Descartes Labs

Using Satellites and Advanced Analytics to Track Fires

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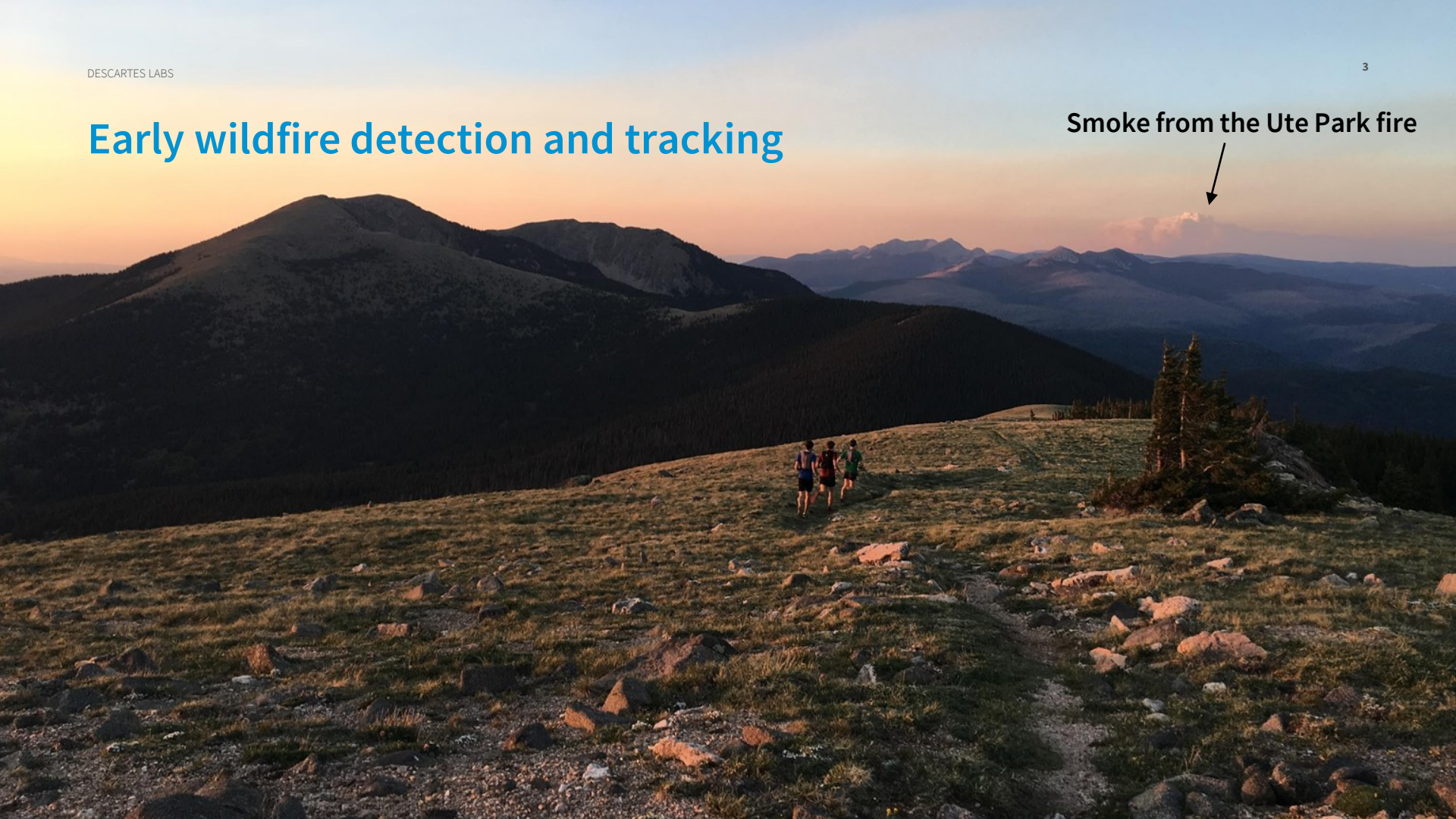
Who are we?

- 99 people, $38M in VC investment
- Decades of experience in large-scale computing, remote sensing, and machine learning
- **Goal:** Build a digital twin of the Earth

Early wildfire detection and tracking



Detecting wildfires: The tried and true methods

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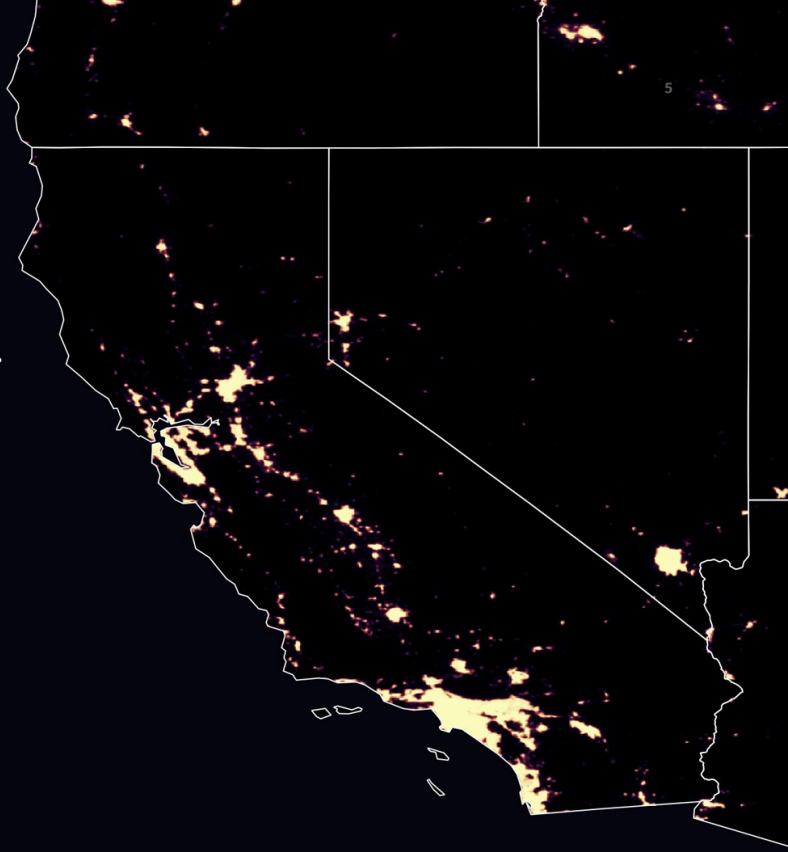
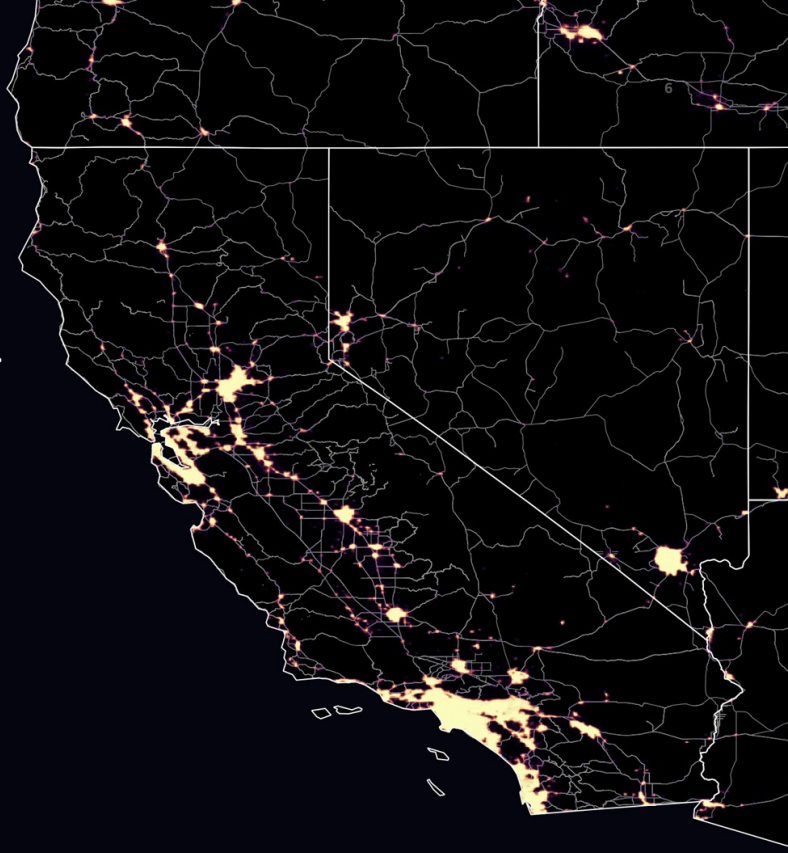
  - Where they live



Detecting wildfires: The tried and true methods

- Traditionally, wildfires have been detected by people…
  - Where they live
  - Where they are travelling



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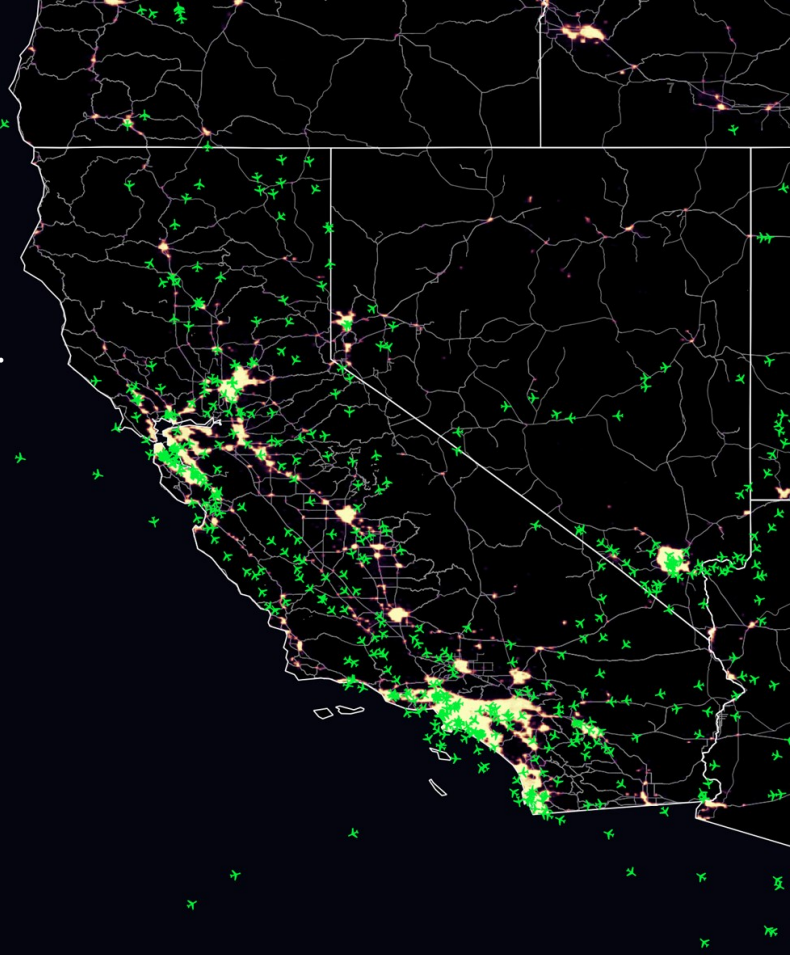

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- Traditionally, wildfires have been detected by people…
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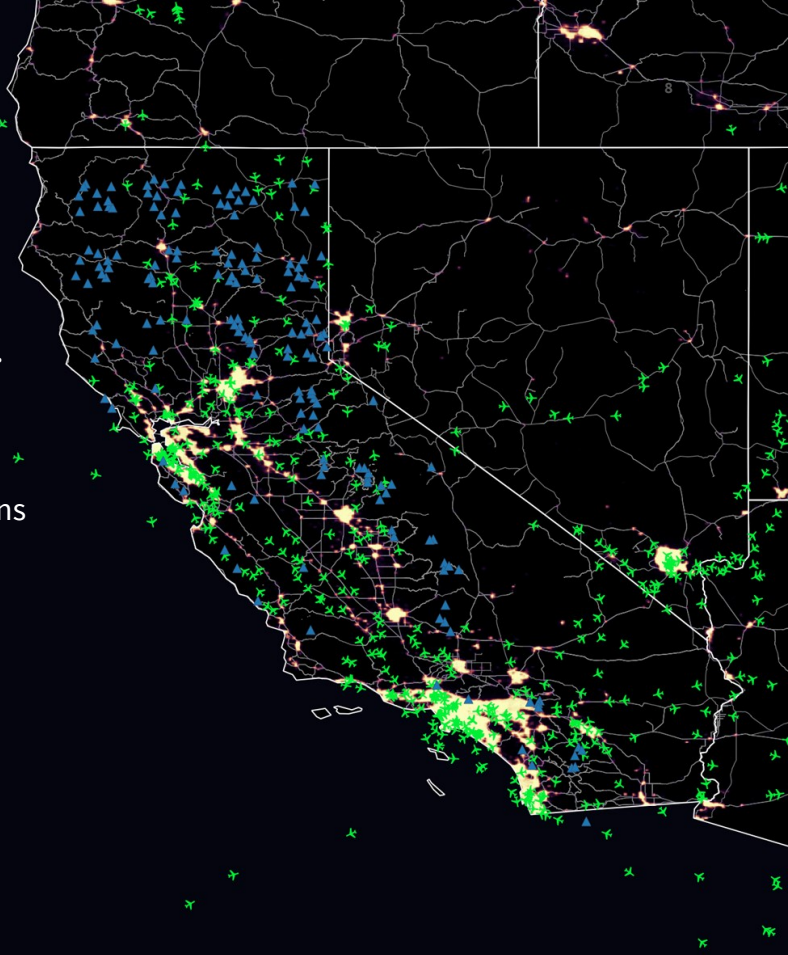
  - Where they are travelling
  - By pilots flying overhead
  - And by dedicated fire suppression infrastructure and operations
    - Fire lookout towers
    - Reconnaissance flights



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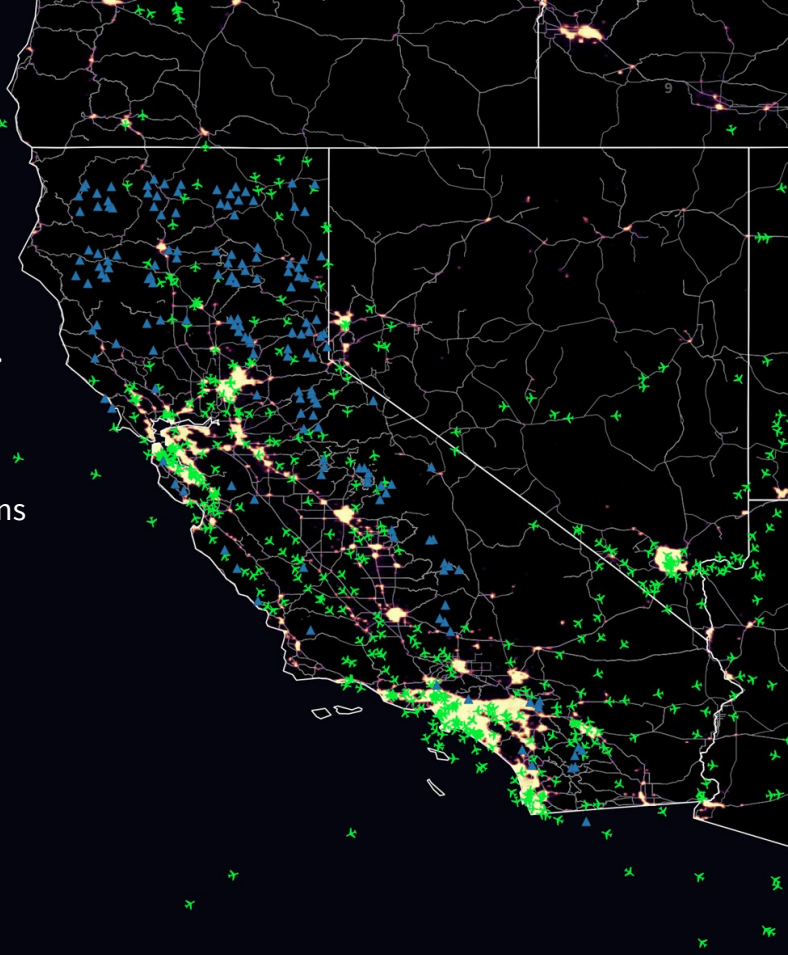
- However, big gaps still exist…
  - Spatially: Remote areas still exist
    - People cannot be everywhere at once
  - Temporally: Day versus night
    - Visibility decreases during the night
    - People go to sleep



What can we do to help?

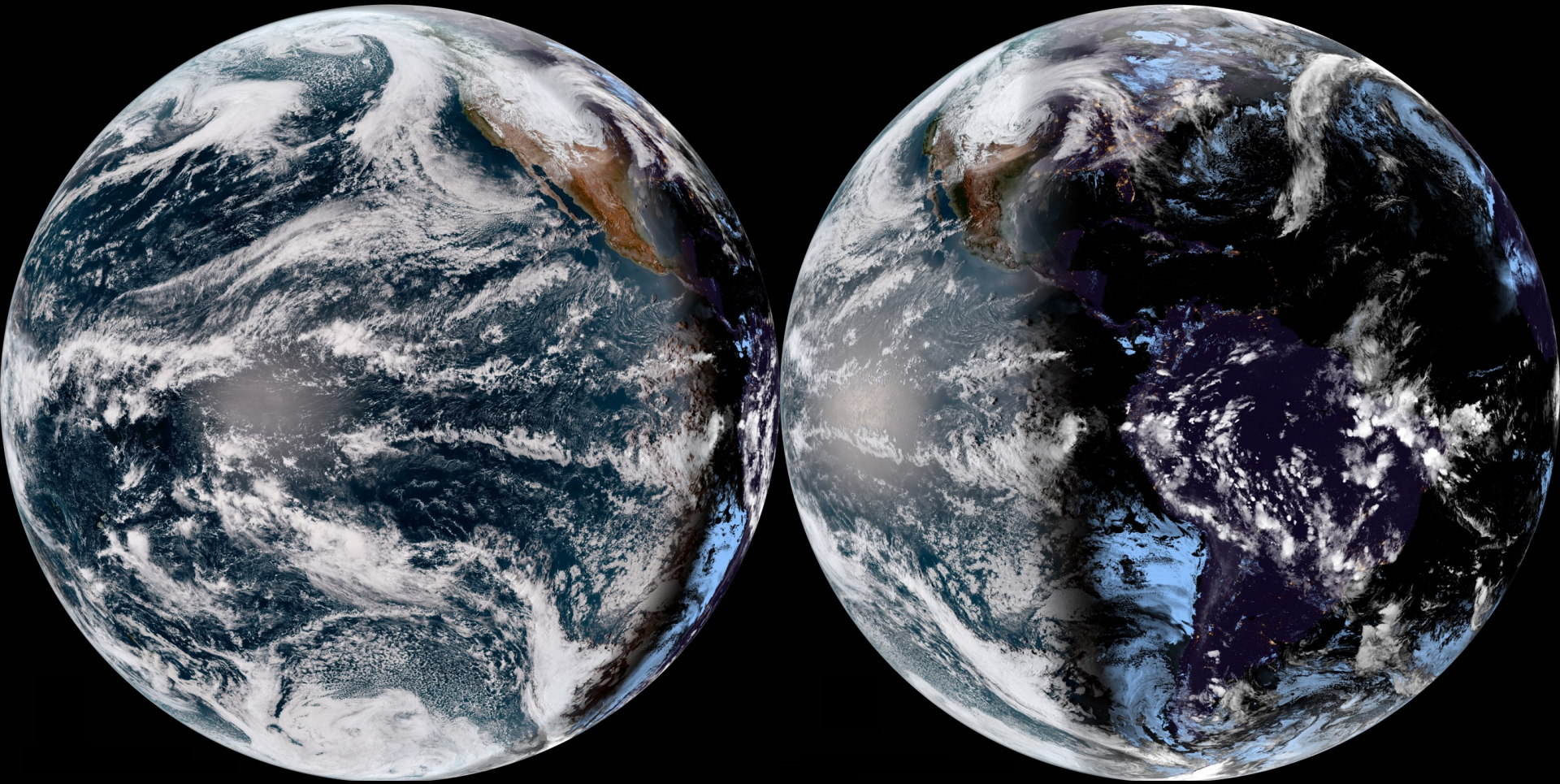
- We are building an “early-warning” wildfire detector using remote sensing imagery and machine learning

- Augment, not replace existing detection methods
  - There is no one detector to rule them all

- Concrete goals:
  - Detect at least three large wildfires per year, before they are reported
  - Produce as few false positives as possible

GOES-17 (GOES West)

GOES-16 (GOES East)

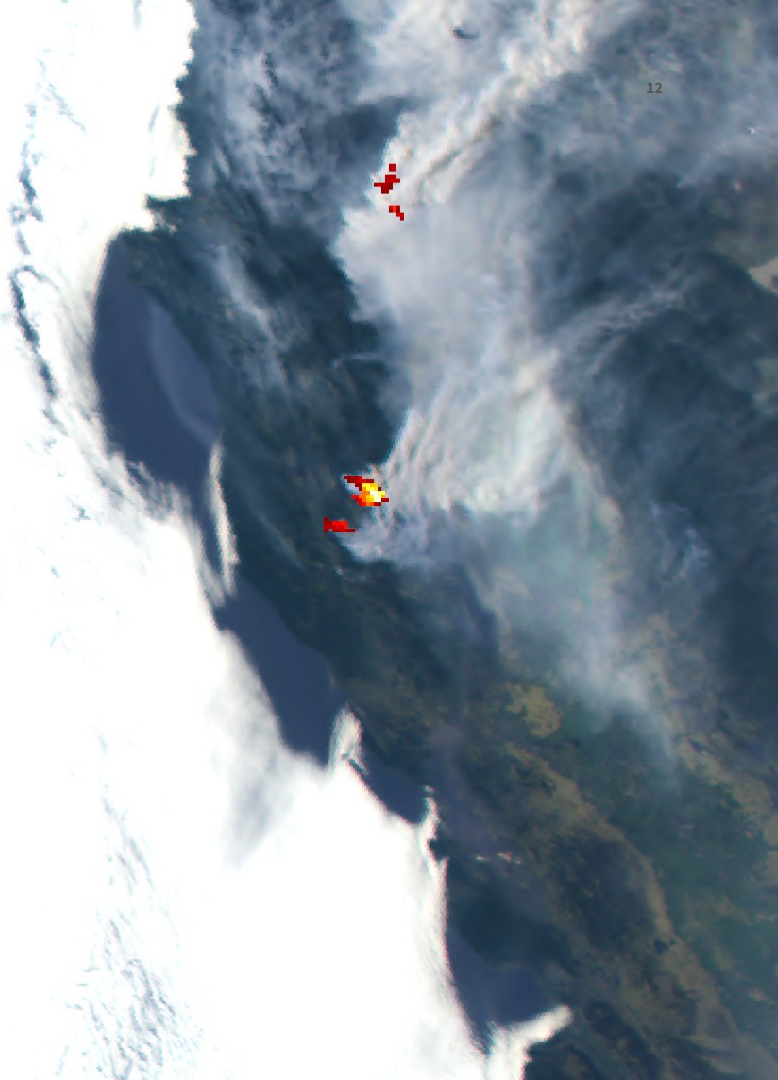


GOES-16 and -17: Keeping an eye on the Western Hemisphere

- Image are collected:
  - Every 5 minutes over CONUS/PACUS
  - Every 15 minutes over the “full disk”
- It takes us around 4 minutes to ingest these images into our platform after they have been captured

- Images are collected in the thermal infrared spectrum
  - Useful for detecting and tracking hot things (wildfires)
  - Pixel size: 2 km × 2 km

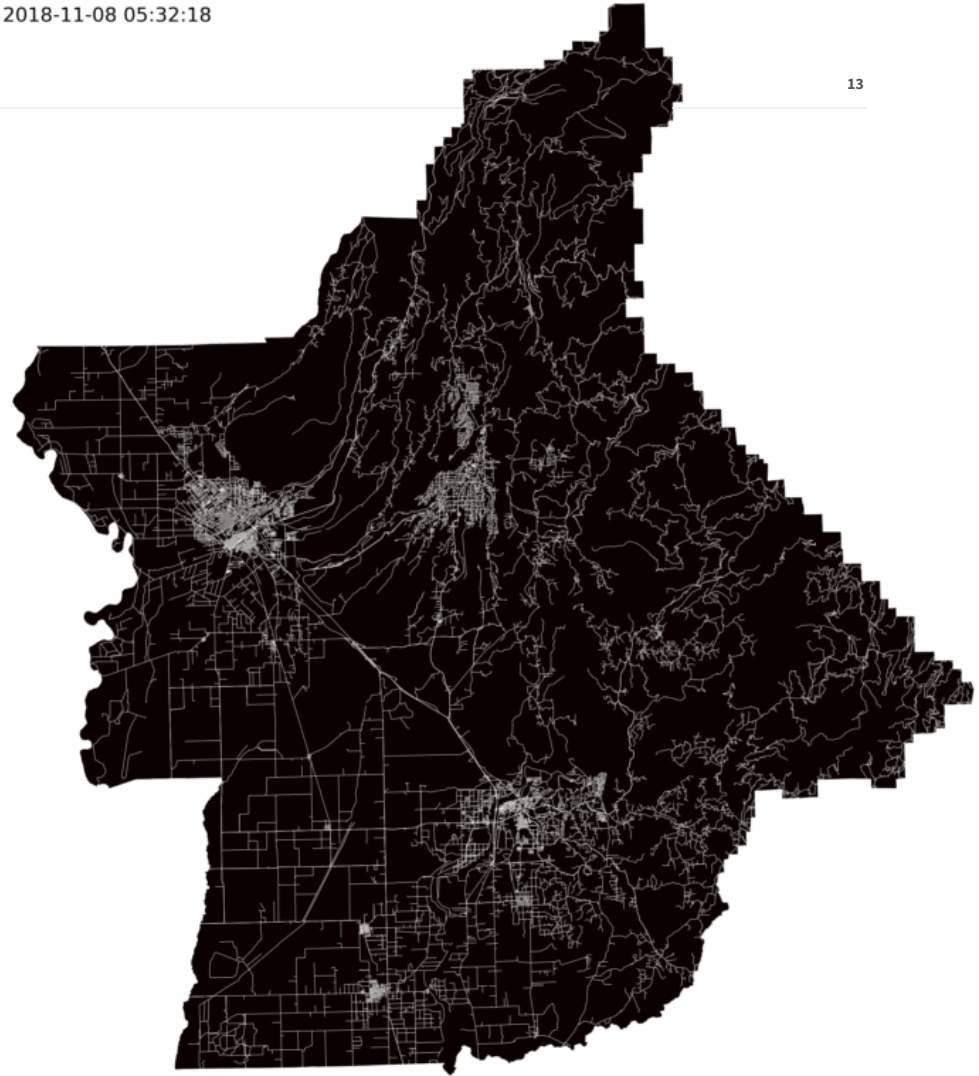
- Enables us to build a detector that is real time and always on
  - Comes at a cost: We are best at detecting fast burning wildfires



The first day of the Camp Fire, as seen by GOES-16

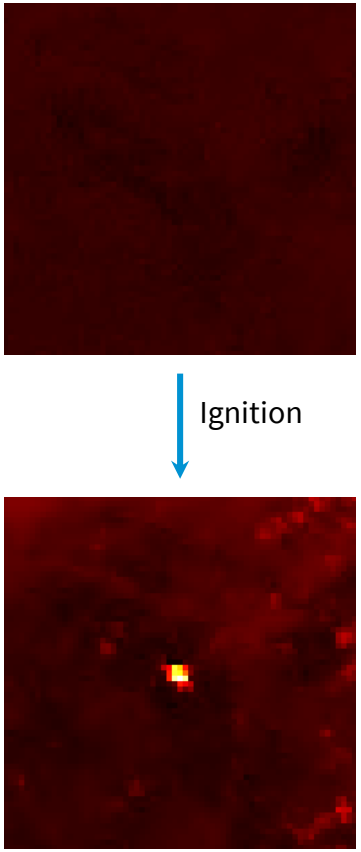
- The animation on the right shows:
  - Temperature (in red), as measured by the GOES-16 3.9 µm thermal infrared band
  - 911 calls related to the disaster, as released by the Butte County Sheriff's Office

- Fast burning wildfires begin as a subpixel area in the image
  - Results in one pixel that is slightly hotter than its surroundings
  - How can we leverage this to build a wildfire detector?



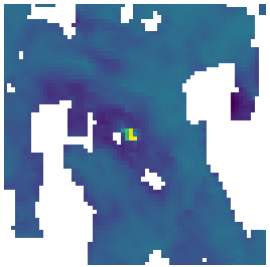
Wildfires as anomalies

- For a given location, wildfires are rare and cause this area to be much hotter than normal
  - In this way, wildfires are anomalous
- Hotter than normal:
  - In an absolute sense
  - In a physical sense
  - In relation to the past
- Strategy: Model what normal looks like, and compare this model with the current situation to detect wildfires

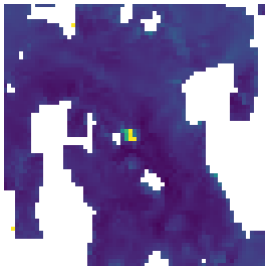


Ignition detection

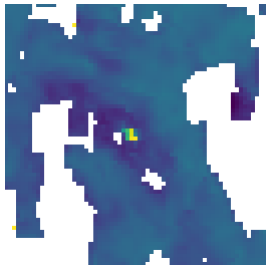
$T_{3.9\ \mu m}$



$\Delta T_{3.9 - 10.3\ \mu m}$



$\Delta T_{generated}$



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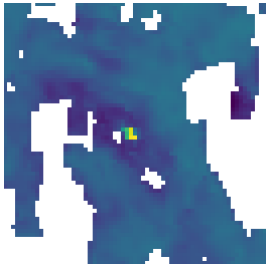
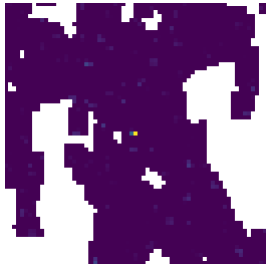


Median subtraction



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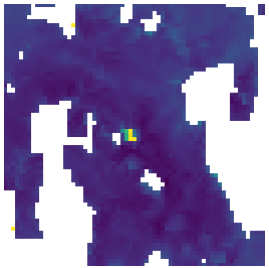

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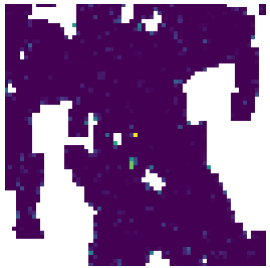

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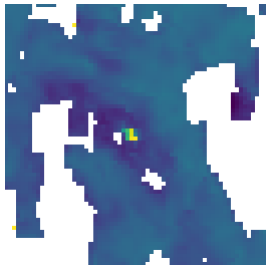

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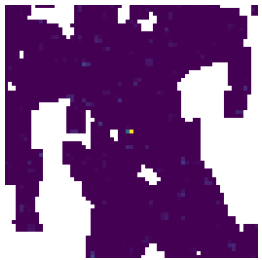

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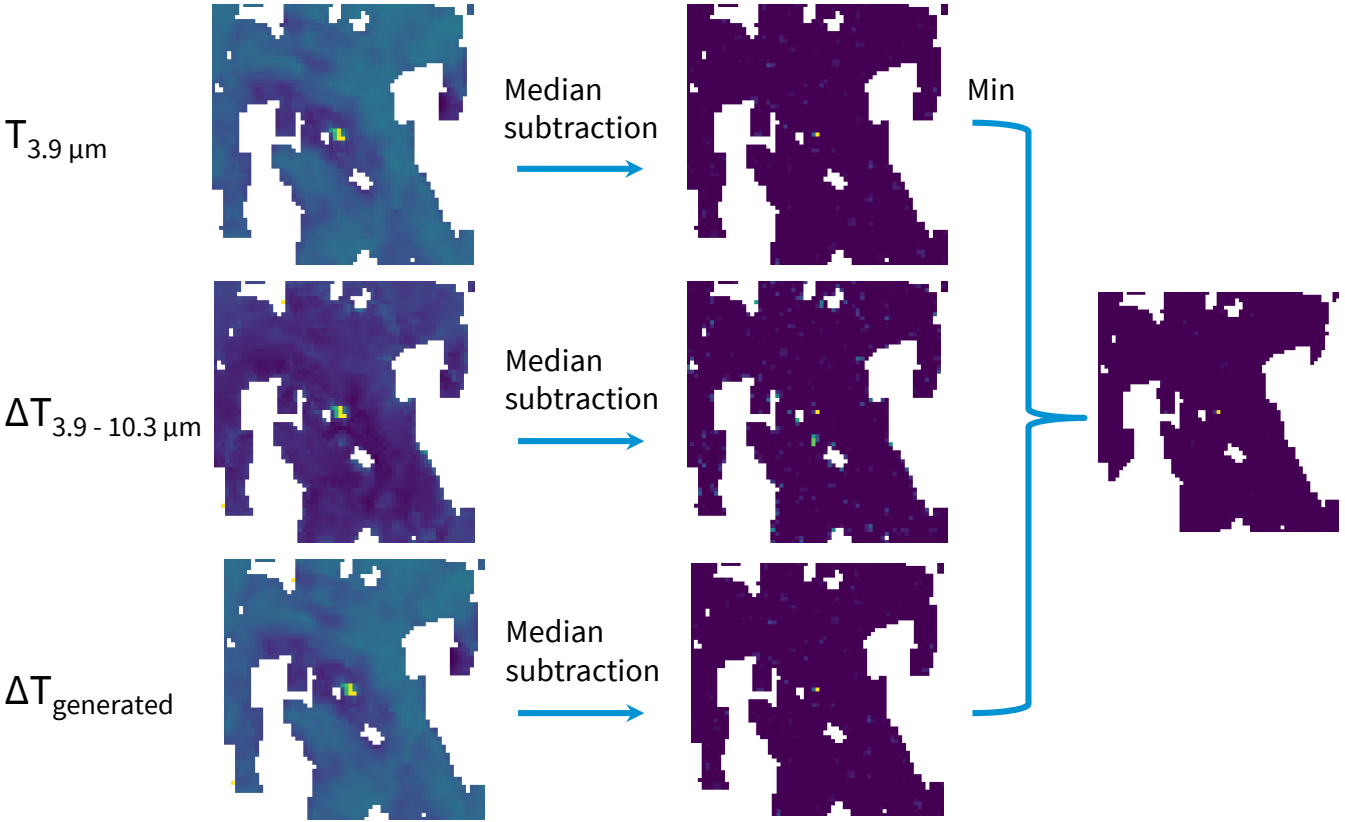

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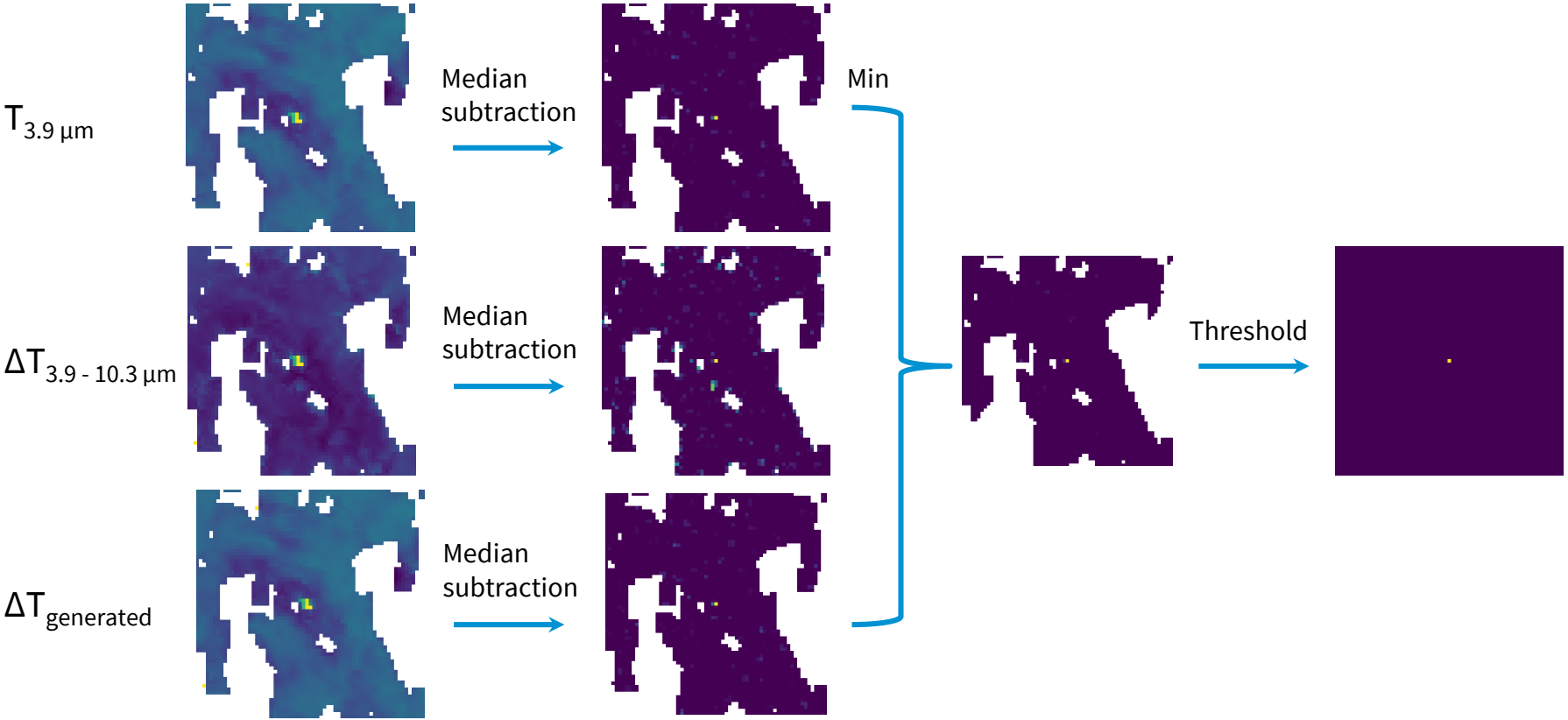

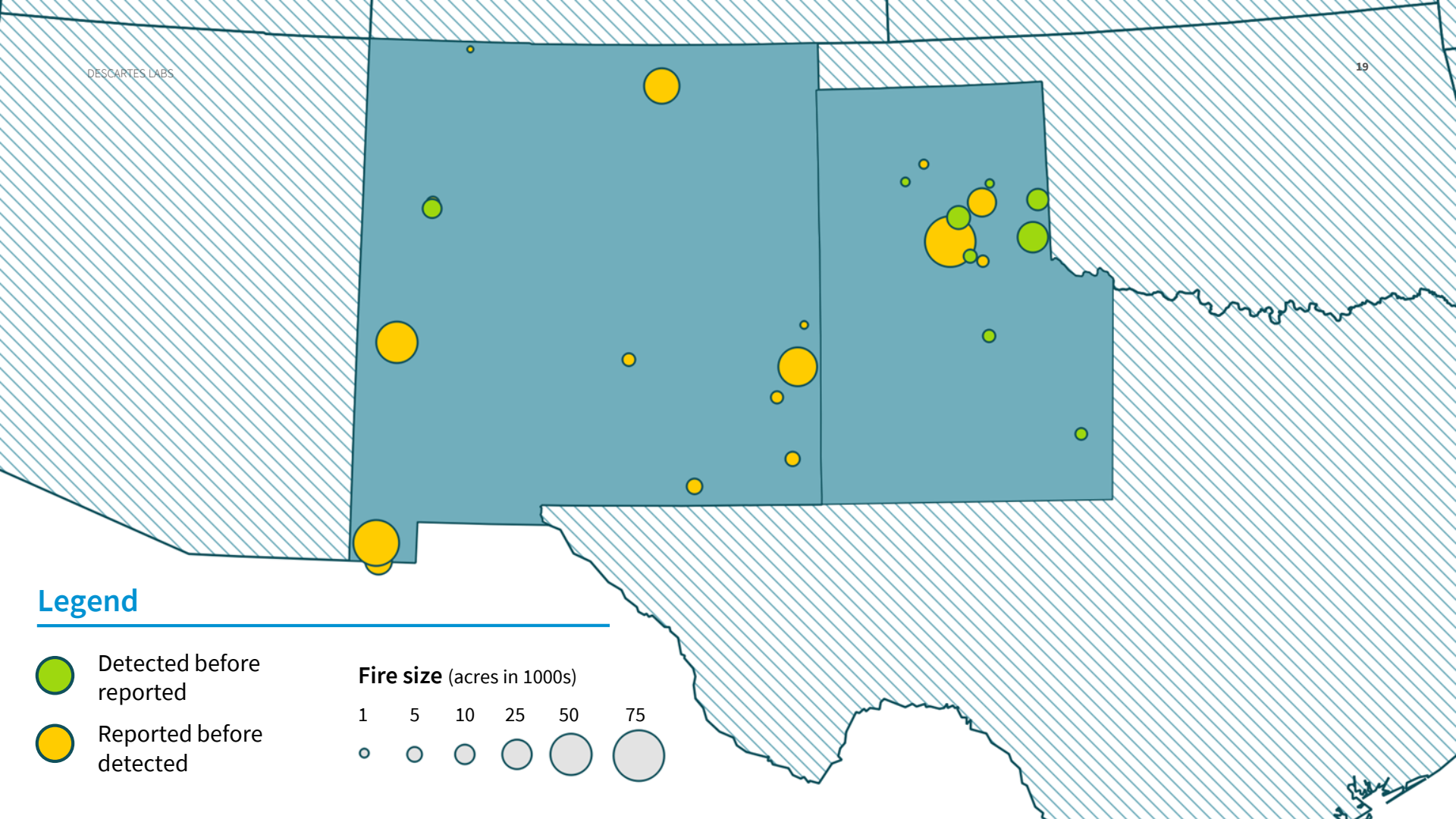
Legend
Detected before reported
Reported before detected
Fire size (acres in 1000s)
1
5
10
25
50
75

Conclusions, and where we're headed

- We've built a wildfire detector, and early results seem promising
- Next step is to operationalize our detector, begin making detections in real time
  - Start at the state level
  - Scale up to CONUS/PACUS, eventually the Western Hemisphere
- Simultaneously, we want to start trialling our detector with wildfire response organisations
  - Aim is to build an operationally useful detector, feedback is critical

Questions?