Colorado Fire Prediction System
CO-FPS

Dead Fuel Moisture Content and Terrain Resolution Sensitivity

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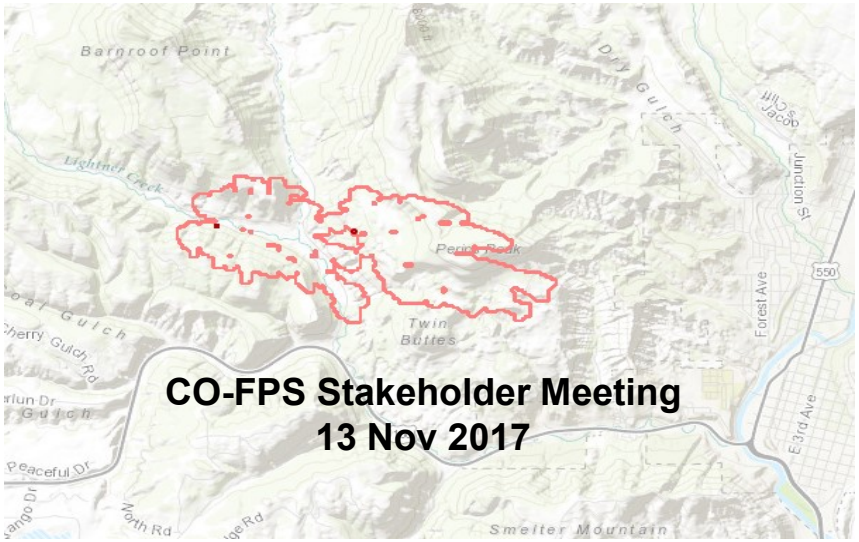
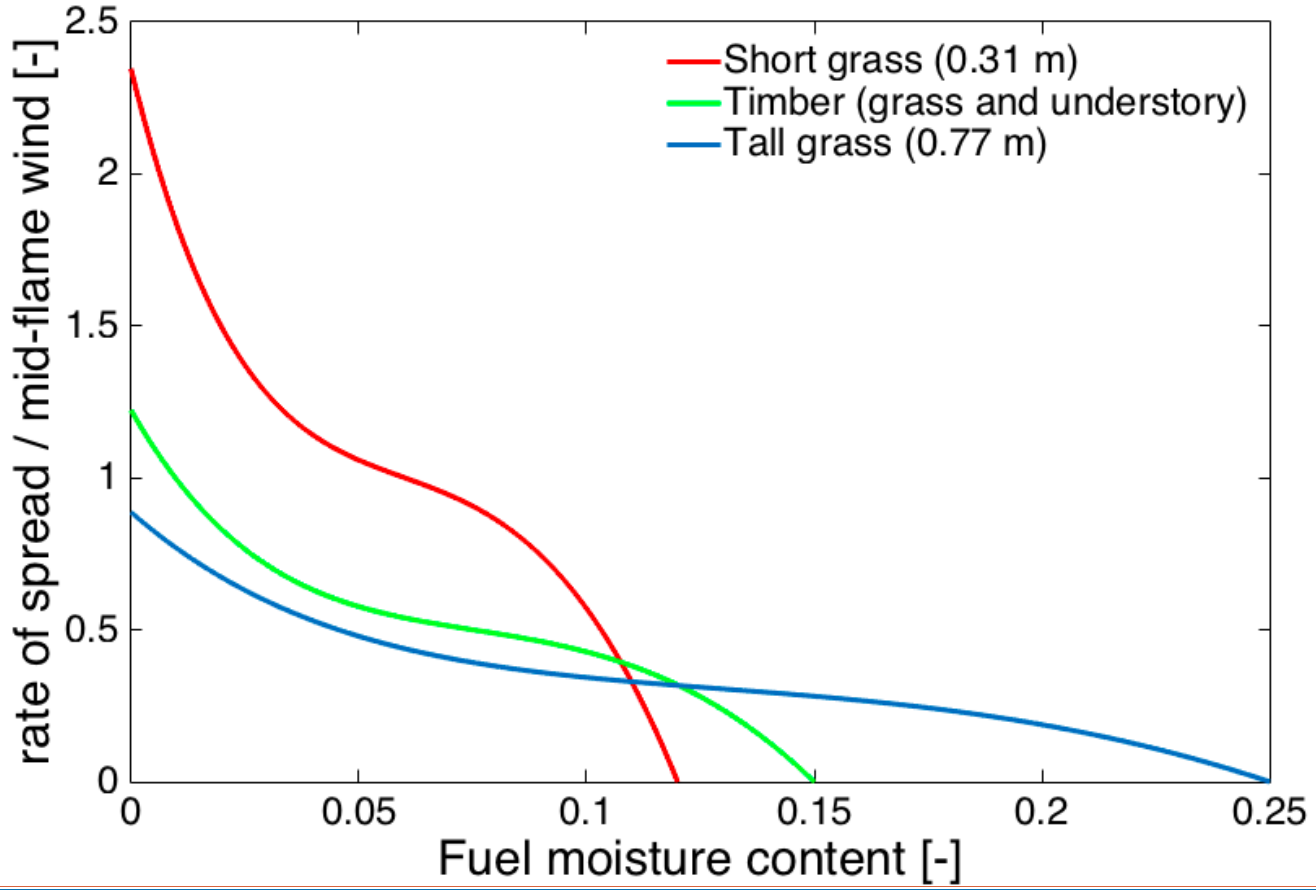
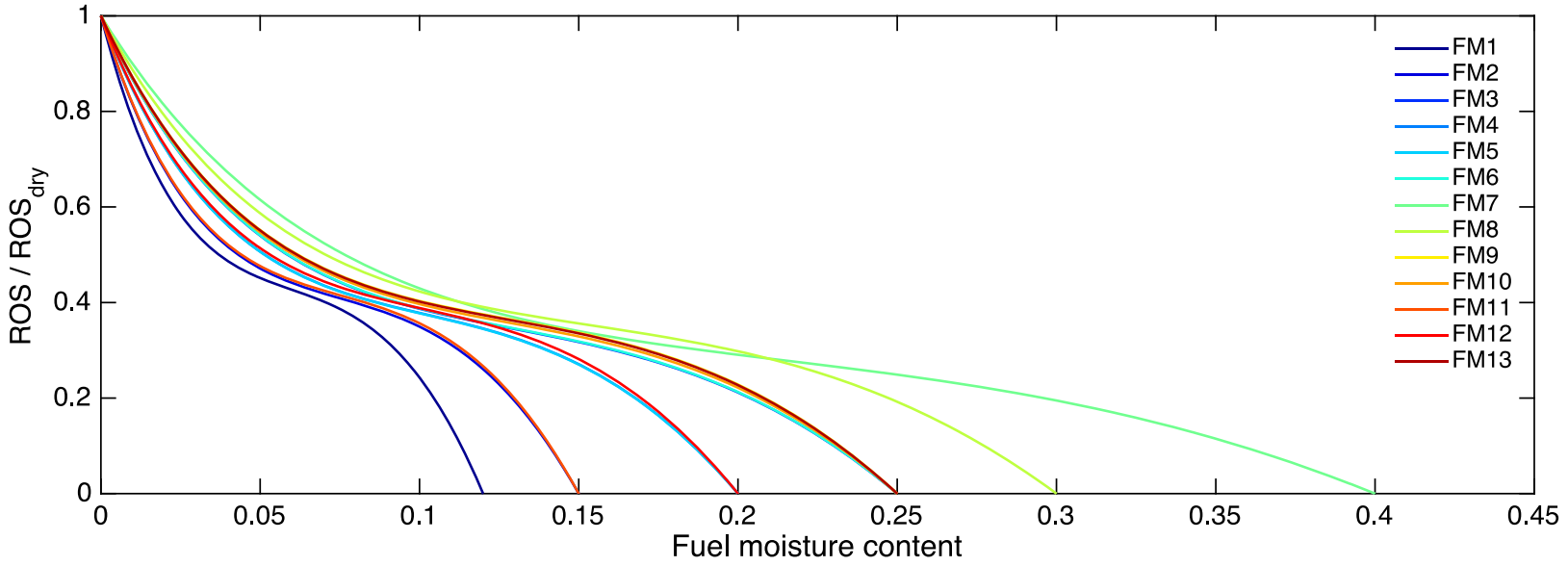
Domingo Muñoz Esparza



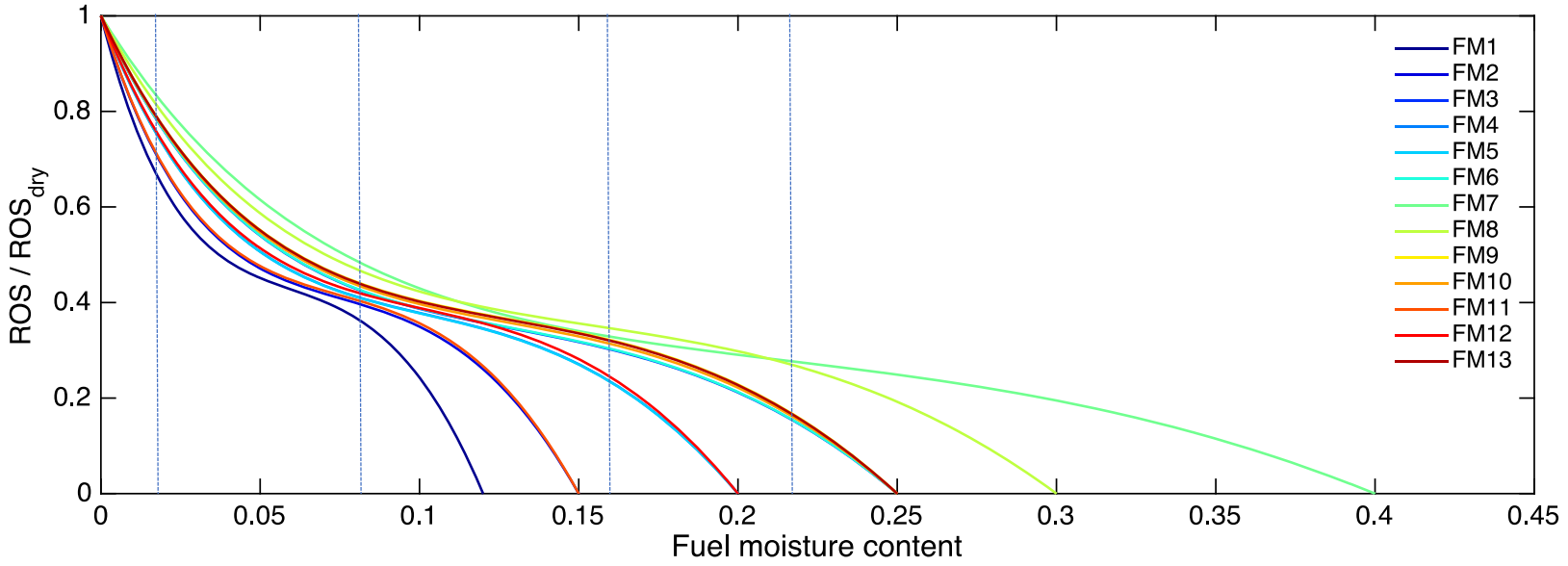
Non-dimensional Rate of Spread as a Function of Fuel Moisture Content



Normalized Rate of Spread as a Function of Fuel Moisture Content

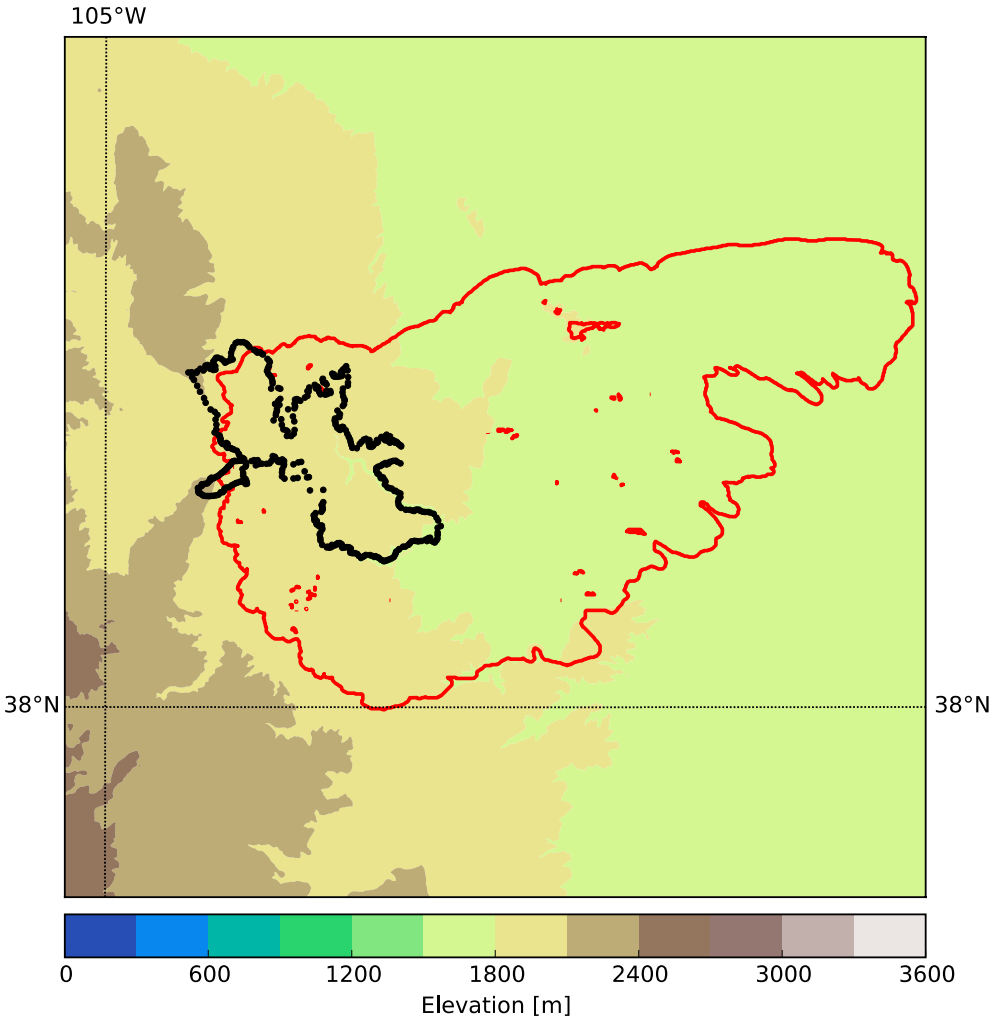


Normalized Rate of Spread as a Function of Fuel Moisture Content



Beulah Hill Fire

FMC = 0.02



Scott and Burgan Fuel Model

Fuel type	Fuel model number block	Used in original or new set
	1-13	1-13
	14-89	
Non-burning	90-99	91-93, 98-99
Grass	100-119	101-109
Grass-Shrub	120-139	121-124
Shrub	140-159	141-149
Timber-Understory	160-179	161-165
Timber Litter	180-199	181-189
Slash-Blowdown	200-219	201-204
	220-256	

Scott and Burgan - Anderson Fuel Model "Crosswalk"

We are testing full Scott and Burgan model.

Presently model parameters from Anderson model are used following "crosswalk" table between Anderson and Scott and Burgan model

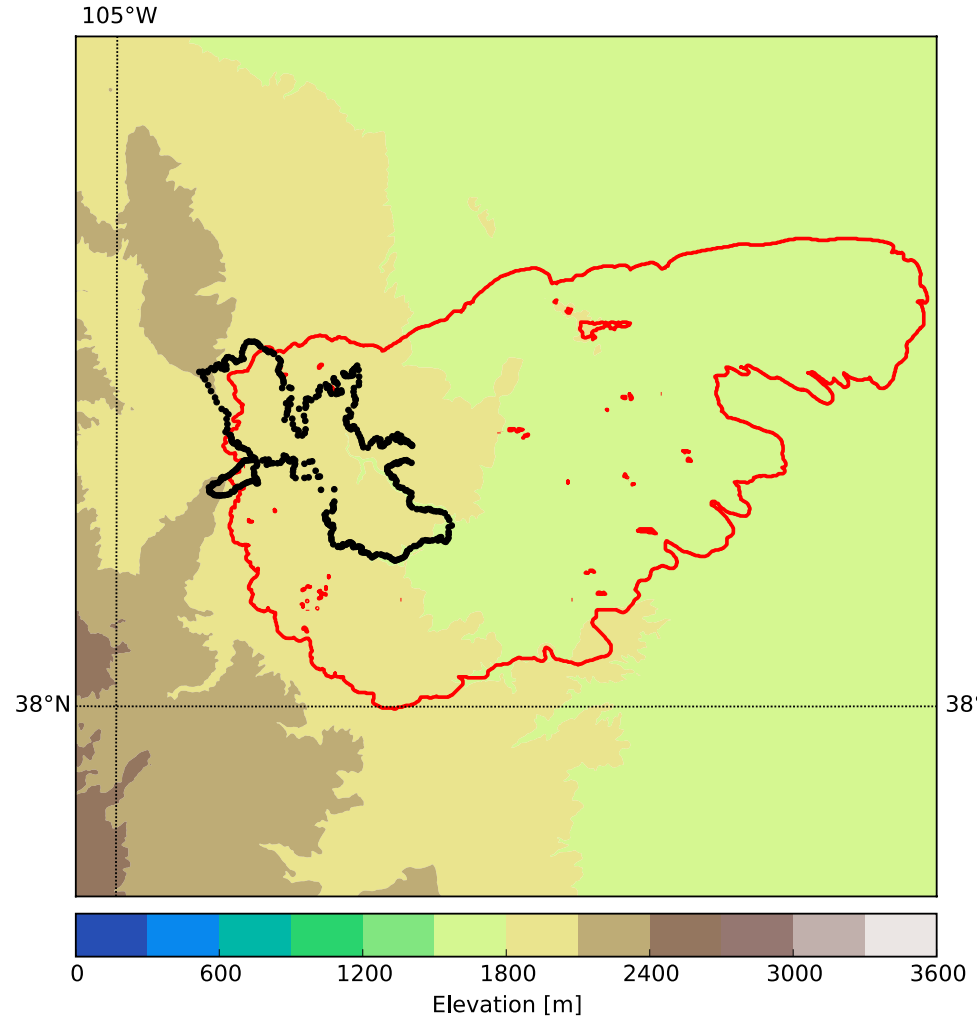
Grass fuel type

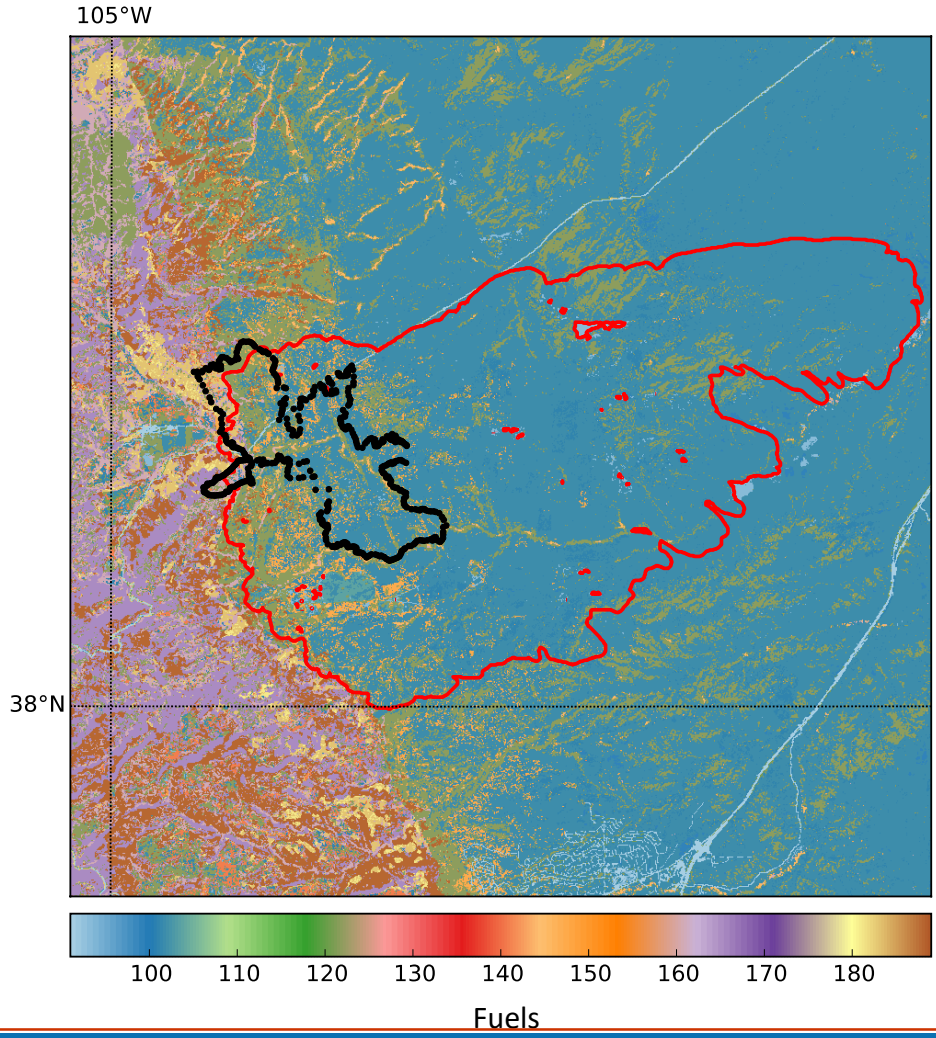
Consider using one of these fuel models from the new set...	... if you used one of these models from the original set. 1 Short Grass	2 Timber Grass and Understory	3 Tall Grass
GR1	For very sparse or heavily grazed grass; for lower spread rate and flame length		
GR2	For slightly lower spread rate and comparable flame length	For comparable spread rate and slightly lower flame length	
GR3			For lower spread rate and slightly lower flame length
GR4	For slightly lower spread rate and much higher flame length	For higher spread rate and slightly higher flame length	
GR5			For lower spread rate and slightly lower flame length
GR6			For slightly lower spread rate and comparable flame length
GR7	For comparable spread rate and significantly higher flame length	For much higher spread rate and flame length	For comparable spread rate and slightly higher flame length
GR8			For comparable spread rate and higher flame length
GR9			For higher spread rate and much higher flame length
GS1		For slightly lower spread rate and lower flame length	
GS2		For slightly lower spread rate and flame length	

Note: All grass fuel models from the new set are dynamic fuel models, which means that herbaceous load is transferred between live and dead categories according to live herbaceous moisture content. Original models 1 and 3 have only a dead component. Original fuel model 2 has a live herbaceous component but is static. Exact fire behavior comparisons between original and new grass models can only be made when live herbaceous moisture content is 30 percent or less. These comparisons were made with a live herbaceous moisture content of 60 percent (two-thirds cured).

Beulah Hill Fire

FMC = 0.02

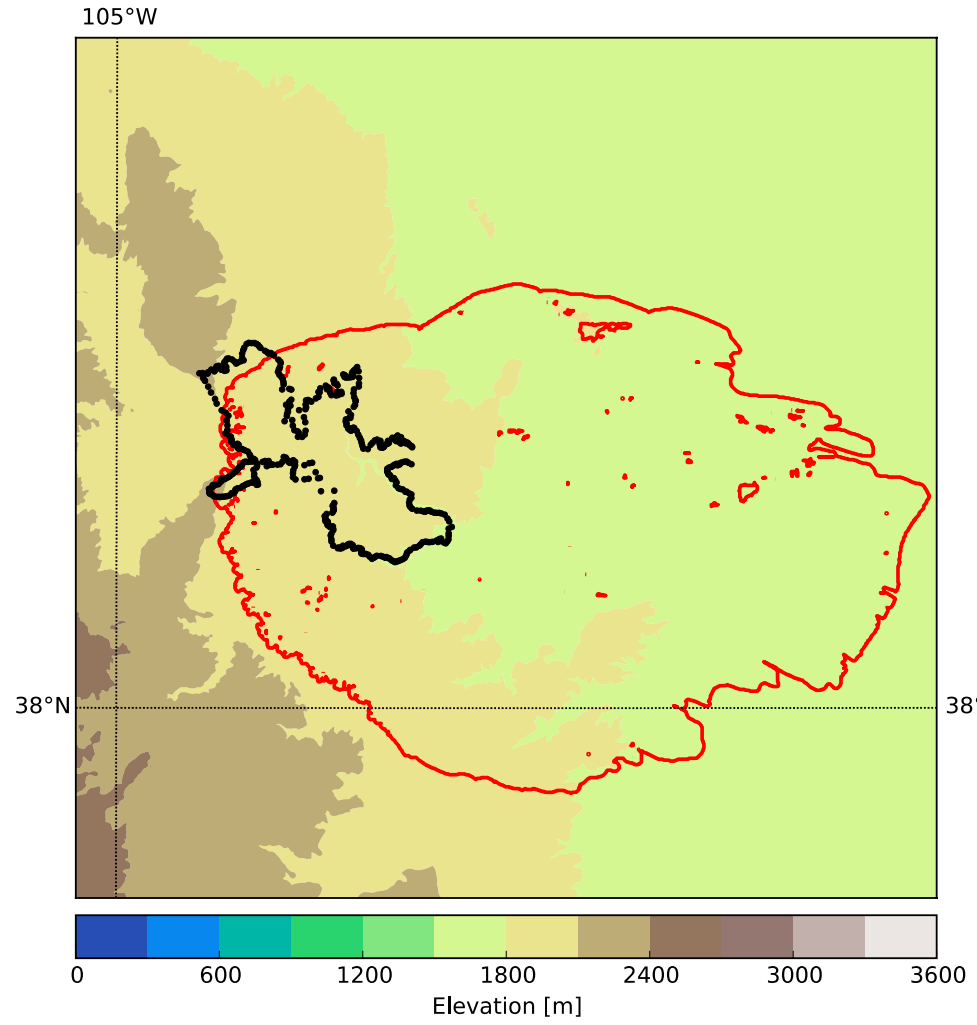


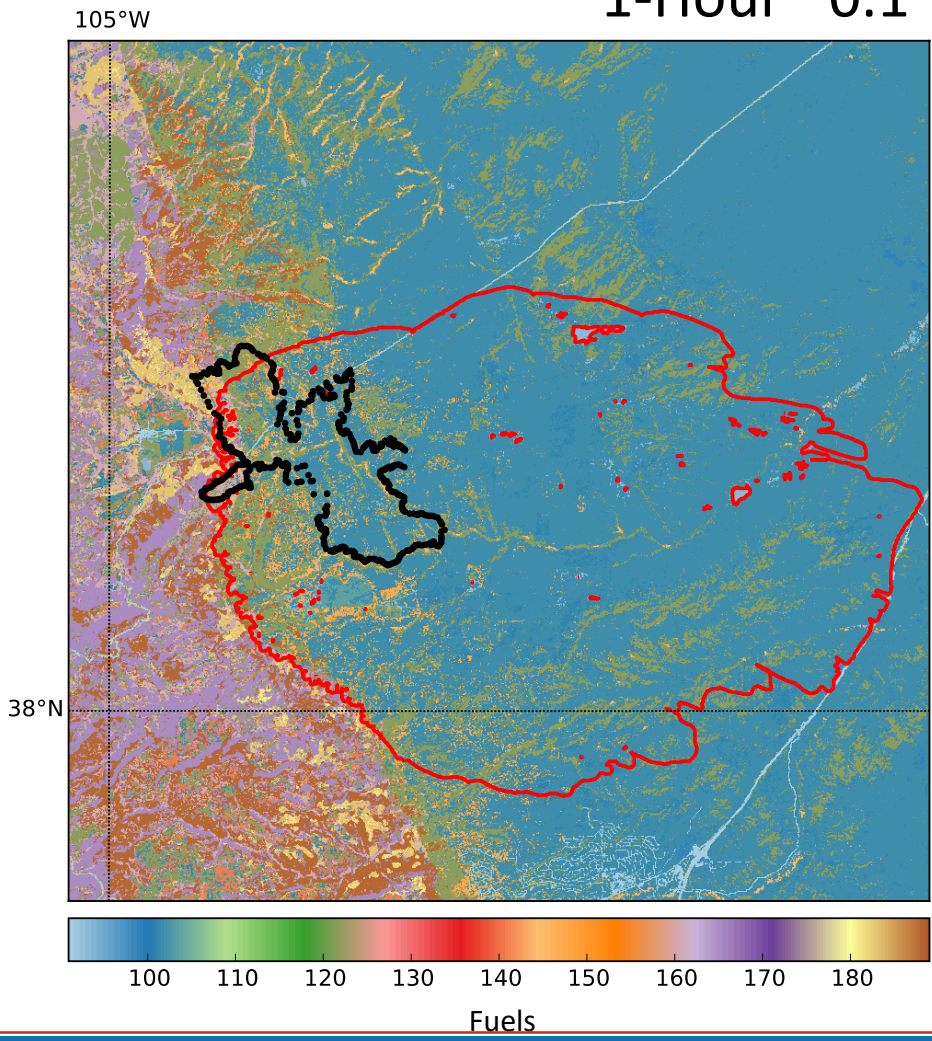


Beulah Hill Fire

FMC = 0.08

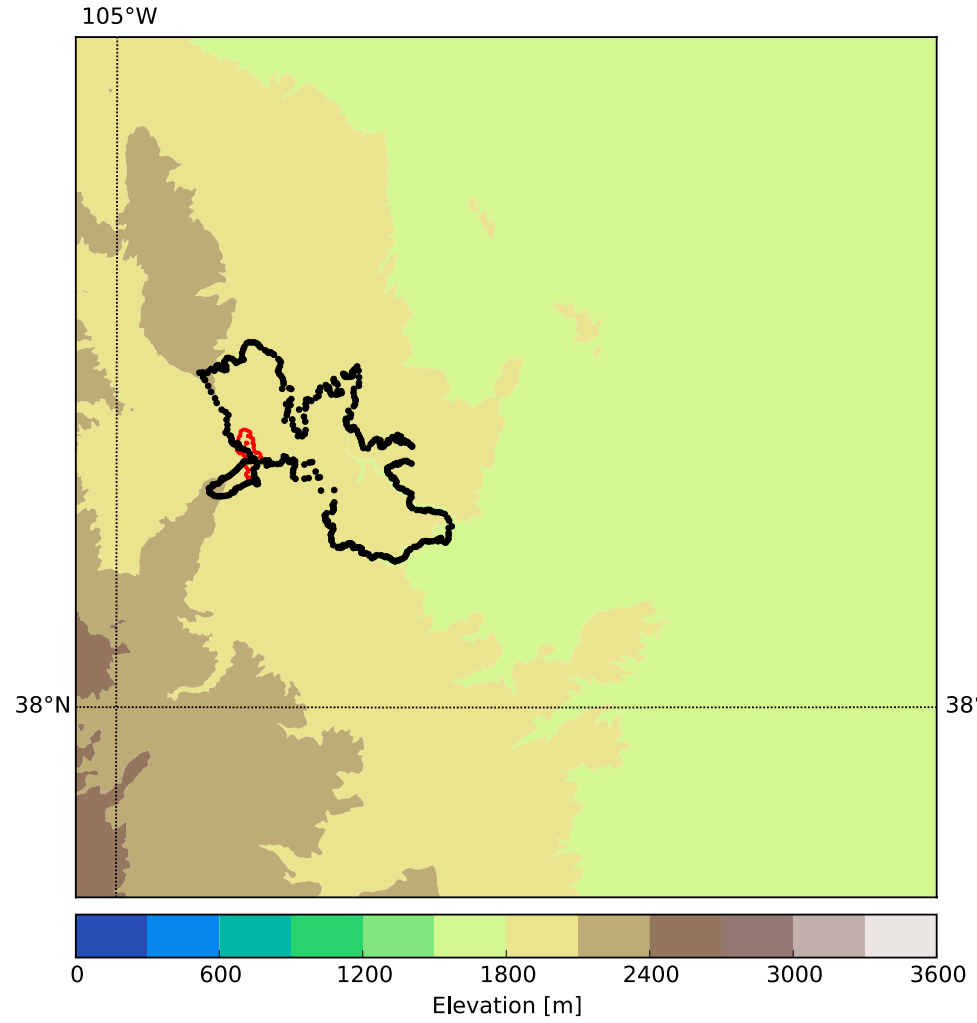
1-Hour ~0.1

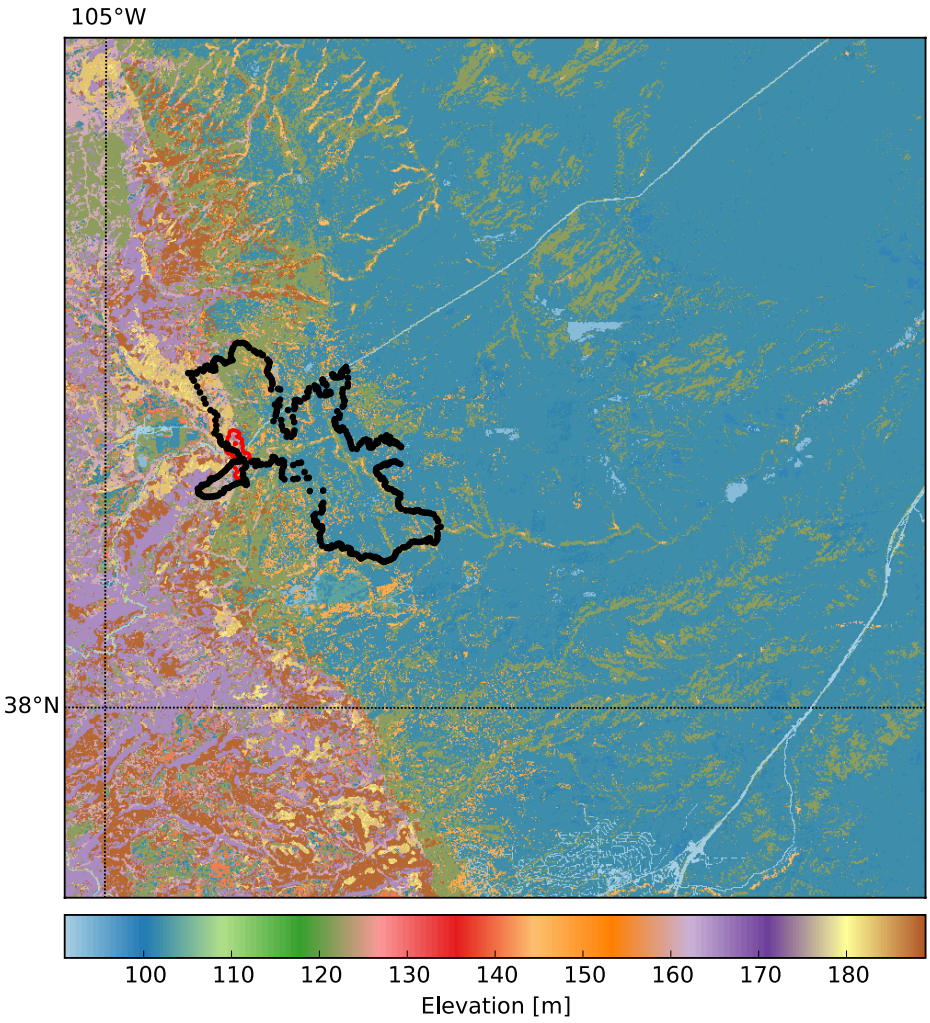




Beulah Hill Fire

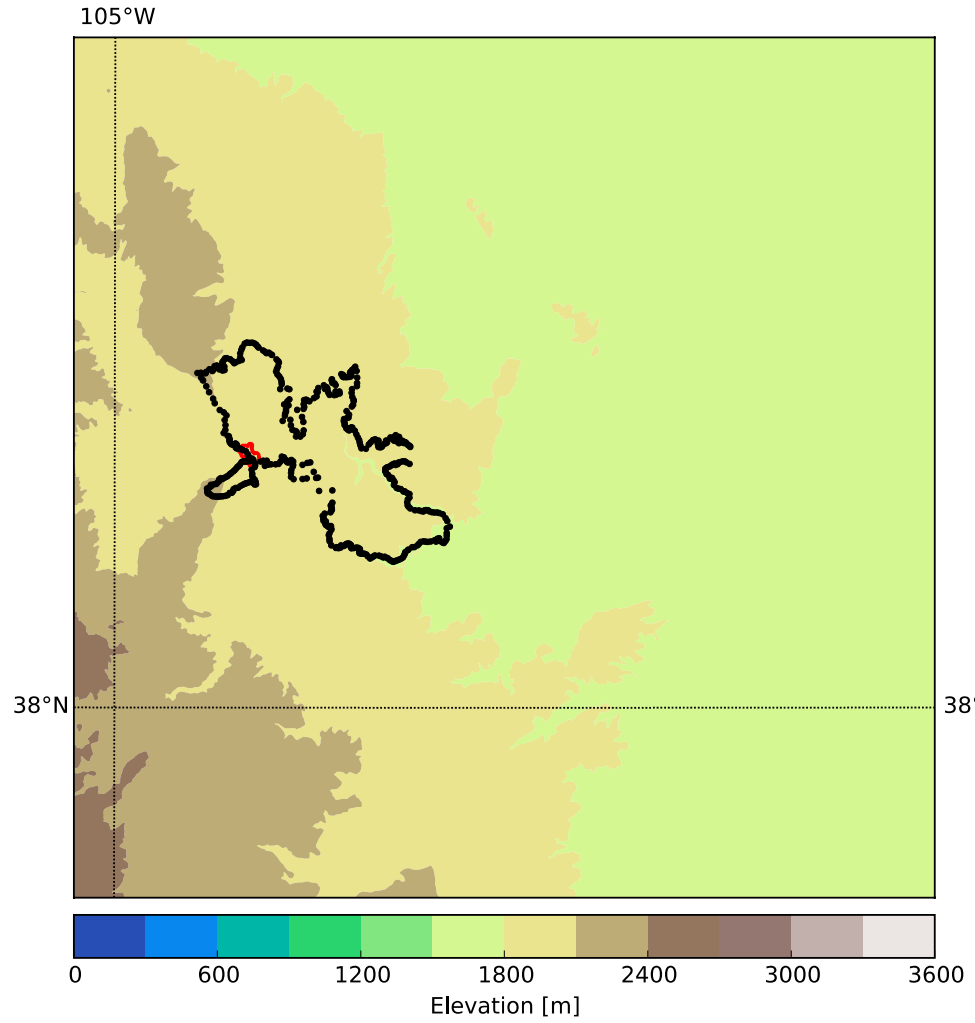
FMC = 0.16

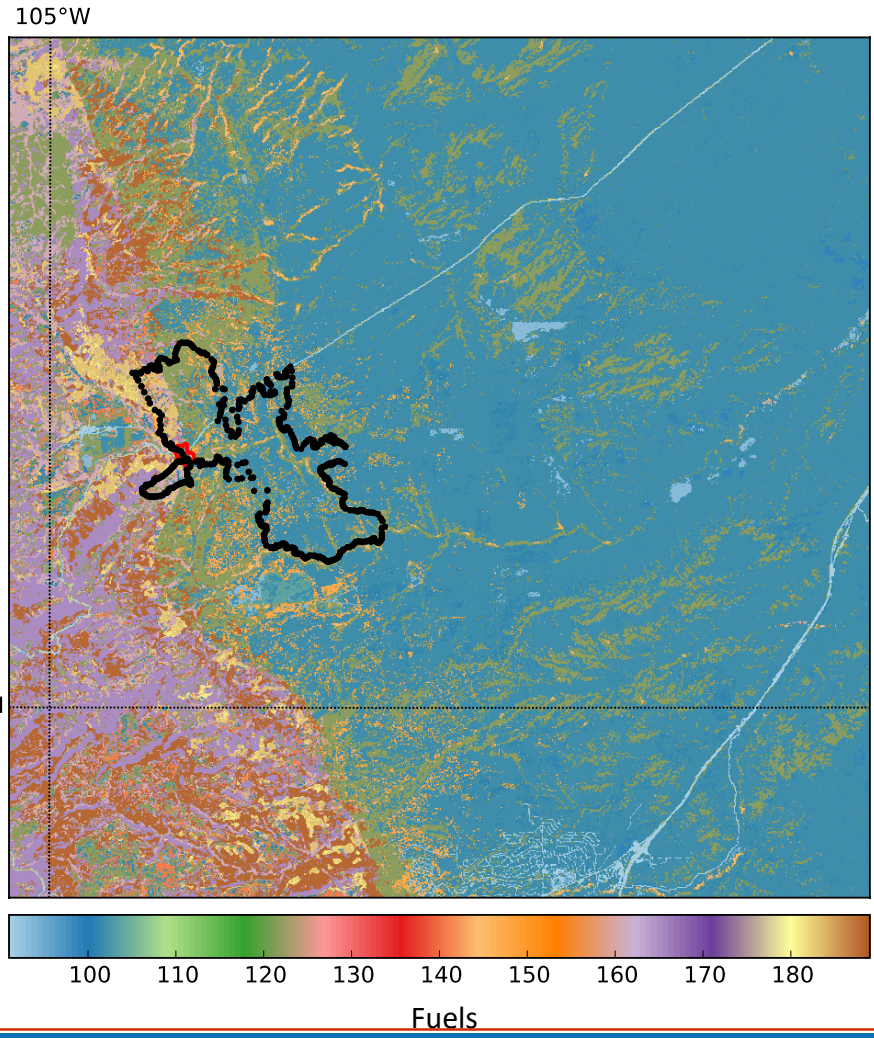




Beulah Hill Fire

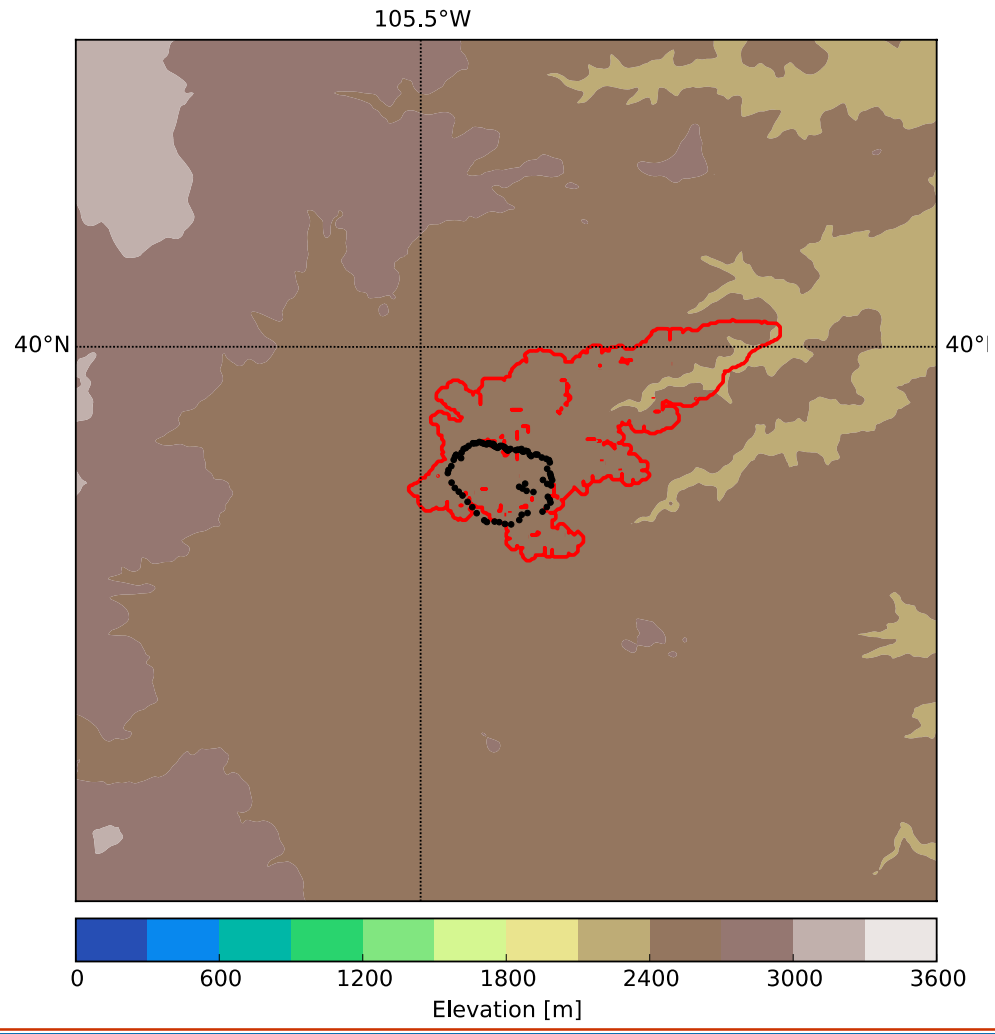
FMC = 0.22

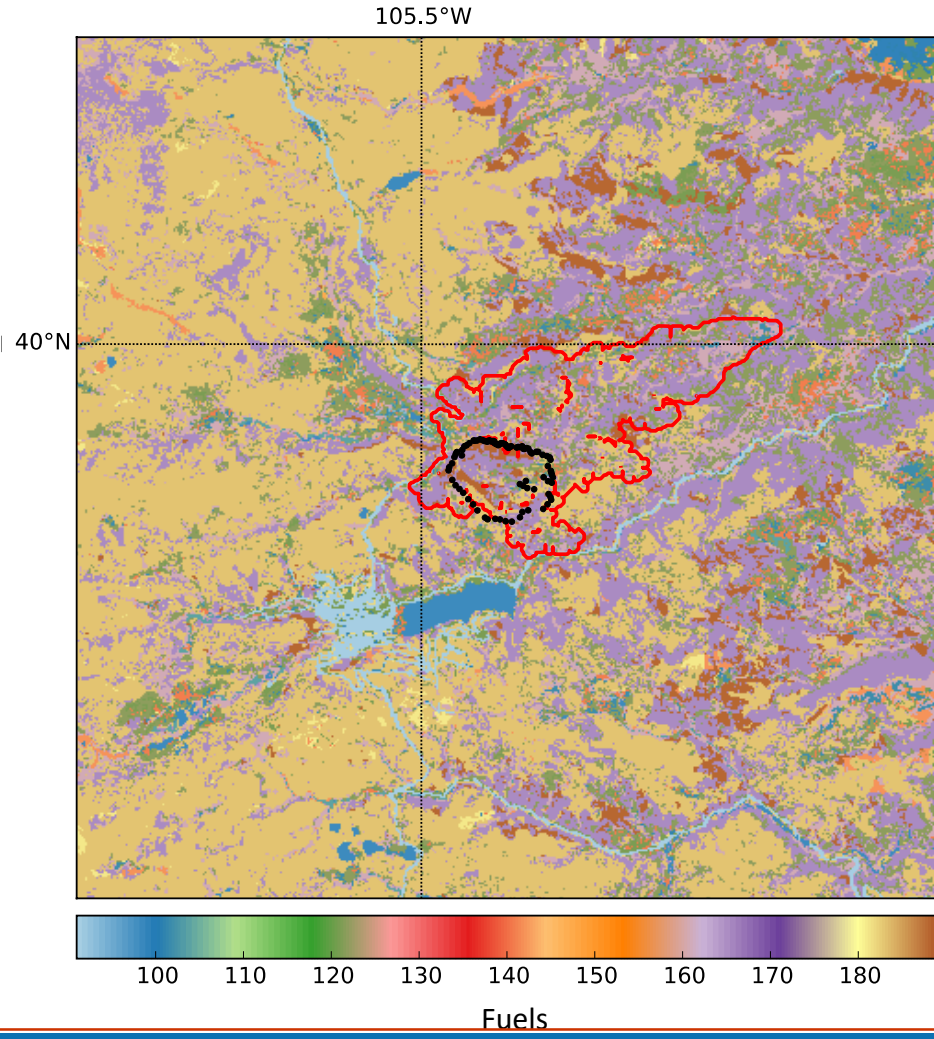




Cold Springs

FMC = 0.02

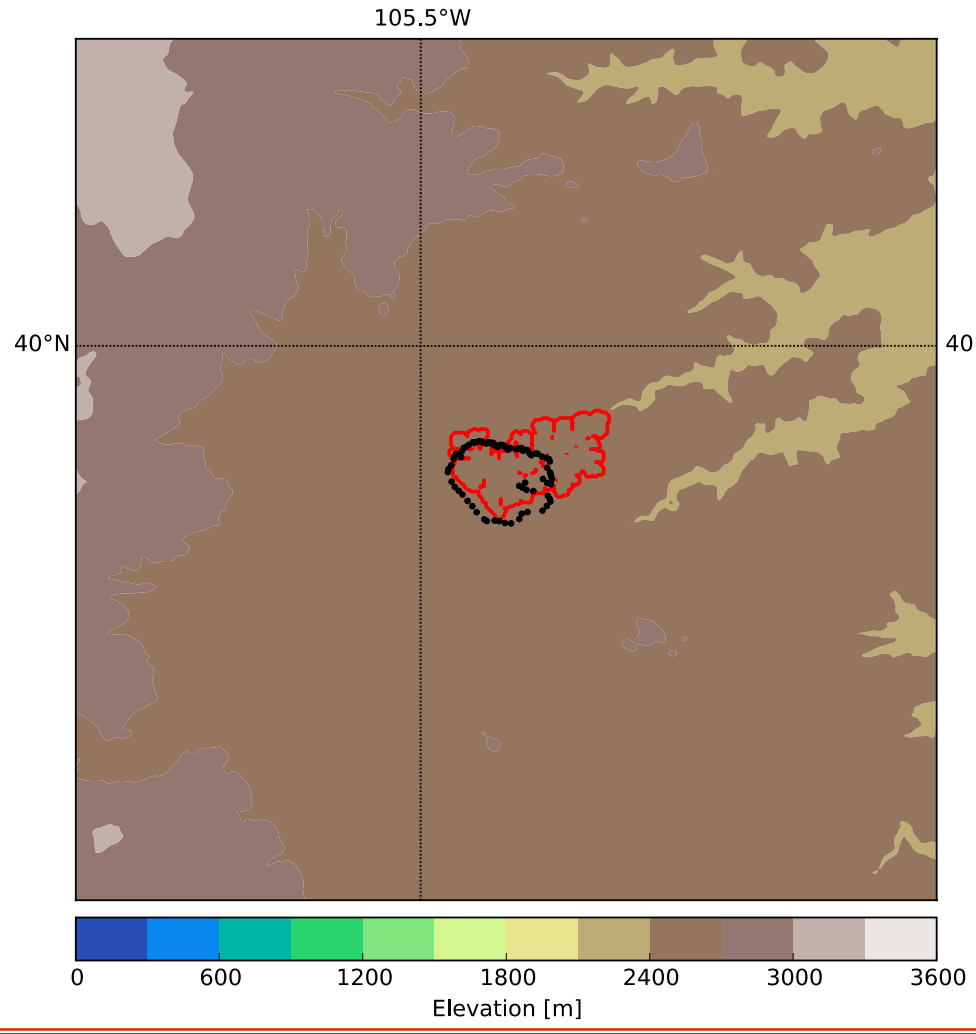


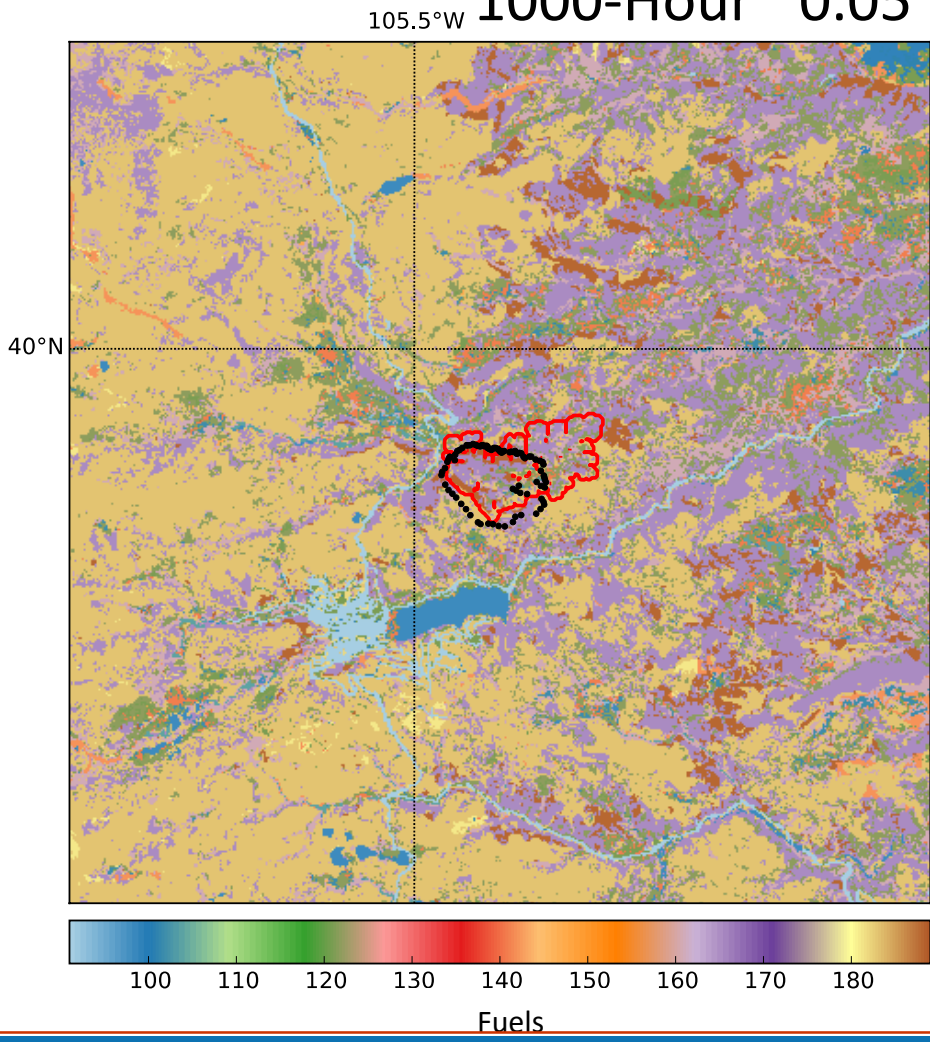


Cold Springs

FMC = 0.08

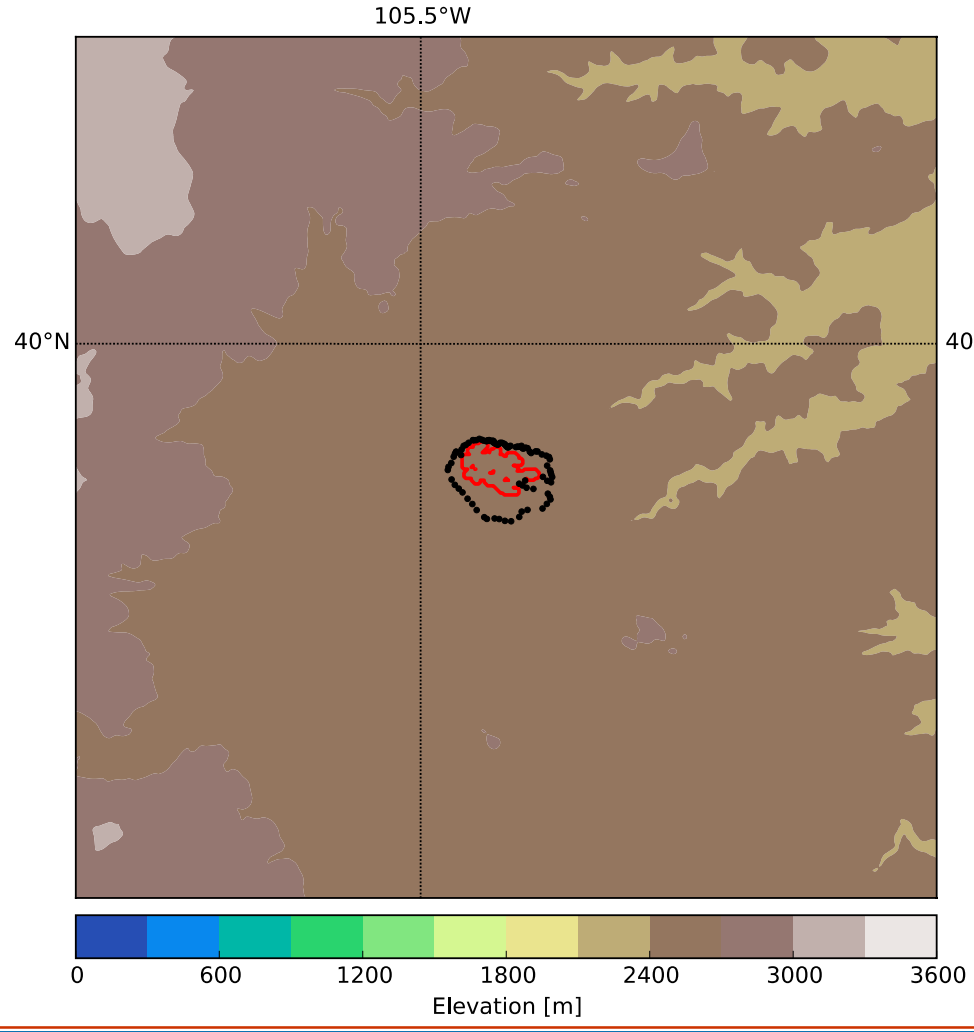
1000-Hour ~0.05

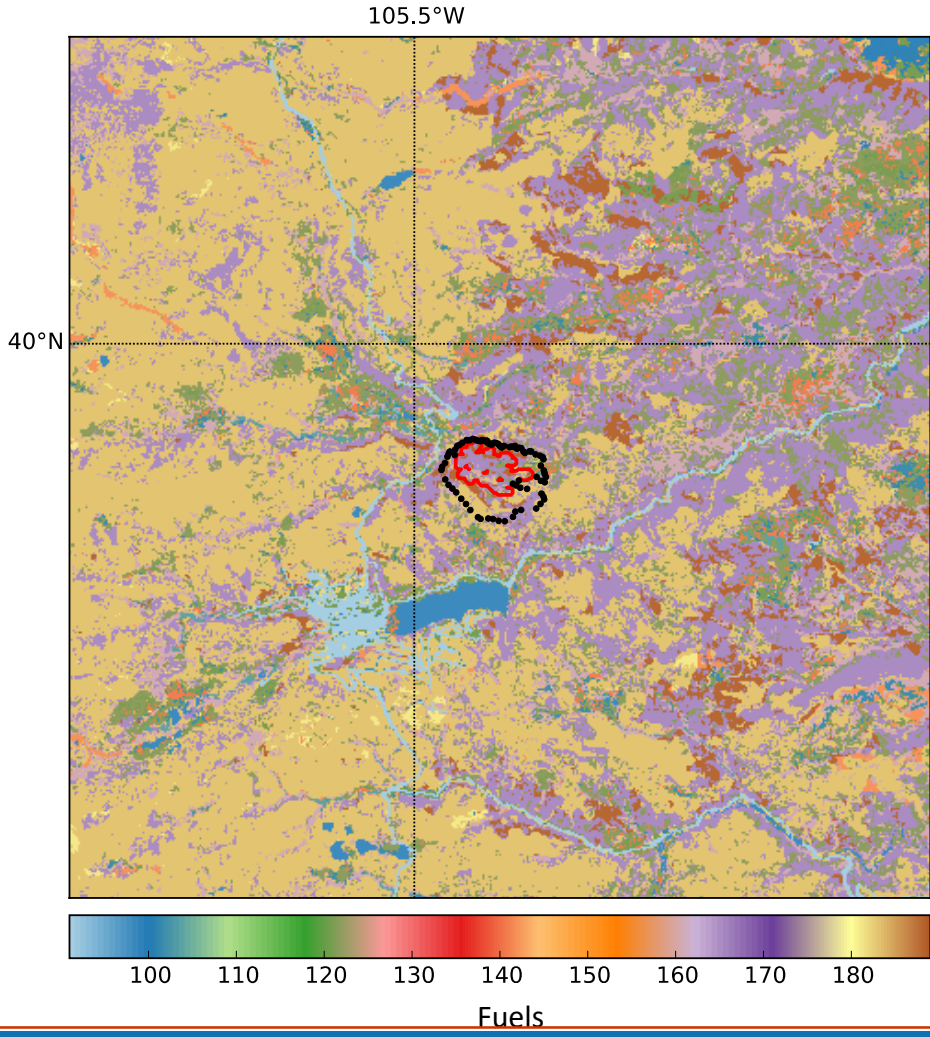




Cold Springs

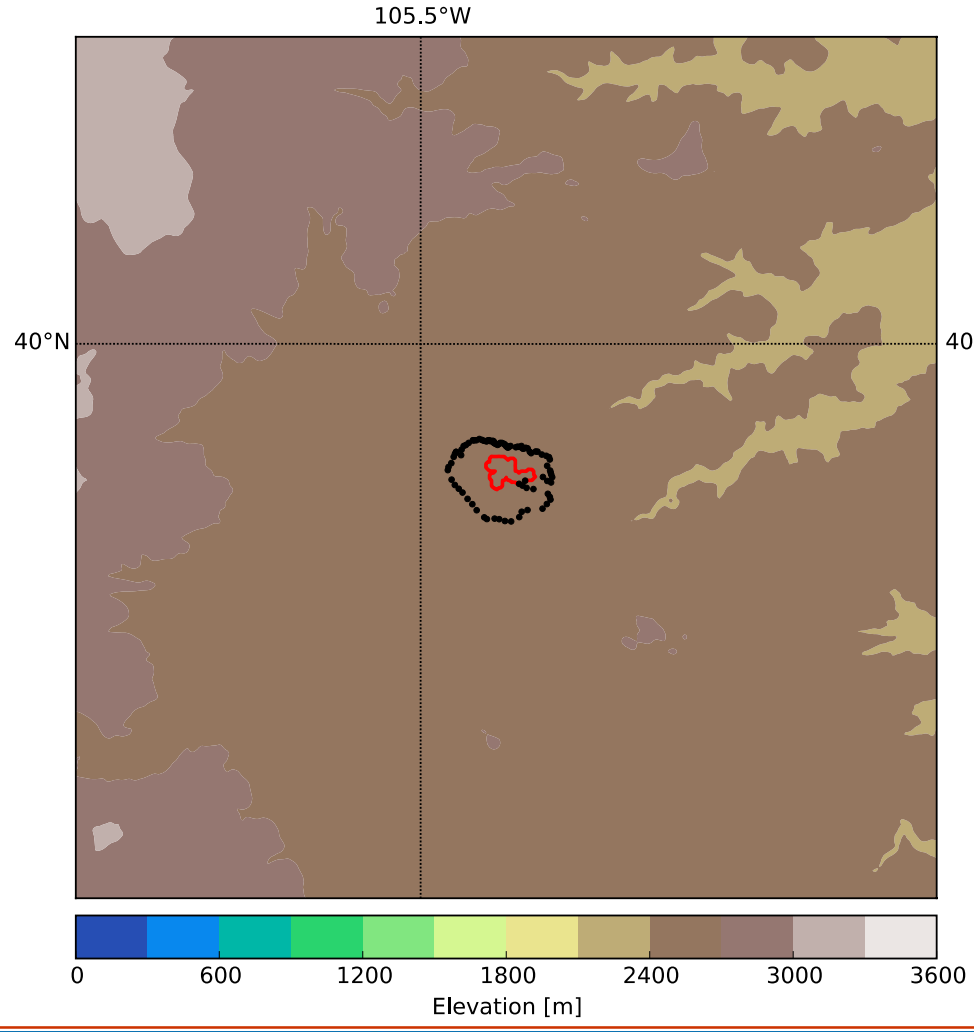
FMC = 0.16

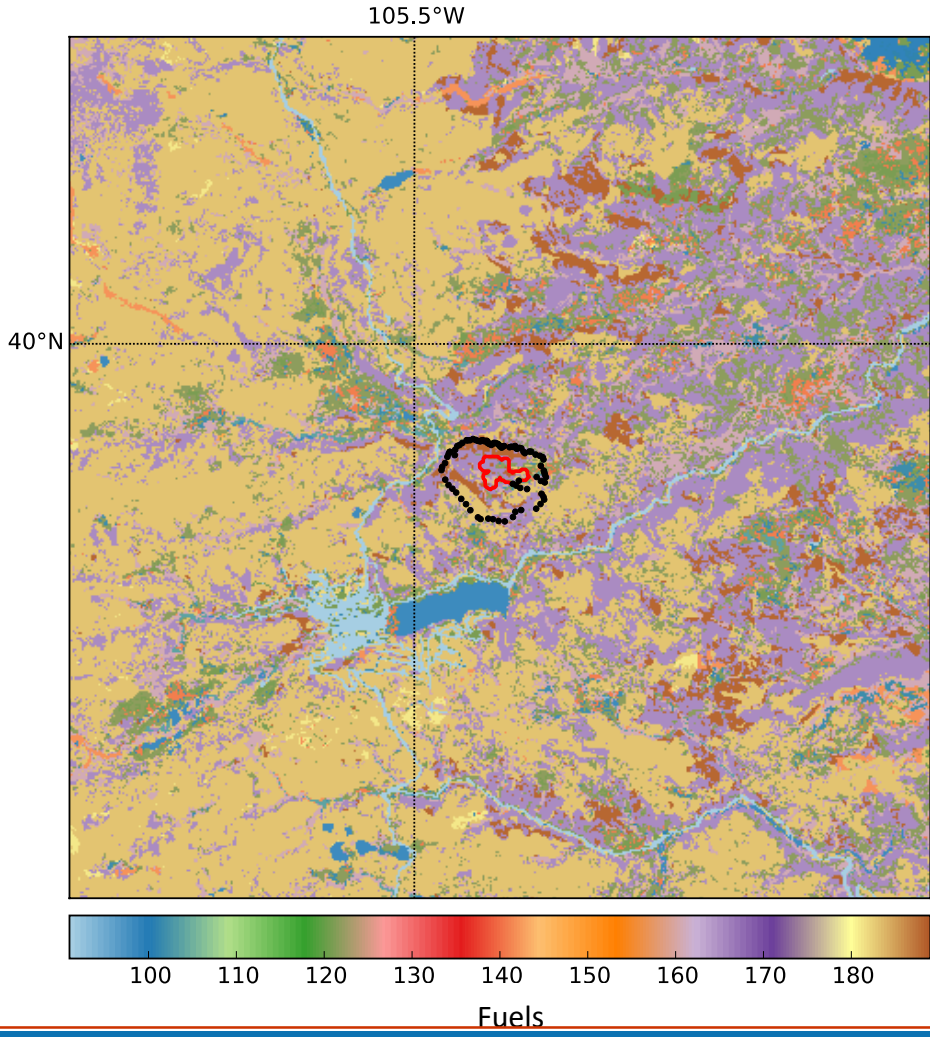




Cold Springs

FMC = 0.22

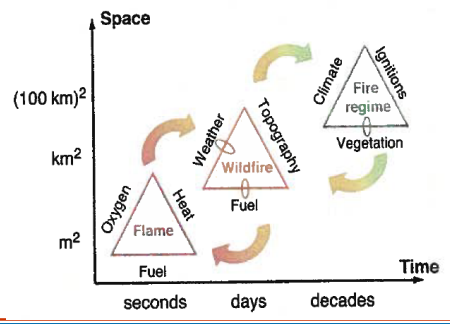




Real-Time High-Resolution Fuel Moisture Content from Satellite Data

(NASA AIST Funded Project)

- Develop, implement, and demonstrate dynamic, real-time Fuel Mositure Content (FMC) database in WRF-Fire coupled atmosphere wildland fire prediction model (a component of CO-FPS).
- Achieve more accurate accounting for live and dead FMC that will result in more realistic, dynamic representation of fuel heterogeneity and in improved accuracy of wildland fire spread prediction.
- Assess the effectiveness of the coupled atmosphere wildland fire spread prediction model accounting for the FMC in collaboration with the Center for Excellence for Advanced Technology Aerial Firefighting using observations of wildland fires over Colorado.

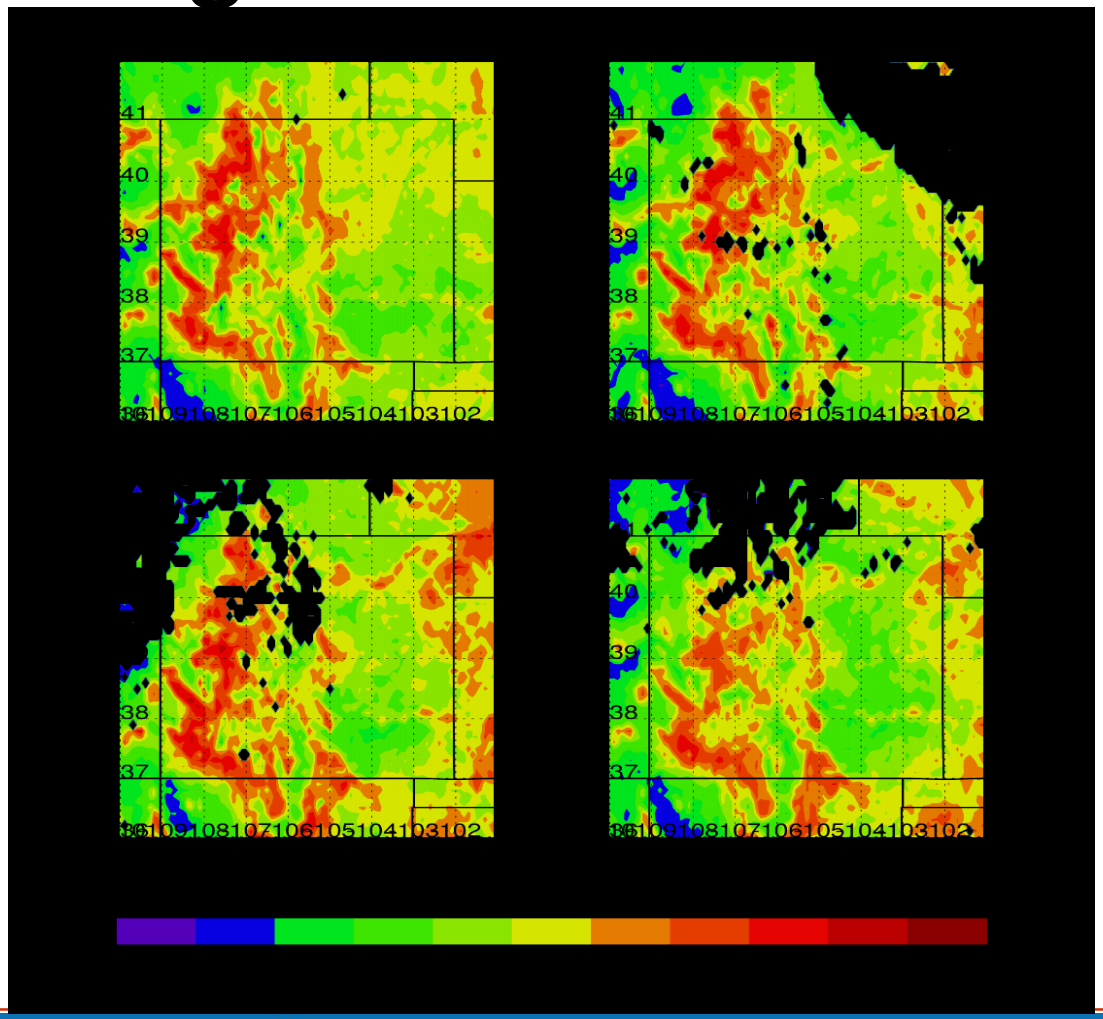


Real-Time High-Resolution Fuel Moisture Content from Satellite Data

(NASA AIST Funded Project)

- Accurate information about FMC is essential for more accurate wildland fire spread prediction.
- The National Fuel Moisture Database (available via the Wildland Fire Assessment System) provides sporadically updated information about FMC based on interpolating of sparse manual sampling and surface observations from Remote Automated Weather Stations (RAWS)
- FMC data that is not up to date, or not representative of local environment can result in large errors when applied to an operational system
- We will develop a dynamic, gridded FMC data set that can be assimilated in real-time in the operational system does not exist.

MODIS – Normalized Difference Vegetation Index

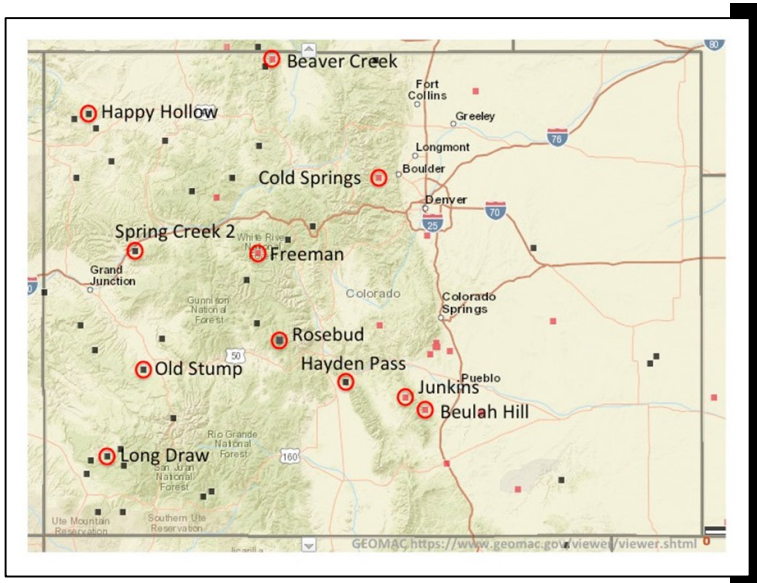


Red-yellow pattern is related to elevation (and its associated types of vegetation)

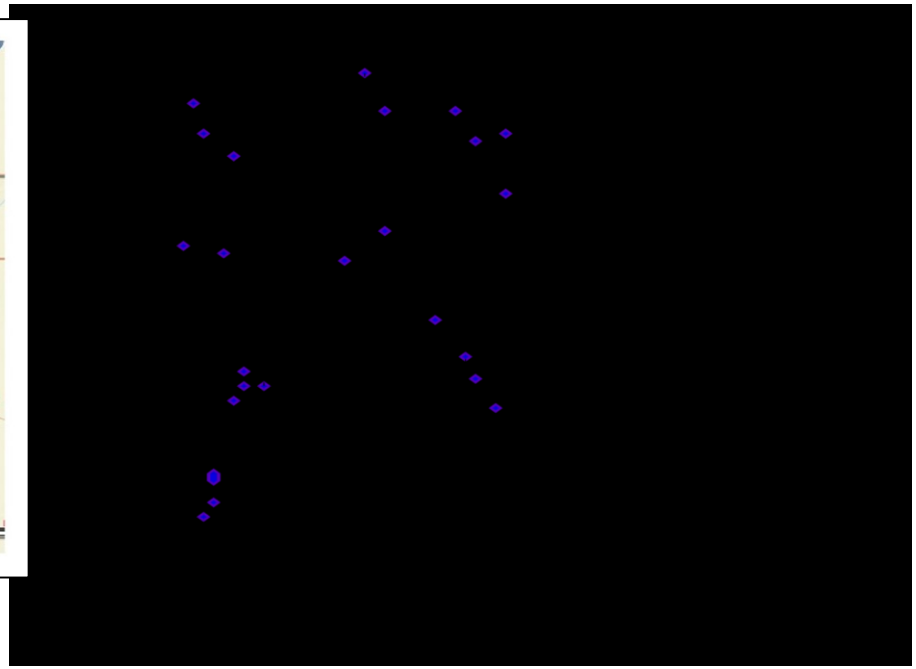
White areas indicate clouds

Satellite Observations Will Be Calibrated Using Surface Observations From NFMD

Selected Colorado Wildfires 2016



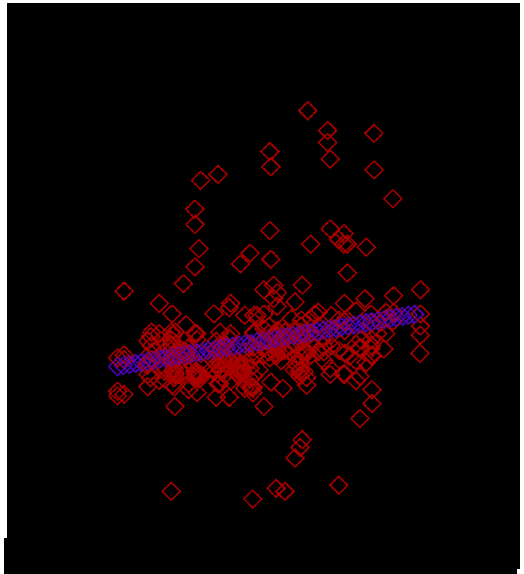
Selected NFMD Sites



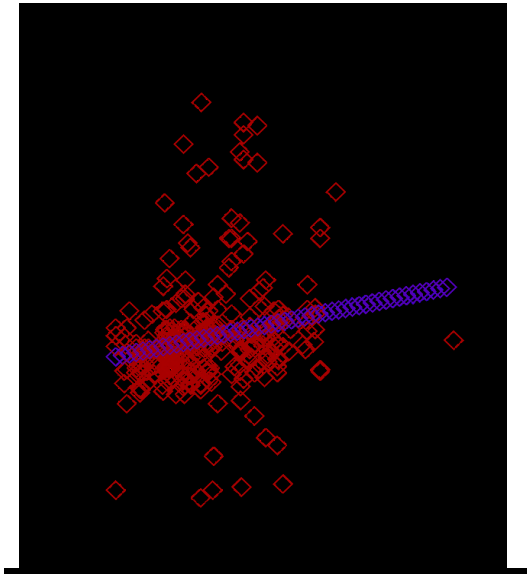
We have selected 11 wildfires that were observed in Colorado during fire season 2016.
These 11 fires will be used to assess the performance of the newly developed fuel moisture content dataset.

MODIS Derived Indices

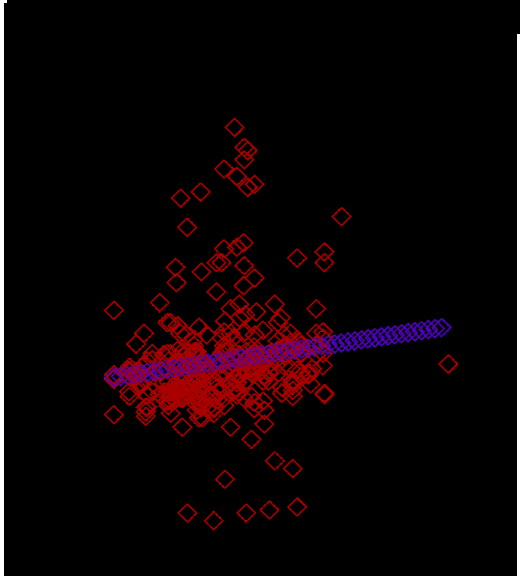
NDVI



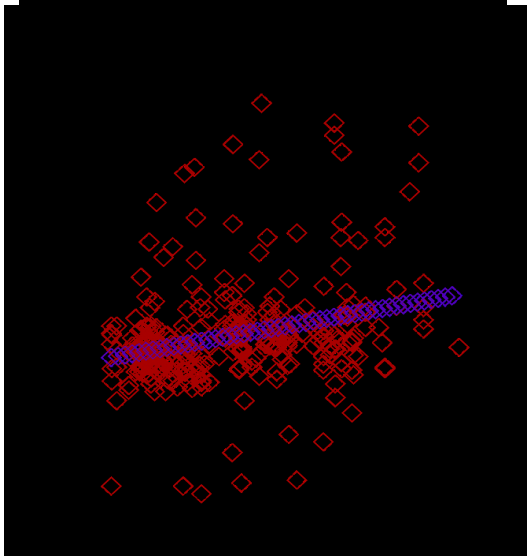
NDWI



PMI

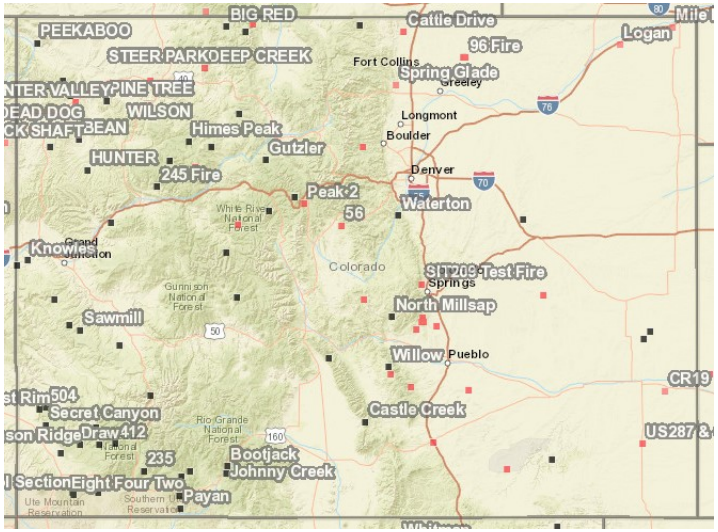


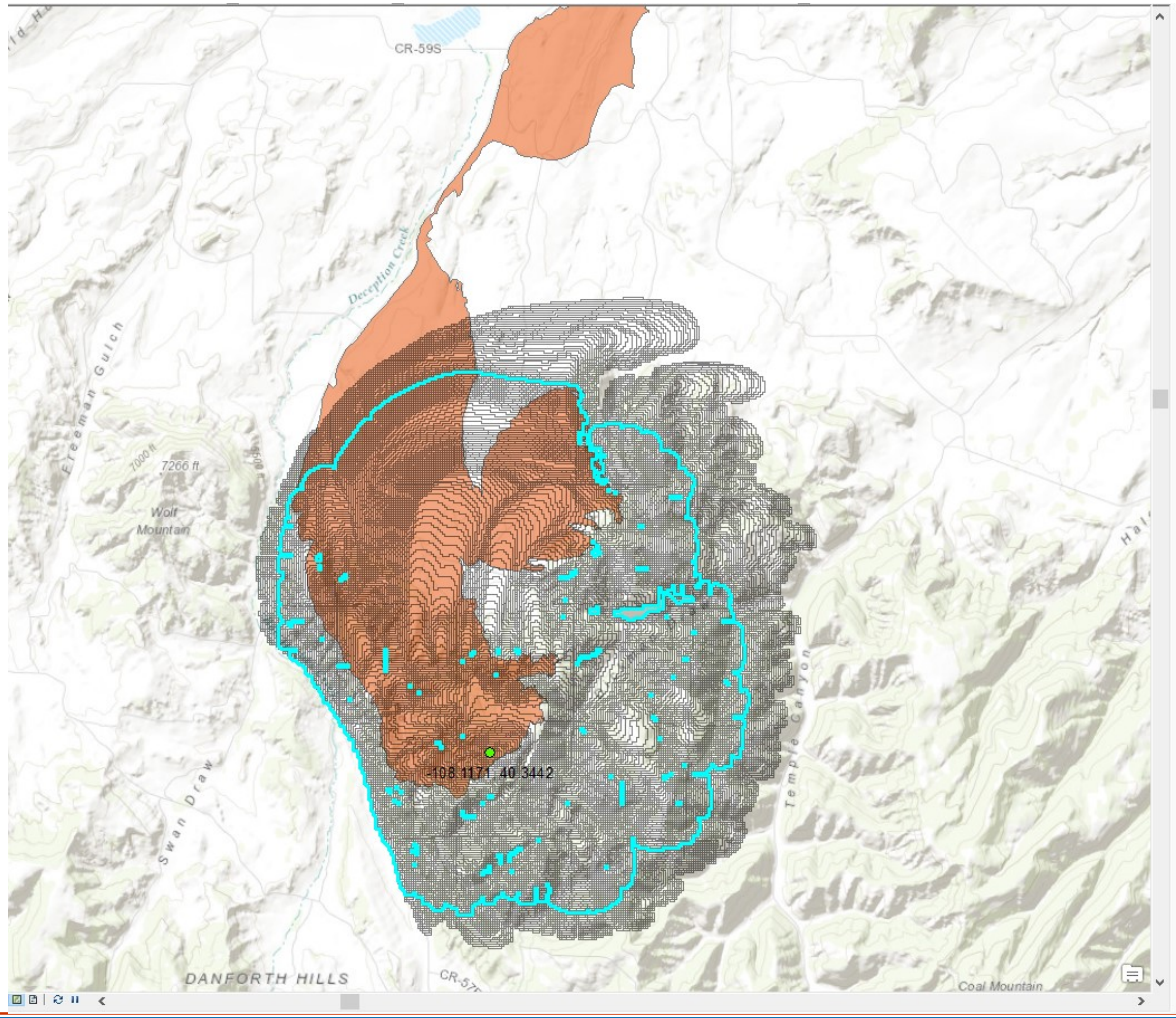
VARI



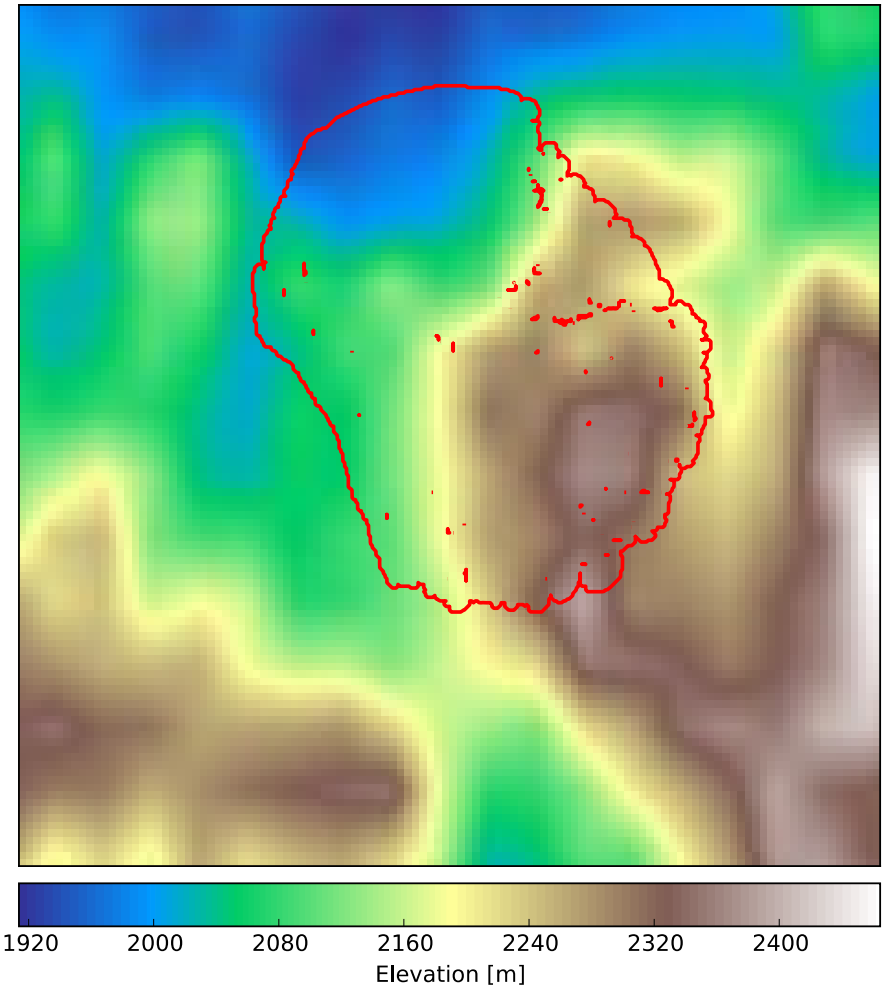
Pine Tree Fire

Latitude: 40.3442
Longitude: -108.1171
Discovery Date: 9/9/2017
3:59:00 PM UTC

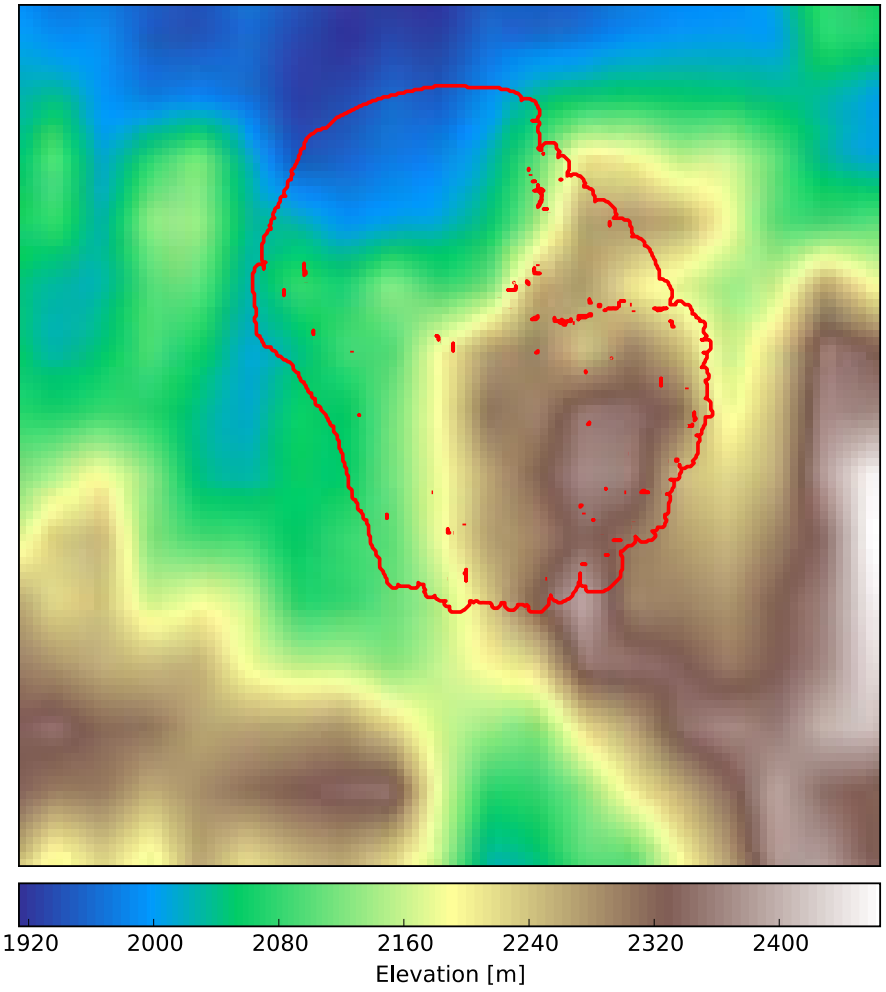


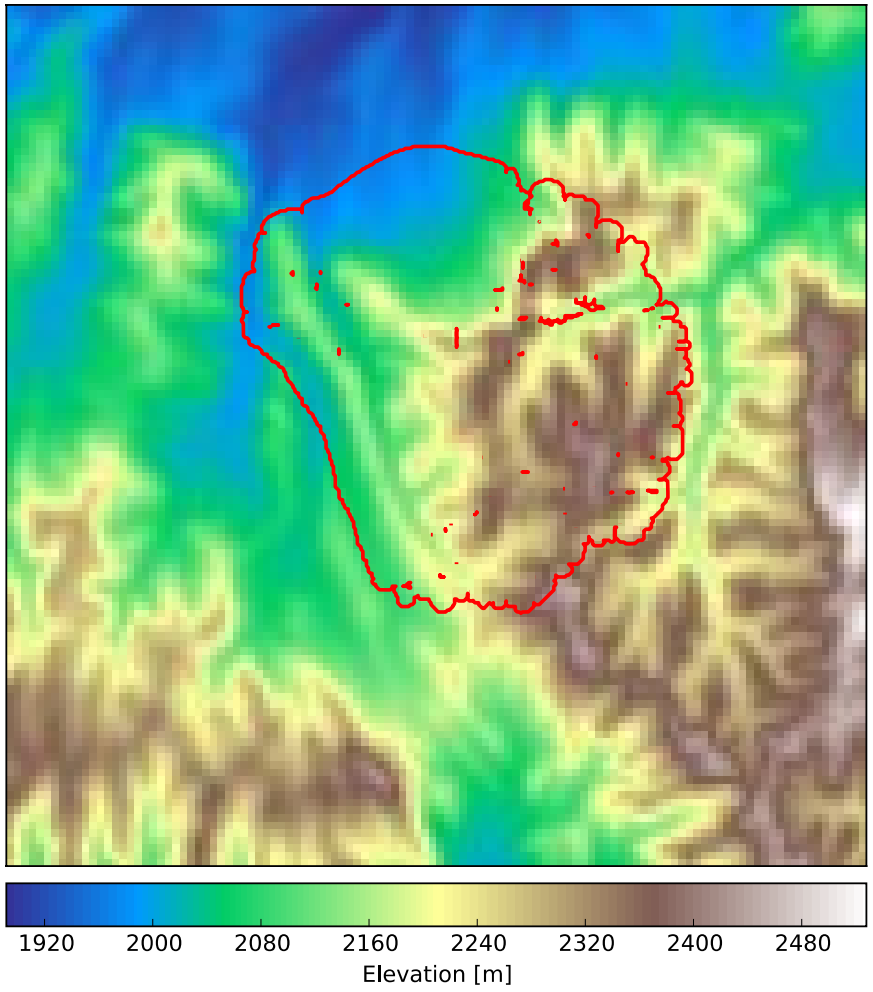


Pine Tree Fire – Terrain Resolution

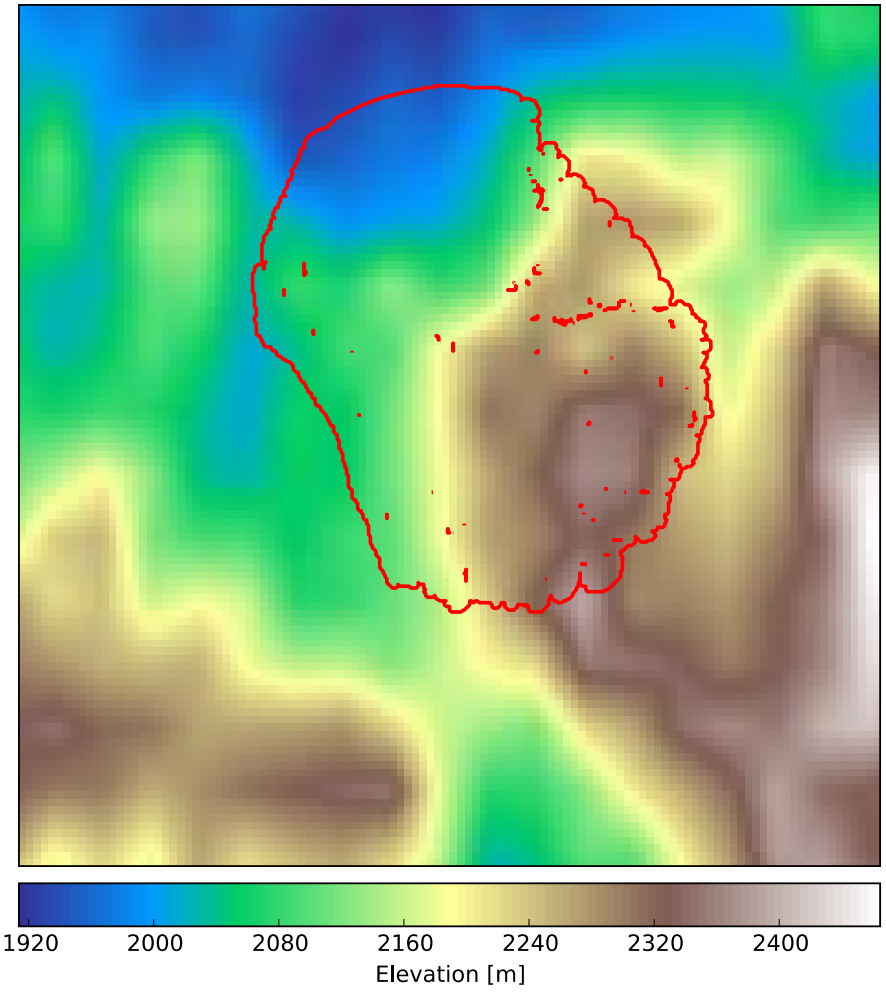


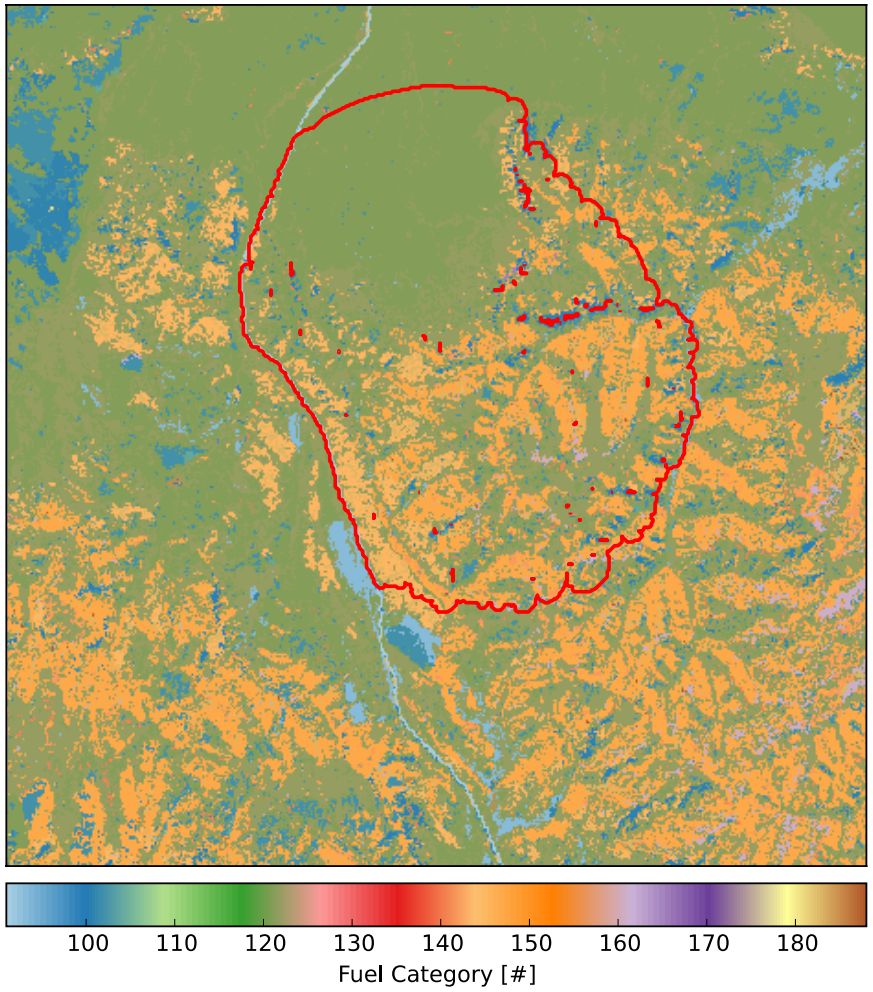
Pine Tree Fire – Terrain Resolution



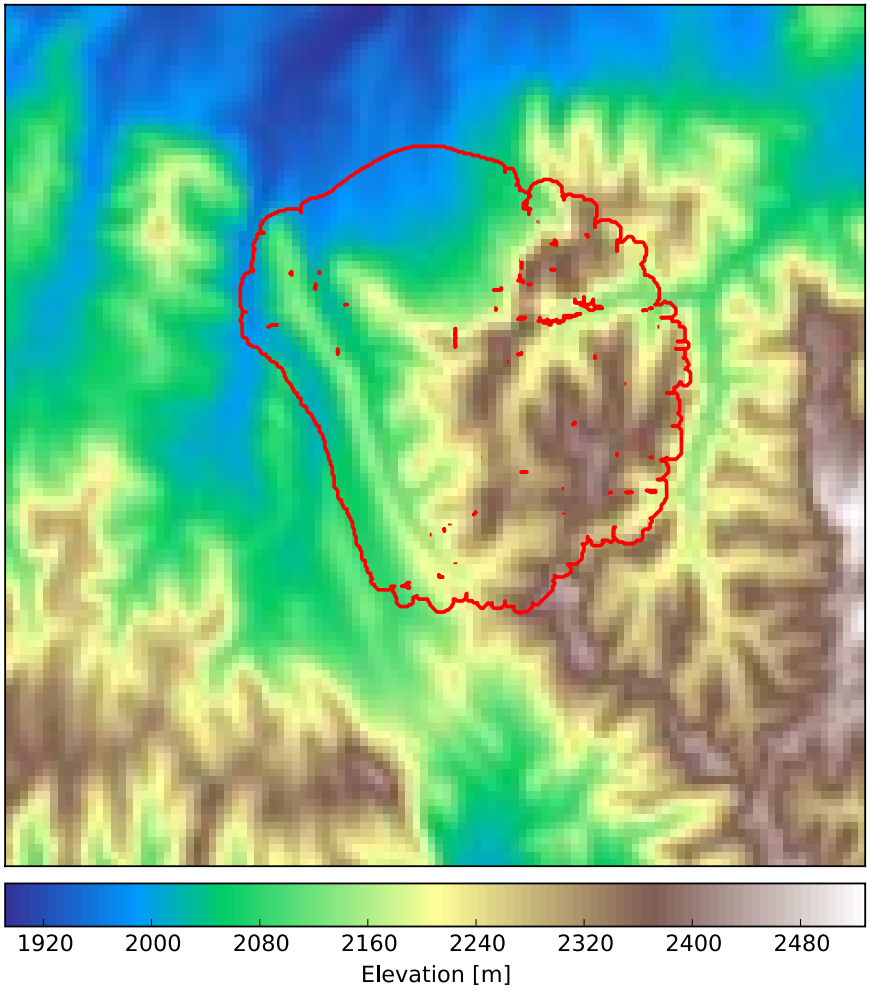


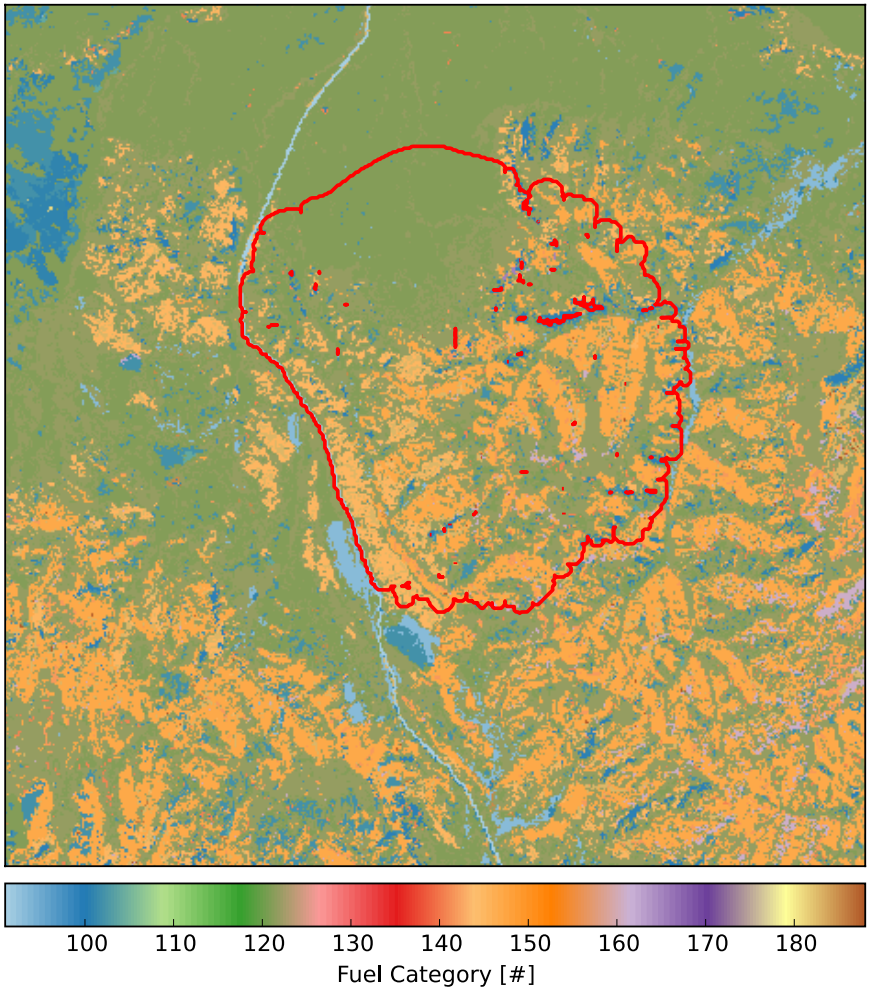
Pine Tree Fire – Terrain Resolution



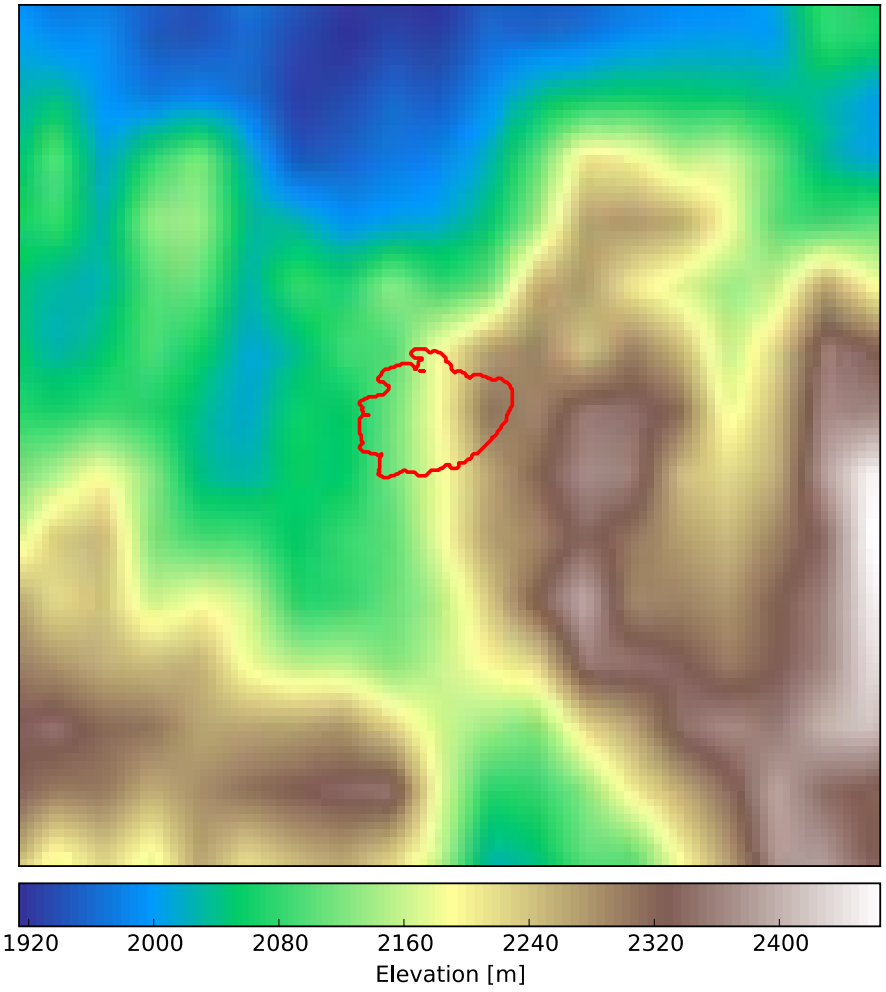


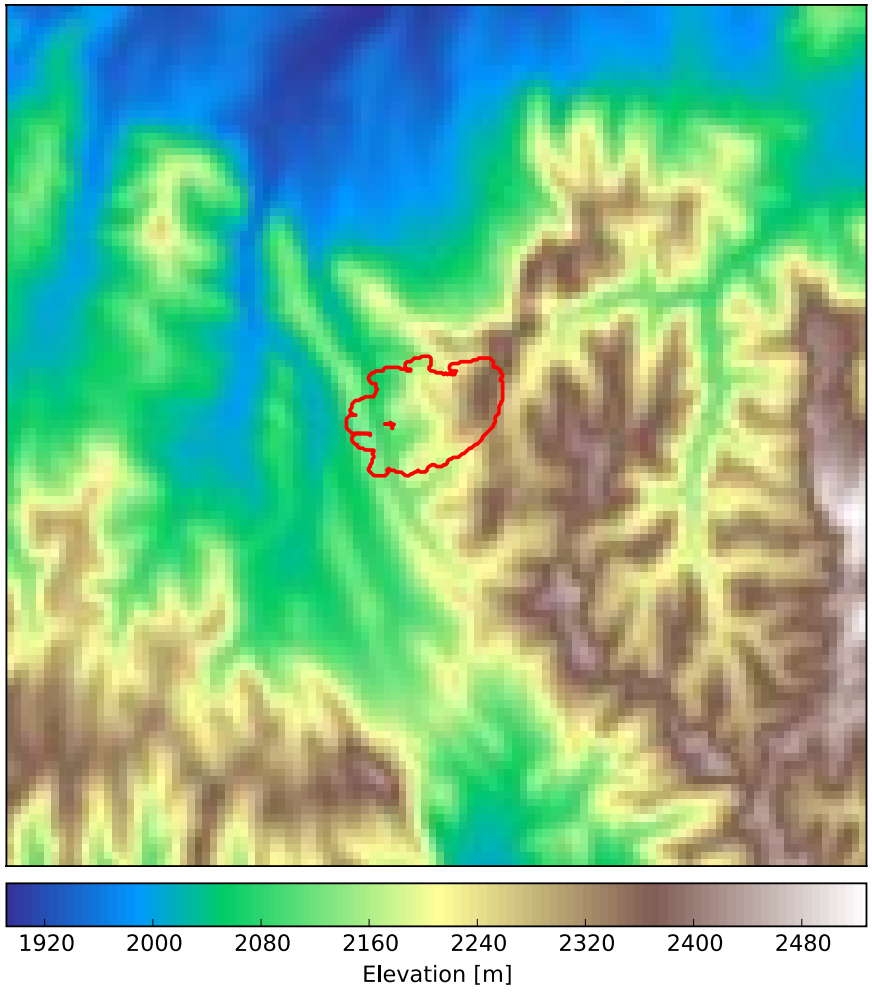
Pine Tree Fire – Terrain Resolution



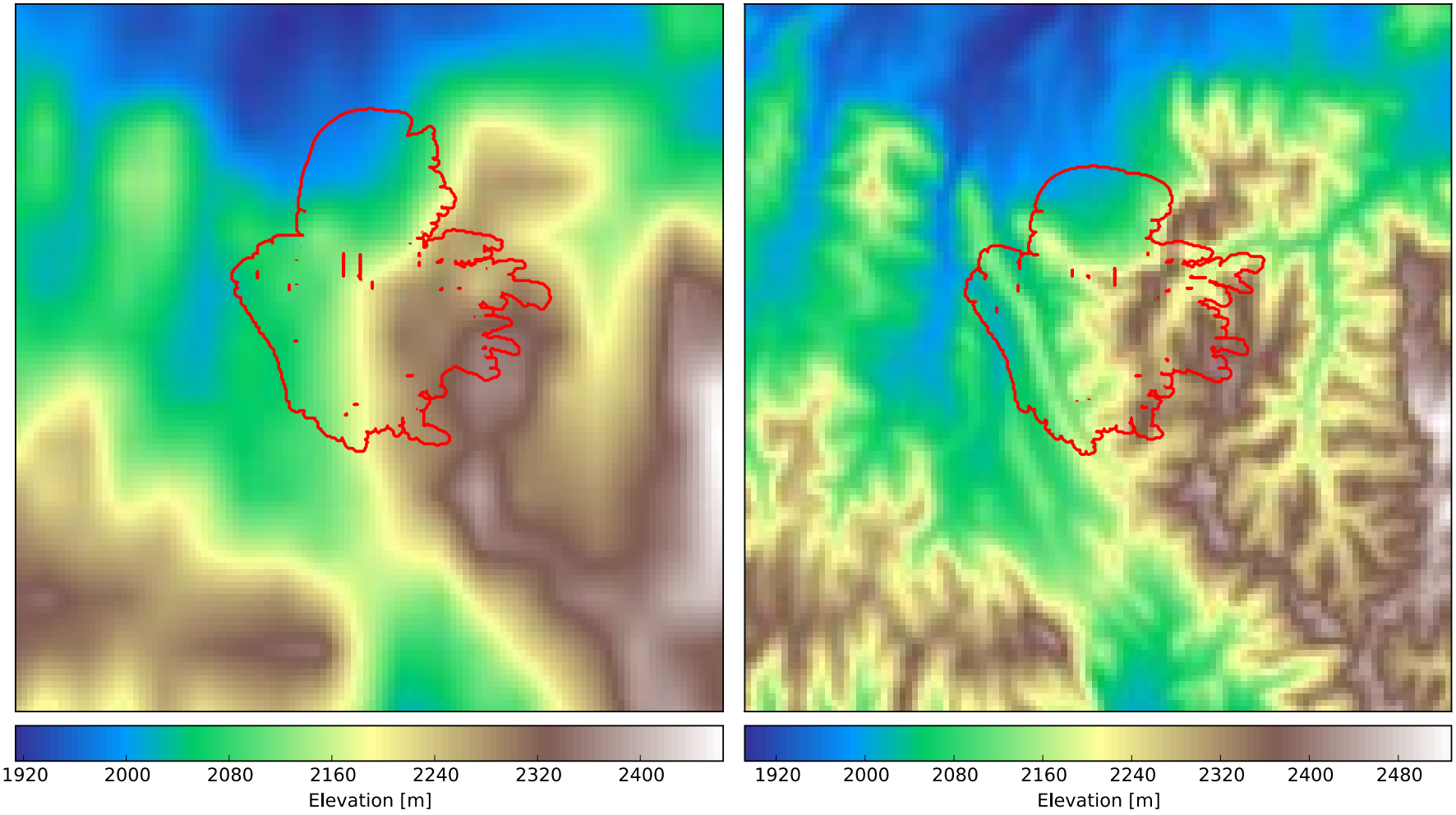


Pine Tree Fire – 4 hours





Pine Tree Fire – 10 hours



Fire Spread Model Sensitivity to Fuel Moisture and Terrain Resolution

- As expected fire spread model exhibits significant sensitivity to dead fuel moisture
- Accuracy of fuel type distribution could affect the sensitivity to fuel moisture
- Accuracy of fuel type is difficult to assess
- Fire spread model did not exhibit significant sensitivity to terrain resolution in the case of Pine Tree fire