Detection of Fire Burn Scars by UAVSAR: Immediate, Short-term, and Multi-year Observations and Applications

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NASA/JPL UAVSAR L-band Radar

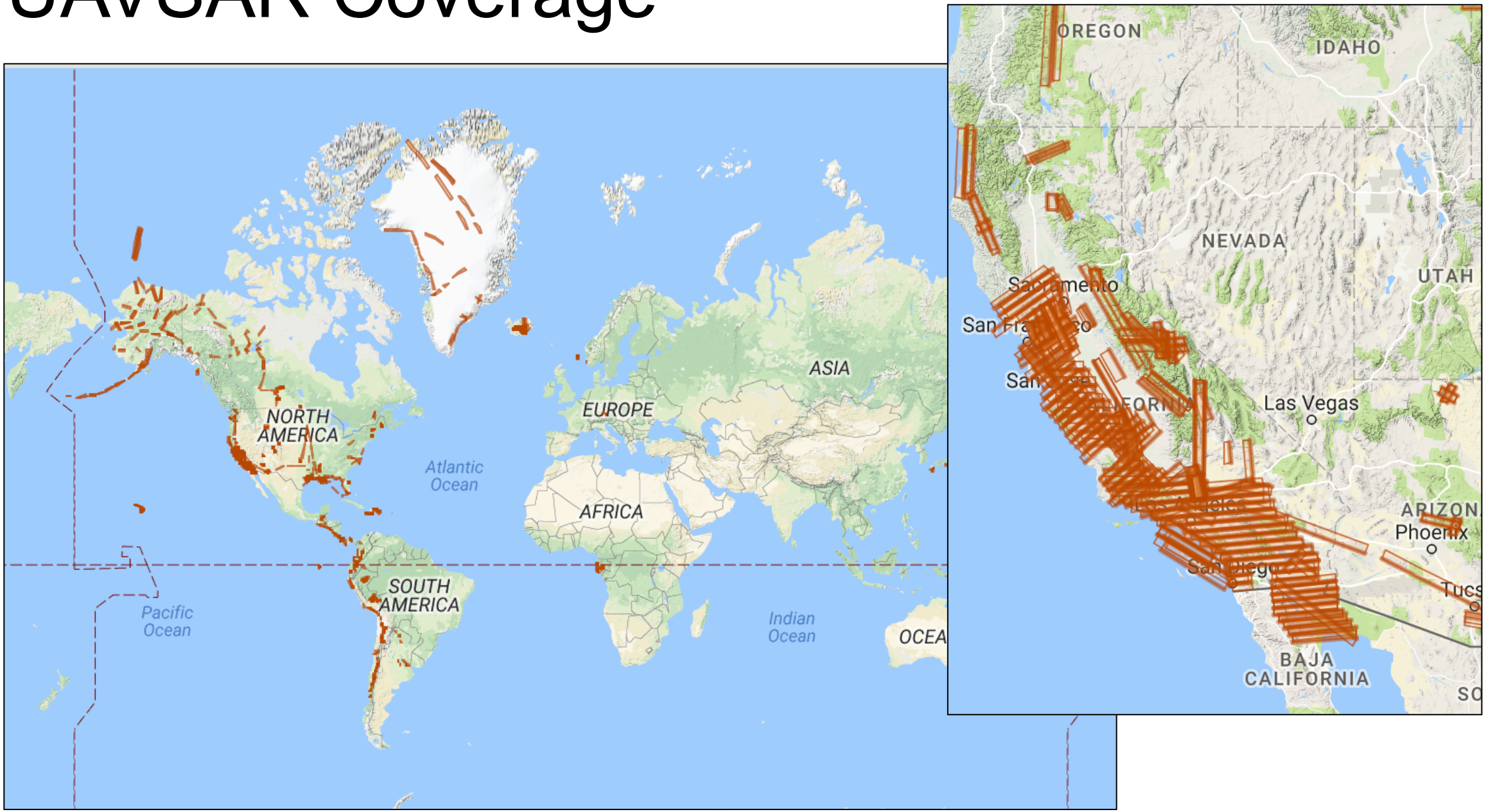

Source: NASA/JPL

- Active Sensor
- Airborne
  - Flown on Gulfstream III airplanes
- Flexible scheduling
- Can fly day or night
- High Resolution (5 m)
- Cloud-penetrating
- Smoke-penetrating

Source: NASA/JPL

www.uavsar.jpl.nasa.gov

UAVSAR Coverage



UAVSAR Applications

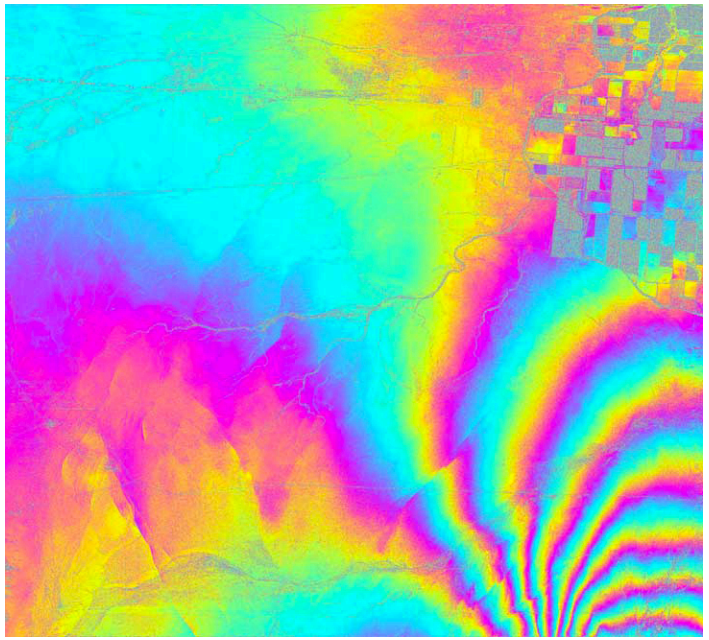
Radar contains different information than other remote sensing due to long wavelength

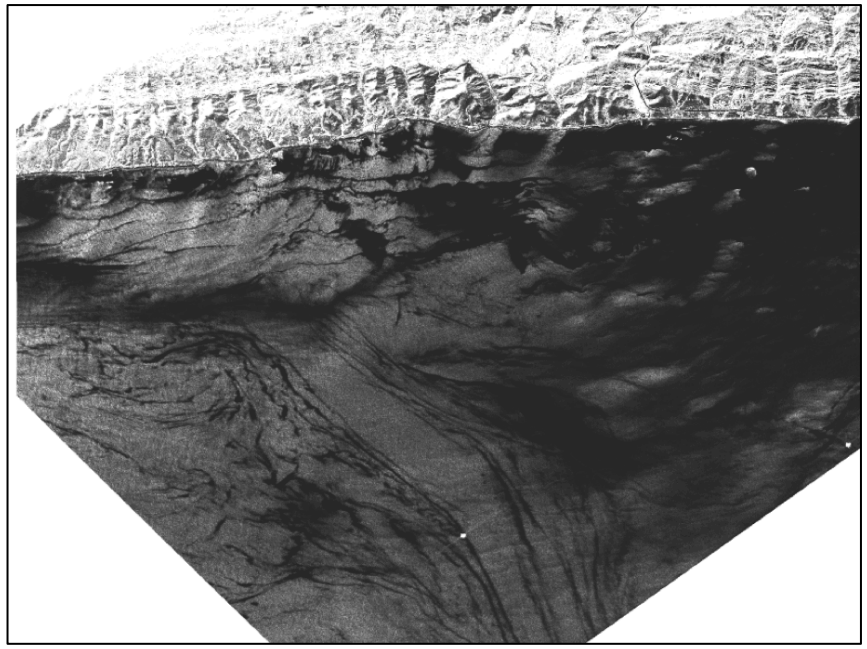
Radar response correlated with:

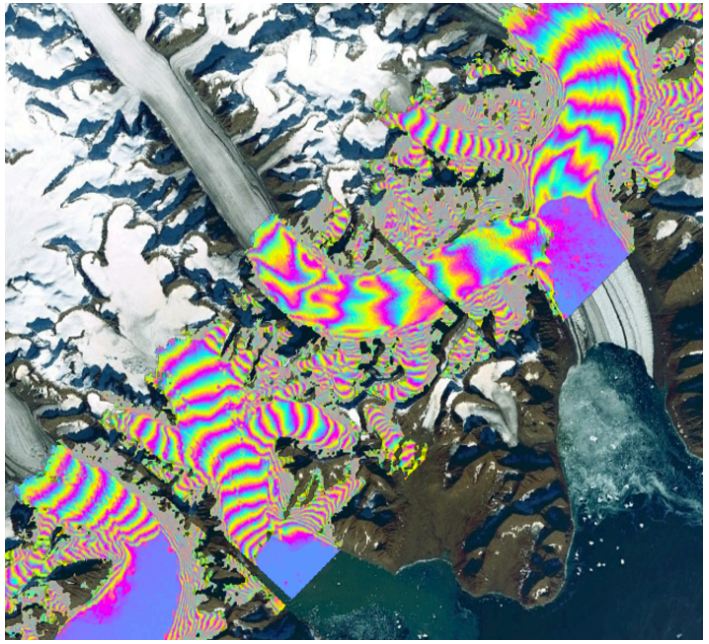
- Roughness
- cm-scale structure
- Moisture

Regular applications:

- soil moisture/flooding
- land deformation due to earthquakes, subsidence, and landslides
- oil slicks
- glacier movement
- vegetation/land cover/biomass

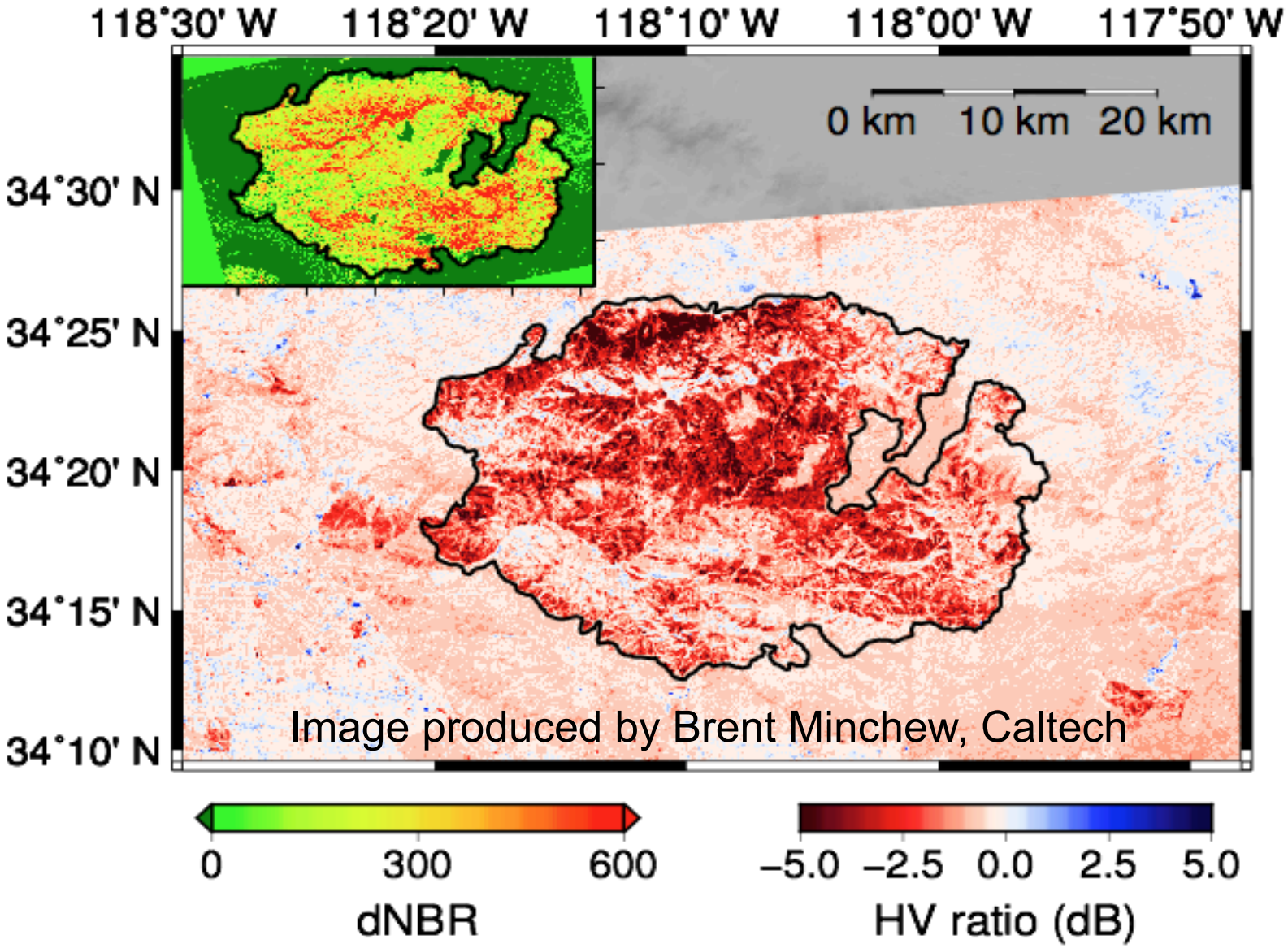






Inspiration – Station Fire, Los Angeles, 2009

- Start date
  8-26-09
- Observation date
  9-18-09
- Fire end date
  10-16-09



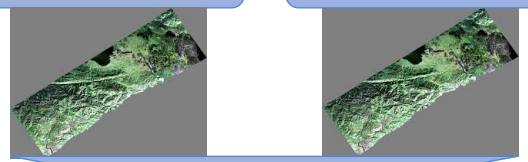
Project Methodology

Phase 1: Identify Case Studies and Download Data

UAVSAR

BEFORE

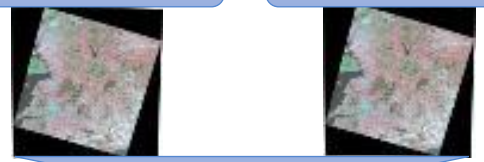
AFTER



Landsat 7 and 8

BEFORE

AFTER



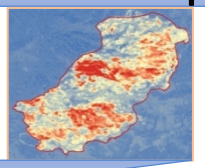
Phase 2: Process Data

dB Difference Calculations

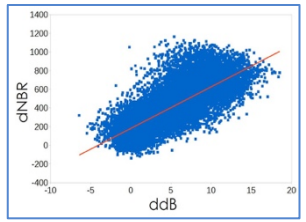
ddB Map

dNBR Calculations

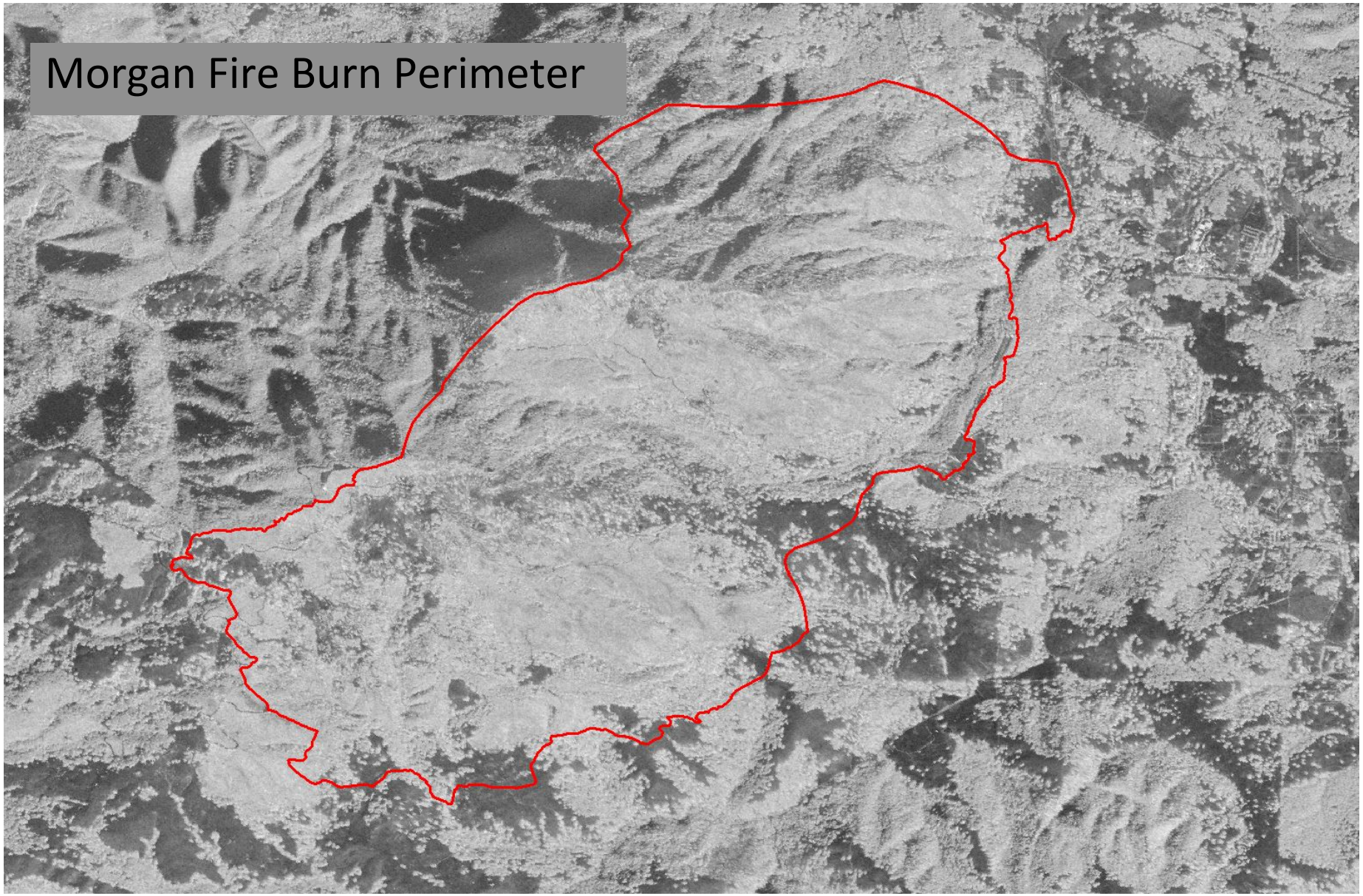
dNBR Map



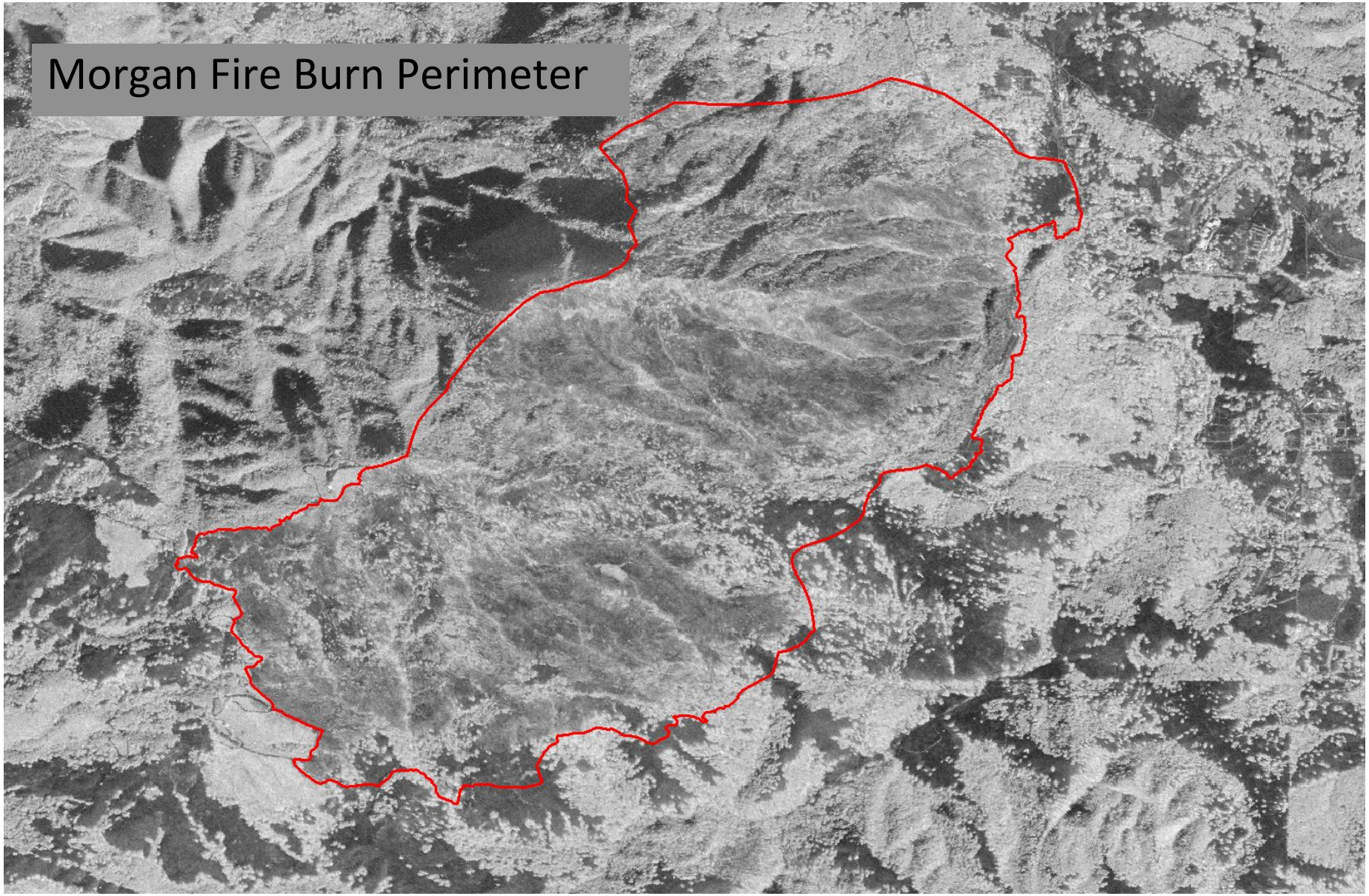
Phase 3: Analyze Results



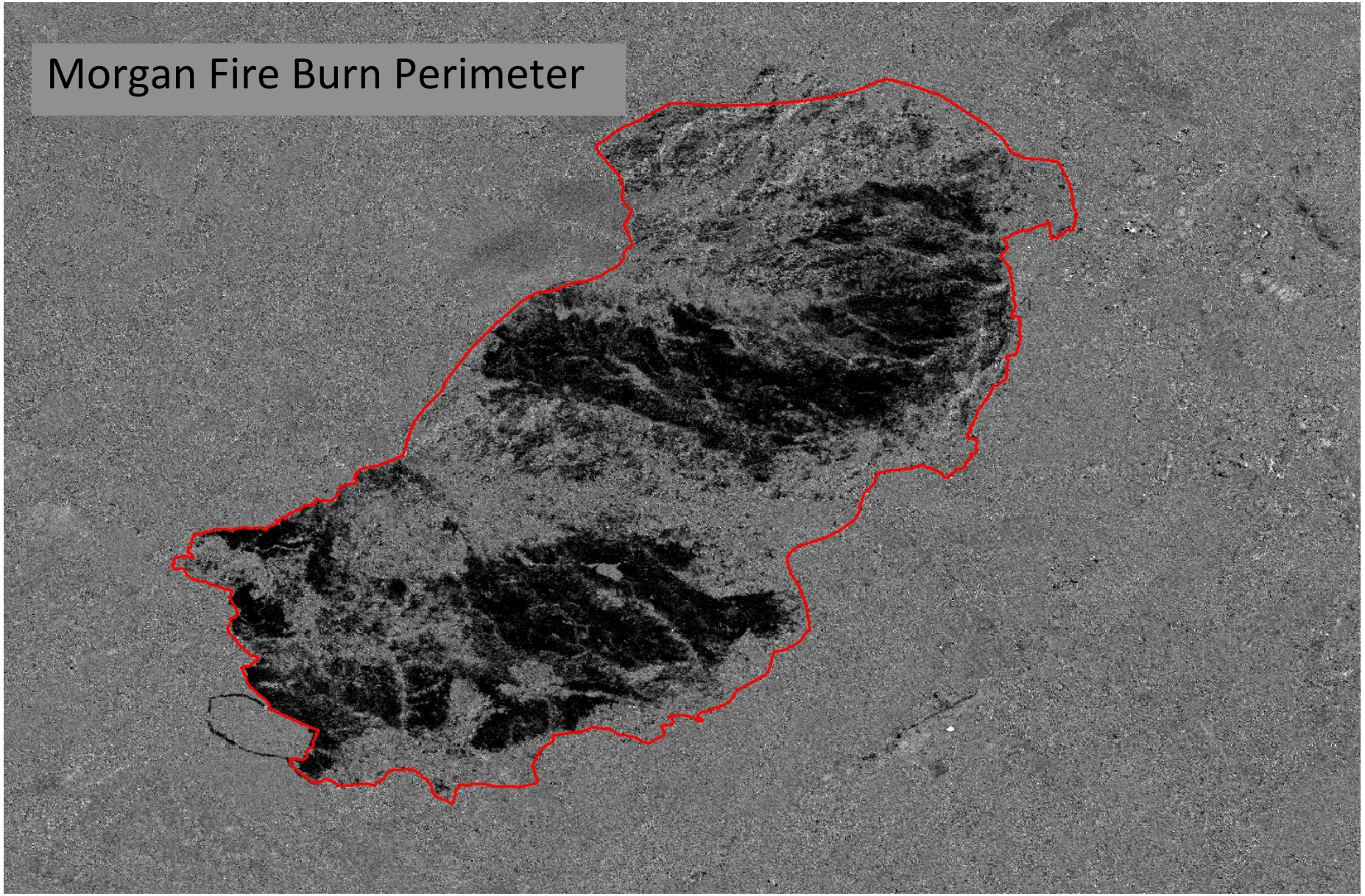
Methodology: UAVSAR (before)



Methodology: UAVSAR (after)



Methodology: UAVSAR (differenced)

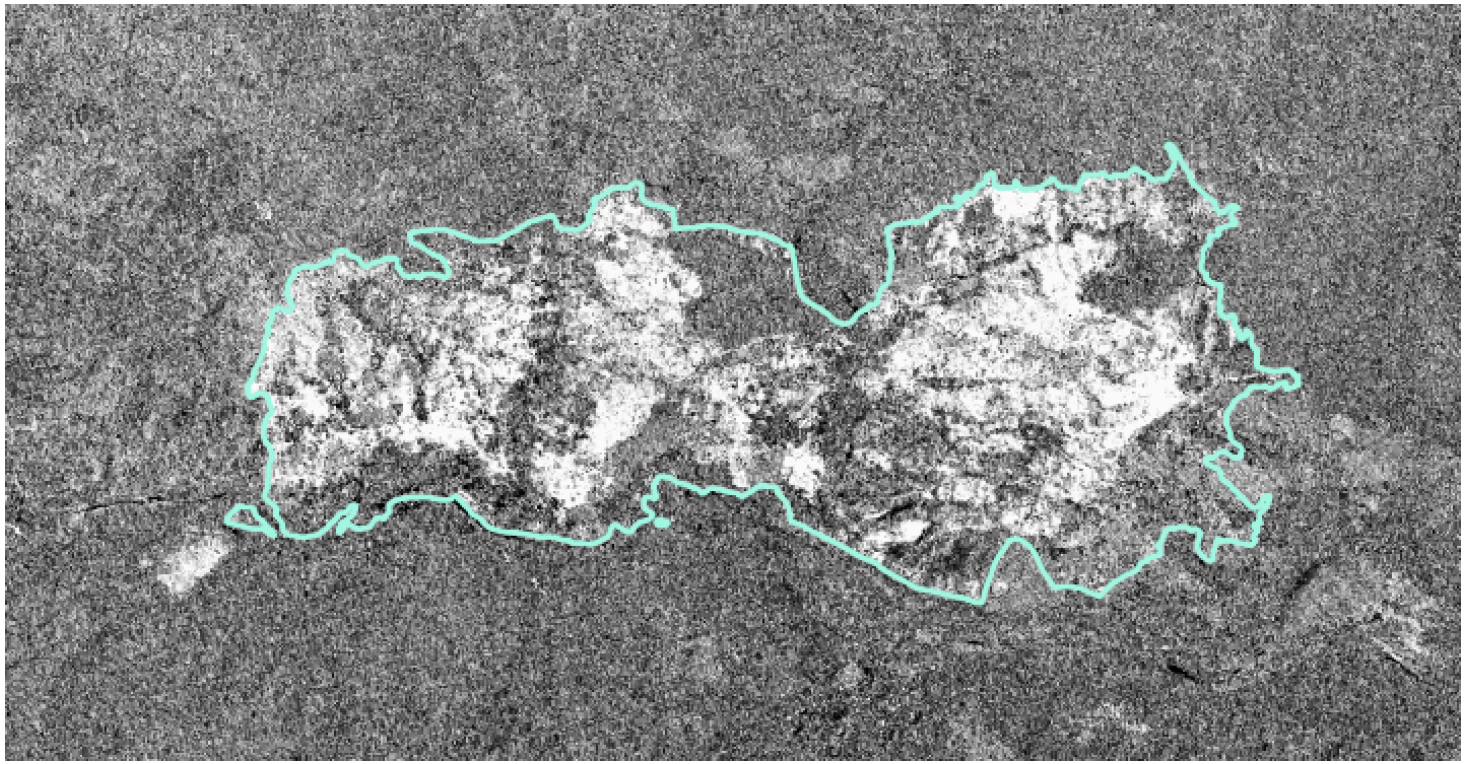


Immediate Response

During-fire mobilization

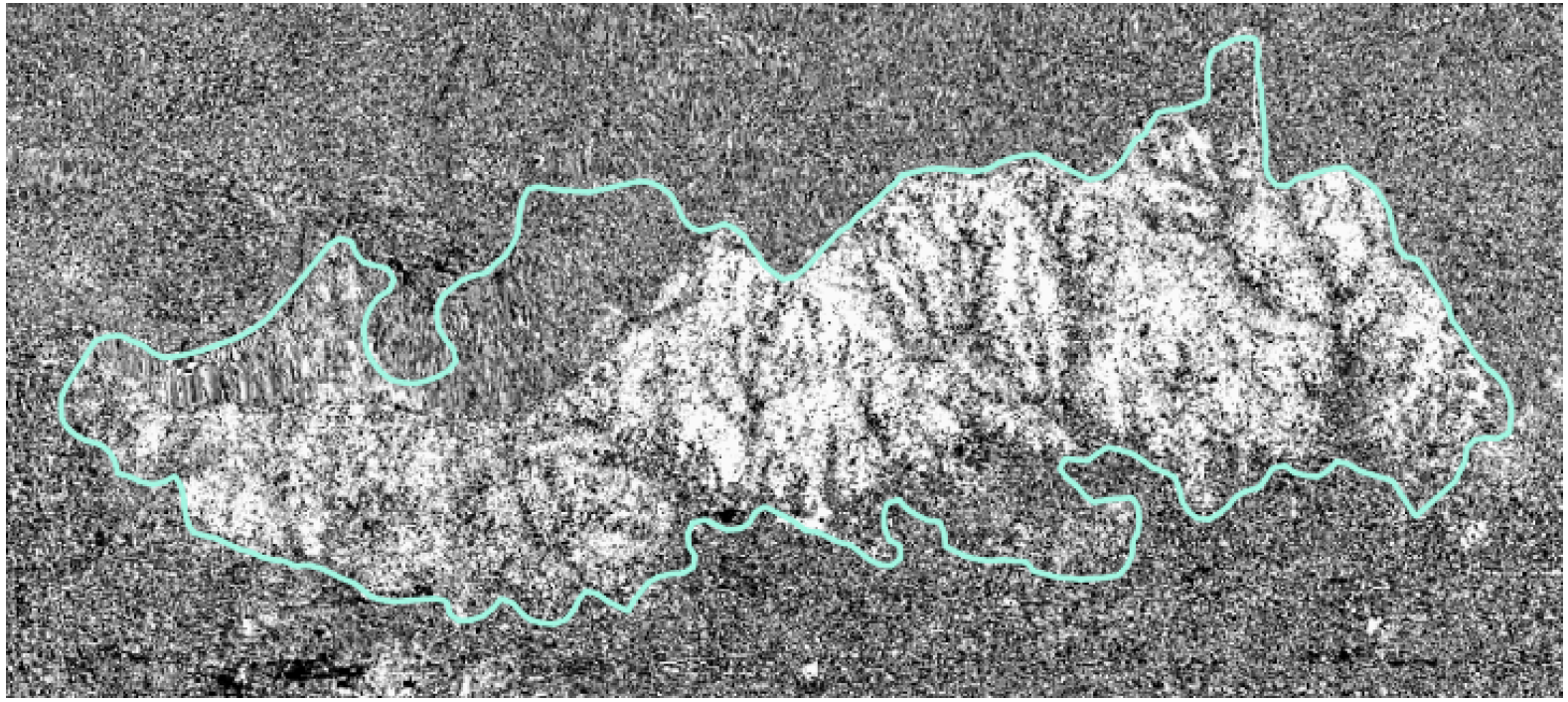
White Fire – Los Padres National Forest

- Start Date 5/27/2013
- End Date 5/30/2013
- Pre-observation Date 5/17/2012
- Observation Date 5/31/2013
- 1,984 acres
- Observation obtained serendipitously



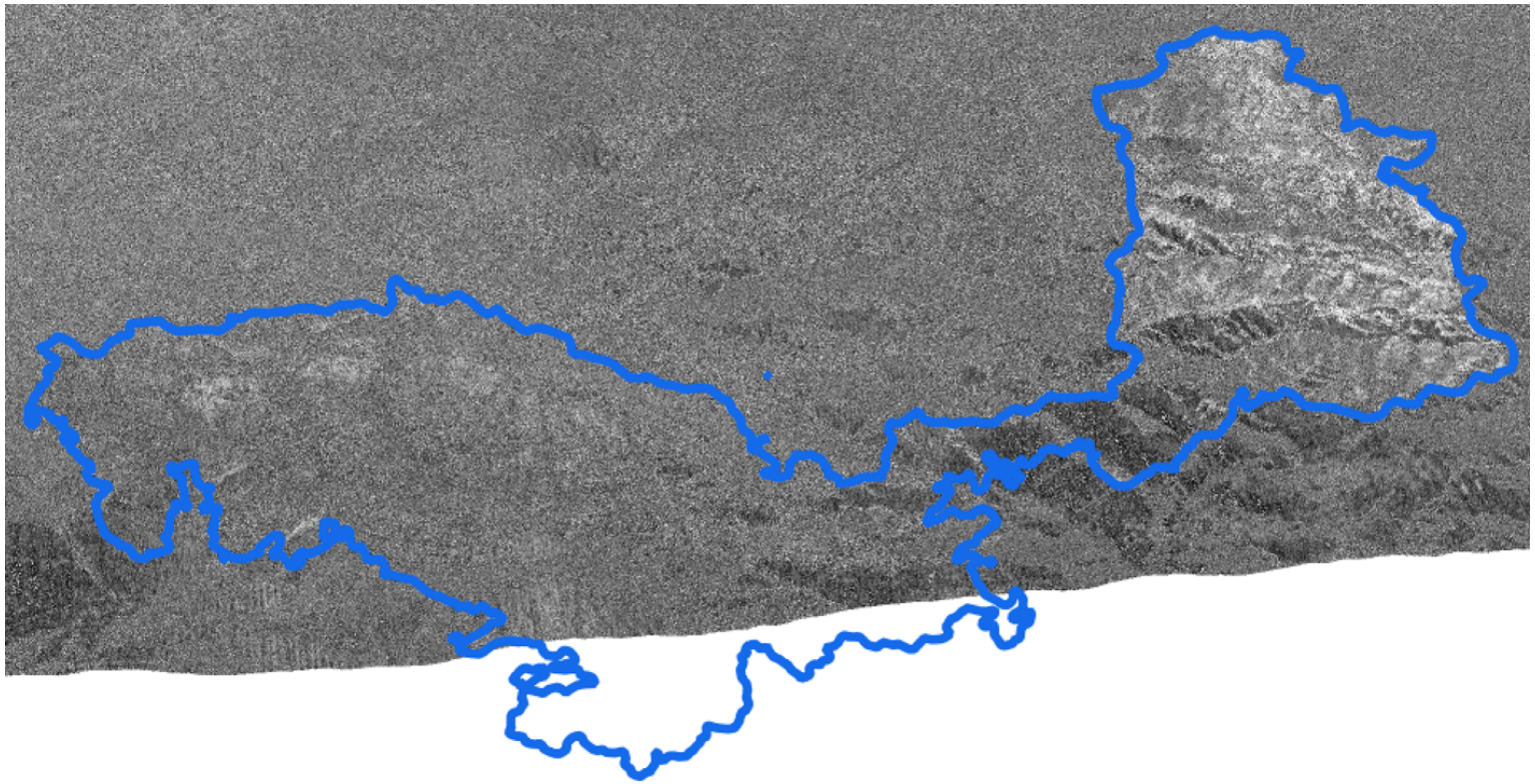
Colby Fire – Los Angeles National Forest

- Start Date 1/16/2014
- End Date 1/25/14
- Pre-Observation Date 5/13/14
- Observation Date 1/17/14
- 1,992 acres



Lake Fire – San Bernardino National Forest

- Start Date 6/17/2015
- End Date 7/21/15 (contained 6/21)
- Pre-Observation Date 5/28/14
- Observation Date 6/24/15
- 31,359 acres

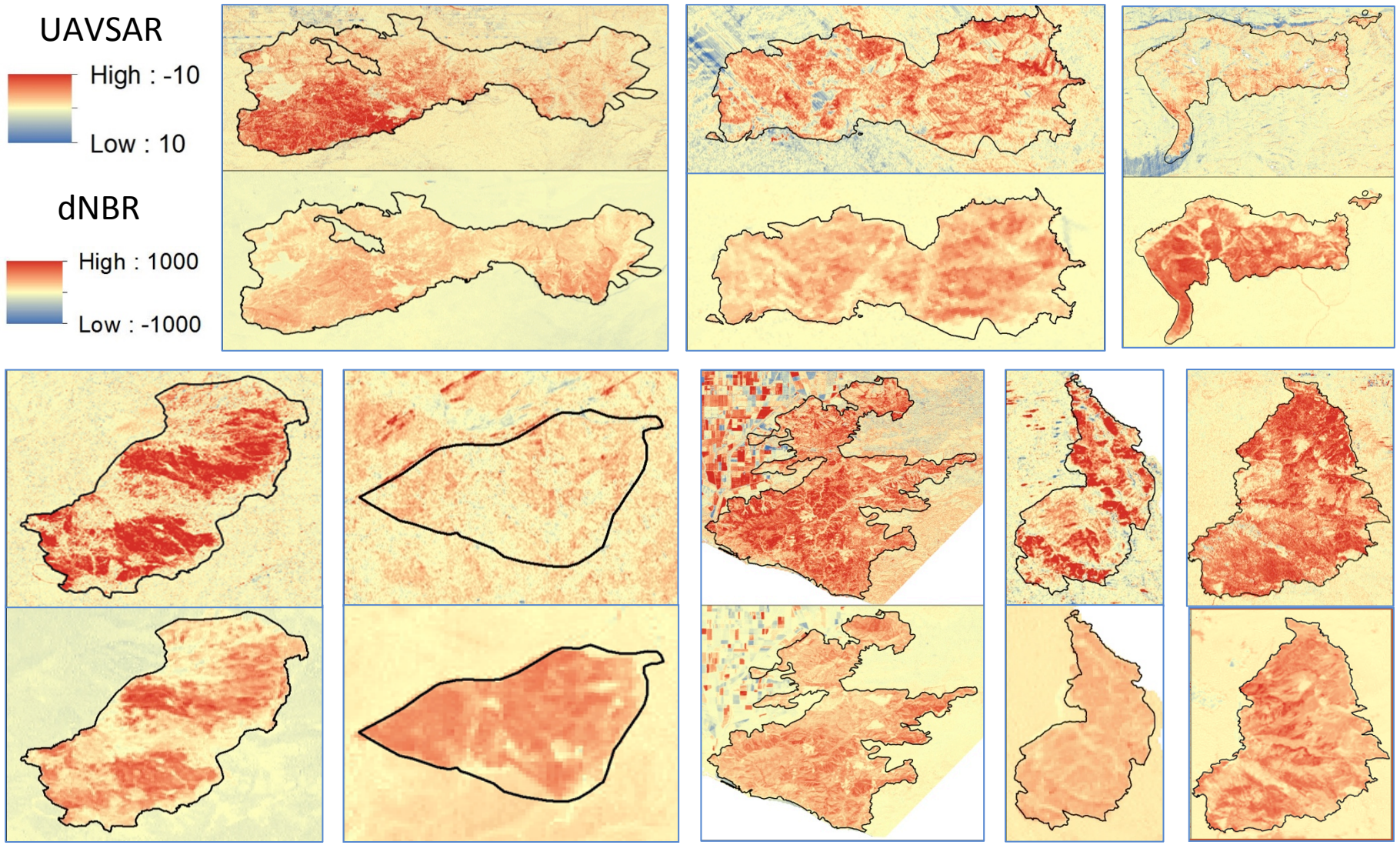


Inconclusive results for immediate detection of fire damage.

Short-term Response

Examined over 50 fires

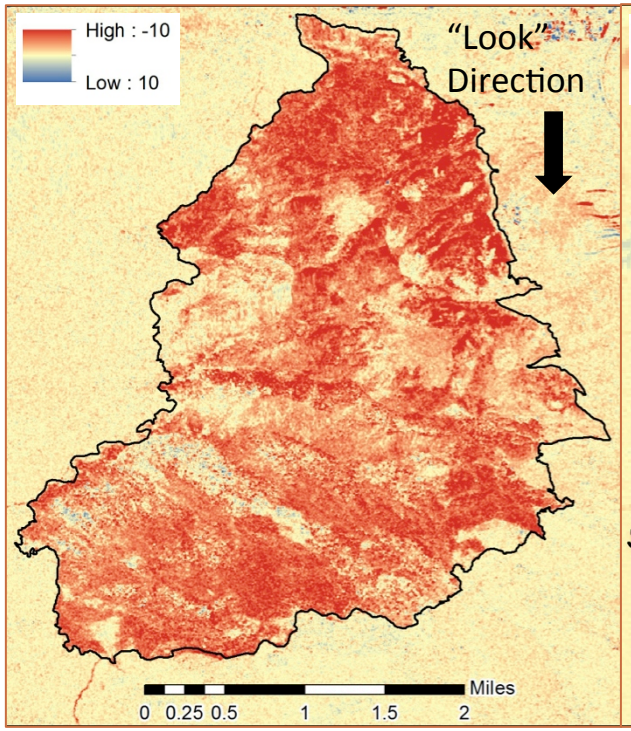
- In general, both products show the same area as burned
- UAVSAR often shows a different pattern than dNBR
- UAVSAR product is much more detailed



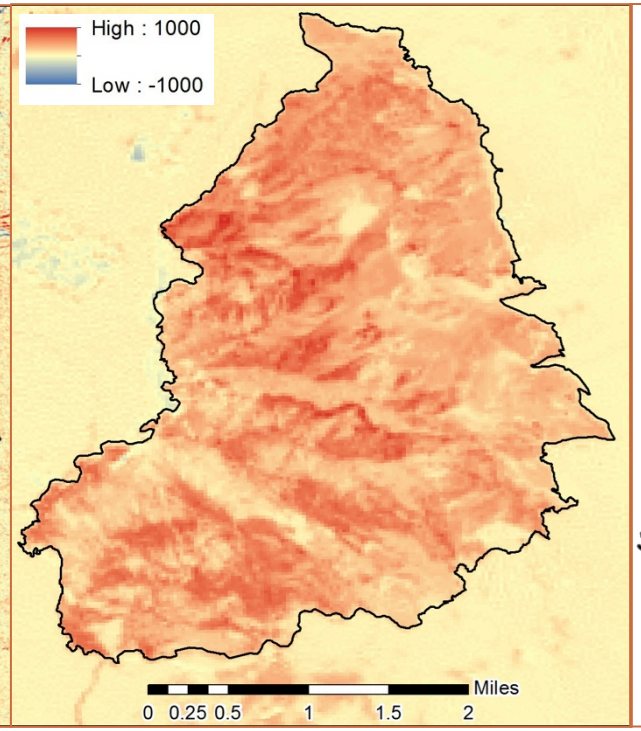
Vegetation Effect seemed to be important

Grand Fire

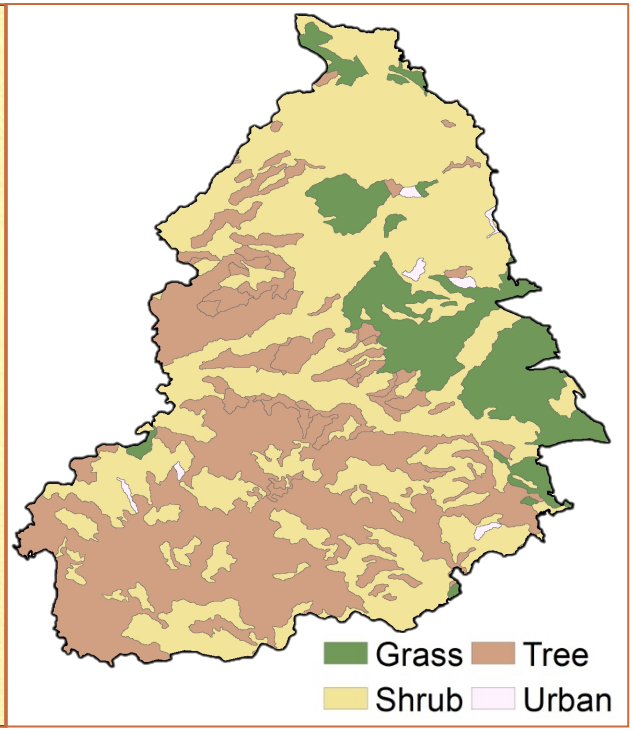
UAVSAR



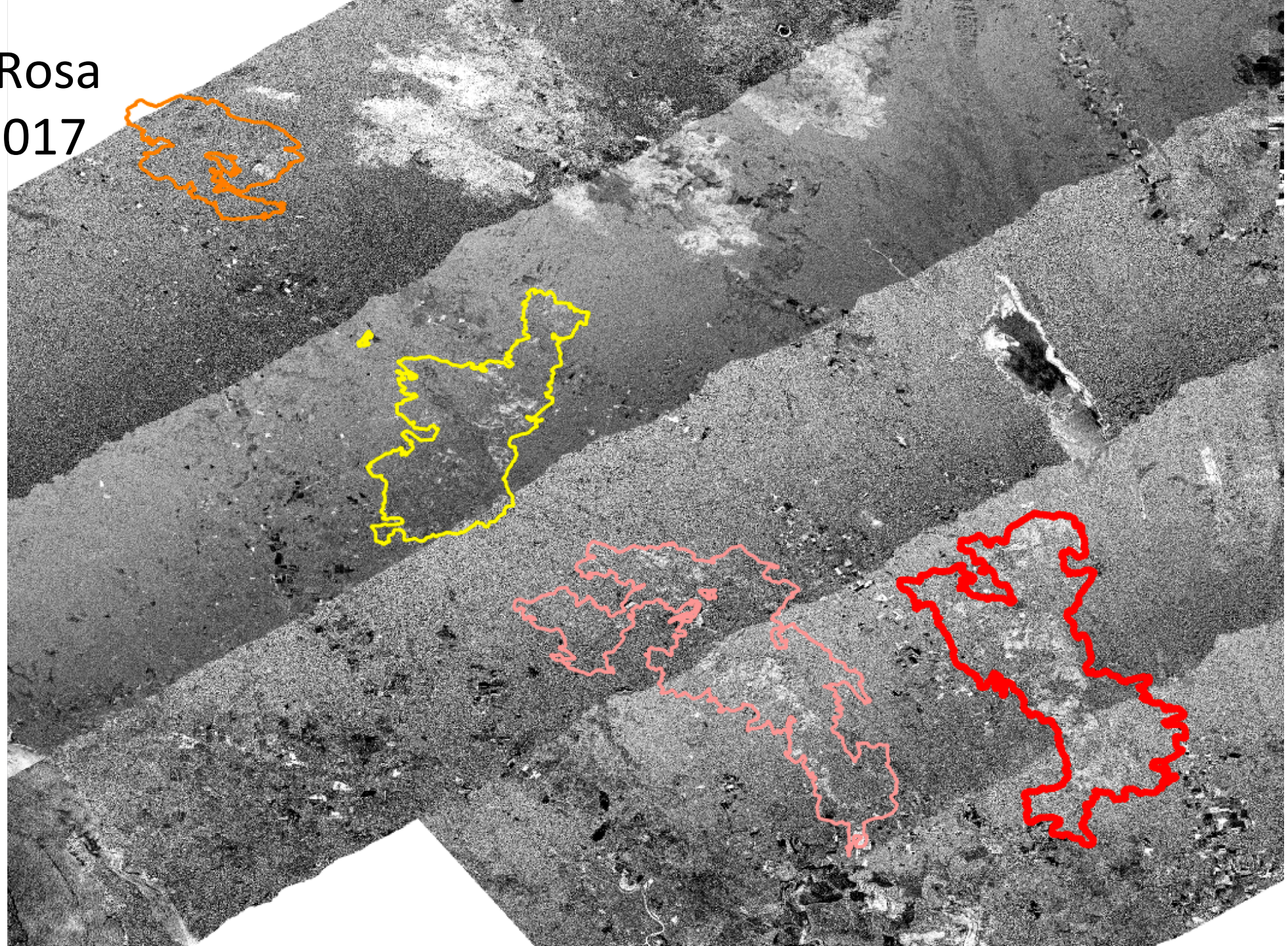
dNBR



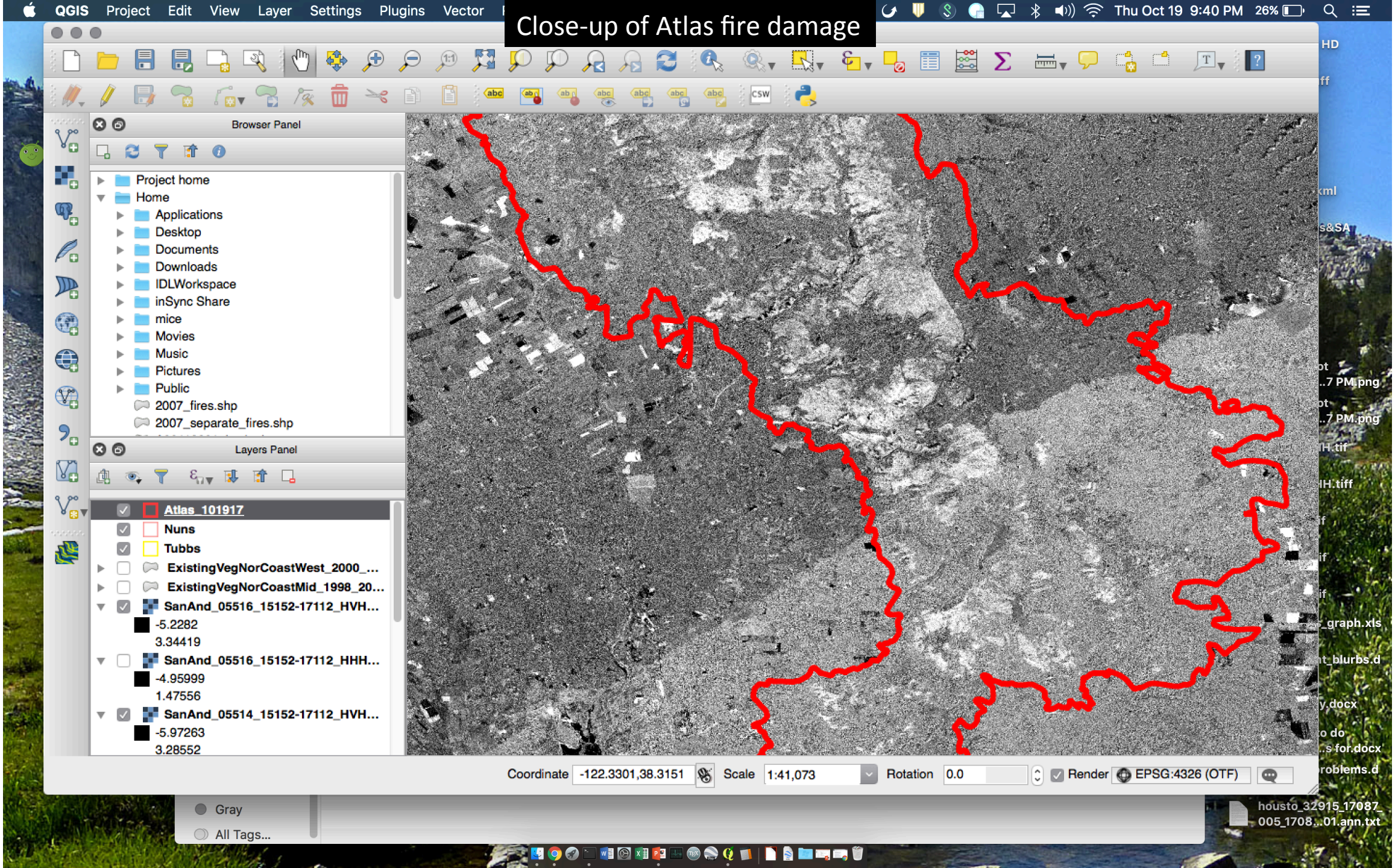
Vegetation

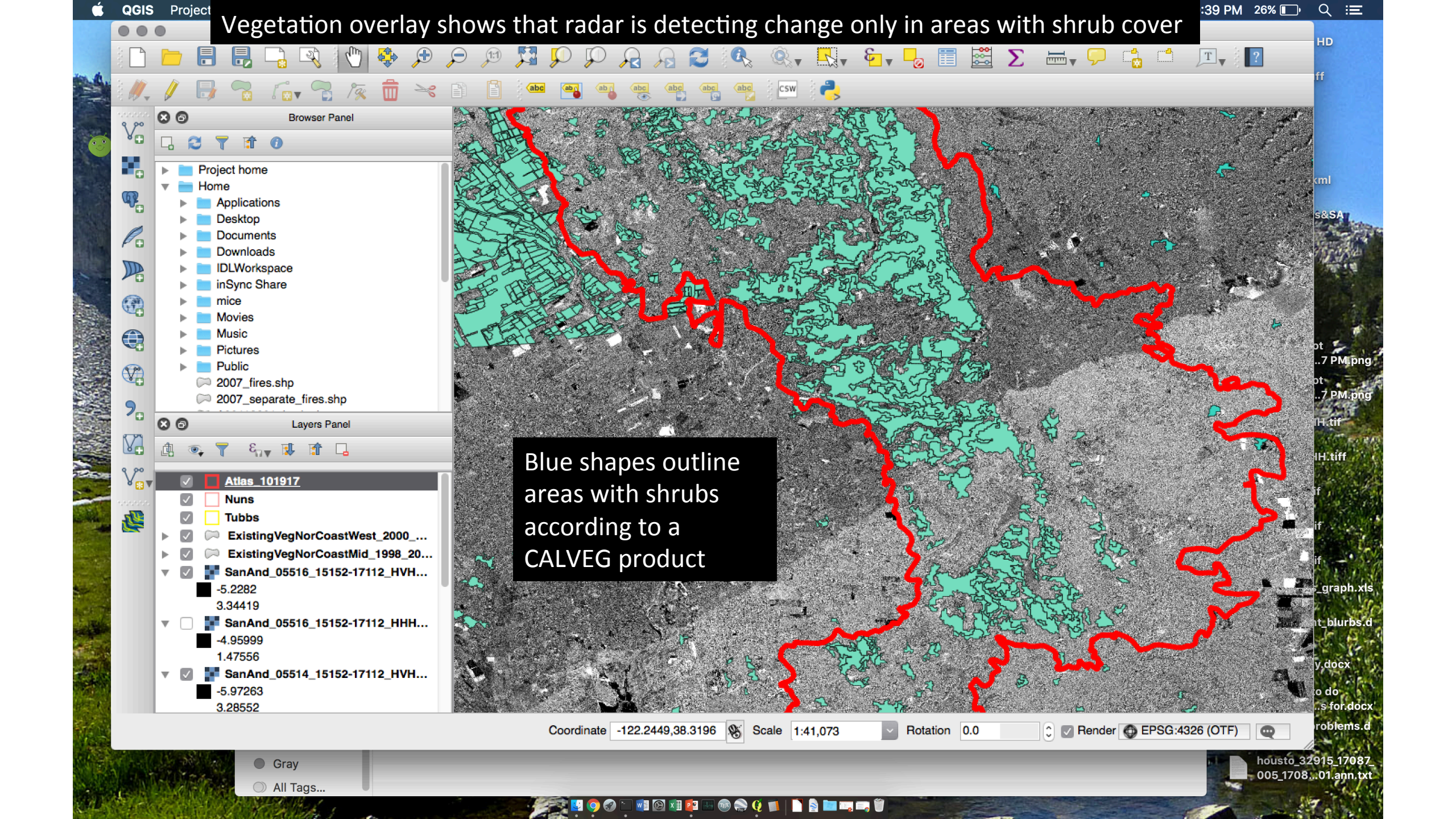


Santa Rosa Fires 2017



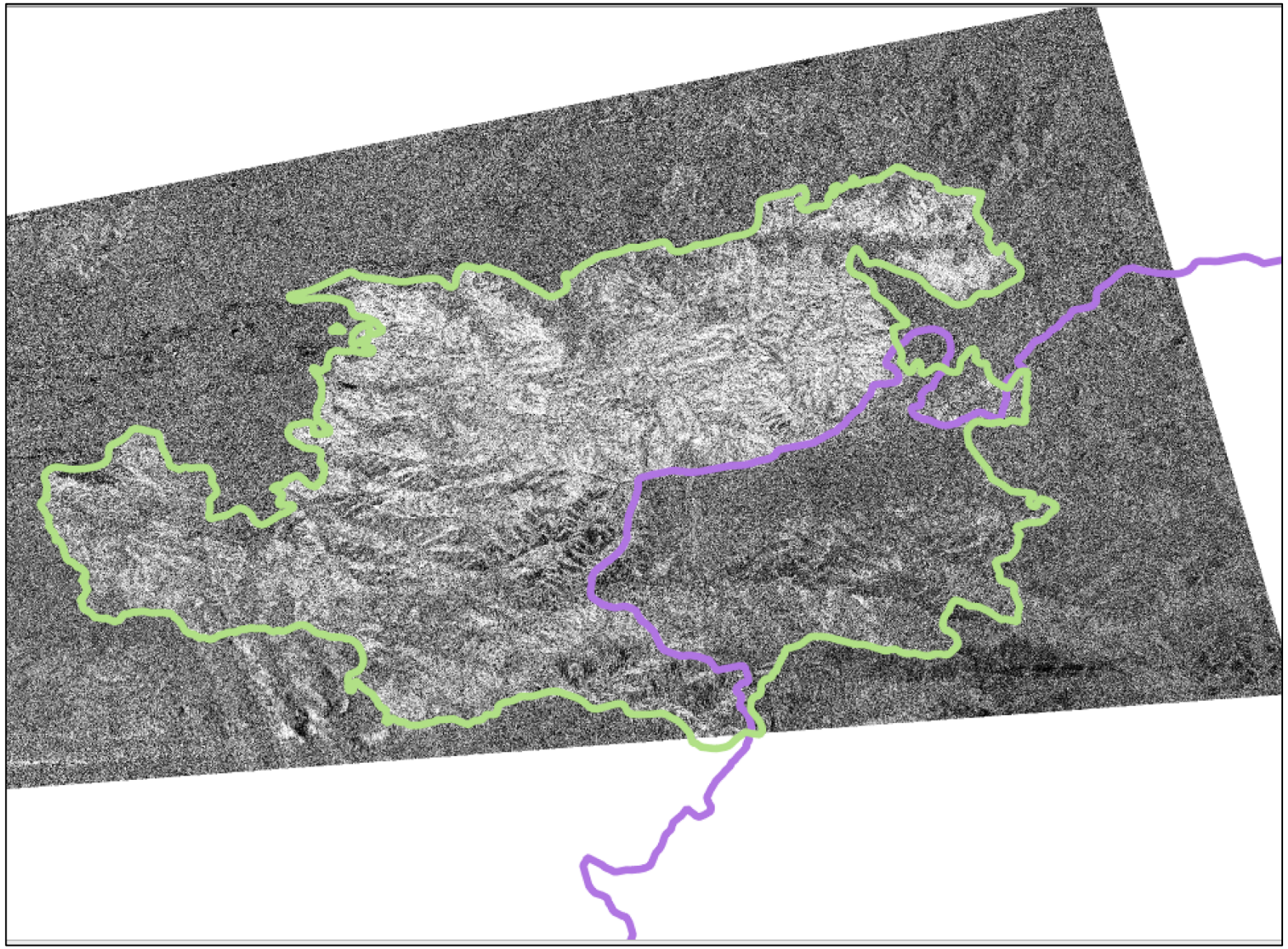
Close-up of Atlas fire damage




Vegetation overlay shows that radar is detecting change only in areas with shrub cover
Blue shapes outline areas with shrubs according to a CALVEG product
Browser Panel
Project home
Home
Applications
Desktop
Documents
Downloads
IDLWorkspace
inSync Share
mice
Movies
Music
Pictures
Public
2007_fires.shp
2007_separate_fires.shp
Layers Panel
Atlas_101917
Nuns
Tubbs
ExistingVegNorCoastWest_2000_...
ExistingVegNorCoastMid_1998_20...
SanAnd_05516_15152-17112_HVH...
-5.2282
3.34419
SanAnd_05516_15152-17112_HHH...
-4.95999
1.47556
SanAnd_05514_15152-17112_HVH...
-5.97263
3.28552
Coordinate -122.2449,38.3196
Scale 1:41,073
Rotation 0.0
Render
EPSG:4326 (OTF)

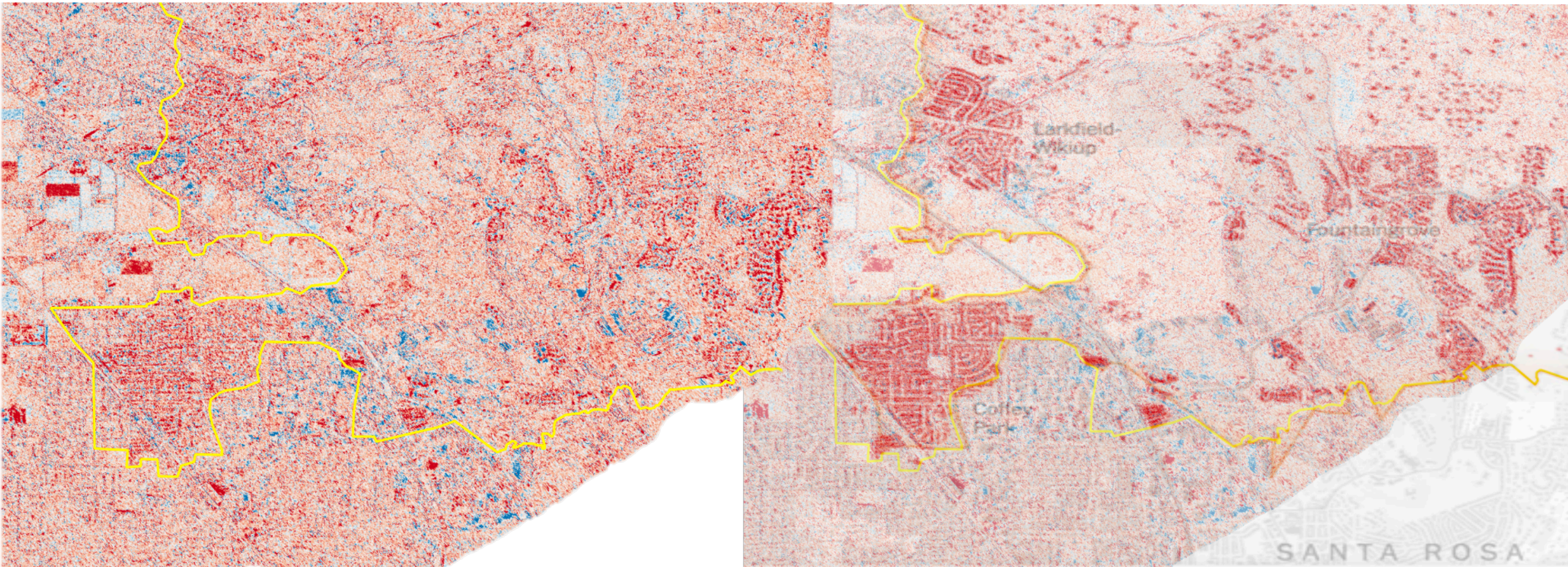
Sand Fire – Los Angeles County 2016

- Observation within a few days of the fire start
- Most of the fire scar is visible
- However, the missing section coincides exactly with the Station Fire scar
- The previously-burned vegetation is not detectable as "burned"



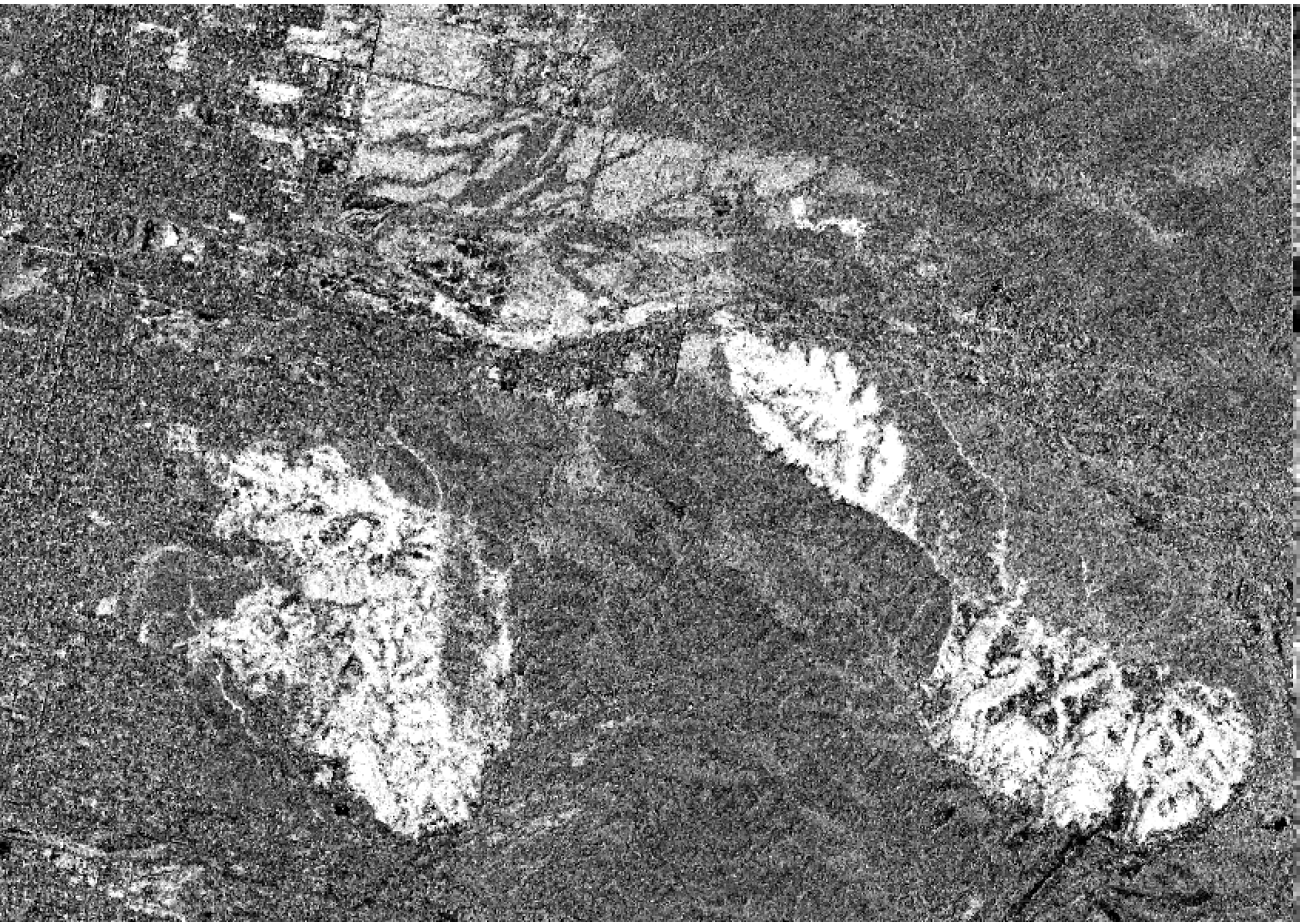
Tubbs Fire, structural damage

- Start Date 10/8/17
- End Date 10/31/17
- Pre-observation Date 4/23/2017
- Observation Date 11/12/2017
- 1,159/ 860 acres



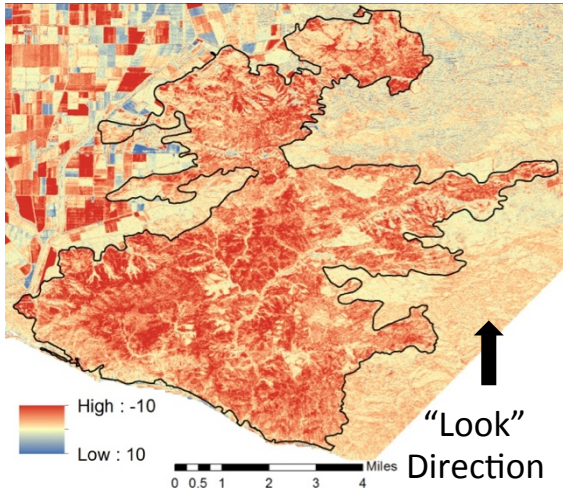
What is UAVSAR telling us?

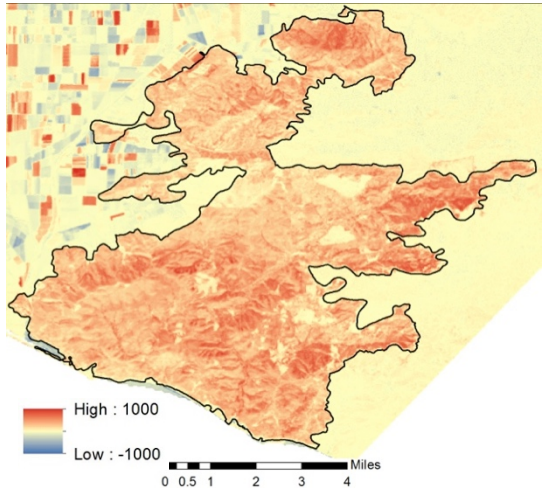
- Oak Glen and Pendleton Fires – Yucaipa
- Start Date 8/30, 8/31/09
- End Date 9/8, 9/4/09
- Pre-observation Date 4/23/2009
- Observation Date 9/11/2009
- 1,159/ 860 acres

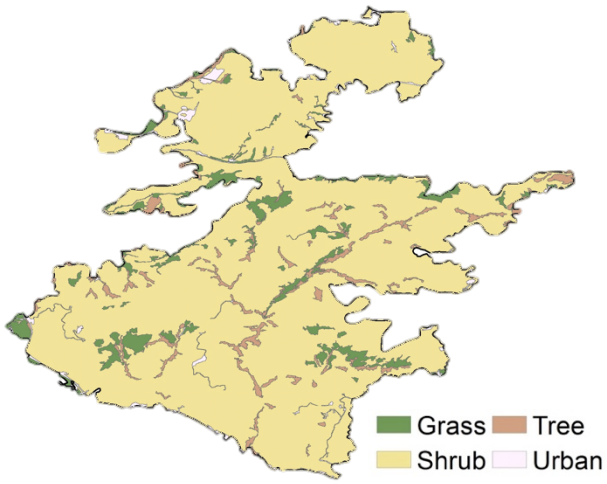


Project Conclusions

- For most case studies, the UAVSAR difference maps clearly identified burn scars.
- They showed similar patterns in burn severity detection as Landsat-derived dNBR burn severity products, but at a finer resolution.
- Vegetation type and time since last burn affect the detectable radar response.







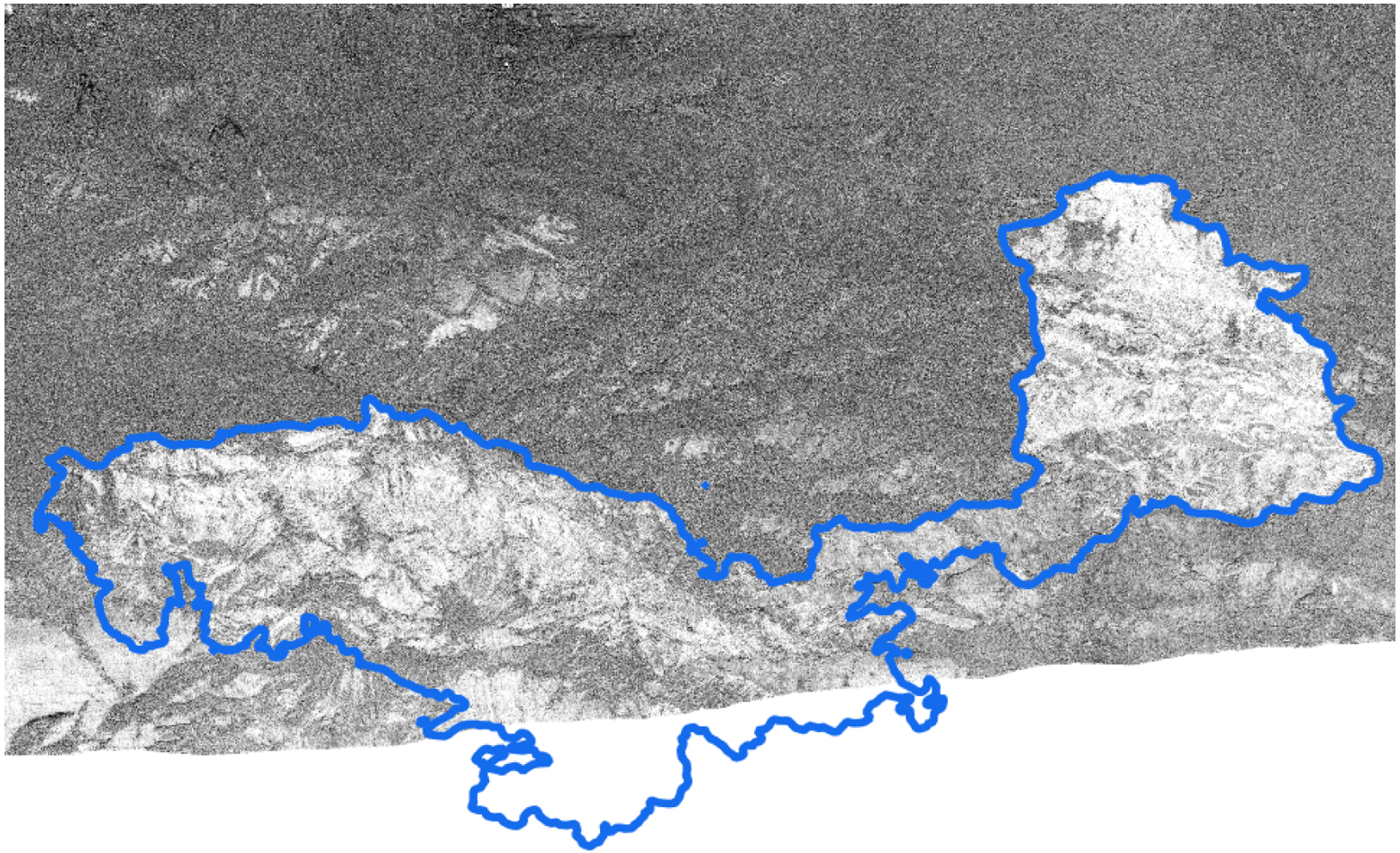
Springs Fire: ddB dNBR Vegetation

Long-term Response

Original Results for Lake Fire 2015

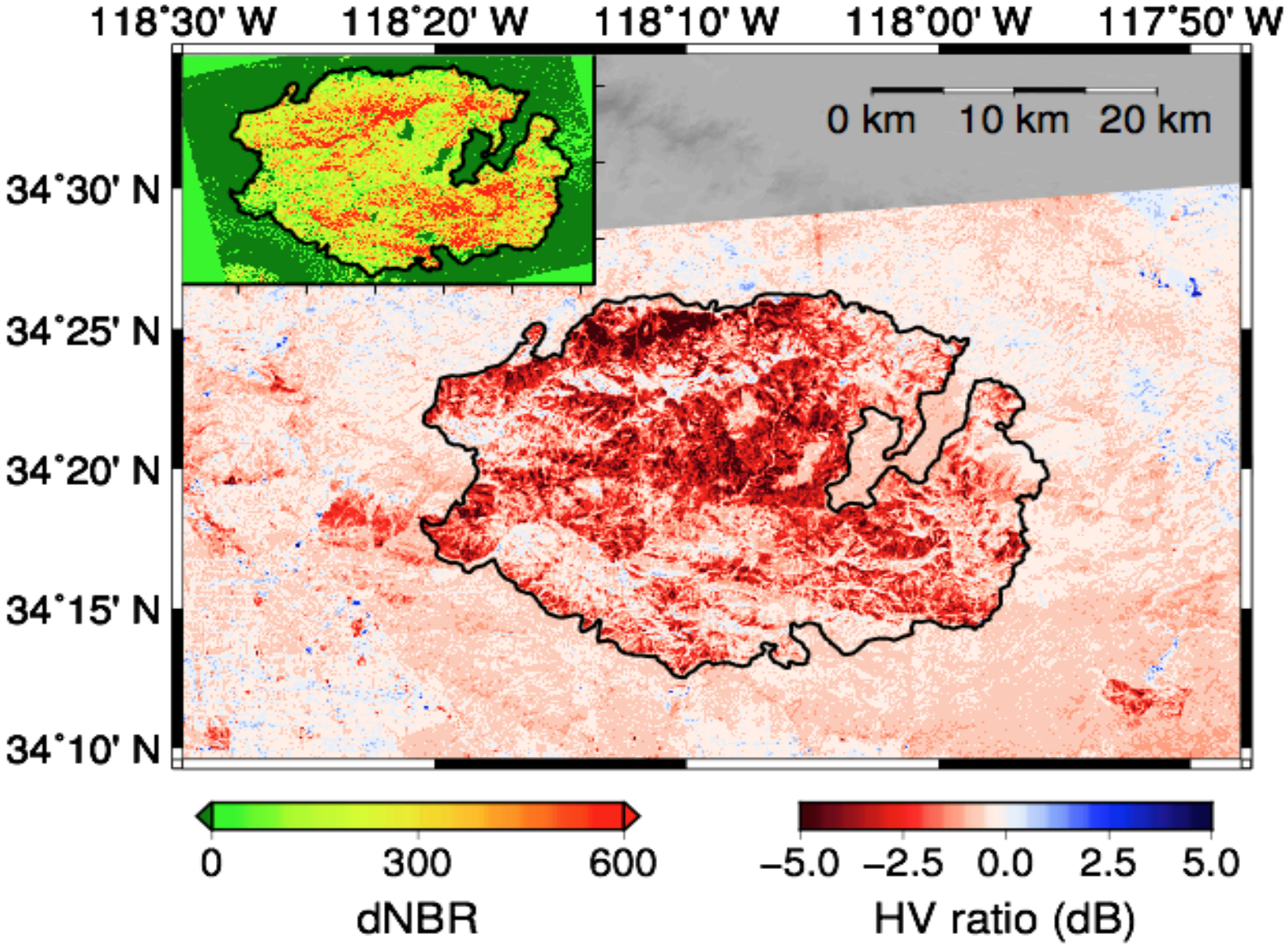
Fire scar barely visible

Results one year later

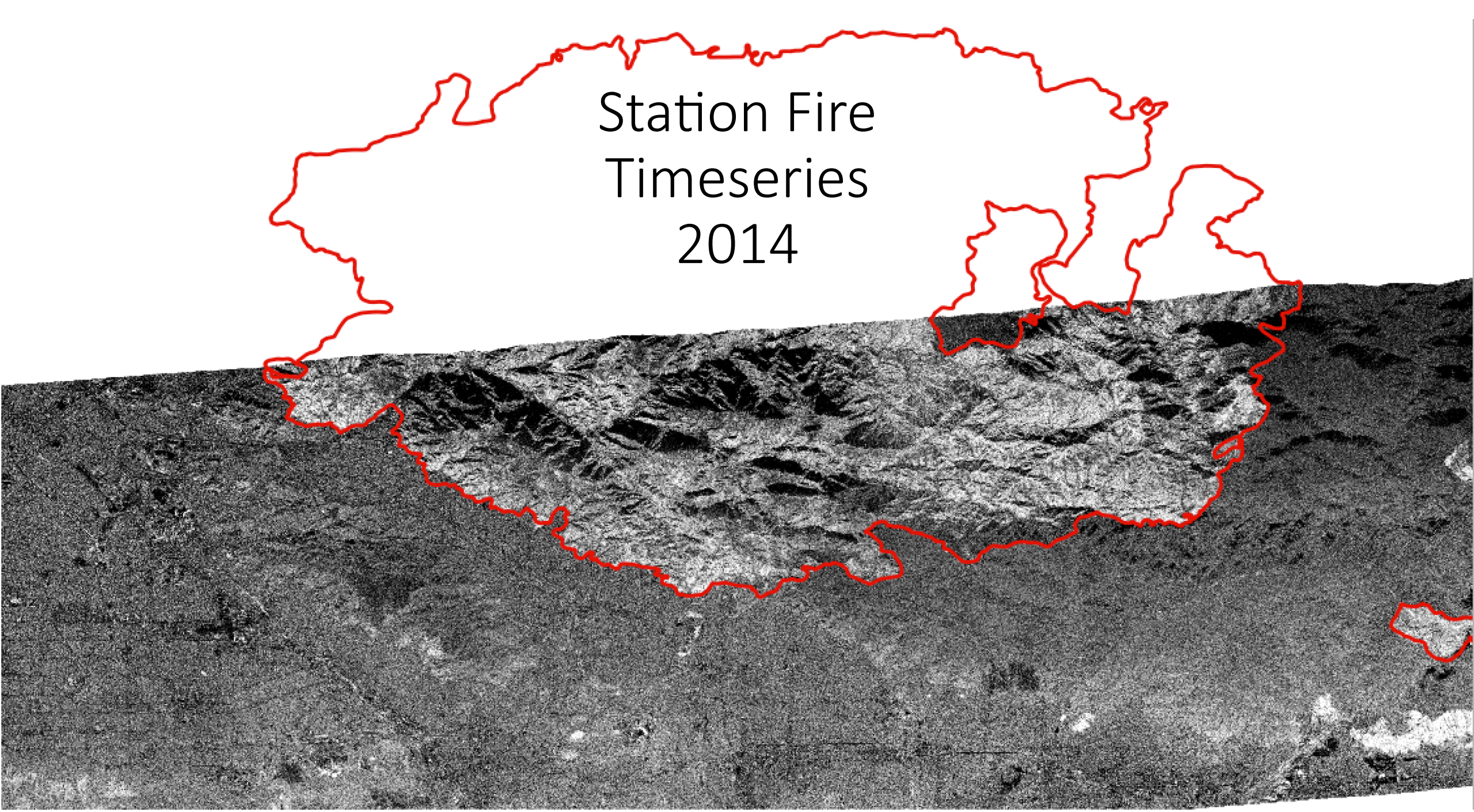


Fire scar clearly visible

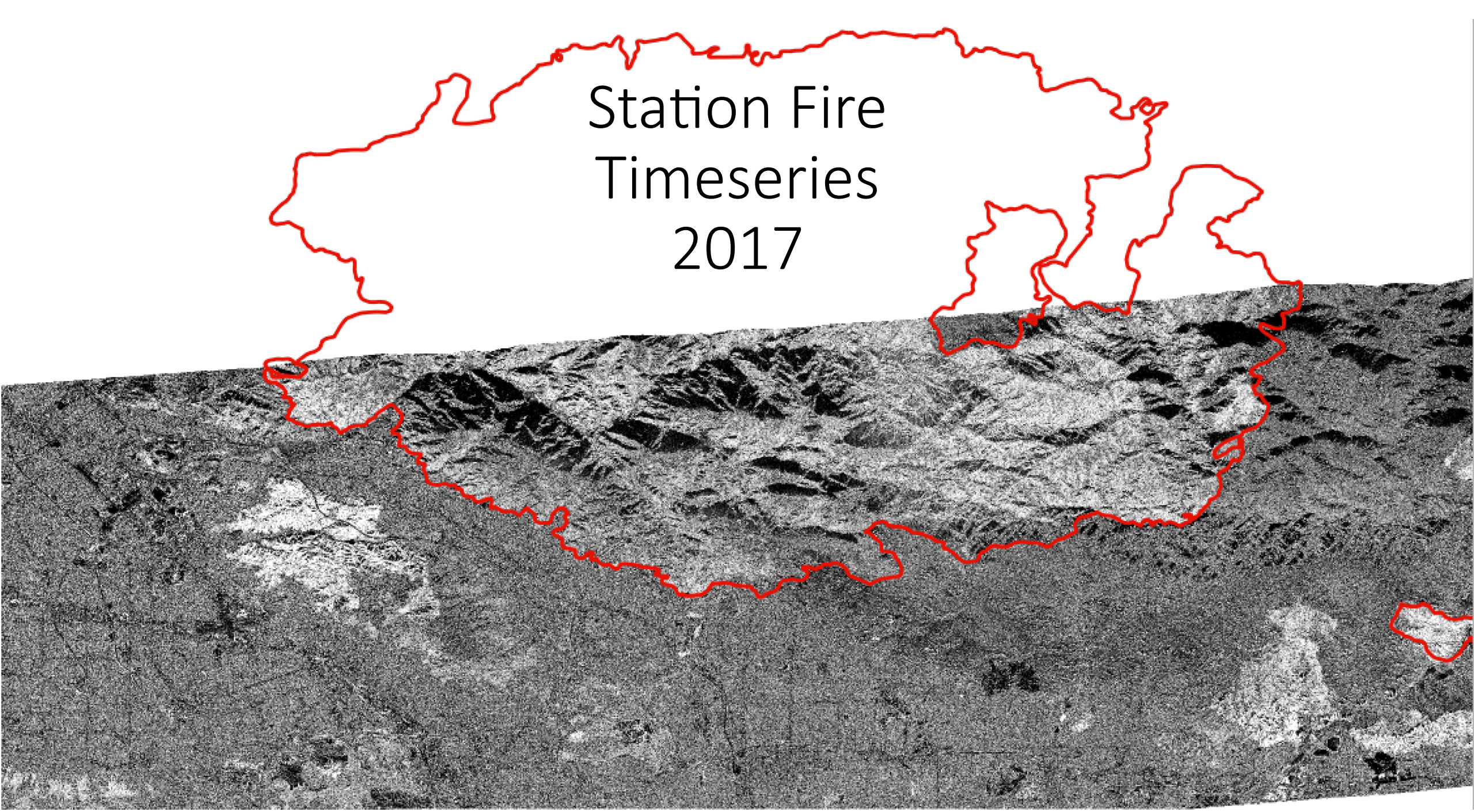
Station Fire Timeseries – Original scar visibility



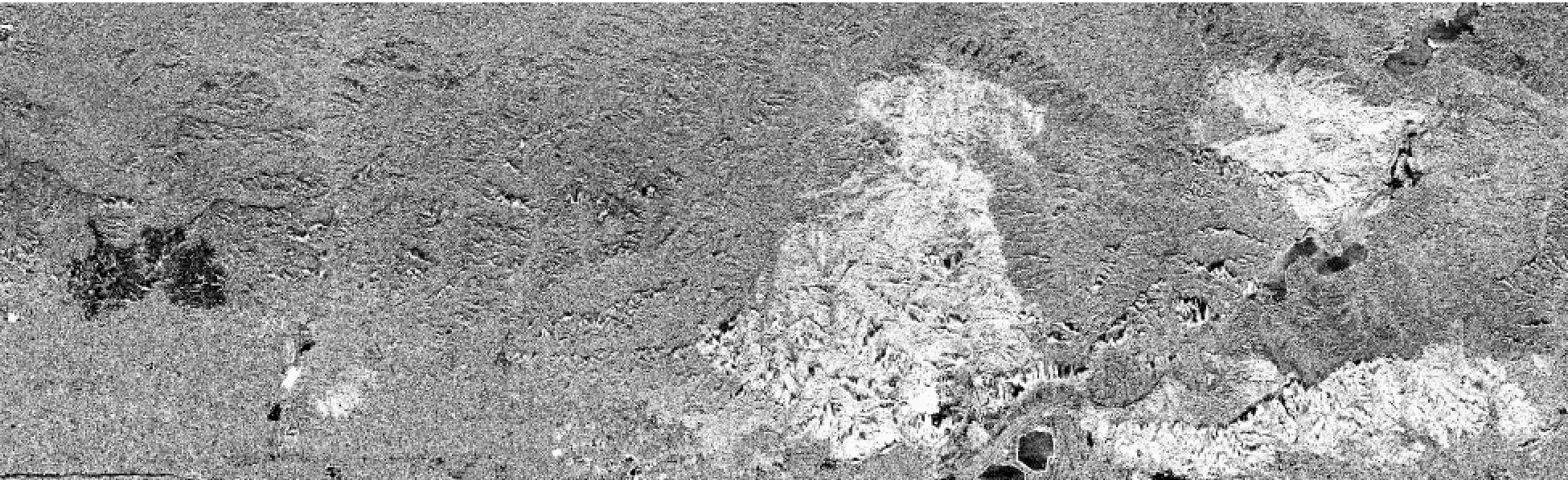
Station Fire Timeseries 2014



Station Fire Timeseries 2017



What is this telling us about the vegetative response over year-long or decade-long scales?



There is a lot of information in this data—We need ground-truthing and partnerships to explore it!