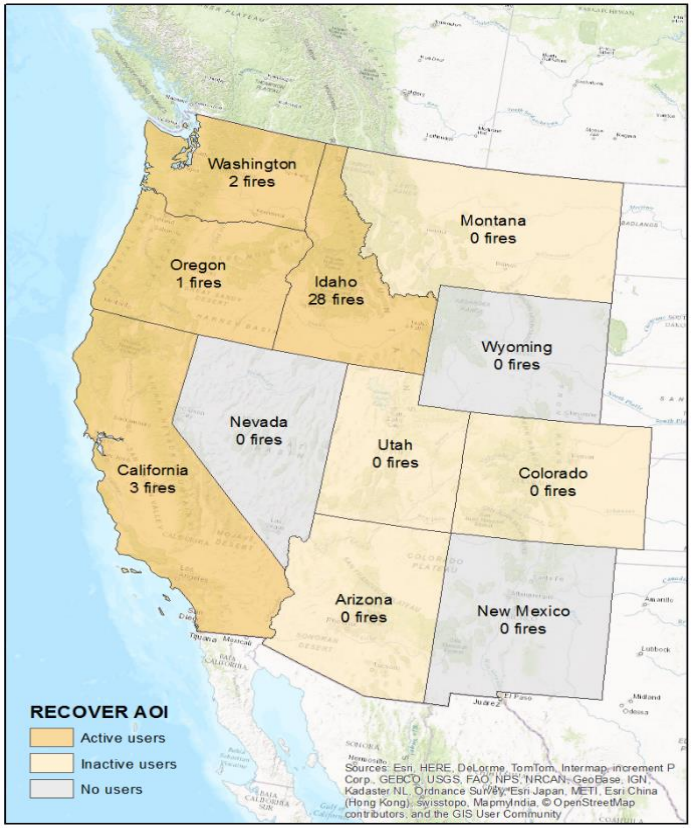
Current Status: NASA RECOVER DSS



- The RECOVER DSS has been used for **36** wildfires (1.8 million acres)
  - Five (5) demonstration fire sites
  - 31 fire sites 2013-2016

Specific Fire	Year	State	Acres Burned	Active User
Timbered Dome	2016	Idaho	2,096	ID-BLM
Baker-ORPAC	2016	Oregon	336,504	OR-BLM
Henry's Creek	2016	Idaho	52,935	ID-BLM
Yale Road	2016	Washington	5,873	WHATCOM Conservation District
Spokane Complex	2016	Washington	6,358	NOAA & WHATCOM Conservation District
Pioneer	2016	Idaho	64,369	IDL and USFS
MM14	2016	Idaho	4,311	ID-BLM
Blue Cut	2016	California	36,323	NOAA-NWS
Lawyer 2	2015	Idaho	2,213	IDL
Cape Horn	2015	Idaho	1,326	IDL
Soda	2015	Idaho-Oregon	279,144	ID-BLM
Dodge	2015	California	10,570	Caltrans
Clearwater	2015	Idaho	68,127	IDL
Valley	2015	California	76,067	Caltrans
Powerhouse	2015	California	30,274	Caltrans
Johnston (Prescribed)	2015	Idaho	0	USDA-ARS
Motorway	2015	Idaho	33,983	IDL
Woodrat	2015	Idaho	7,797	IDL
Clearwater Complex	2015	Idaho	47,282	IDL
Lolo 2	2015	Idaho	1,405	IDL
Parker Ridge	2015	Idaho	995	IDL
Tepee Springs	2015	Idaho	3,337	IDL
Big Cougar	2014	Idaho	65,279	IDL
Timber Butte	2014	Idaho	7,013	IDL
Whiskey	2014	Idaho	9,452	IDL
2 ½ Mile	2013	Idaho	924	ID-BLM
Pony	2013	Idaho	148,170	ID-BLM
Incendiary Creek	2013	Idaho	1,100	IDL
State-line	2013	Idaho-Utah	30,206	ID-BLM
Mabey	2013	Idaho	1,142	ID-BLM
Chips	2012	California	76,343	USFS
Charlotte	2012	Idaho	1,029	ID-BLM
Ridgetop	2012	Idaho	16,616	ID-BLM
Drive-In	2011	Idaho	1,223	ID-BLM
Jefferson	2010	Idaho	188,151	ID-BLM
Crystal	2006	Idaho	220,000	ID-BLM

Interview Process

- Participants were identified through previous RECOVER DSS interactions
  - Provided with the interview instrument as well as project proposal ahead of the interview
  - In-person or teleconference option
- Participants were categorized into two categories
  - Agencies role and purpose

Tier – 1 Users: Land Management Agencies

- Partners:
  - Bureau of Land Management
  - Forest Service
  - Idaho Department of Lands
  - Idaho Fish and Game

Tier – 2 Users: Non-Land Management Agencies

- Partners:
  - Bureau of Reclamation
  - National Oceanic and Atmospheric Administration
  - Department of Transportation

Analysis of Results and Trends

- To date, **seven** Tier–1 interviews conducted
  - ➢ Results:
    - Time- and cost-savings for decision makers and support staff in developing ES&R and BAER plans
    - Improved Communication
    - Value of better-informed decisions

Staff Time and Related-Costs

- Collection & assessment of fire data (fire size & location)

Rehabilitation Planning

– Saved up to **500** hours of staff time

Public Meetings

– Saved up to **96** hours

Improved Communication

- BAER team members
- Partnering agencies
- General Public
- Local stakeholders and decision-makers

❖ GIS novices (staff, management, etc.)

Better-Informed Decisions

- Comprehensive and reliable web map
  - Accurate picture of land post-fire
- Rapidly identifies high-risk, difficult to assess areas
  - Debris-flow
  - Burn severity
- Henry's Creek Fire
  - $500K wood-mulch application

Future Direction

- Completion of stakeholder interviews
- Analysis of data
- Quantify proximate benefits of RECOVER DSS
- Quantitative analysis of RECOVER DSS
- Characterize ultimate benefits of RECOVER DSS
- Submission of final socioeconomic benefits report

Suggestions or Questions

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