PROGRESS IN QUANTIFYING DEBRIS FLOW RISK FOR POST-WILDFIRE EMERGENCY RESPONSE

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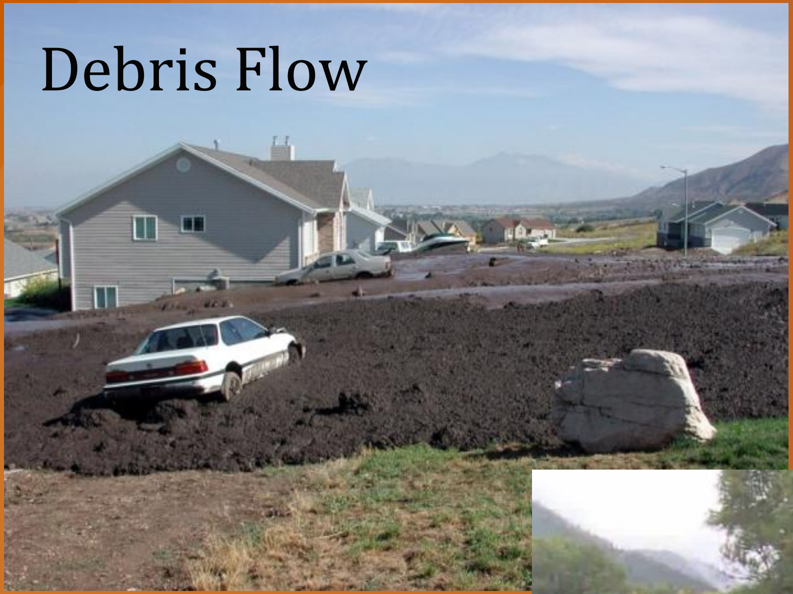
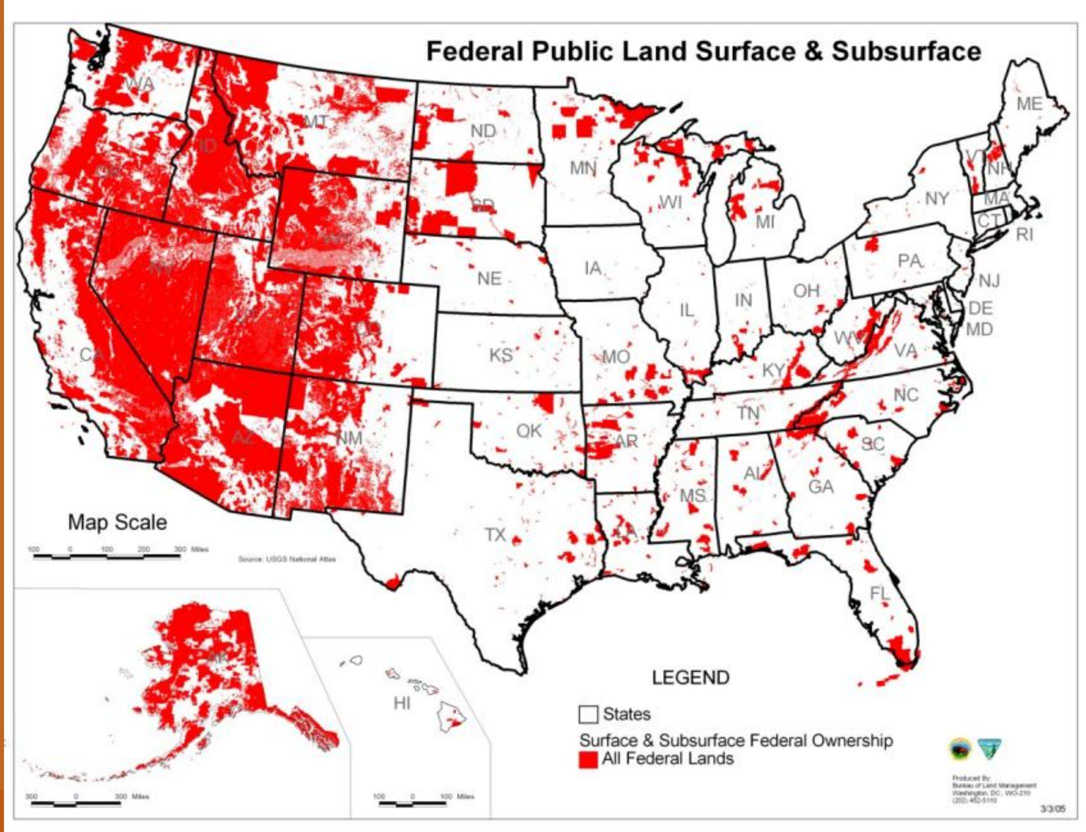
Post-wildfire Storm Responses



What makes debris flows hazardous?

Debris flow risk assessment

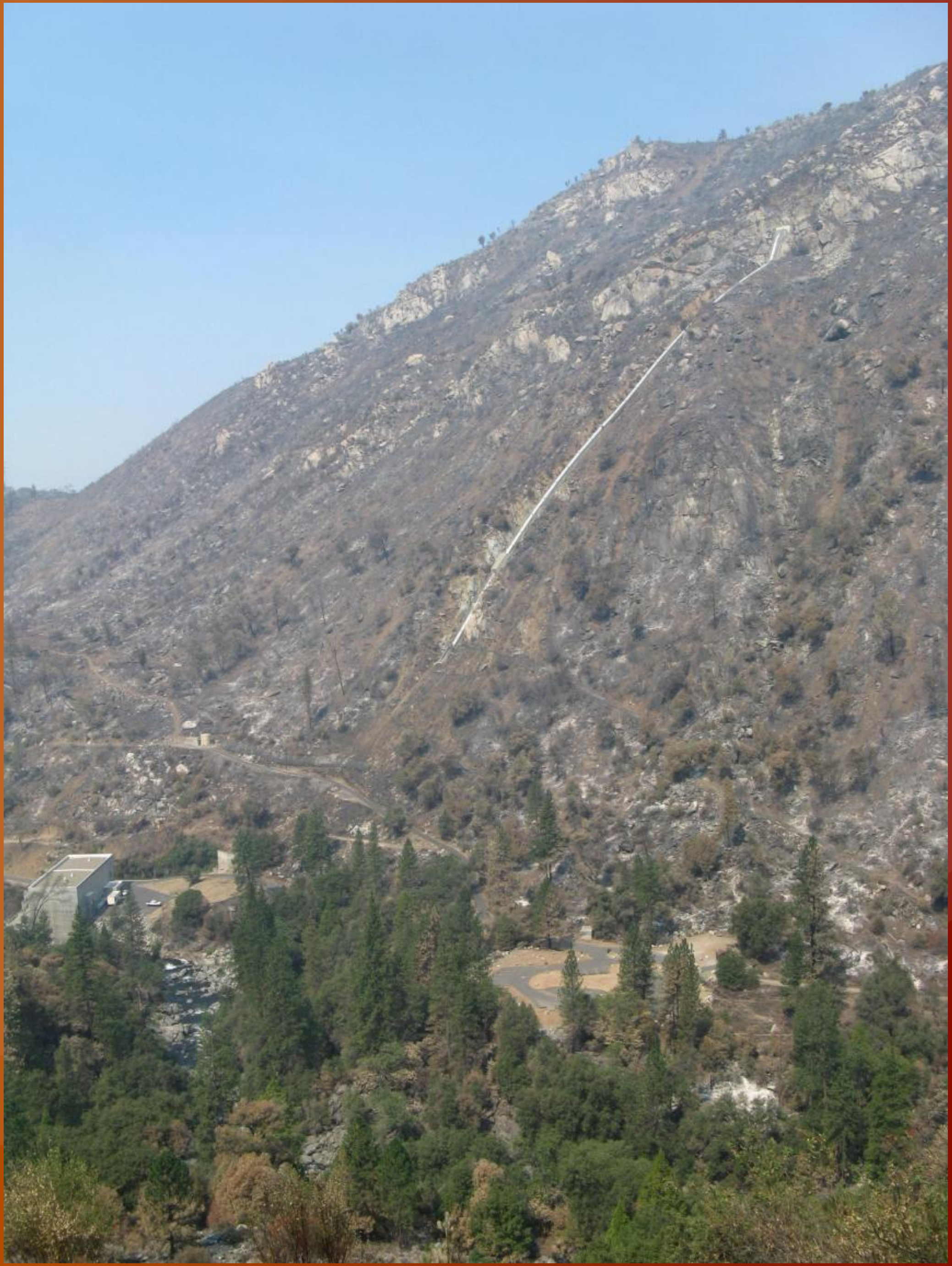
- Mountainous
- Greater frequency of large wildfires
- Rapidly growing population
- Increasing wildland-urban interface



Western United States

Rapid assessment of what is threatened

- People
- Property
    - Structures
    - Infrastructure
- Historic and archeological resources
- Threatened & endangered species



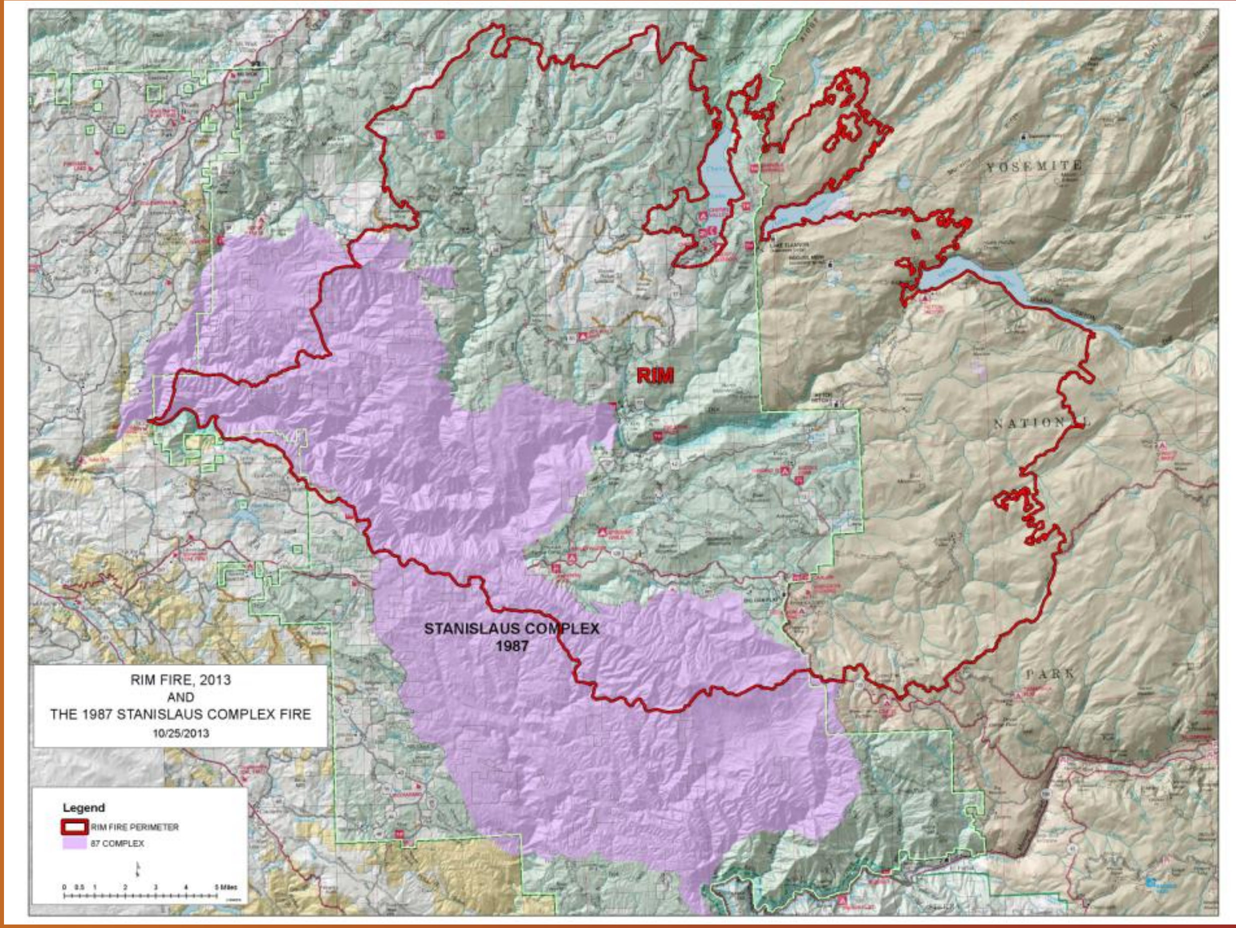
Progress in quantifying debris flow risk

- Scientific understanding of the process
- Technological improvements in soil burn severity mapping
- Development of empirical models predicting debris flow probability, volume, and inundation areas

Illustrating Progress

Stanislaus Complex Fire

August 1987 - Lightning
145,980 acres
(591 sq. km)
Loss of 28 structures
No. 14 of 20 largest in CA



Rim Fire

August 2013 – Campfire
257,135 acres
(1,041sq. km)
Loss of 112 structures
No. 3 of 20 largest in CA

Stanislaus Complex Fire

<u>Scientific Understanding</u> – Assumed post-fire debris flows are initiated by infiltration-triggered slope failure

- Presence of past debris flow activity considered indicative of greater future risk
- Risk assessment was site-specific for the value-at-risk

Rim Fire

Scientific Understanding – Now recognized that debris flows from burned areas are initiated by runoff- dominated surface erosion

- Fire's effect on soil conditions and vegetative cover are better predictors than past debris flow activity.
- Risk is assessed for specific values-at-risk based debris flow hazard

Stanislaus Complex Fire

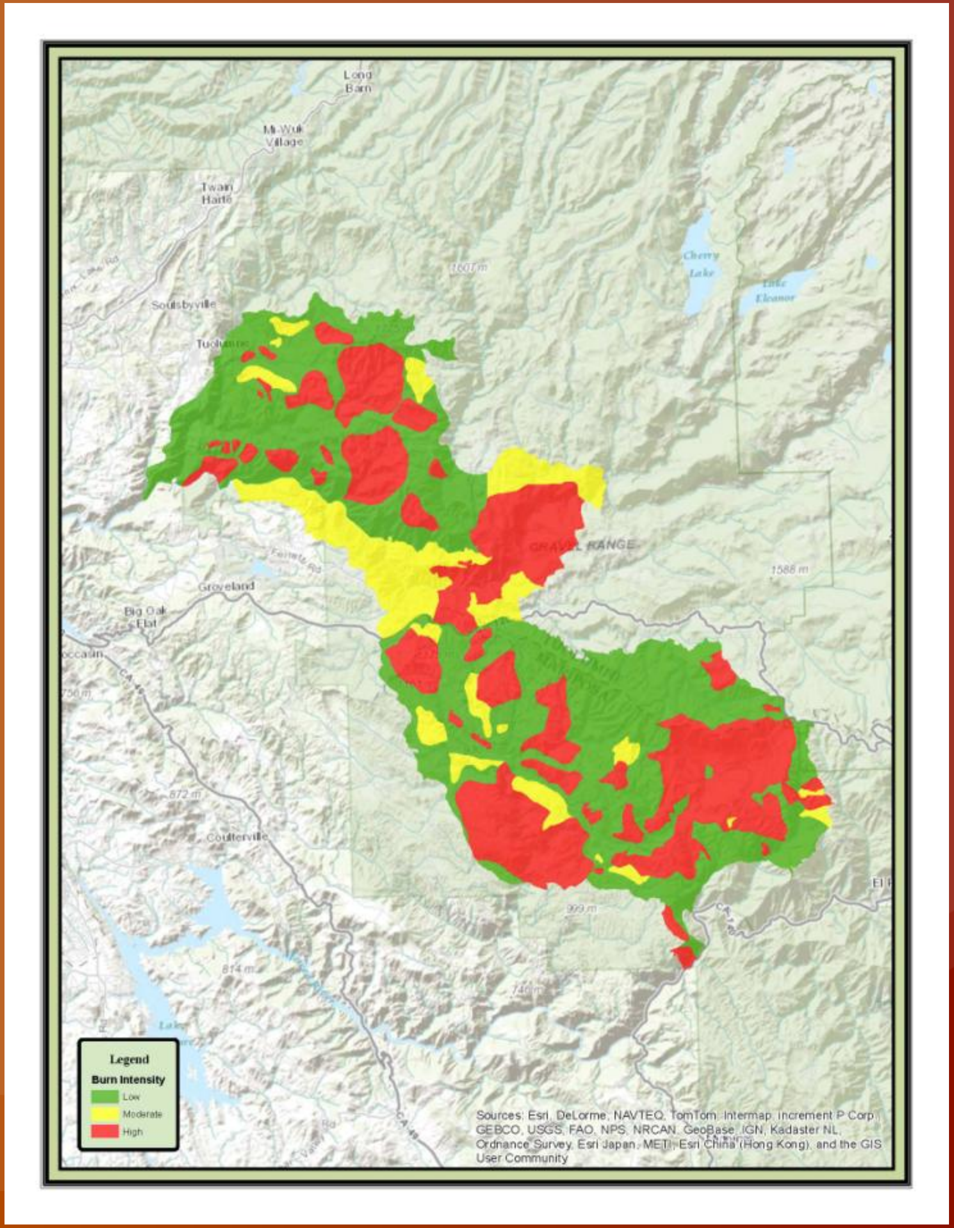
Technology - Mapping soil burn severity

- Marked on topographic map during helicopter overflight.
- Severity designations of high, moderate, low and unburned applied to mapped areas.

Rim Fire

<u>Technology</u> - Mapping of soil burn severity

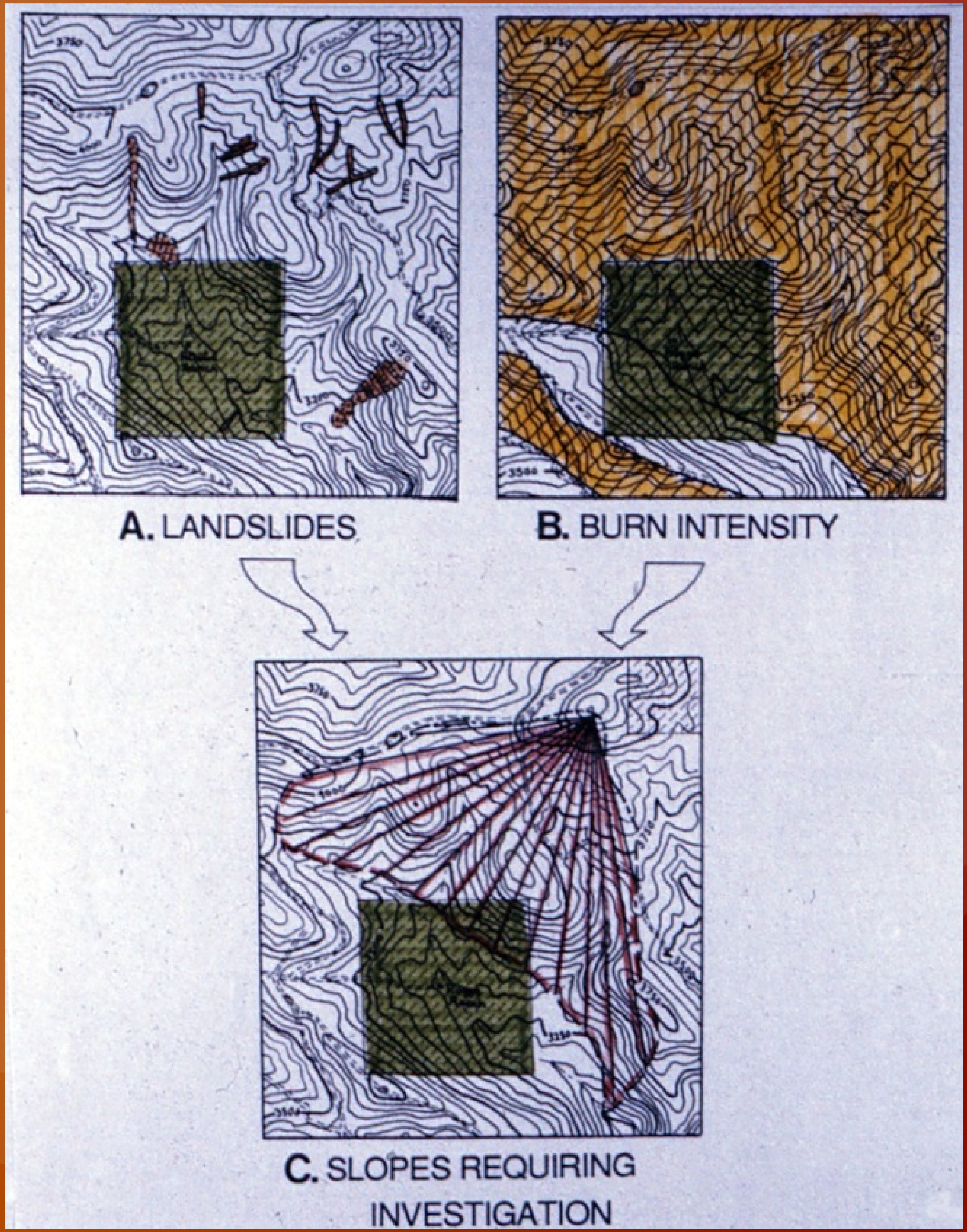
- A burned area reflectance classification (BARC) derived from comparison and interpretation of satellite imagery.
- Severity designations of high, moderate, low and unburned modified by field assessment of soil conditions.



Stanislaus Complex Fire

Determination of debris flow hazard for risk assessment

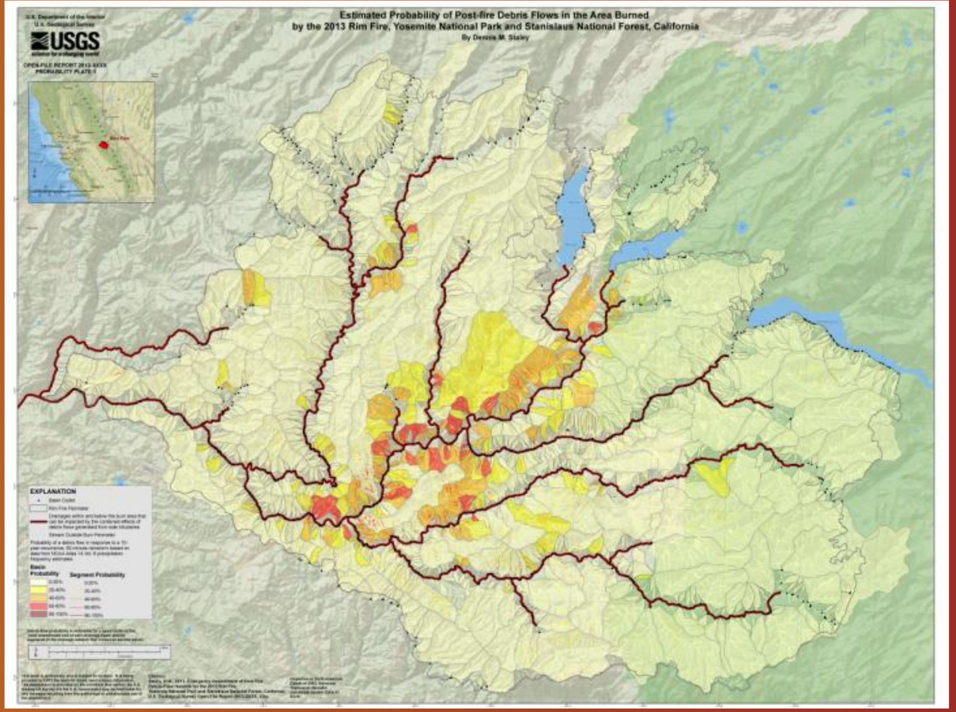
- Professional judgment used in combination with slope steepness, soil burn severity, and presence of past debris flow activity.
- Risk assessment was site-specific for the identified value-at-risk.

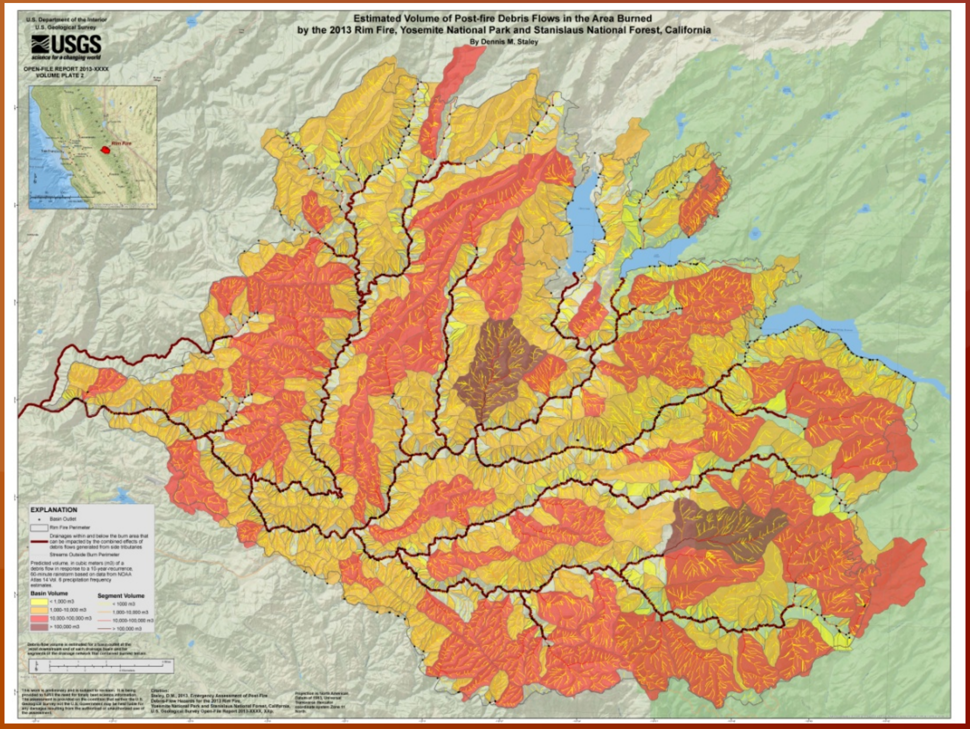


Rim Fire

Empirically-based modeling produces maps for watersheds as small at 0.2 sq. km

- Show the <u>probability</u> of debris flow occurrence and ranges of expected volume.
- Combining occurrence and volume probabilities shows overall relative debris flow hazard in watersheds.
- Risk is assessed for downstream values-at-risk where probability and/or volume will be greatest.





Conclusions

- Rapid assessment of debris flow risk from burned areas is now based on:
  - a better understanding of the underlying geologic process
  - and enables a more quantitative representation of the debris flow hazard and, in turn, the risk posed.
- The ability to generate these quantitative results rapidly:
  - is enhanced by technological advances in data gathering/mapping
  - and contributes to a more robust rapid risk assessment than was possible in the past.