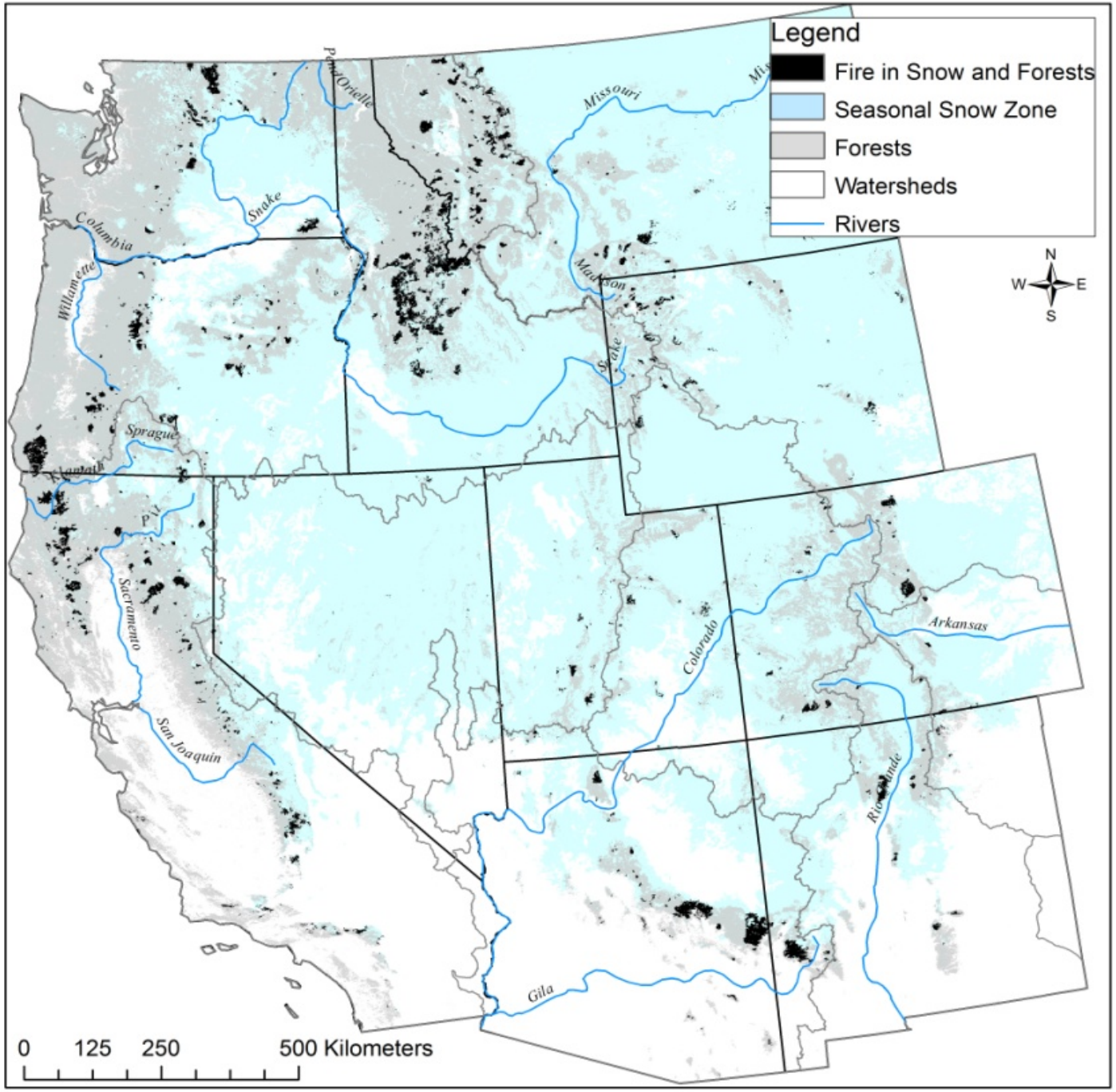
Post-wildfire summer greening depends on the previous winter's snowpack

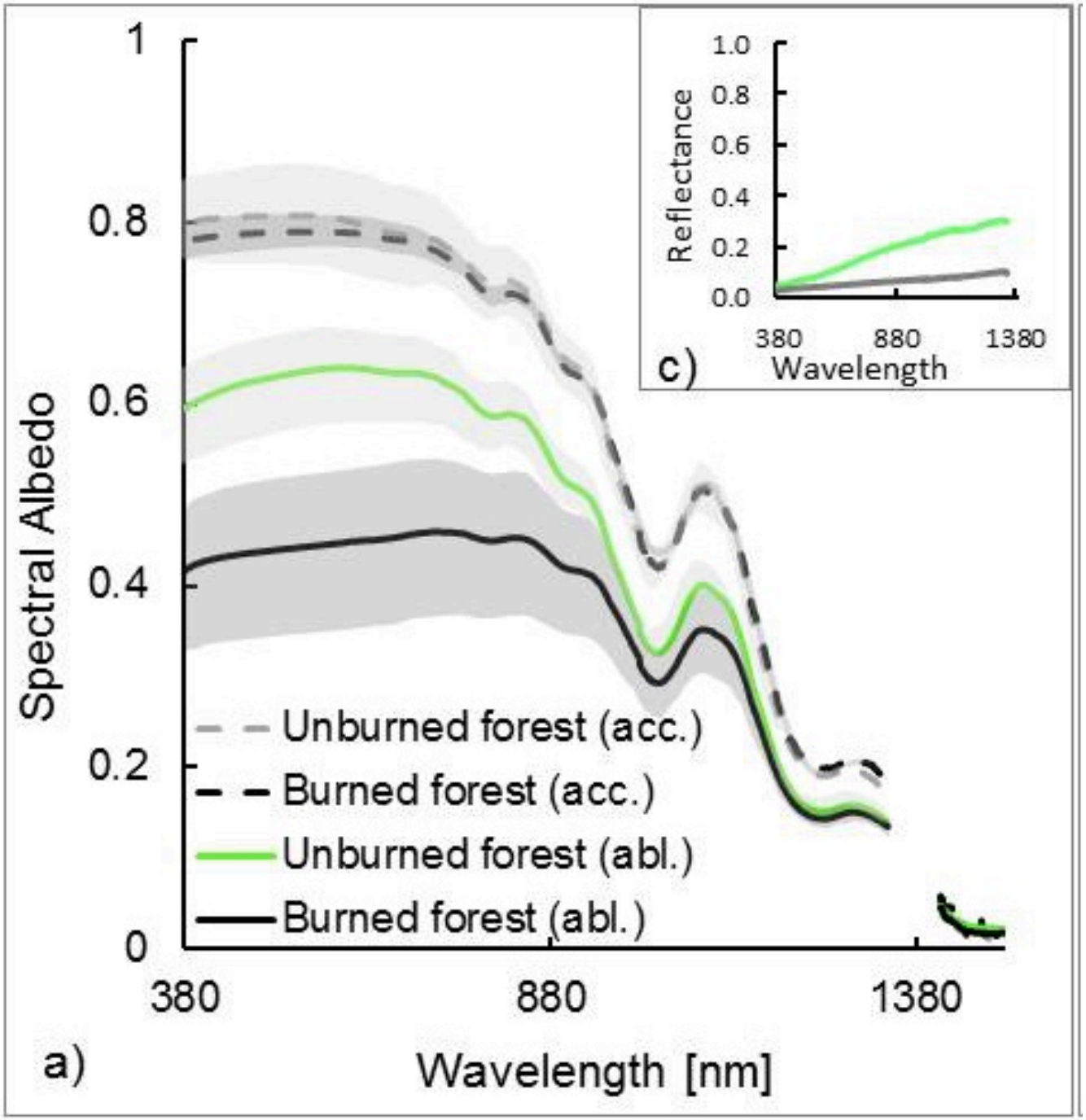
Anne Nolin
and the Mountain Hydroclimatology Research Group
Oregon State University

Wildfire is a key aspect of forests



Over 80% of forest fires in the western U.S. burned within the seasonal snow zone

Gleason et al. 2013



Burned woody debris decreases snow albedo and causes snow to melt weeks earlier than in adjacent unburned areas.

Albedo decay for forests and burned forests

Gleason et al. 2013

Gleason & Nolin 2016

How does snow affect forest health and forest (re)growth?

- Relationship between snow and summer greening (Trujillo et al. 2013)
- Relationship between snow and wildfire (Westerling et al. 2006)

Question: Does snow affect summer greening (vegetation regrowth) in the post-fire environment?

New Snow Metrics

In the absence of reliable estimates of western US SWE we have derived several new snow metrics based on daily snow cover from the Moderate Resolution Imaging Spectroradiometer (MODIS):

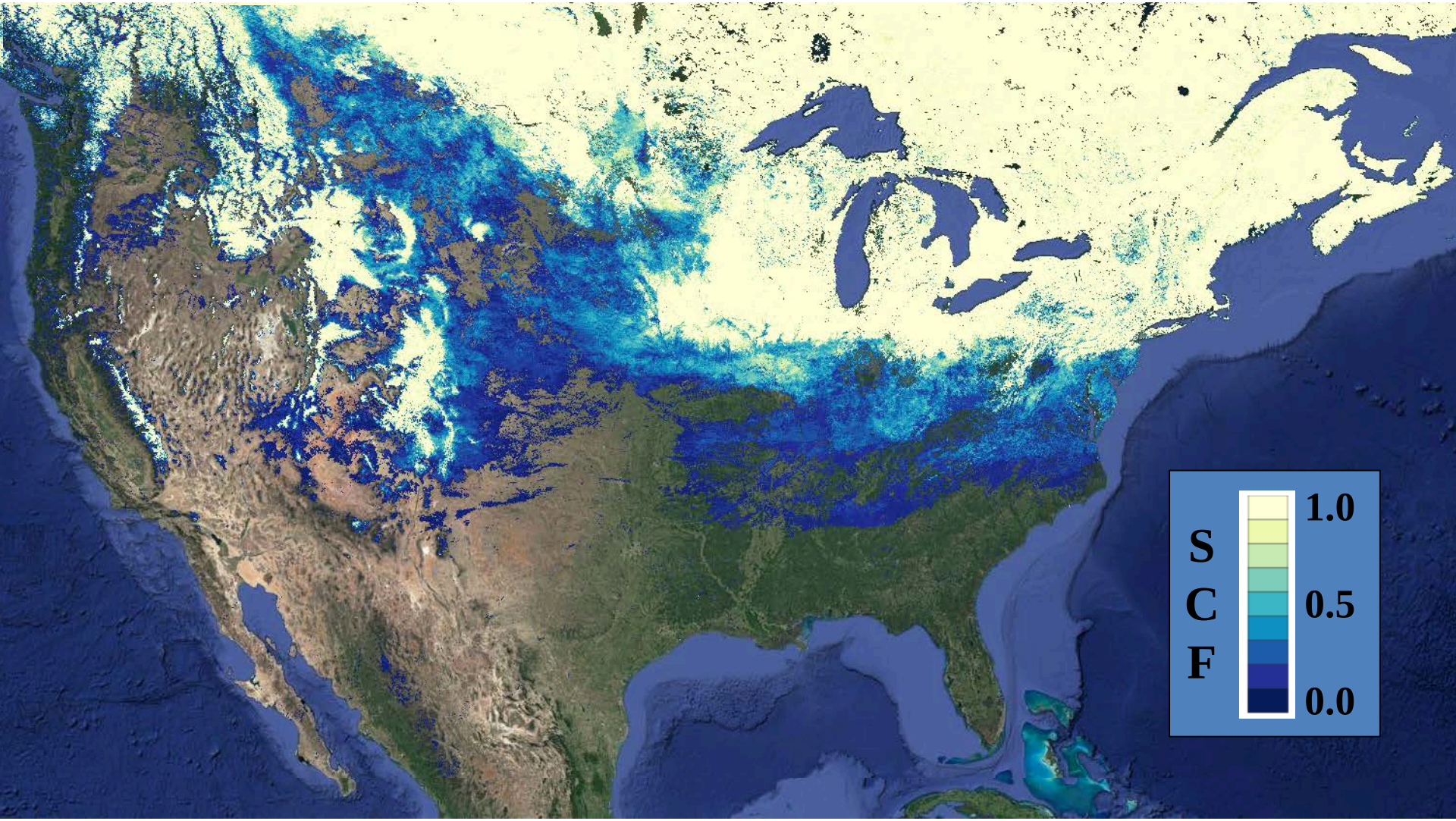
- Snow Cover Frequency
- Snow Disappearance Date
- Snow Cover Duration

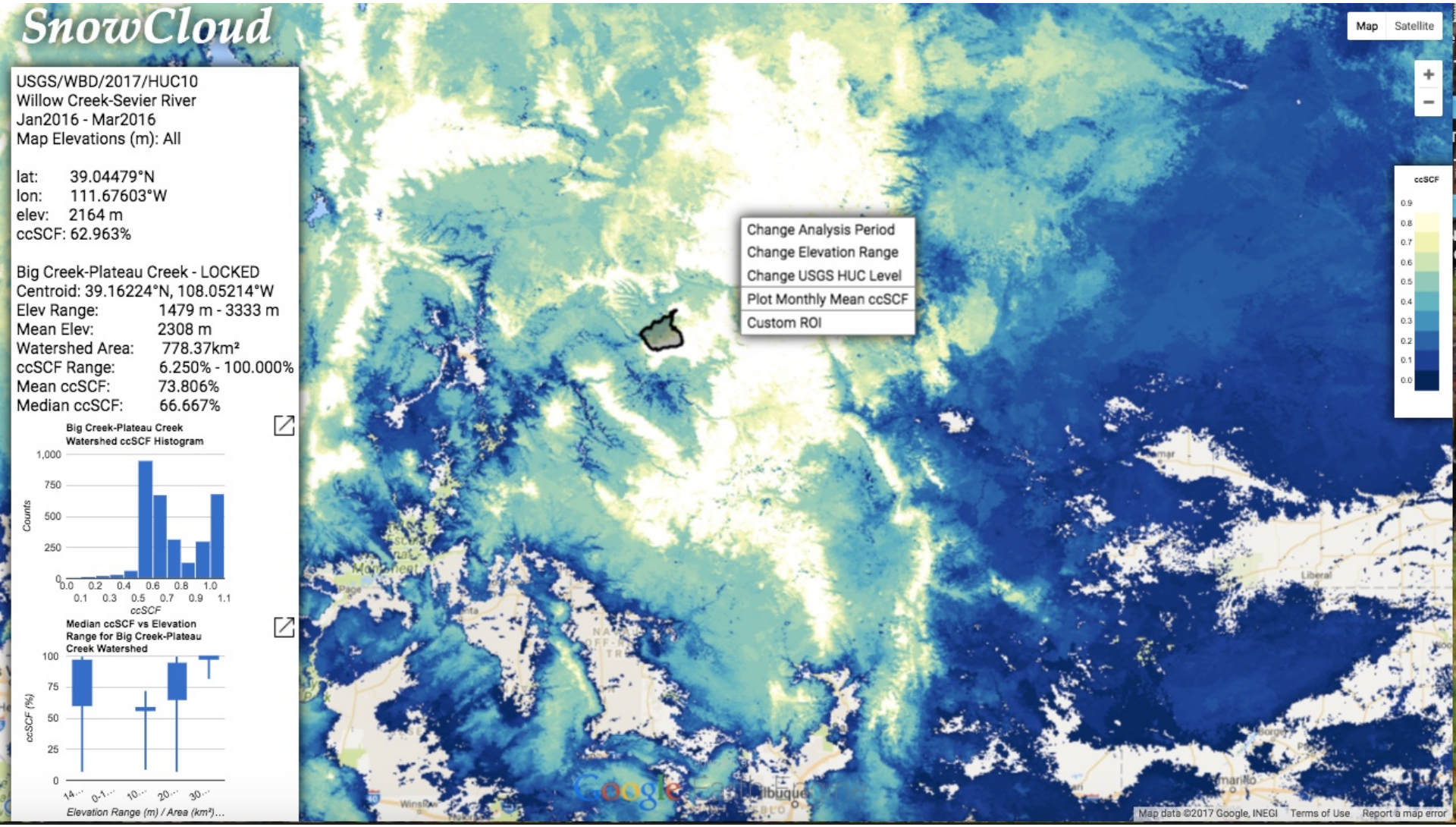
Snow Cover Frequency (SCF)

$$\mathrm{SCF} = \frac{\#\text{ of snow observations}}{\#\text{ of valid observations}}$$

- Uses remote sensing observations from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS)
- Daily observations of snow cover (MOD10A1) at 500-m spatial resolution
- Cloud correction is applied
- Computed in Google Earth Engine

Snow Cover Frequency February 2011 and February 2015





New website-based implementation called SnowCloud

- Watershed and HUC-level selection (or user-supplied ROI)
- Elevation range (m)
- Date range (min 30 days, max. 1 year)

http://mountains.ceoas.oregonstate.edu/snowcloud/

The OSU Mountain Hydroclimatology Research Group

Snow – Ice – Climate – Hydrology – Communities

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SnowCloud

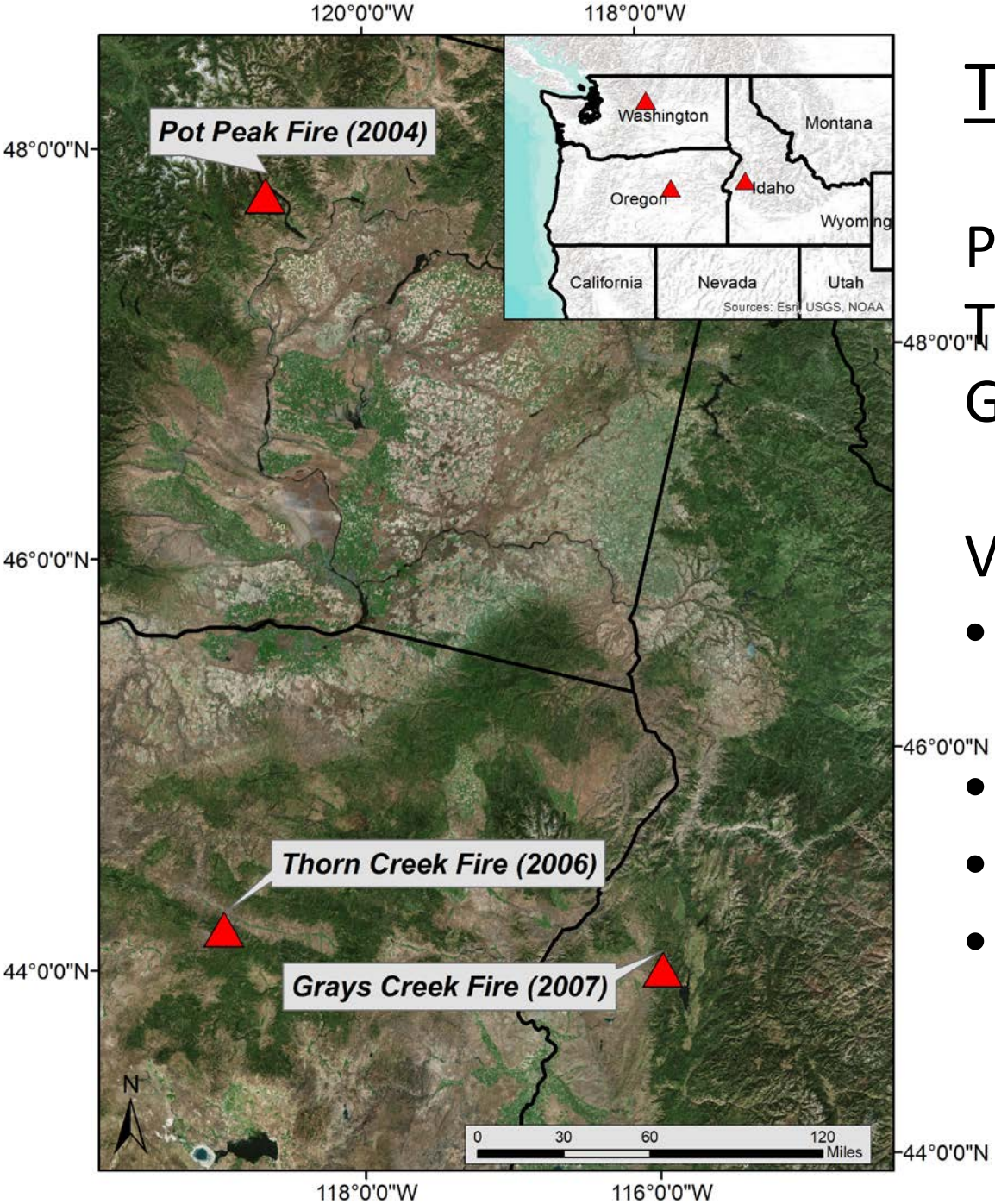
¡Haga clic aquí para la versión en español!

How do you predict streamflow in the absence of field data?
This challenge is particularly vexing in snowy mountain regions. Critical data are often absent and prediction efforts are hampered by lack of timely snow data. Predicting low flows is particularly important where water resources are limited.

Remote sensing, cloud computing, and interactive web-based mapping tools offer a new paradigm for delivering key streamflow data to water resource managers.

LATEST NEWS

- Nolin to join UNR as Director of Hydrologic Sciences program
- March 17-25 Nolin and Cosgrove complete snow surveys in Alaska
- Nolin hosts Mountain Sentinels workshop in Bend, Oregon
- Chris Cosgrove receives a



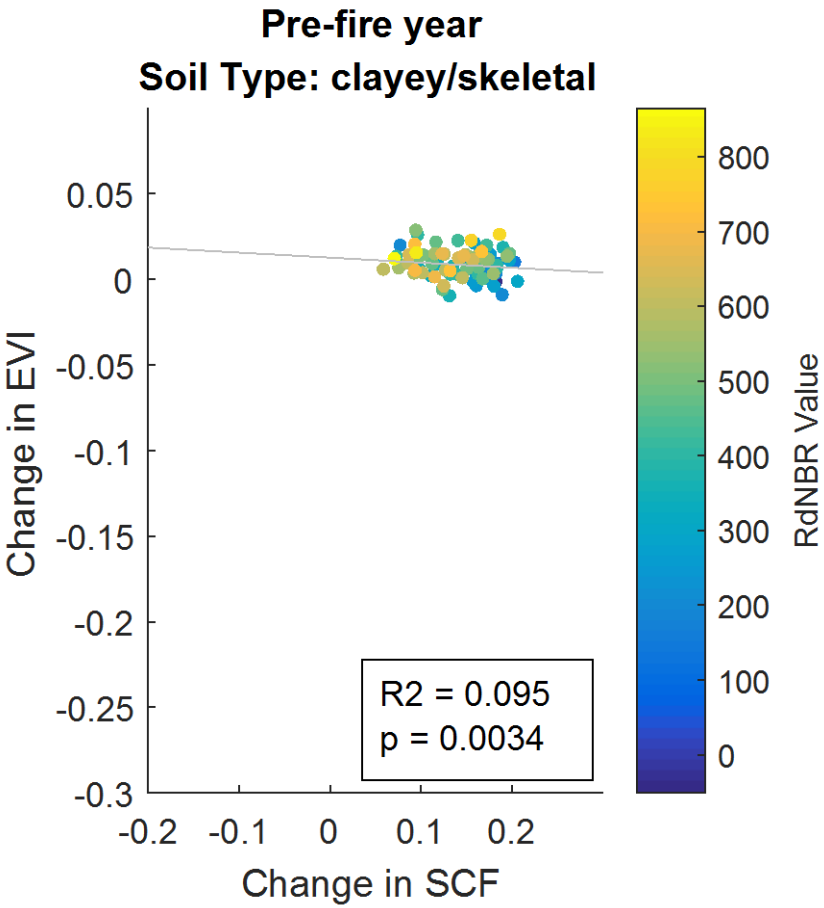
Three fires:

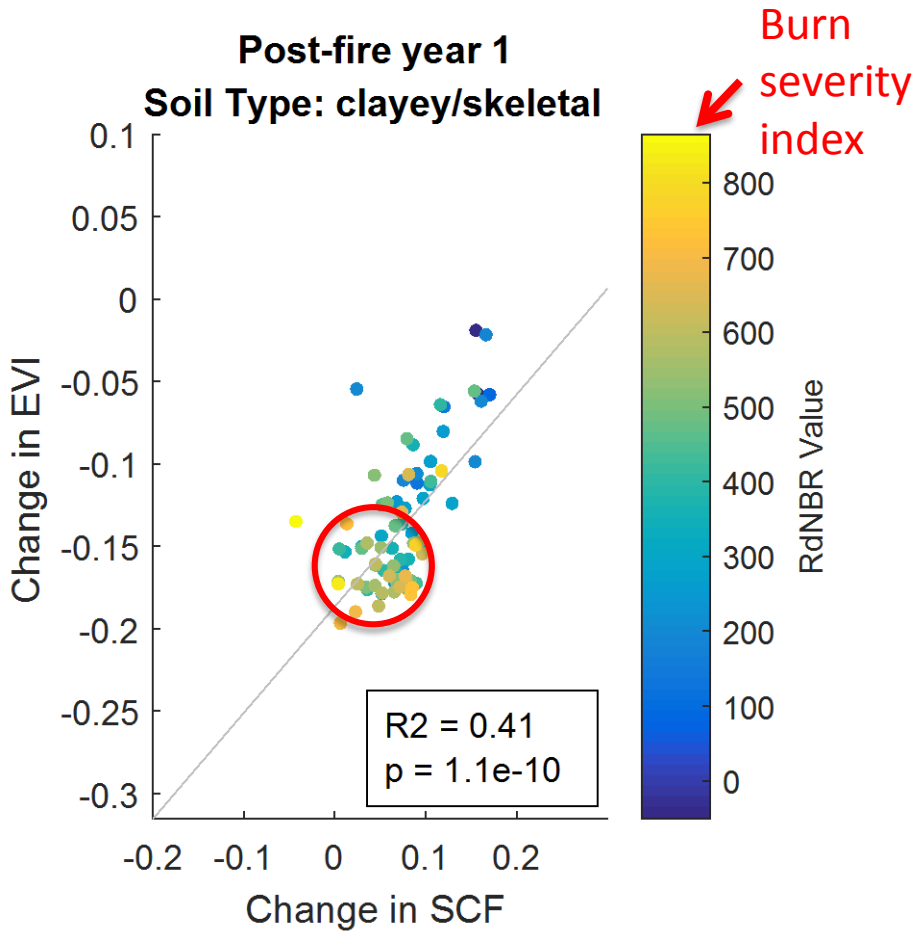
Pot Peak (2006)
Thorn Creek (2006)
Grays Creek (2007)

Variables:

- Max summer EVI (greenness)
- SCF
- Soil type
- Land cover type

Grays Creek Fire – clayey/skeletal soil

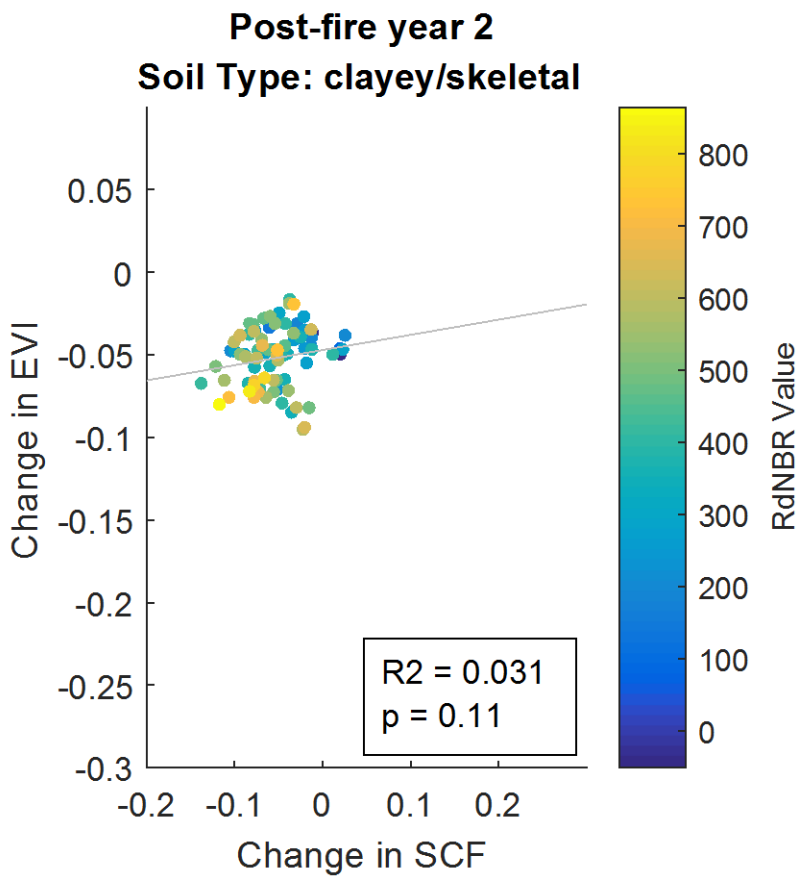




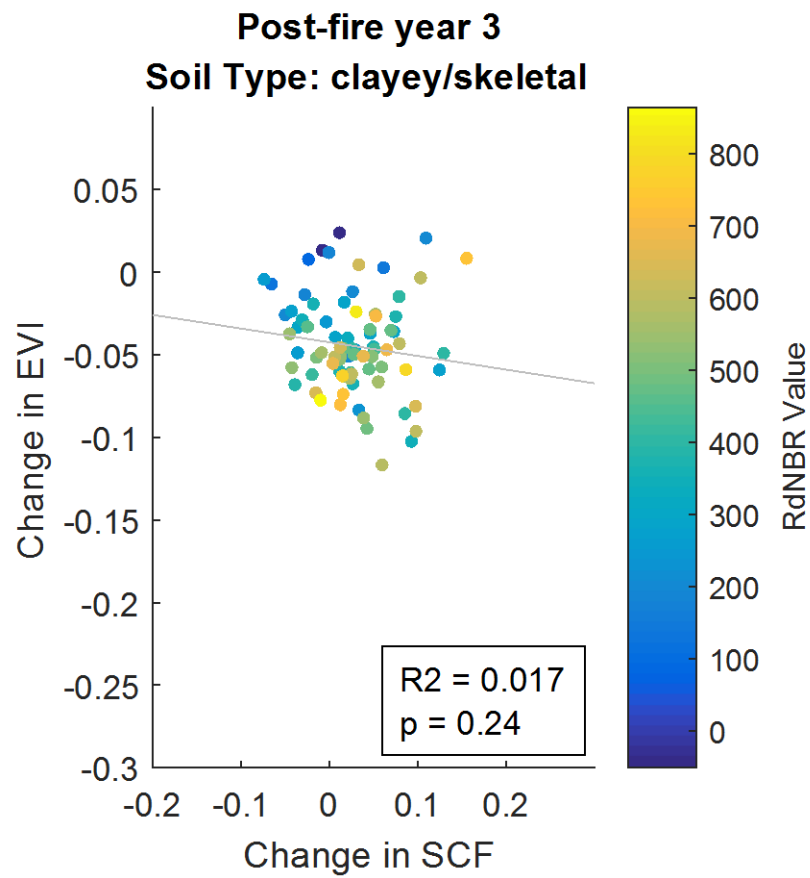
Pre-fire average ΔEVI vs. ΔSCF relationship is not significant

Year 1 post-fire ΔSCF explains **41%** of variance in ΔEVI

Grays Creek Fire – clayey skeletal soil

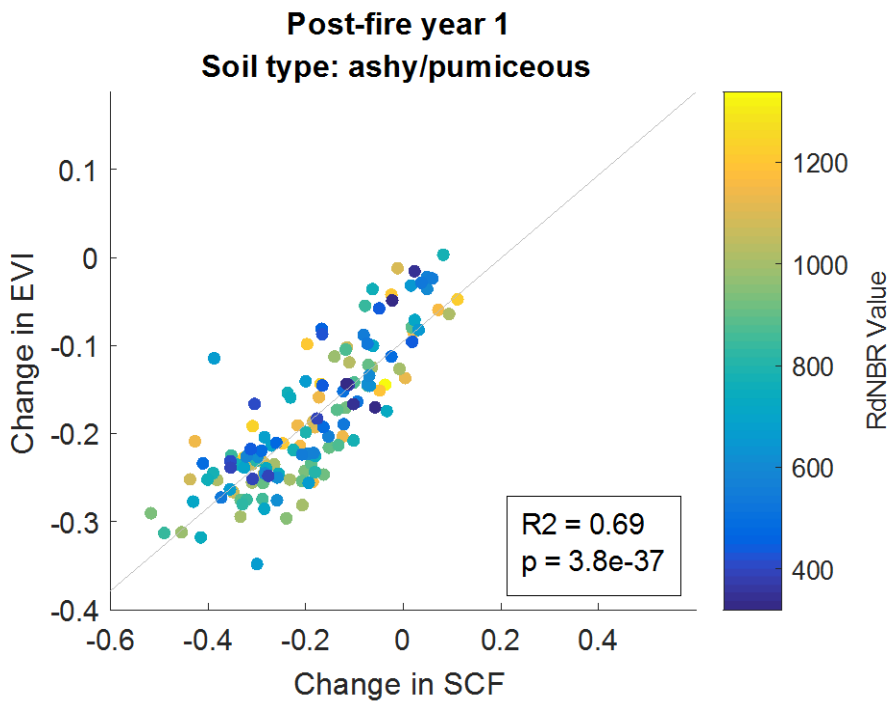


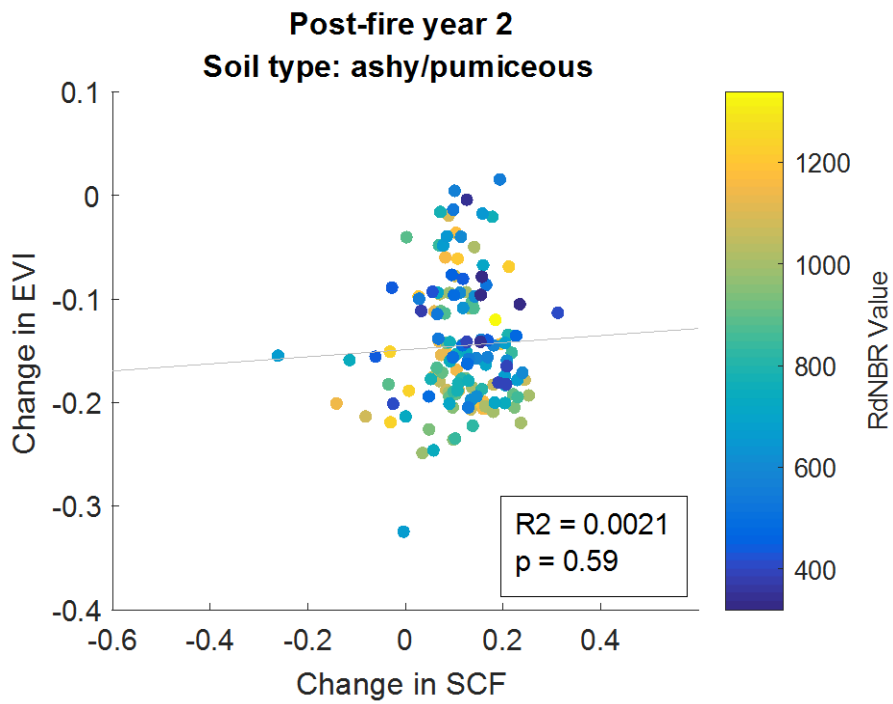
Year 2 post-fire ΔEVI vs. ΔSCF relationship is not significant



Year 3 post-fire ΔEVI vs. ΔSCF relationship is not significant

Pot Creek Fire – ashy/pumiceous soil

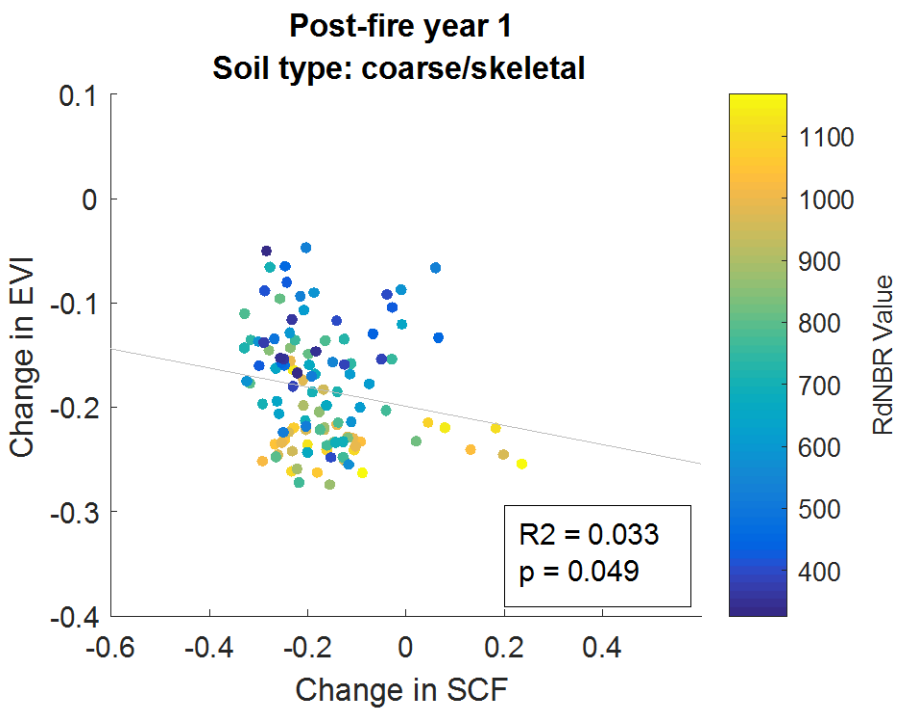




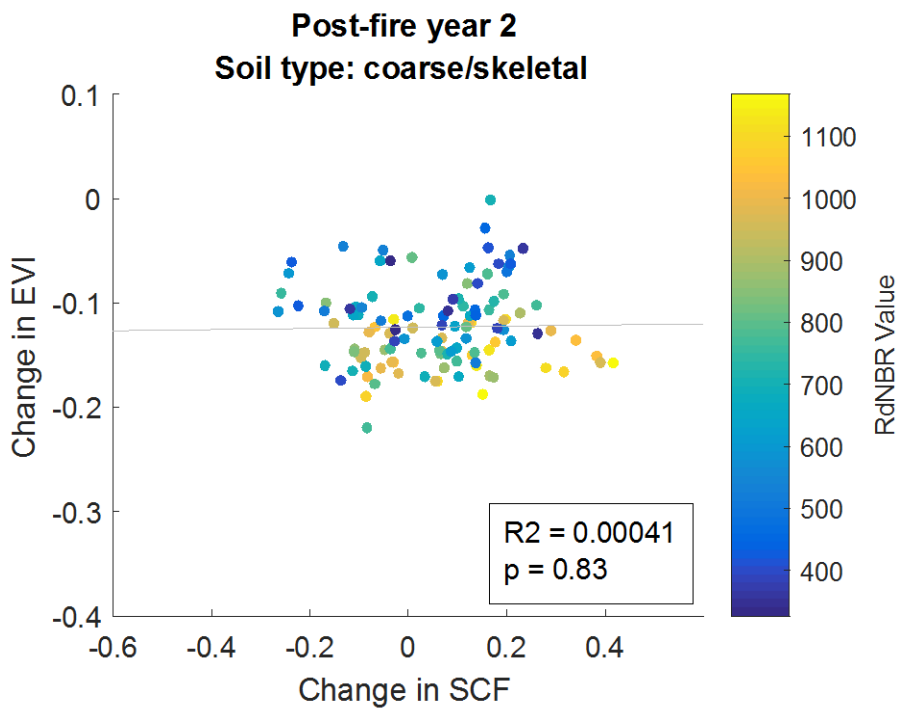
Year 1 post-fire ΔSCF explains **69%** of variance in ΔEVI

Year 2 post-fire ΔEVI vs. ΔSCF relationship is not significant

Pot Creek Fire – coarse/skeletal soil

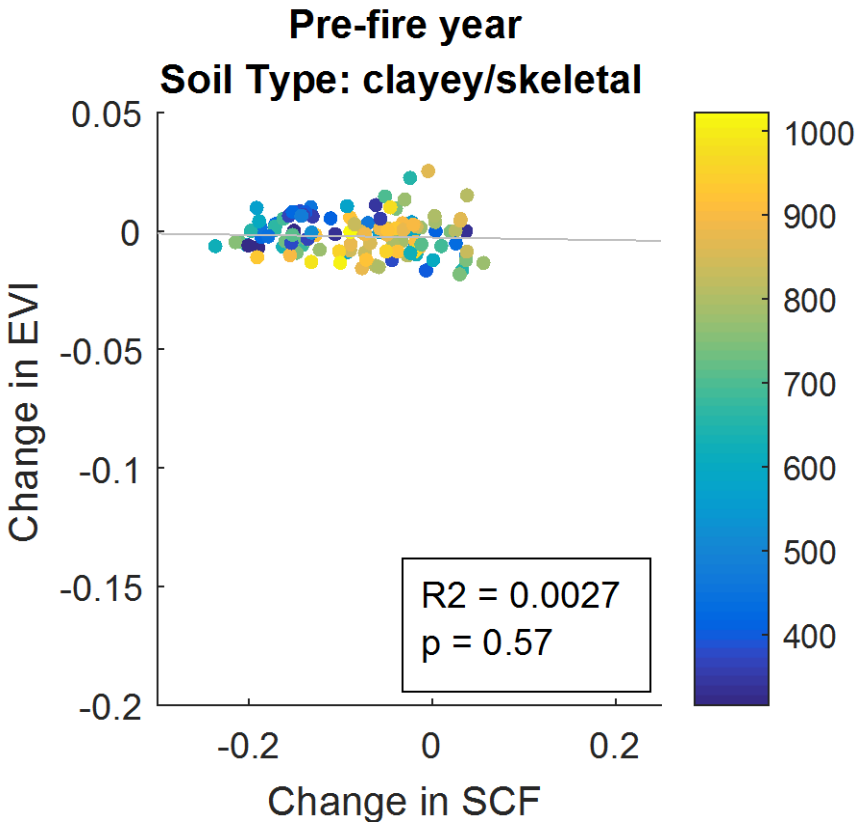


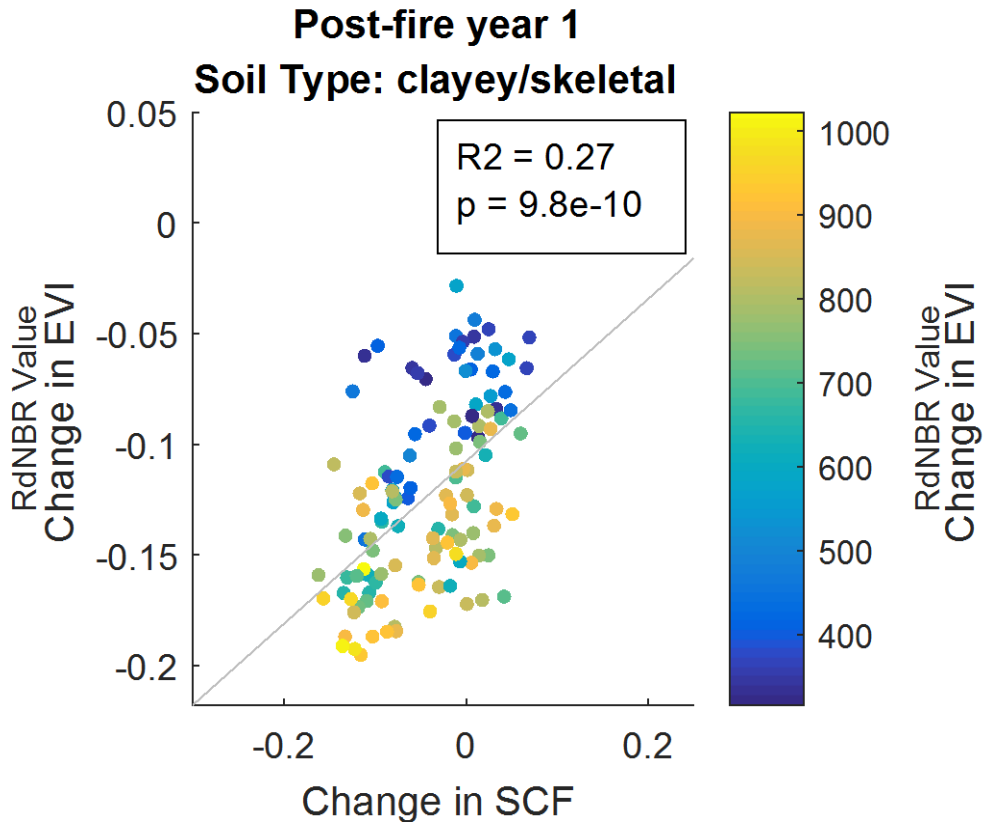
Year 1 post-fire ΔEVI vs. ΔSCF relationship is not significant



Year 2 post-fire ΔEVI vs. ΔSCF relationship is not significant

Thorn Creek Fire – clayey/skeletal soil

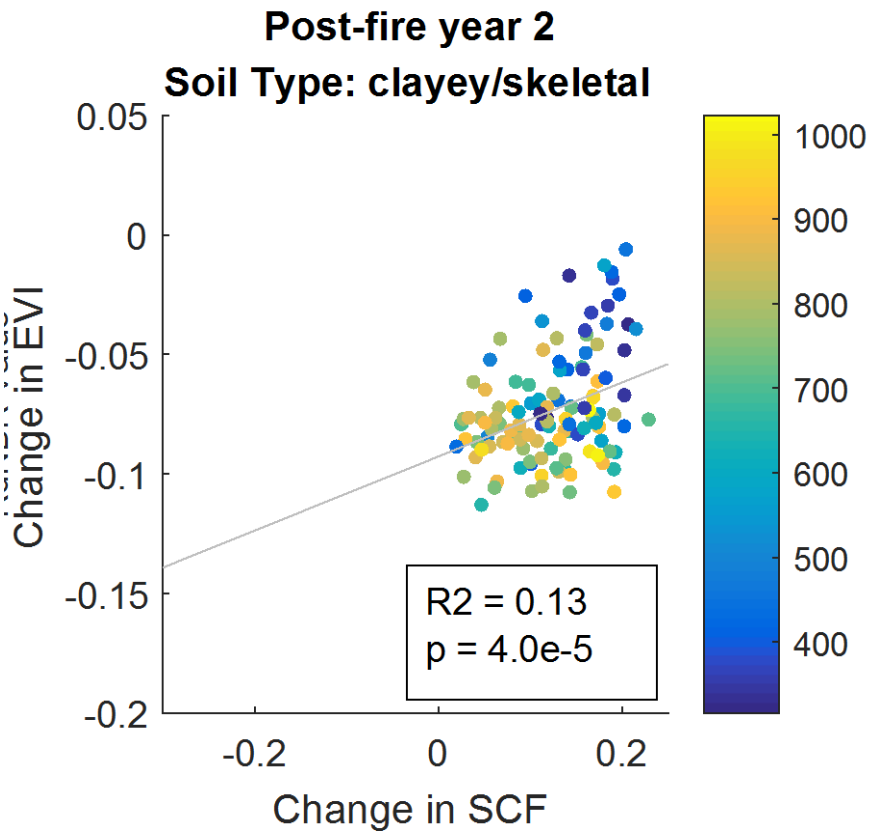




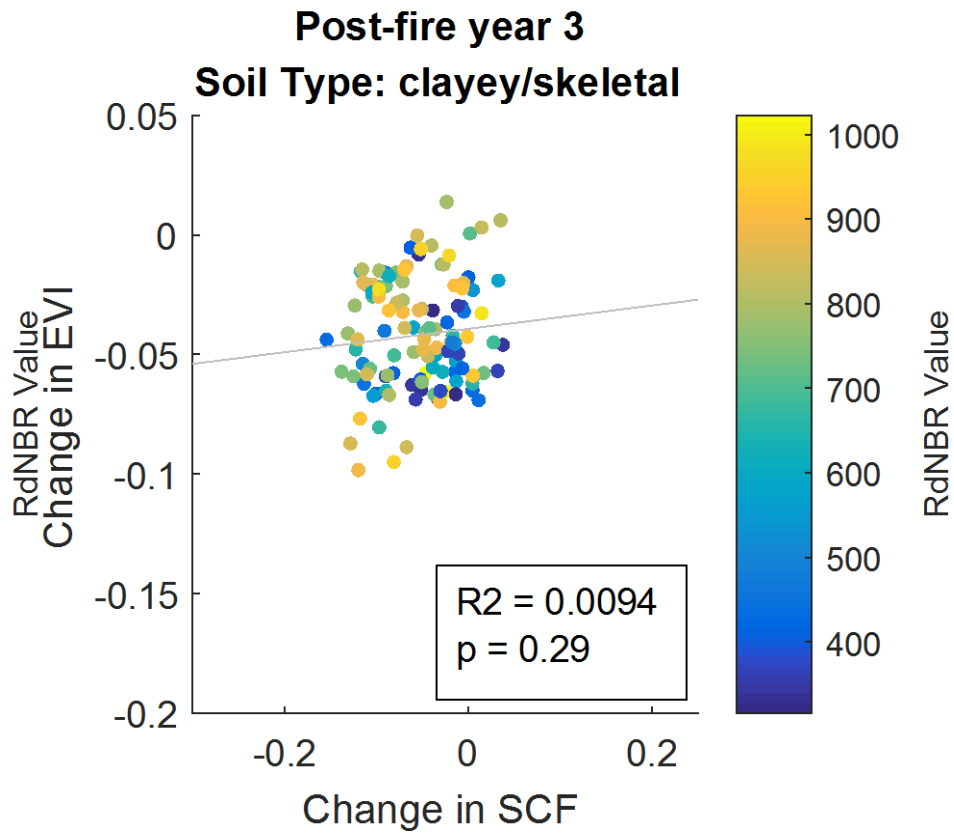
Pre-fire average ΔEVI vs. ΔSCF relationship is not significant

Year 1 post-fire ΔSCF explains **27%** of variance in ΔEVI

Thorn Creek Fire – clayey/skeletal soil

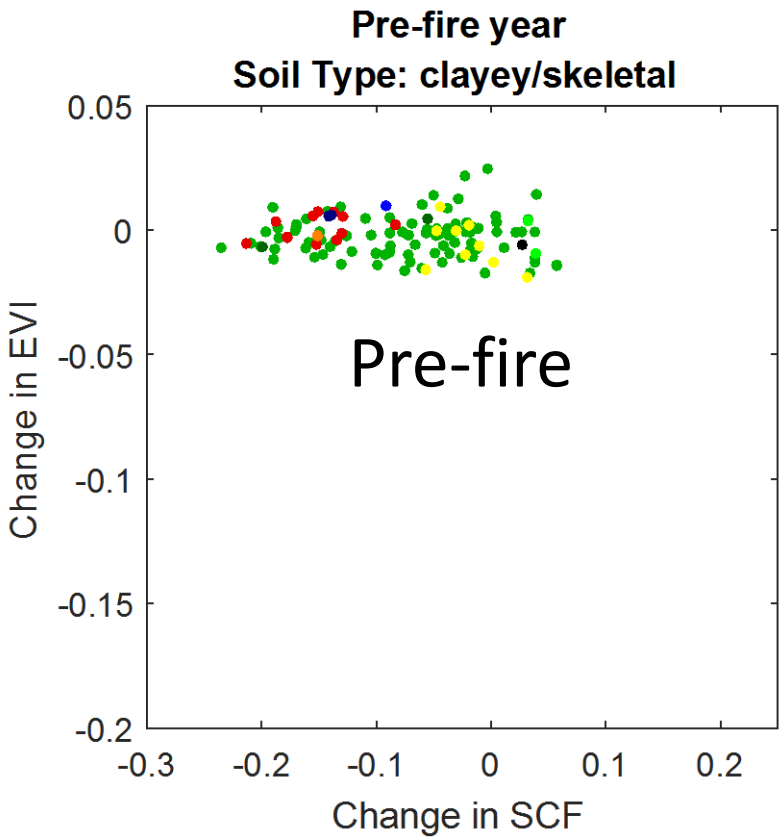


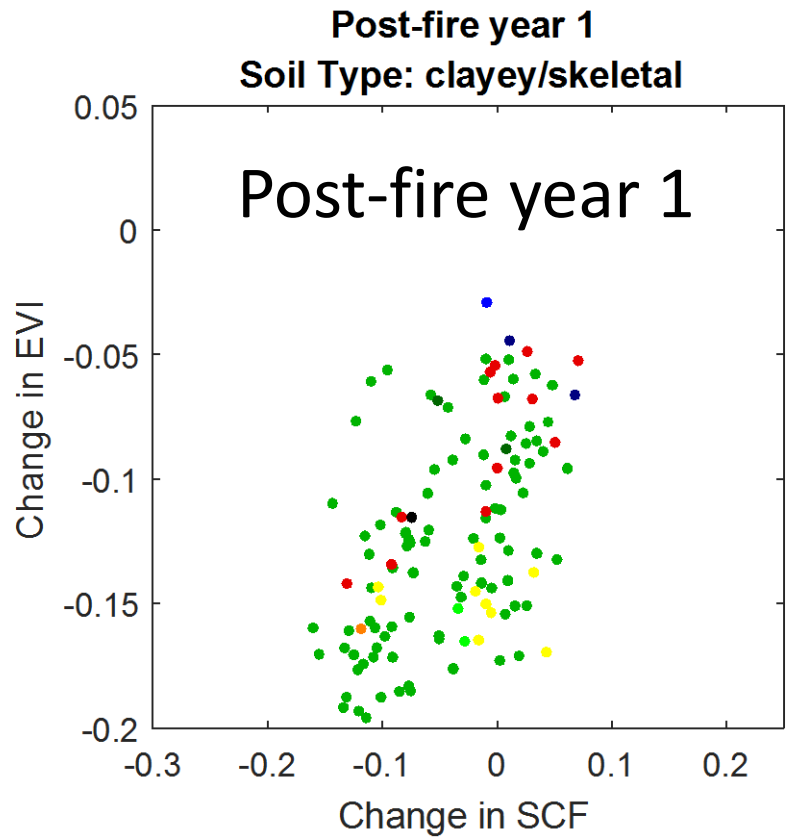
Year 2 post-fire ΔSCF explains **13%** of variance in ΔEVI

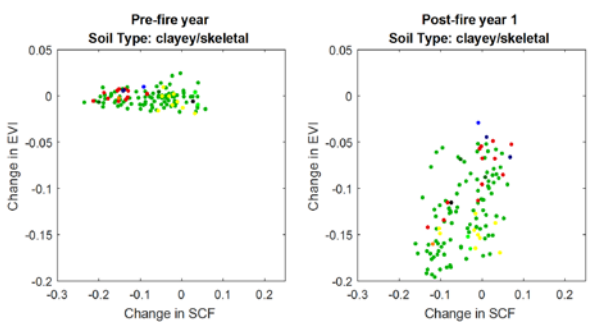


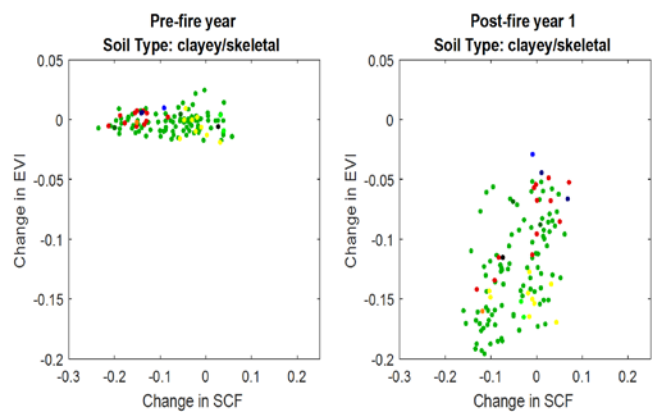
Year 3 post-fire ΔEVI vs. ΔSCF relationship is not significant

Thorn Creek Fire – vegetation types

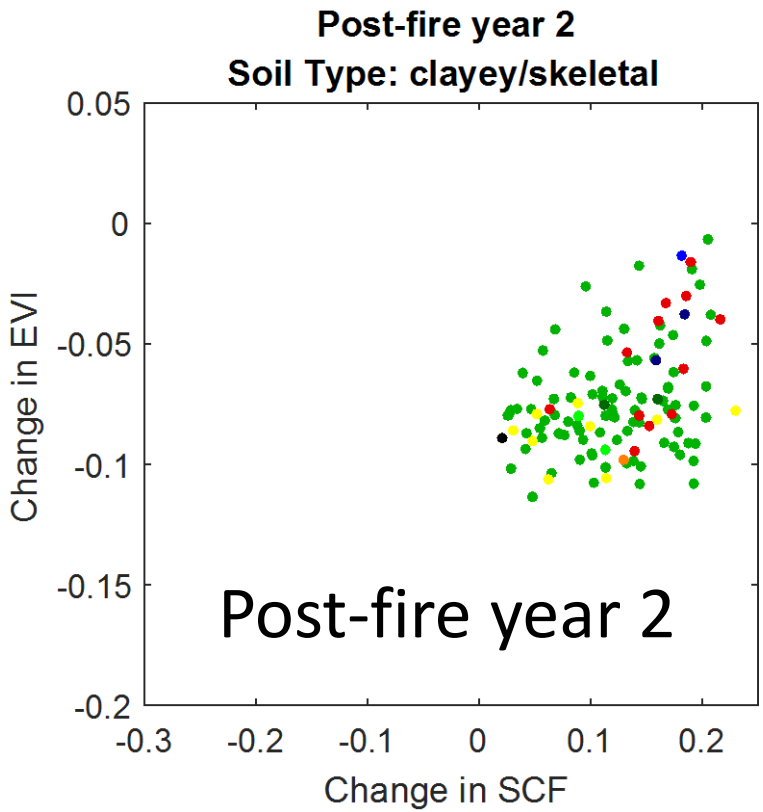


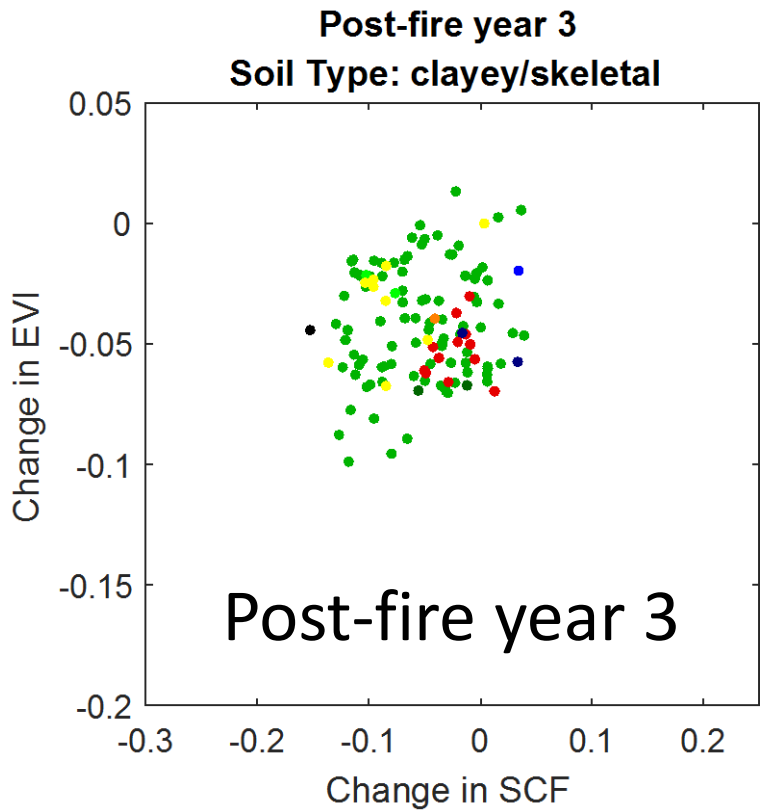






Thorn Creek Fire – vegetation types





- Dry-Mesic Montane Mixed Conifer Forest
- Mesic Montane Mixed Conifer For
- Ponderosa Pine Woodland and Savanna
- Subalpine Dry-Mesic Spruce-Fir Forest and Woodland

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Summary

- Snow matters in the post-fire environment
- Preliminary results suggest that antecedent snowcover affects post-fire summer greening but need to examine many more fires, more variables
- Simple snow metrics can be very helpful in the absence of SWE

Next Steps

Identify key physiographic variables (in addition to snow)

Test snow disappearance date (SDD)

Make new snow metrics publicly available via website

Examine in the context of potential future SnowEx sites