Creating IR-verified Gridded Fire Burn Maps using Public NASA and Satellite Data

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SATELLITE USE FOR BURNED AREA GRIDS

- Wildland fire is a natural and integral force on our landscapes and when uncontained, can devastate communities, threaten our health, and result in substantial economic losses
  - Between 2017 - 2021 wildfire insurance claims increased more than $50B.

- Verification of property loss is needed for affected homeowners receive payouts, allowing them to rebuild their lives

Pre-fire: 11/06/2018

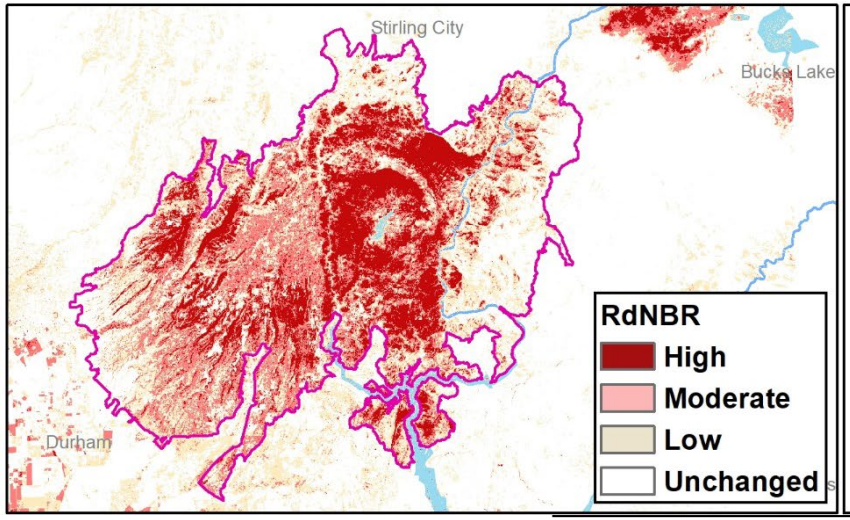
Post-fire: 12/06/2018

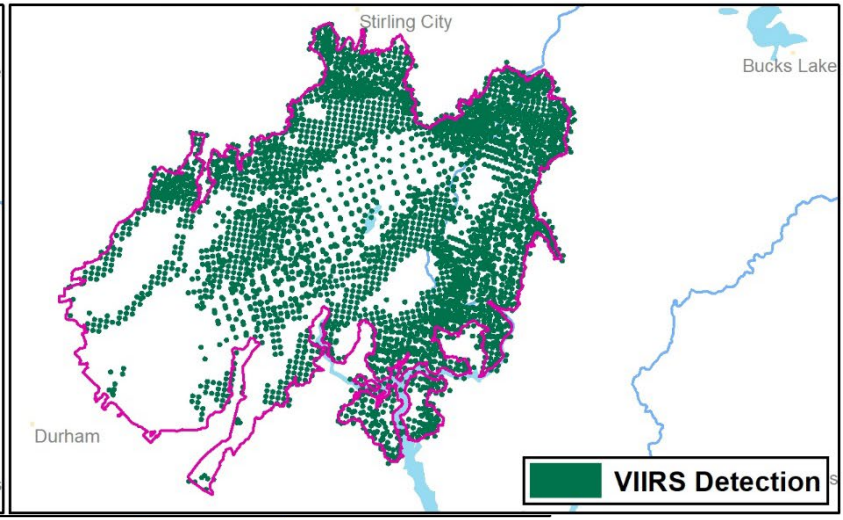


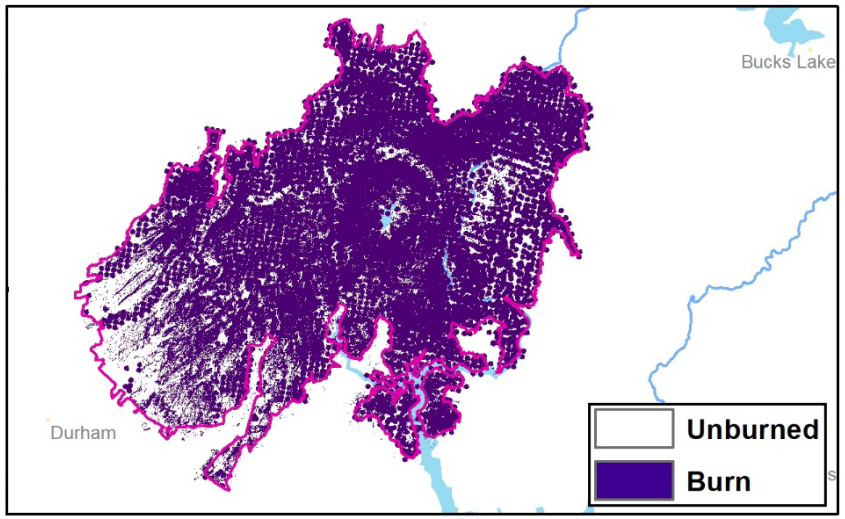
Camp Fire, CA (2018): Homes leveled by the Camp Fire line in the Rodgewood Mobile Home Retirement community in Paradise, CA.

BURNED AREA PRODUCT PROCESS

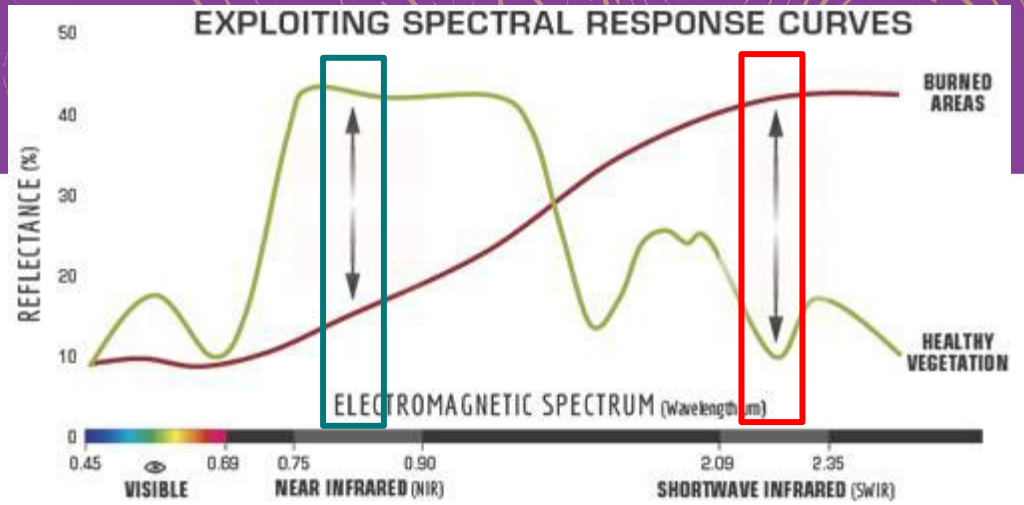
- A fire is considered out or has diminished greatly according to SIT-209 reports
- Buffer VIIRS fire detections to 375m
- Combine with RdNBR layer, keeping areas that signify burn
- Remove water and ice features
- Keep burn area touching or within official burned area National Interagency Fire Center (NIFC) perimeters







RELATIVE DIFFERENCE NORMALIZED BURN RATIO INDEX (RDNBR)



https://www.fs.fed.us/eng/rsac/baer/barc.html

- Sentinel-2 (20-m) Pre- and Post- fire scenes
- Relative dNBR index used to provide a more consistent definition of severity between landscapes and allow for higher accuracies in high severity burn in heterogeneous landscapes.
- High and moderate burn areas or areas marked as low *with* VIIRS detection are marked as "burned"

$$NBR = \frac{NIR - SWIR}{NIR + SWIR}$$

$$RdNBR = \frac{PreFireNBR - PostFireNBR}{\sqrt{|PreFireNBR/1000|}}$$

Severity Category	RdNBR
Unchanged	<69
Low	69 - 315
Moderate	316 - 640
High	>=641

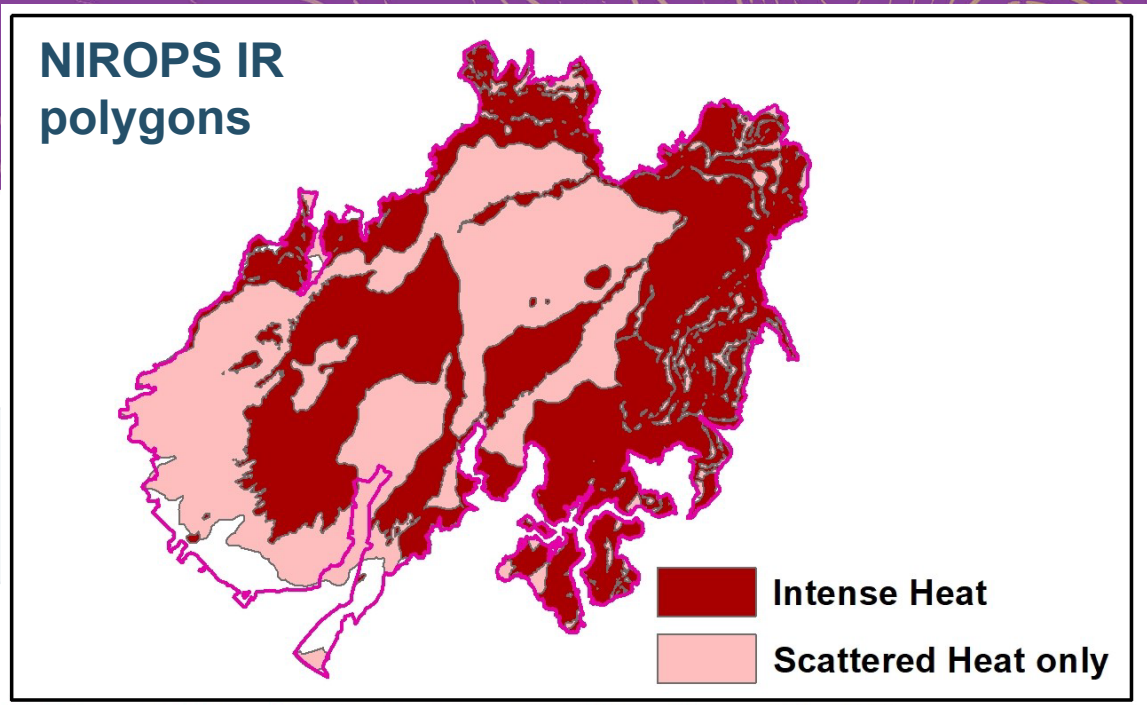
Miller and Thode 2006

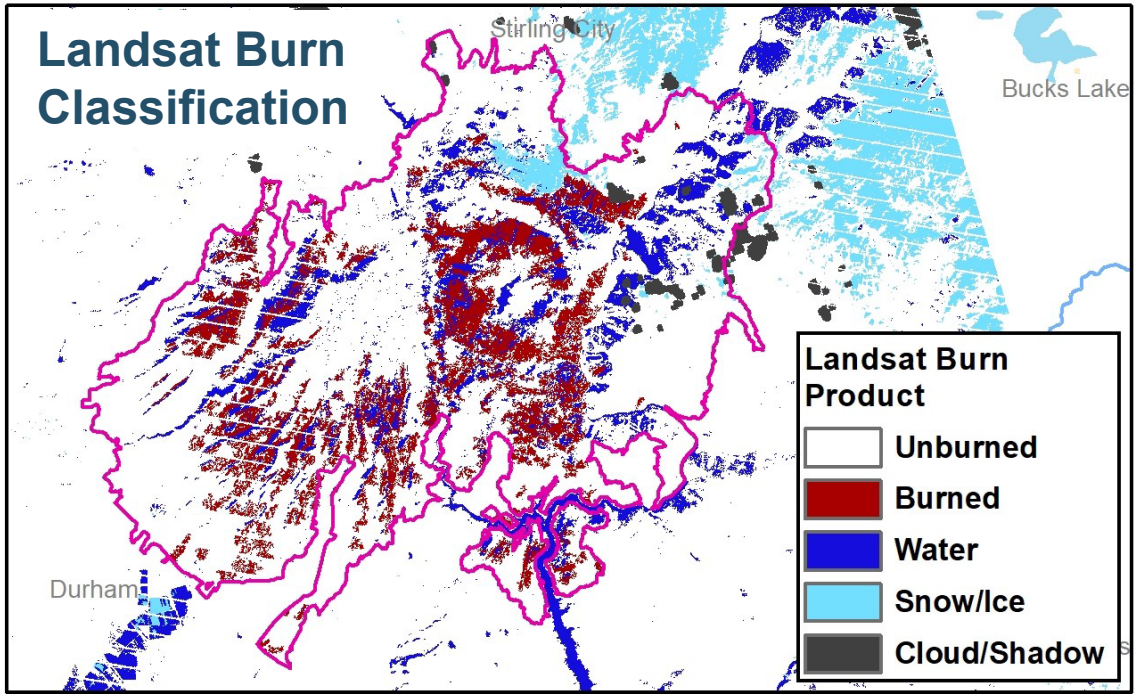
LANDSAT BURN PRODUCT AND NIROPS IR PRODUCTS

Landsat Category	NIROPS Scattered heat only	NIROPS Scattered + Intense heat	NIROPS Intense heat	Our Burn Product
Unburned	61%	66%	70%	63%
Burned	20%	16%	13%	19%
Water	12%	12%	12%	12%
Snow/Ice	2%	2%	1%	2%
Cloud/Shadow	0%	1%	2%	1%
NoData	4%	3%	3%	3%

Intersection of our burn product and NIROPS IR products

Our Burn Product	74	79	84





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METHODOLOGY ITERATIONS

One pre/post RdNBR

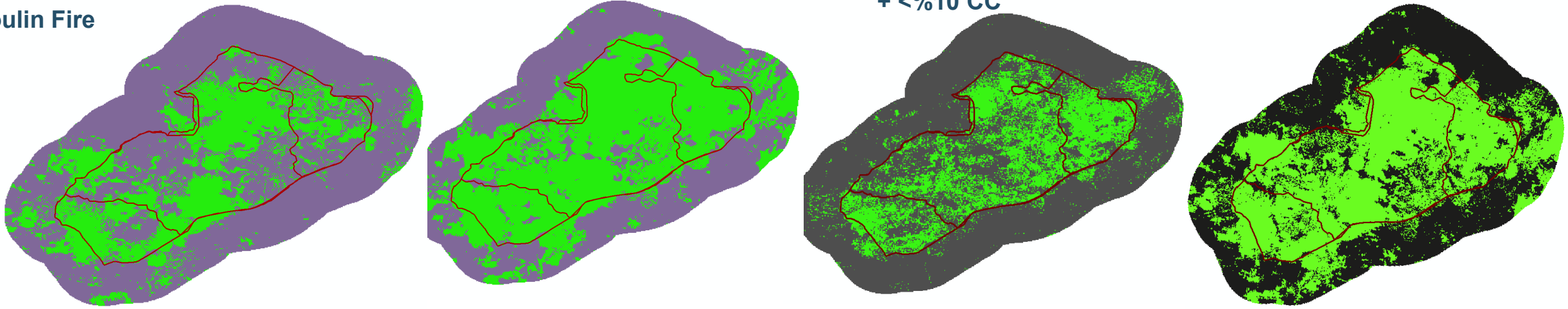
Max RdNBR

75th Percentile RdNBR + <%10 CC

75th Percentile RdNBR only

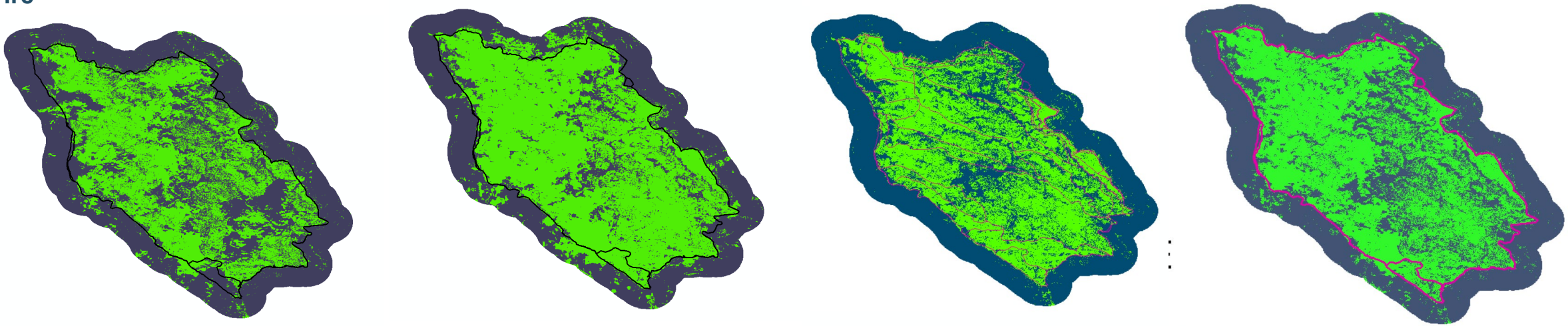
Boulin Fire

Final burn flag



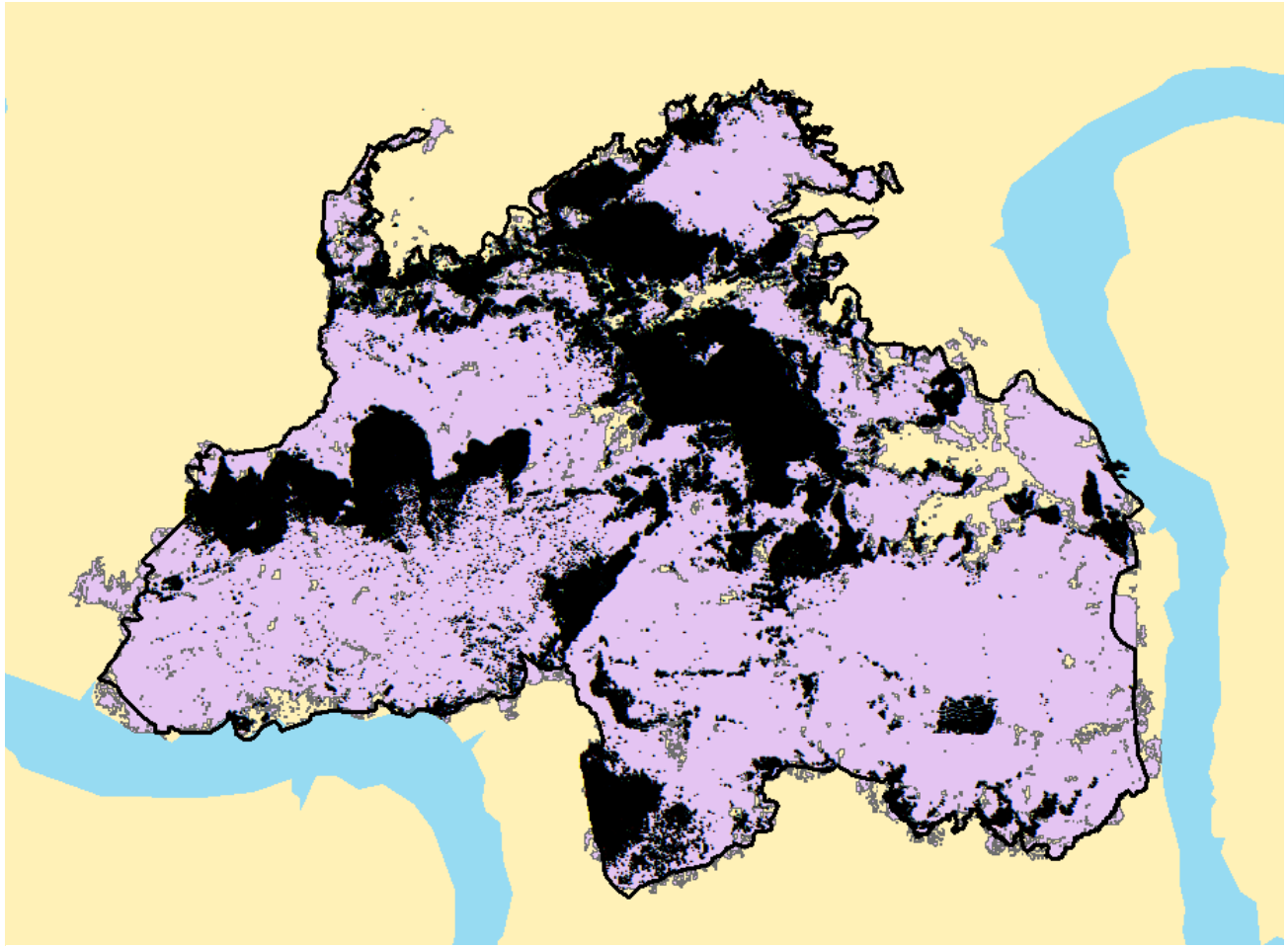
Castle Fire

Final burn flag



MODIS ASTER INFRARED (MASTER IR) SAMPLES

- To verify what we consider burned pixels, we use MASTER IR data flown on the DC-8 during FIREX-AQ 2019 campaign.
- Each point is a MASTER pixel sample that marks a point actively burning when the DC-8 flew over the fire.
- We compared all FIREX-AQ wildfires and counted points that match what we call burn and points that did not.



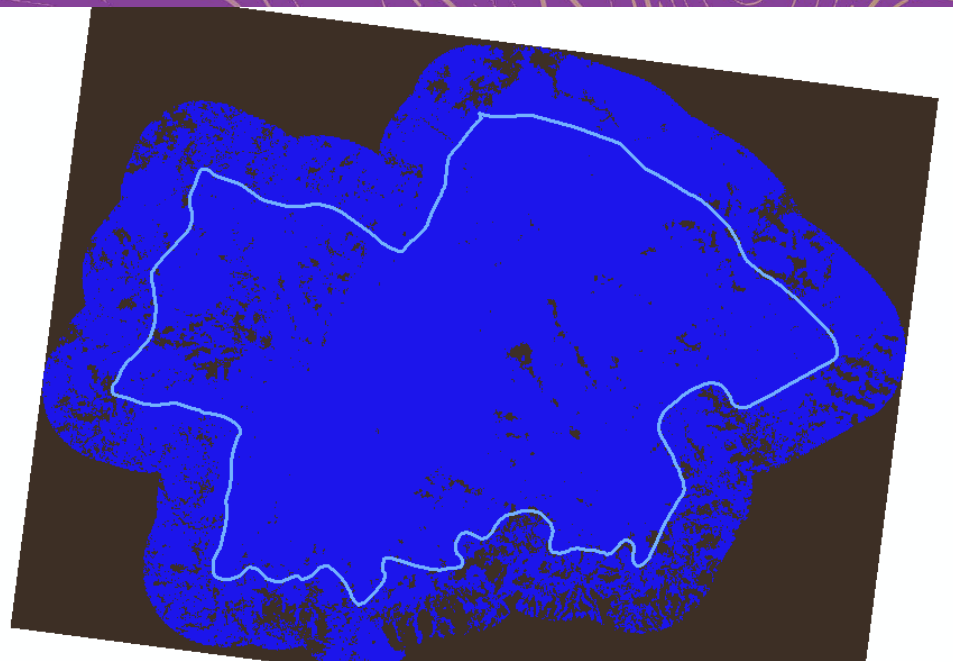
Williams Flats Fire, 2019: 542,054 MASTER points sampled

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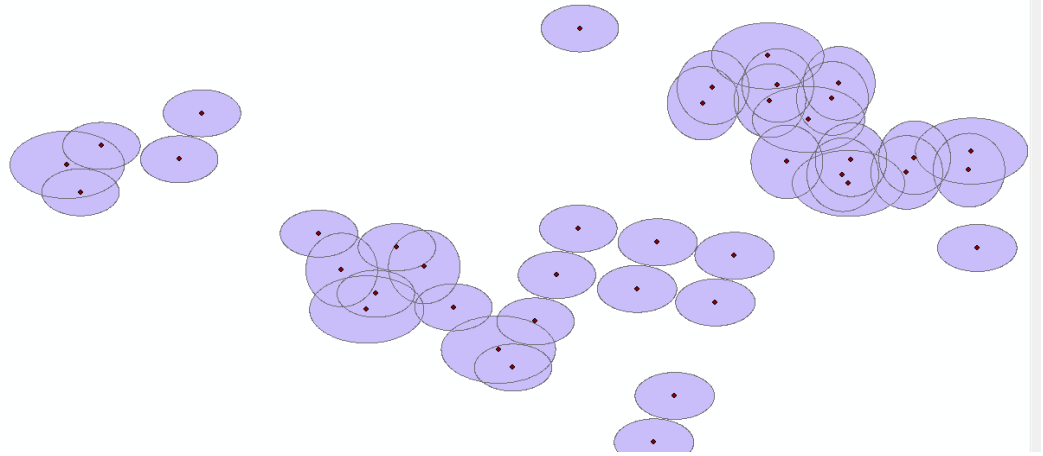
Fire	One Pre/Post Scene RdNBR Agreement	MAX RdNBR Agreement	75th percentile, <10% CC Agreement	75th percentile Agreement
Lick Creek	99%	99%	99%	99%
Snow Creek	99%	97%	99%	99%
Ridgetop	98%	100%	100%	98%
Sheridan	97%	97%	99%	99%
Springs	94%	97%	70%	97%
Sheep	90%	99%	96%	97%
Saber	75%	84%	85%	78%
Left Hand	95%	100%	99%	99%
Boulin	86%	94%	72%	88%
Castle	64%	91%	80%	79%
Trumbull	81%	94%	85%	85%
Horsefly	98%	99%	98%	98%
Ikes	39%	87%	63%	61%
North Hills	96%	97%	98%	98%
	88%	**95%**	**90%**	**90%**

FUTURE STEPS

- Analysis on false positives
- Incorporate track and scan angle for VIIRS
- Analyze ecosystem sensitivities (rock/bare regions)
- Automate in Google Earth Engine and ArcGIS



Bare soil and rocky regions often flag as burn

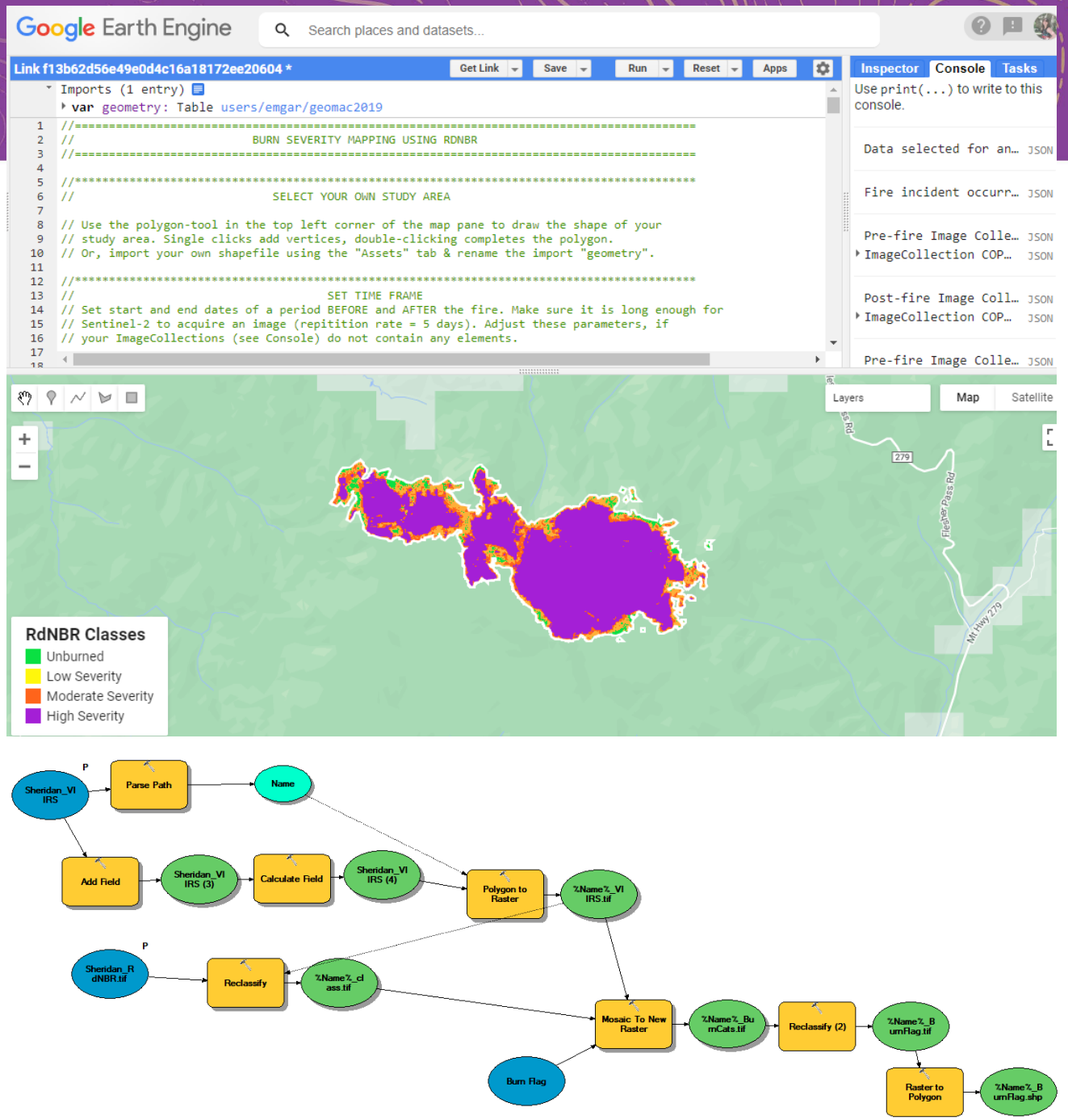


VIIRS fire detections scan and track angle changes detection shape

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PUBLICLY AVAILABLE

- Burned area grids for fires will be available online to the public (NASA DAAC)
- GEE and ArcGIS model made available if users would like to run their own processing
- Currently targeting fires in CA as test cases, but process would work all over the world.



THANK YOU

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