Rapid Response database for hydrological modeling

Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts

Mary Ellen Miller, PhD
Michael Billmire, CMS-GIS/LIS
Nancy French PhD & David Banach
Michigan Tech Research Institute, Ann Arbor, MI

Forest Service Partners:
Bill Elliot, PE, PhD and Pete Robichaud, PE, PhD
USFS Rocky Mt Research Station, Moscow, ID

Project Summary: Rapidly integrate NASA Earth Observations into process based models in order to aid post-fire mitigation.

Earth Observations applied: Burn severity maps derived from multispectral imagery (Landsat, Aster, EO-1 ALI)

http://geodjango.mtri.org/geowepp/

Spatial WEPP Model

geodjango.mtri.org/geowepp/

Burned Area Emergency Response

Spatial WEPP Model Inputs Generator

Spatial WEPP Products | Static Files

Draw Burned Area Extent on the Map

Draw Selection on Map

Or, Select an MTBS Fire

Select state: CO

Select year: 2002 (45 fires)

Select an MTBS fire: HAYMAN_E

☑ Burn land cover and soil layers by MTBS fire

Or, Use a Custom BARC Map

Upload BARC Map | Use My Private Key

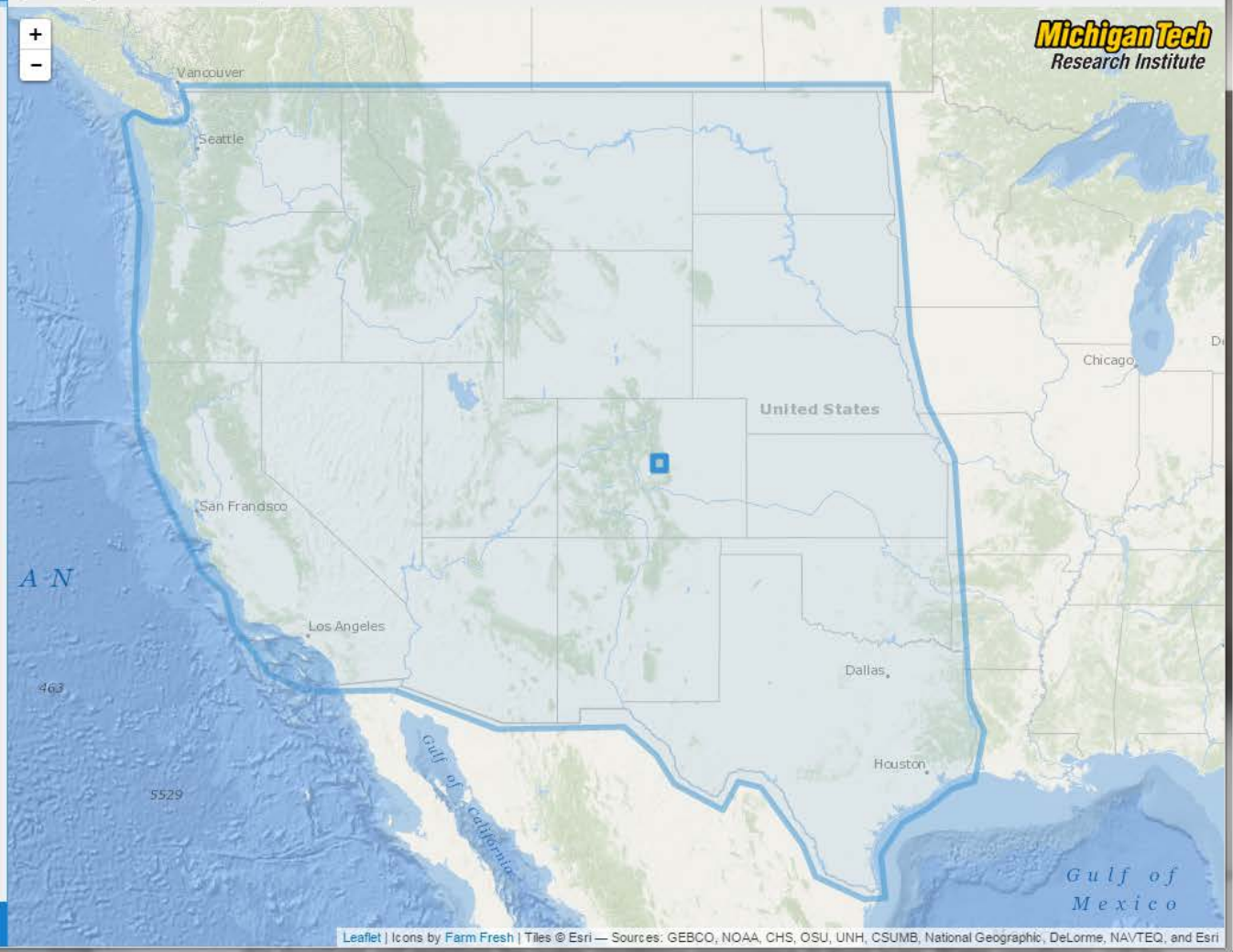
Products:
- ☑ Land cover and linkage files
- ☑ Soils and linkage files
- ☑ Digital elevation model (DEM)

File format: ASCII Grid (*.asc)

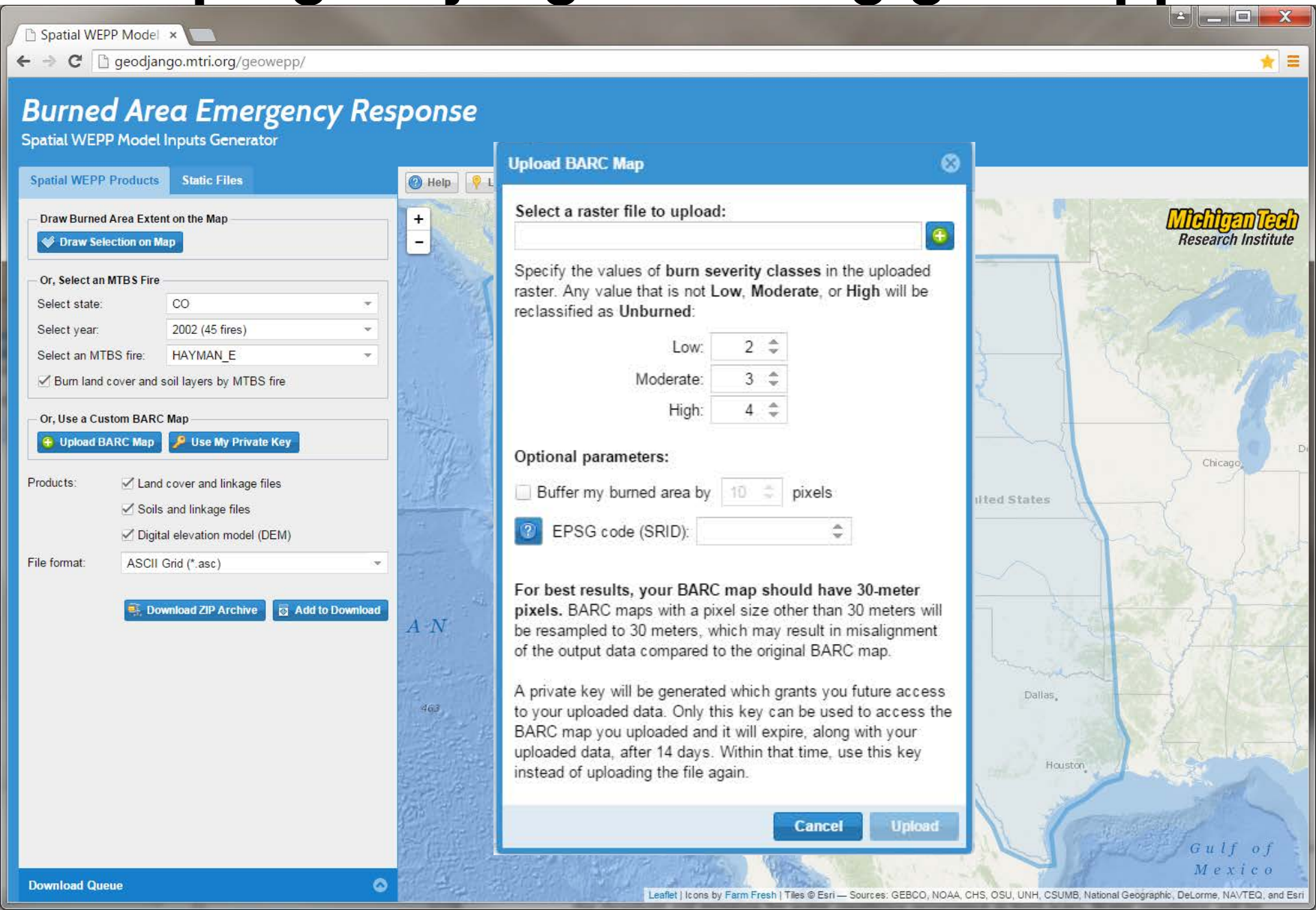
Download ZIP Archive | Add to Download

Download Queue

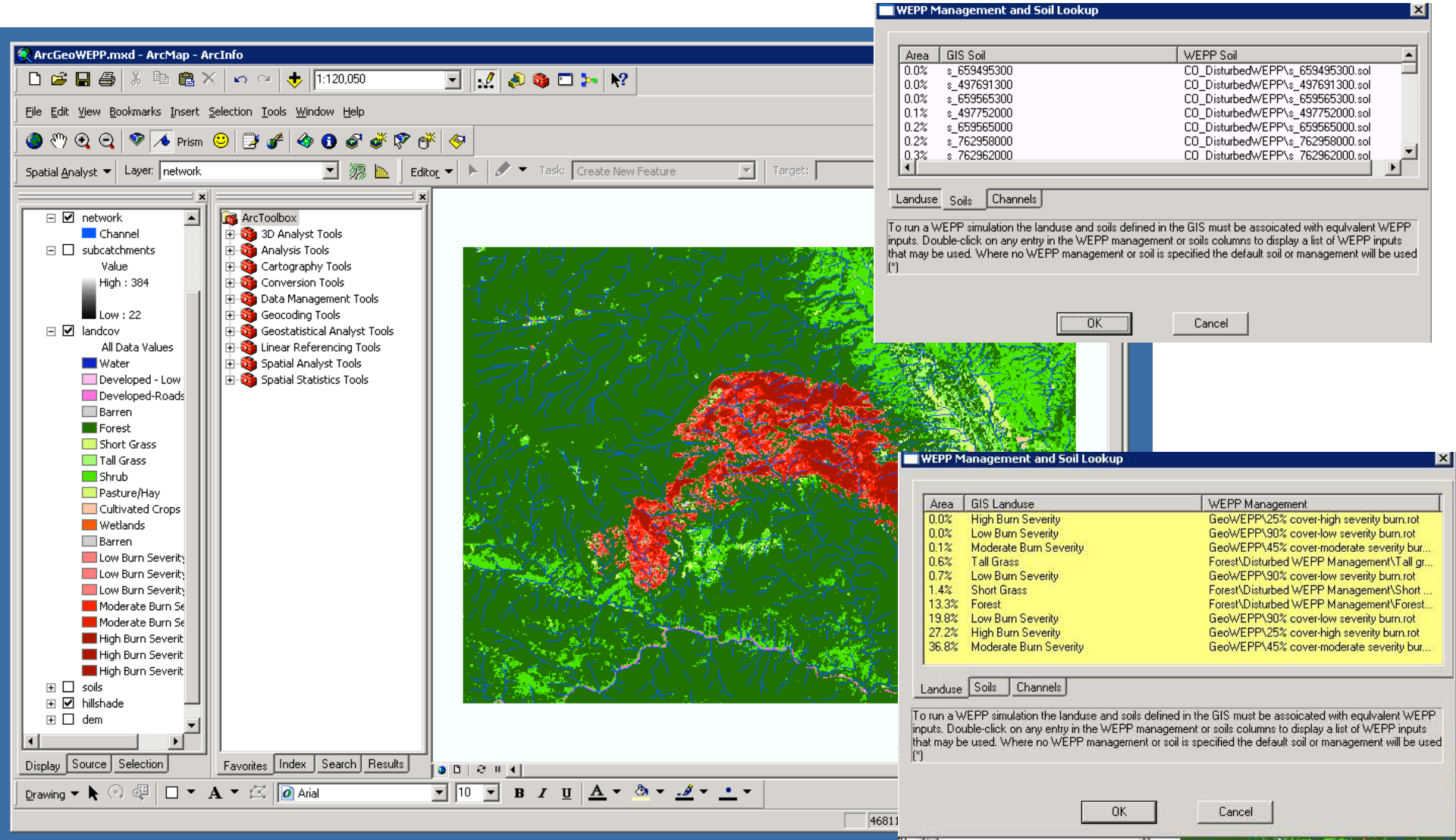
Help | Locate Me on Map | ☑ Show available data on map



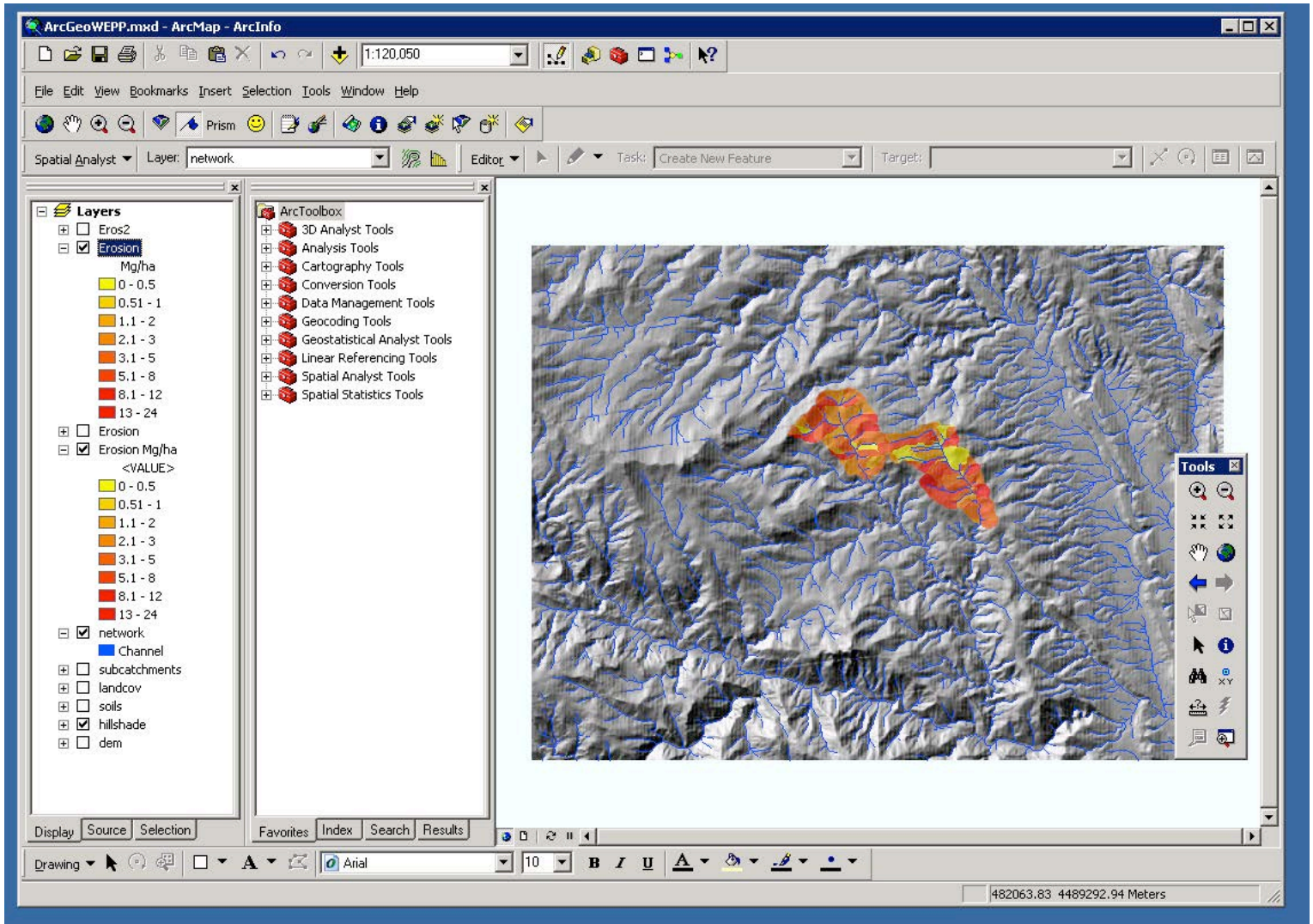
http://geodjango.mtri.org/geowepp/



NASA BAER database creates WEPP linkage files!



BAER Teams can focus on modeling!



Applied Sciences Program

Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts

PI: Mary Ellen Miller, PhD, Michigan Tech Research Institute (memiller@mtu.edu, (734) 994-7221)

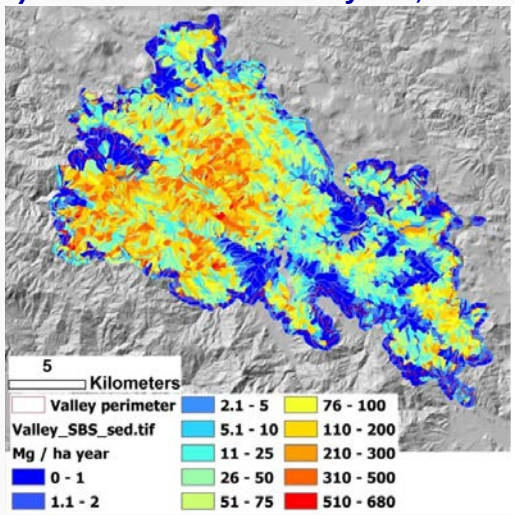
Wildland Fire Program
ACTIVE PROJECT
February 3 2016

Purpose and Objective

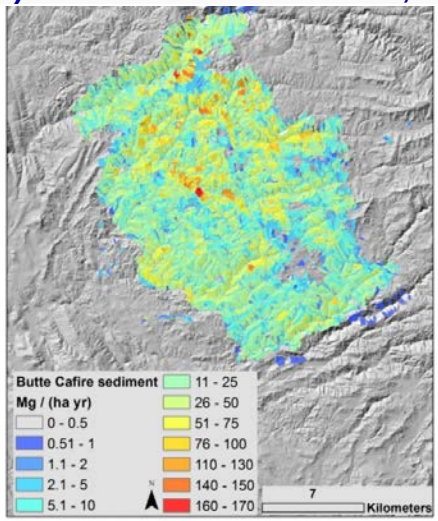
Provide tools and datasets that will allow for the integration of NASA Earth Observation data of burn severity into process based models in order to aid decision-making activities related to post-fire risk assessment and rehabilitation. This work is needed as assembling the data needed to run spatially explicit erosion models can be a daunting task even without time constraints, therefore preparing the required input data ahead of time makes sense.

Societal Benefit Area(s): Protect life, property, & natural resources
Geographic Focus: CONUS with emphasis on fire prone states
Targeted End-Users: BAER Teams, hydrologists and researchers

a) Post-fire erosion Valley fire, CA



b) Post-fire erosion Butte fire, CA



"Your WEPP research was a key input for the "Watershed Clearinghouse," a joint FEMA-State technical services group" Mary M. Shaw FEMA Emergency Management Planner

Approach

Create an online spatial database to support post-fire remediation through erosion modeling. Our database (http://geodjango.mtri.org/geowepp/) for the Western US is online and allows users to import burn severity maps which are combined with soils and land cover to rapidly provide spatial model inputs. By preparing ahead of time the modeling work can be carried out rapidly and the results can be used for decision-making activities related to post-fire risk assessment and rehabilitation. The rapid response website delivers model inputs in mere seconds; previously assembling and formatting this type of data would have taken multiple days.

Database already used operationally for the following fires: Canyon Creek, OR; Clearwater, ID; Butte, CA; Valley, CA; French, CA; Happy Camp, CA; Silverado, CA; King, CA

Key Milestones

	Date
Allow users to upload new burn severity maps into database	11/14
Expansion of database to Western US	05/15
Database used by BAER Teams on the Valley & Butte fires, CA; Canyon Creek fire, OR and for fires in Clearwater NF fires, ID	10/15
Expansion of database to CONUS	06/16
Online empirical Debris Flow model & Ravel Rat	08/16
Support for ERMiT and Disturbed WEPP spatial tools	05/17
Complete transfer of database to Forest Service online toolset	06/17

$ARL_{Start} = 4$ **$ARL_{Most\ Recent} = 6$** **$ARL_{Goal} = 9$**

Biggest Achievement or Advancement to Date

for **Fuels Planning**

- Mokelumne
- Flagstaff

for **BAER Teams**

- Canyon Creek, OR
- Clearwater, ID
- Butte, CA
- Valley, CA
- French, CA
- Happy Camp, CA
- Silverado, CA
- King, CA

for **Validation study**

- High Park, CO

Challenge:

Rapid Response Hydrology database is ready but the BAER modelers are not!

Solution:

Prepare the modelers!

1. **WEPP workshop March 22-23 NRCS offices in Davis, CA**
2. **Follow up with webinar.**
3. **Manual online**

Rapid Response Hydrology
Mary Ellen Miller, MTRI

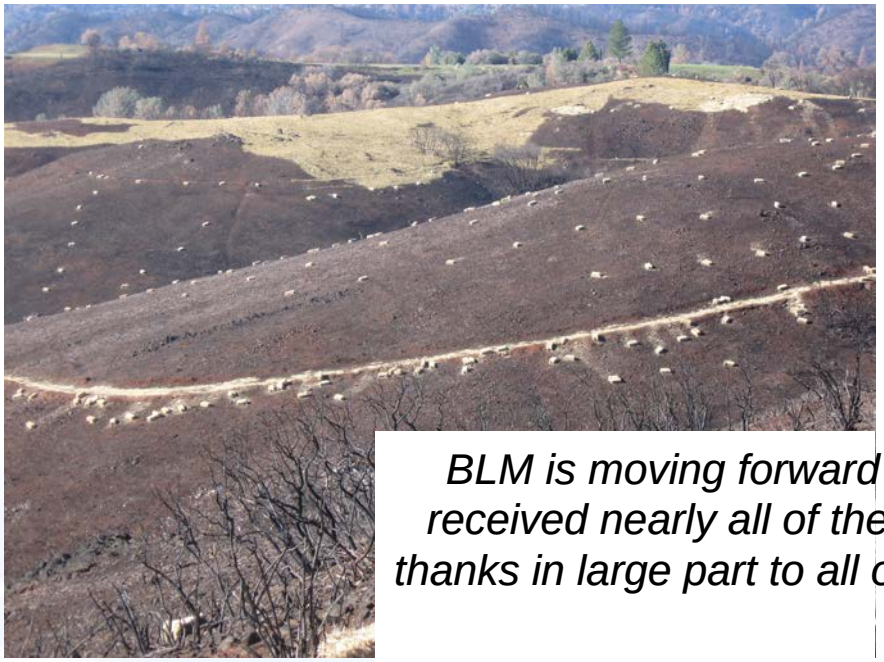


Photo provided by: Bill Haigh

"*It helps us prioritize which watersheds we want to concentrate our treatments on*."
Chuck Jachens, regional hydrologist, Bureau of Indian Affairs.

BLM is moving forward rapidly to implement the Butte Fire ESR plan. We received nearly all of the funding we requested from our Washington Office, thanks in large part to all of the information provided by everyone copied on this email.

We have three erosion control projects either underway or soon to begin:

- *"Our $3 million Wood Shred contract is out for bid, and I expect a contractor will be selected by the end of next week."*

Bill Haigh, Mother Lode Field Manager, BLM

Thank you very much, Mary! Super data; this will be extremely helpful. We are starting BARC checking in earnest today.

Pete Cafferata- Watershed Protection Program Manager, Forester III
California Department of Forestry and Fire Protection

Rapid Response Hydrology
Mary Ellen Miller, MTRI

USDA United States Department of Agriculture

IN THIS ISSUE
- A Rapid Response Database in Support of Post-Fire Hydrological Modeling
- Notices and Technical Tips
- Mid-Winter Drought Conditions: El Niño Storms Bring Much-Needed Relief

StreamNotes

The Technical Newsletter of the National Stream and Aquatic Ecology Center
Fort Collins, Colorado
February 2016

A Rapid Response Database in Support of Post-Fire Hydrological Modeling

Mary Ellen Miller
Research Engineer, Michigan Tech Research institute

William J. Elliot
Research Engineer, USFS Rocky Mountain Research Station

Being prepared for an emergency is important. Every year wildfires threaten homes and lives, but danger persists even after the flames are extinguished. Post-fire flooding and erosion (Figure 1) can threaten lives, property, and natural resources. To respond to this threat, interdisciplinary Burned Area Emergency Re teams assess pot flood risks, necessary, dev plans to protec resources. BA under tight d burn scars m treatments r two weeks Process-base empirical r under-utiliz lumped models both difficult to set up and require properly formatted spatial inputs. Engineers at the Forest Service and Michigan Tech Research Institute

StreamNotes is an aquatic and riparian systems publication with the objective of facilitating knowledge transfer from research and field-based

Watershed, Fish, Rare Plants programs.
Editor: David Levinson
Technical Editors:
- Steven Yochum
- Brett Roper

Layout: Steven Yochum

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Figure 1: Wildfire-induced flood damage and sediment deposition from the 2012 High Park Fire, Colorado (Photo credit: Steven Yochum).

”For me, your erosion modeling and its use in analysis of treatment effects was the most necessary part of our mulch treatment decision-making process.”
Jeff TenPas, Regional Soil Scientist and BAER Coordinator
USDA Forest Service – Pacific Southwest Region (R5)

“Bill, Very nice publication in StreamNotes. Hope you’ll never retire.”
“Your products are very helpful in striving to make fire more time effective and easier to deal with though – thank you for all that you do.”
Gina Rone, Forest Soil Scientist – USDA Forest Service

"*Your WEPP research was a key input for the “Watershed Clearinghouse,” a joint FEMA-State technical services group.*“ Mary M Shaw FEMA Emergency Management Planner

"*Your work was highly valued and appreciated*"
Susan Gembroski FEMA Technical writer

PI Overall Assessment

Summary of Challenges; Problems; Objective Analysis

The Rapid Response hydrology database is ready to provide data support; our end users need preparation as well!

To overcome this issue:

- Modeling workshop filled in three days!
- We plan to follow up with a webinar for folks who cannot attend workshop.
- We also have an easy to use manual available online.

Summary of Positive Progress

The database has provided support on over 8 active wild fires and at least two fuels projects.

Elements of the project are at ARL of 9 as the products have been used to spatially prioritize ~ 4 million in mulching treatments.

We have external customers using the database for fuels projects.

Overall Assessment

Our open source data base has potential to expand beyond fire and the US!

PI Assessment of Future Project Progress

Spatial expansion to CONUS

10 m DEM

Enhance outputs for ERMiT and Disturbed WEPP batch – we will need look up tables.

Transfer of database to partners.

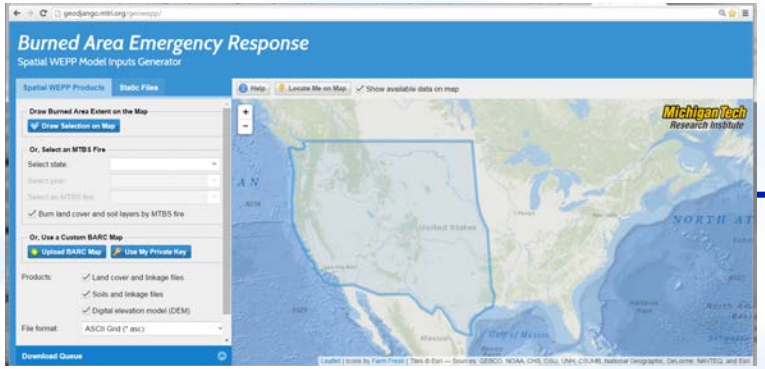
Training of end users through workshops and webinars.

Assistance with development of webinar to assist end users with training in the use of spatial WEPP modeling tools.

Developing other applications for the database

- Agricultural
- Culverts

Spatial expansion of the data base internationally!



Budget progress and future plans to spend down the funding by year.

$ARL_{Start} = 4$ $ARL_{Most\ Recent} = 6$ $ARL_{Goal} = 9$

Relevant Publications, Awards, Accomplishments

Robichaud, P.R., W.J. Elliot, S.A. Lewis and M.E. Miller. Validating post-fire erosion response with a probabilistic erosion model. *International Journal of Wildland Fire* (in press)

Elliot, W.J., M.E. Miller and N. Enstice. Targeting Forest Management through Fire and Erosion Modeling. *International Journal of Wildland Fire* (in press)

Miller, M. E., Billmire, M., Elliot, W. J., Endsley, K. A., and Robichaud, P. R.: Rapid Response Tools and Datasets for Post-fire Remediation: Linking Remote Sensing and Process-based Hydrological Models. *International Journal of Wildland Fire* (in review)

(Best oral presentation! International Symposium on Remote Sensing of the Environment)

Miller, M. E., Billmire, M., Elliot, W. J., Endsley, K. A., and Robichaud, P. R.: Rapid response tools and datasets for post-fire modeling: linking Earth Observations and process-based hydrological models to support post-fire remediation, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XL-7/W3, 469-476, doi:10.5194/isprsarchives-XL-7-W3-469-2015, 2015.

Invited plenary speaker at the Fall 2015 California, Nevada, Hawaii Fire council meeting.

Relevant Publications, Awards, Accomplishments

Press releases:

Miller, Mary Ellen and Elliot, William. A Rapid Response Database in Support of Post-Fire Hydrological Modeling. Stream Notes Feb. 2016

Environmental Monitor article in Winter 2016 issue: Risks after http://www.fondriest.com/news/environmental-monitor-winter-2016-print-edition-out-now.htm.

Great Lakes Radio News: http://broadcast-everywhere.net/56373/great-lakes-radio-news/press-releases/michigan-tech-researcher-works-to-make-burned-areas-safer/

Informed Infrastructure: https://informedinfrastructure.com/16616/preventing-floods-and-erosion-after-fire/

Michigan Tech Notes: http://www.mtu.edu/news/stories/2015/august/following-fire-preventing-floods-erosion.html

Michigan Tech Video Montage for a Football halftime show

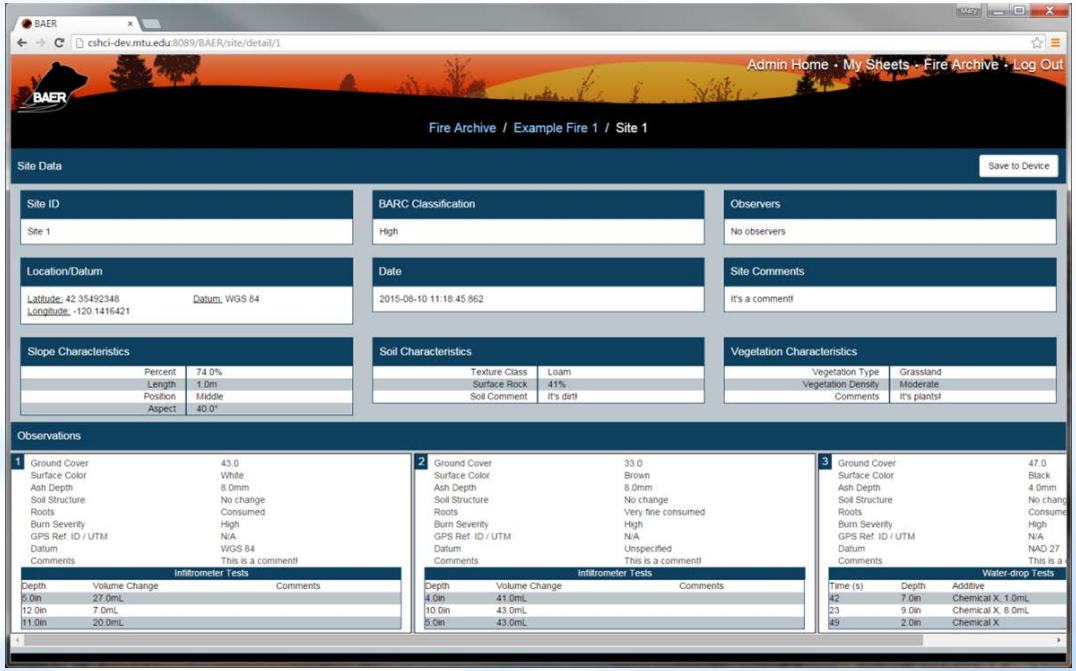
Relevant Publications, Awards, Accomplishments

Accomplishments :

Database in action: Canyon Creek, OR; Clearwater, ID; Butte, CA; Valley, CA; French, CA; Happy Camp, CA; Silverado, CA; King, CA

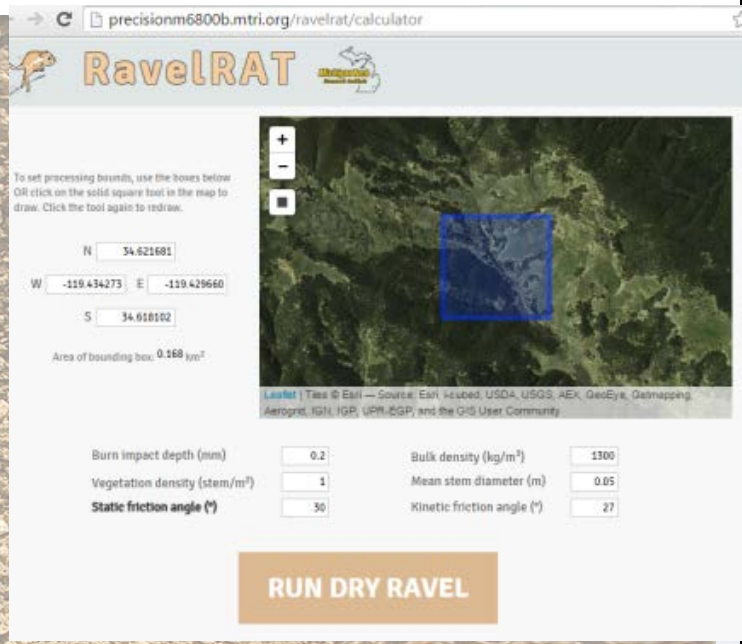
New Customers this year! FEMA, BLM, CALFIRE & BIA

Collaborated with Dr. Robert Pastel on an App for BAER Teams



Deserving Team Members

Mike Billmire:
New RavelRAT interface!



Nor Serocki, Dave Banach & Liz Schold: Downloading and Processing Conus!

Bill Elliot & Pete Robichaud:
Finding end users for the database!

Nancy French
Used IJWF connections to obtain extension for Rapid Response Paper!

Creatively Define the Status of your Project

Fire Removes Cover

Water carries Soil away

NASA BAER models!