Pacific Northwest NATIONAL LABORATORY

RADR FIRE

RADR-Fire

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ECOSTRESS Science and Applications Team Meeting

April 13, 2022

U.S. DEPARTMENT OF ENERGY BATTELLE

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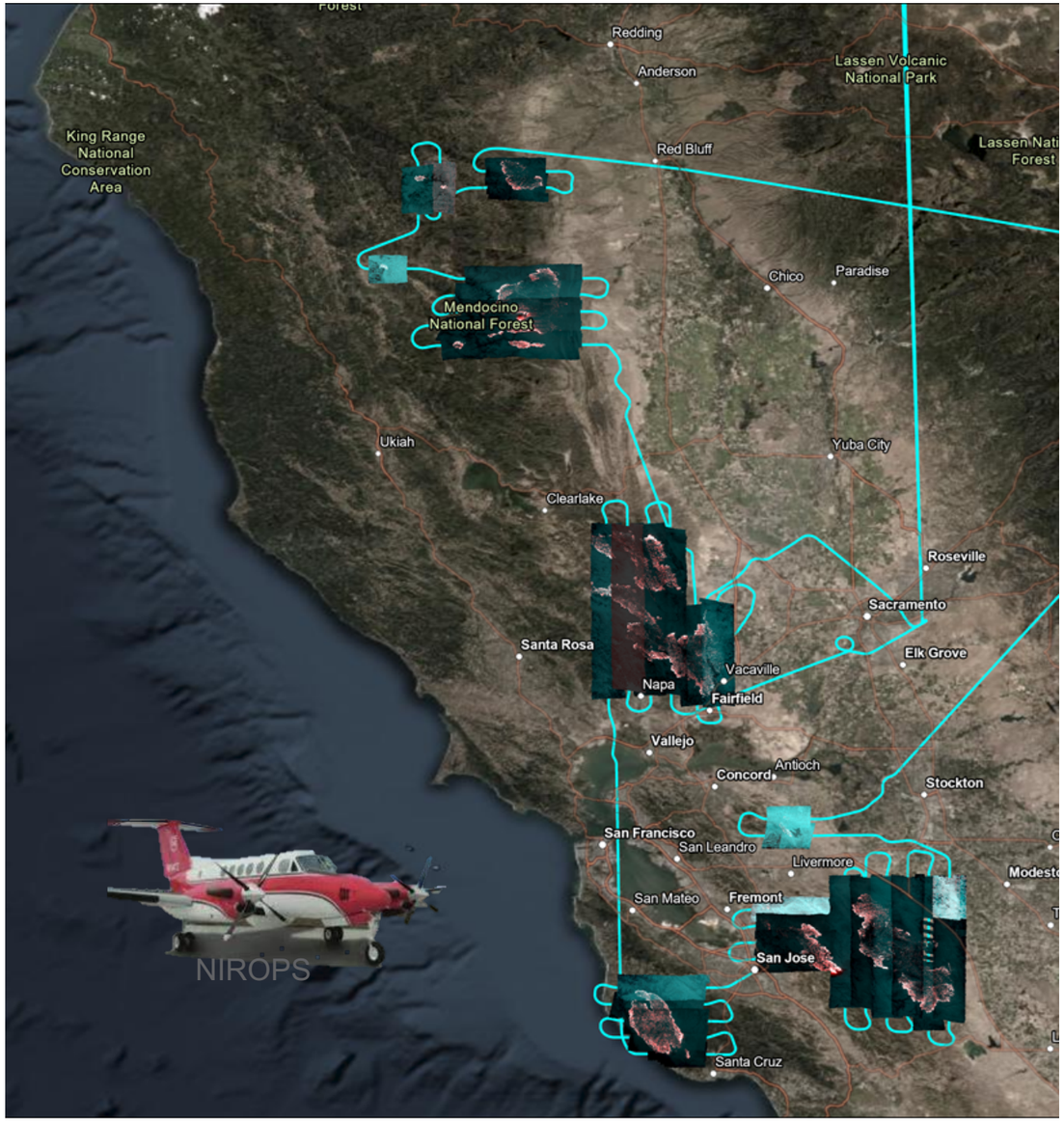
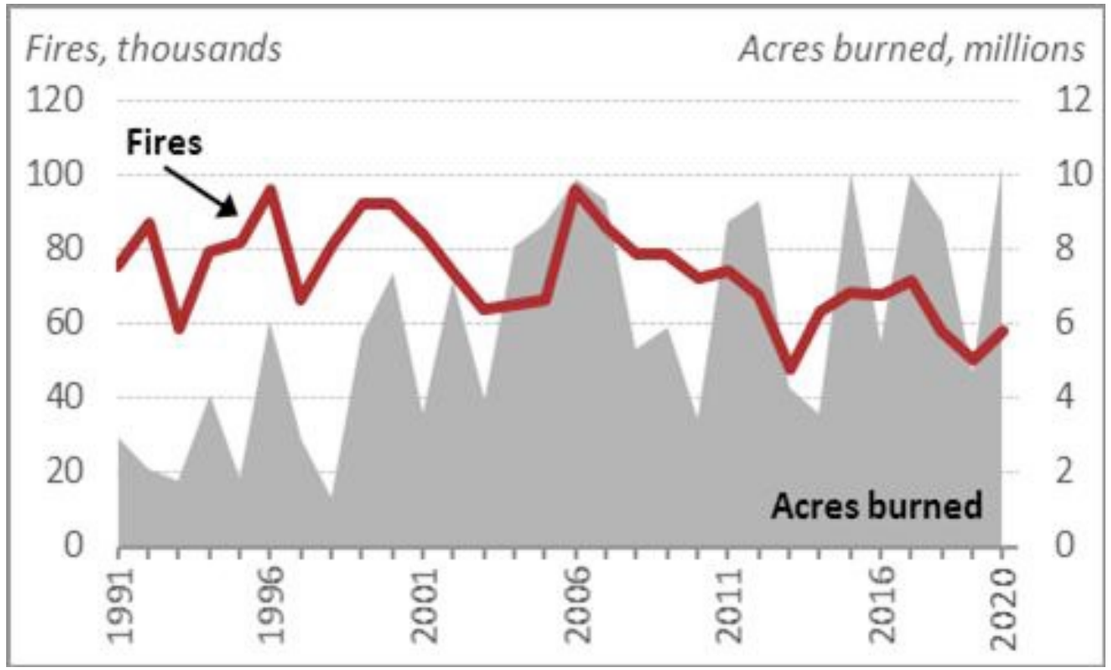
Wildfire Monitoring



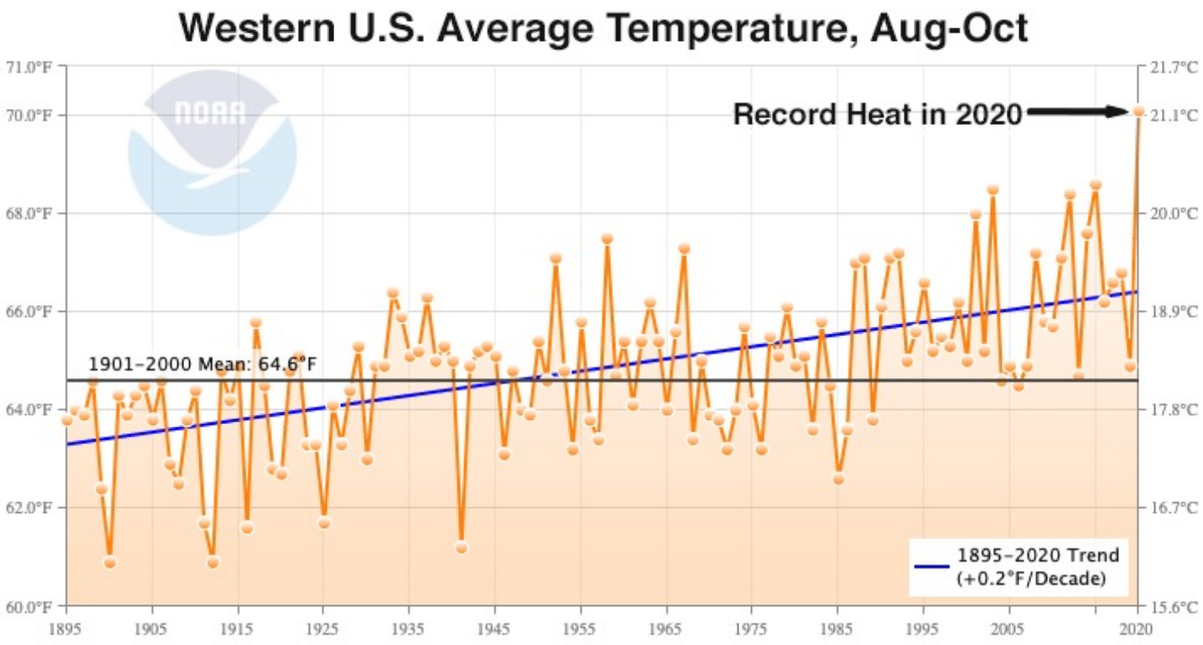
Current Workflow by NIROPS for NIFC

- Airborne data collection
  - Approx. 11pm-1am local time
  - 3-5μm bands, 8-14μm bands; <1x1m res.
- Data downlink from aircraft
- Processing by human image analyst
  - Compare to previous fire boundary and enlarge (never shrink) as necessary
  - Digitize ‘scattered heat’ as vector polygons
  - Digitize ‘intense heat’ as vector polygons
  - Digitize ‘spot fires’ as vector points
- Image analyst uploads vector data and maps to ftp.wildfire.gov
- Local fire analyst integrates GIS fire data with other datasets, local activity, fire modeling before 6am meeting

General Wildfire Trends



Graph: NIFC, 2021

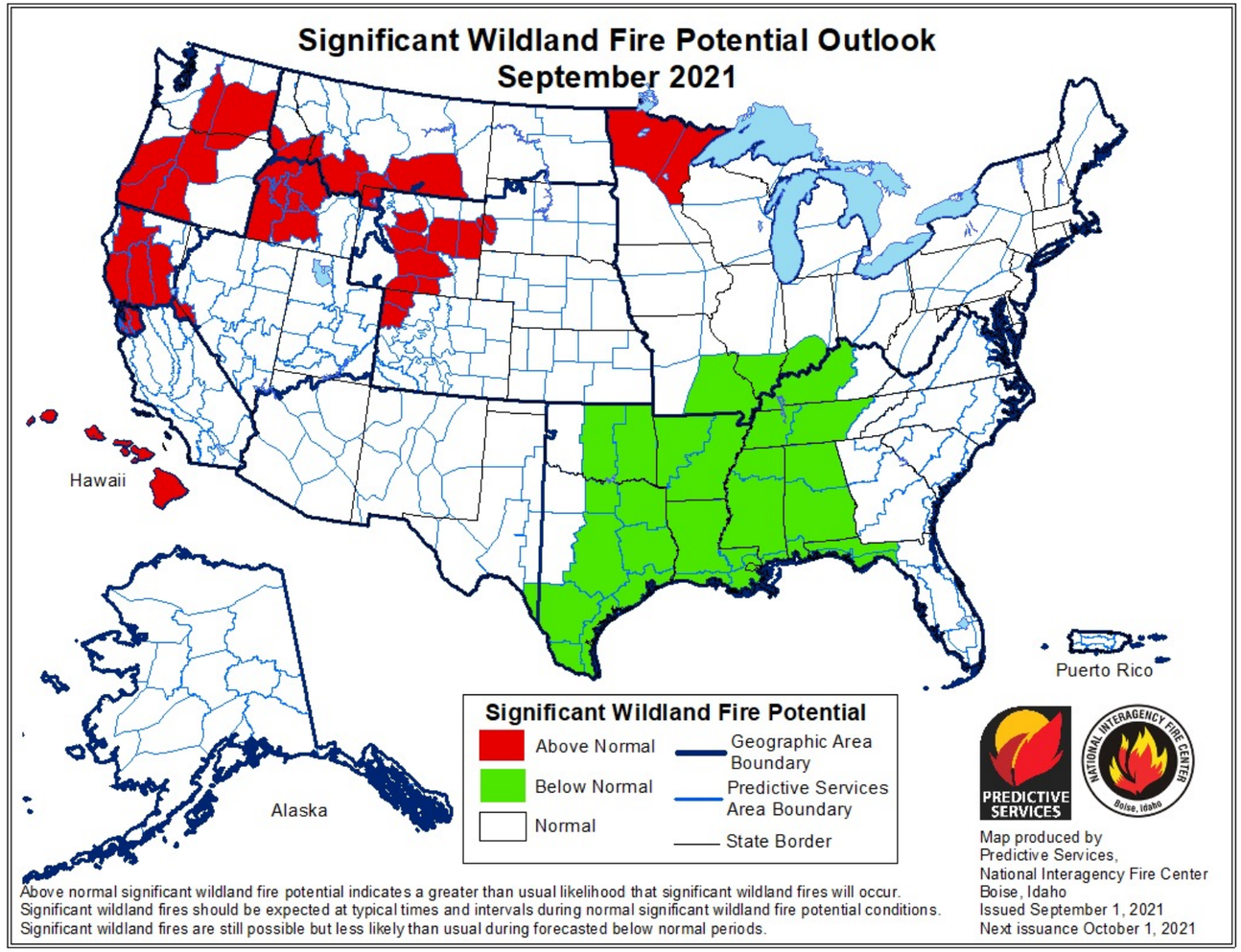


20-year trend

- # of individual wildfires trends slightly negative
- total area burned has a strong positive trend (i.e., larger burn area)

General Wildfire Trends: 2021 in the US

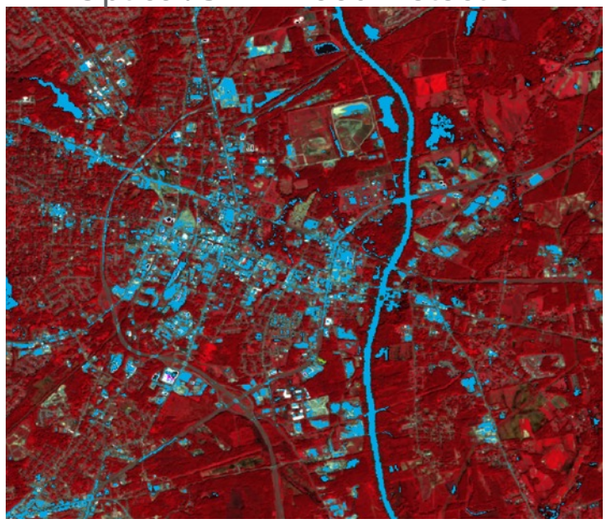
- July 14: moved to National Preparedness Level 5, continued for 68 days (historical record)
- 7/19/2021: 29% more land area burned than in 2020 (+728k acres)
- ~7.1 million acres burned
  - NW = 1.503 million acres (21% of total)
- 48,048 incidents as of 10/25/2021
  - NW = 4,075 incidents
  - 2011-2020 10-yr average: 49,379 / 6.9 million acres
- >25k direct/indirect personnel supporting wildland fire at peak
- In Arizona – there were 311 early season wildfires compared to 127 in the same 4-month period in 2020



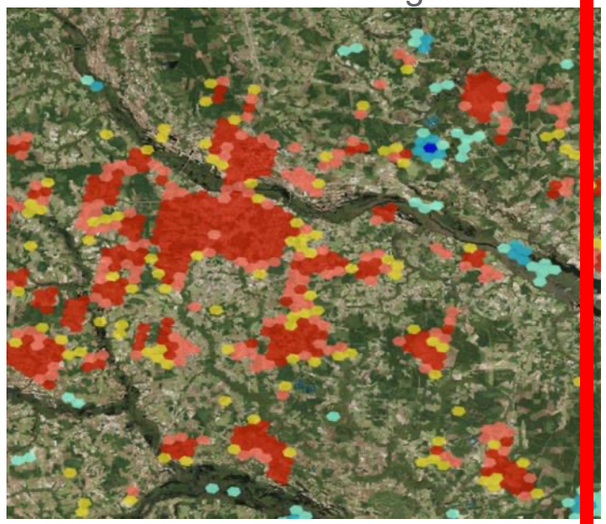
Rapid Analytics for Disaster Response (RADR)

RADR-Fire
(20-70m GSD)

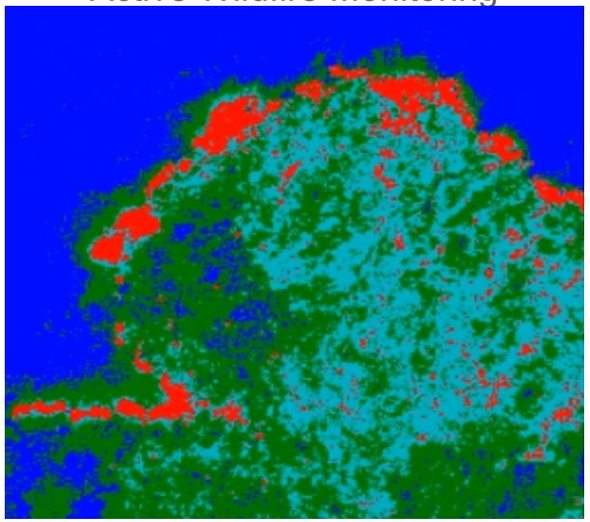
Optical/SAR Flood Detection



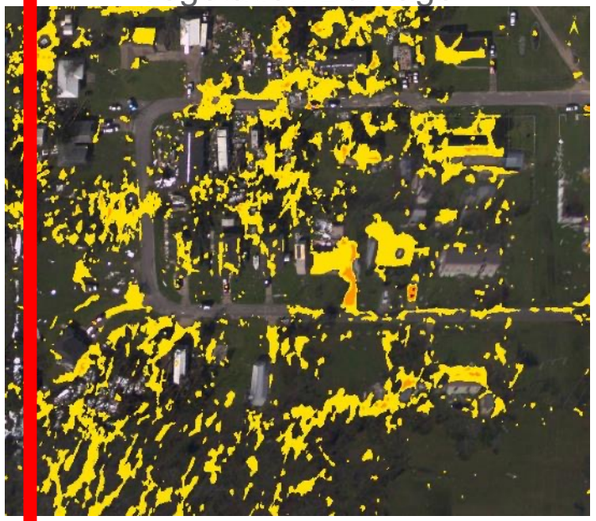
Structural Damage



Active Wildfire Monitoring

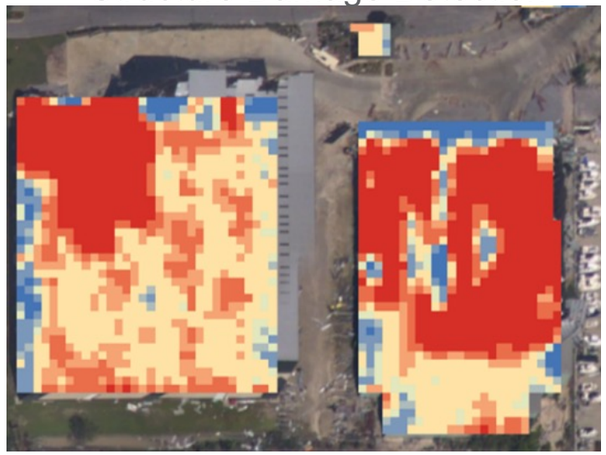


Vegetation Damage

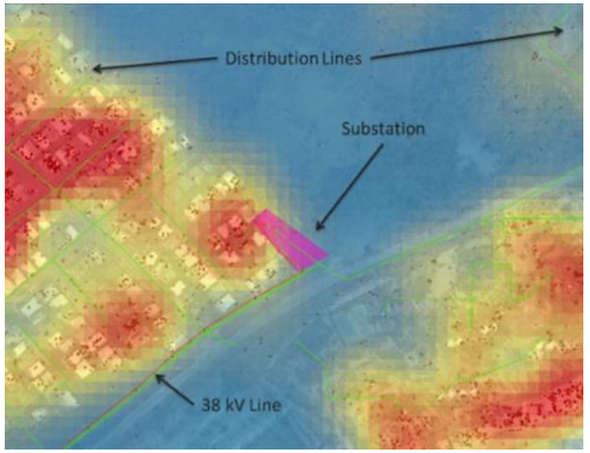


Infrastructure Damage

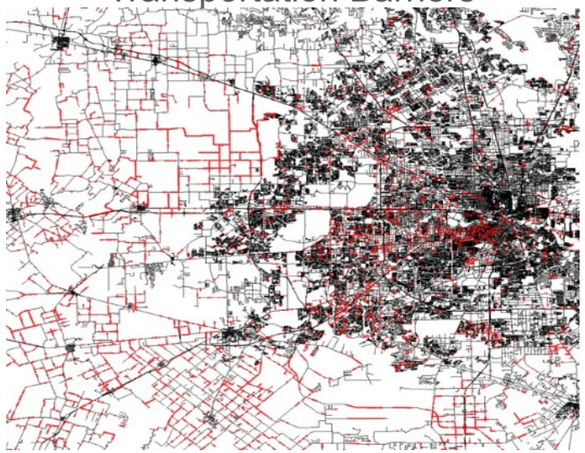
Structure Damage Detection



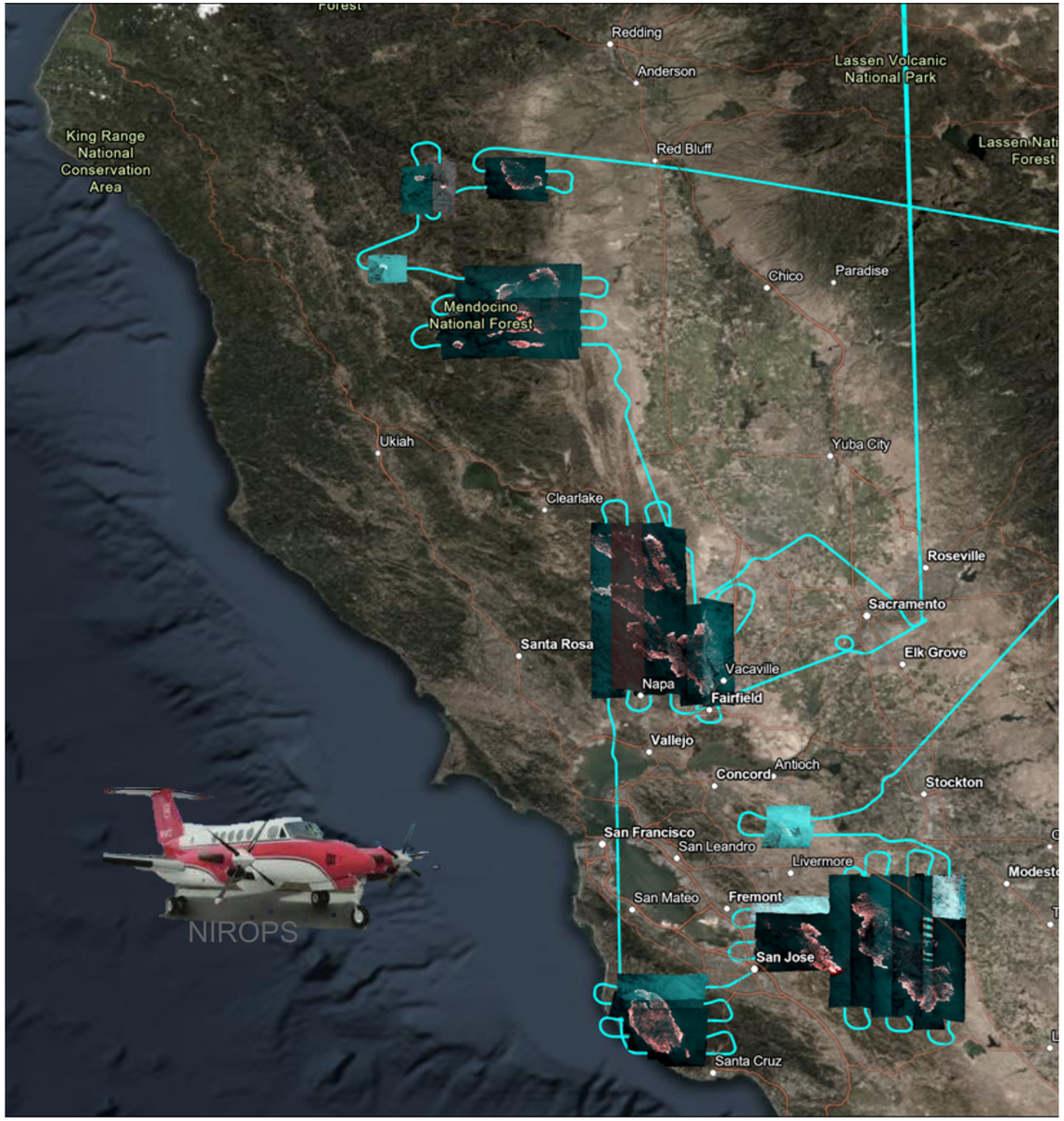
Rubble/Debris Detection

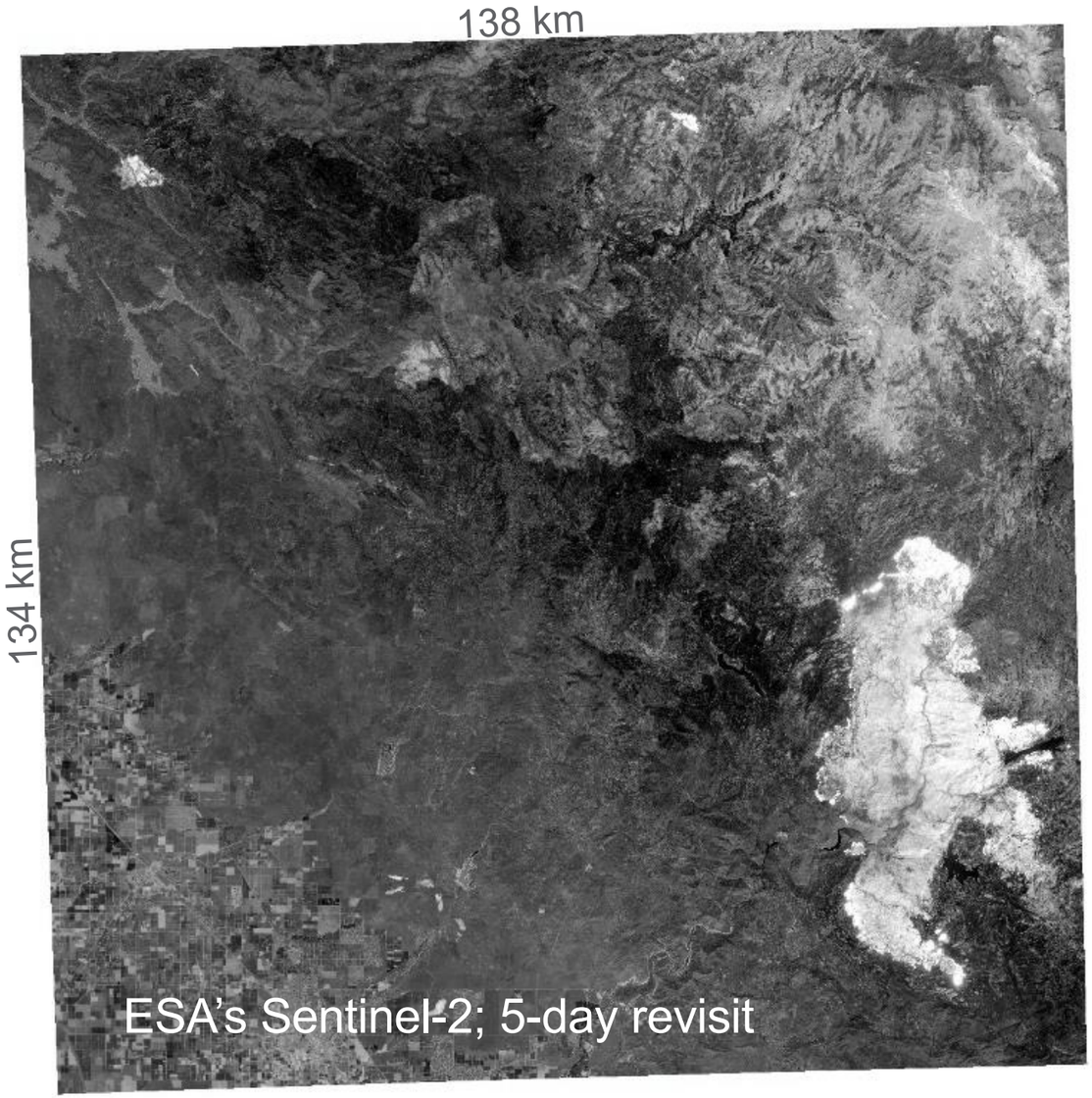


Transportation Barriers



Satellite Observation as a Complement





Assessment Needs of Wildfire Responders

- Airborne MWIR/LWIR nightly collects fulfill 30-45% of imagery requests

- Very-high resolution overhead satellite imaging complements nightly airborne collects

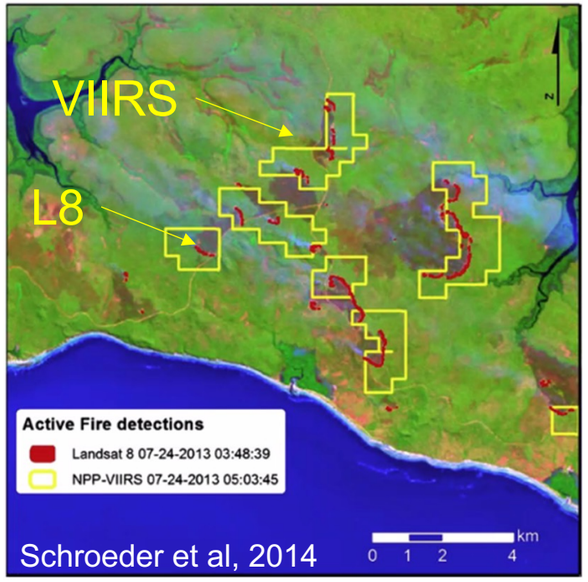
- Spatial and Temporal Resolution
  - High-frequency VIIRS (275m) or GOES (1km) helpful, but don't yield defined boundaries
  - 10m GSD is ideal to define fire activity on either side of a fire line breaks (spot fires)
  - 5-14 day revisits from a <u>single sensor</u> is moderately useful;
    - Clouds and smoke inhibit thermal imaging
  - Overall, 15-minute revisit at <100m GSD would provide next-generation monitoring

- Automated algorithms to process imagery and generate analytics
  - Migrate from human analyst image interpretation – put towards QA
  - Adopt mapping standards/products; deliver in common geospatial data formats and web services

- Delivery well-before 6am morning meeting for integration and planning

- Semi-continuous fire behavior modeling with just-in-time inputs

- Consistent nationwide capability



Schroeder et al, 2014

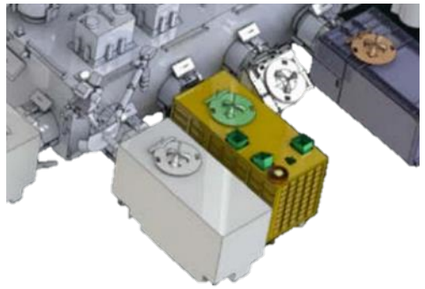
RADR-Fire: Satellite Sensors Evaluated

Sentinel-2 (MSI)

Sentinel-1A/B (SAR)

Sentinel-3 (MSI+)

GOES (MSI)

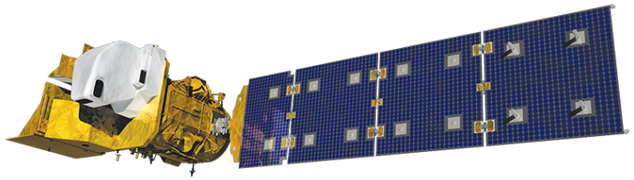


GEDI (LiDAR)

ASTER (MSI)

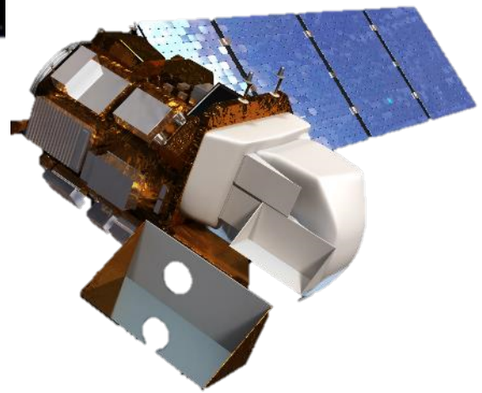
AWiFS (MSI)
LISS-III (MSI)

ECOSTRESS (MSI)



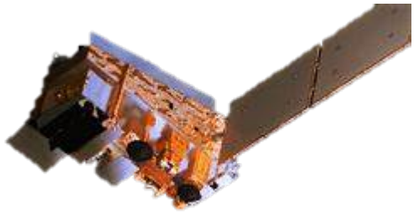
Landsat-9

Landsat-7 (MSI)



Landsat-8 (MSI)

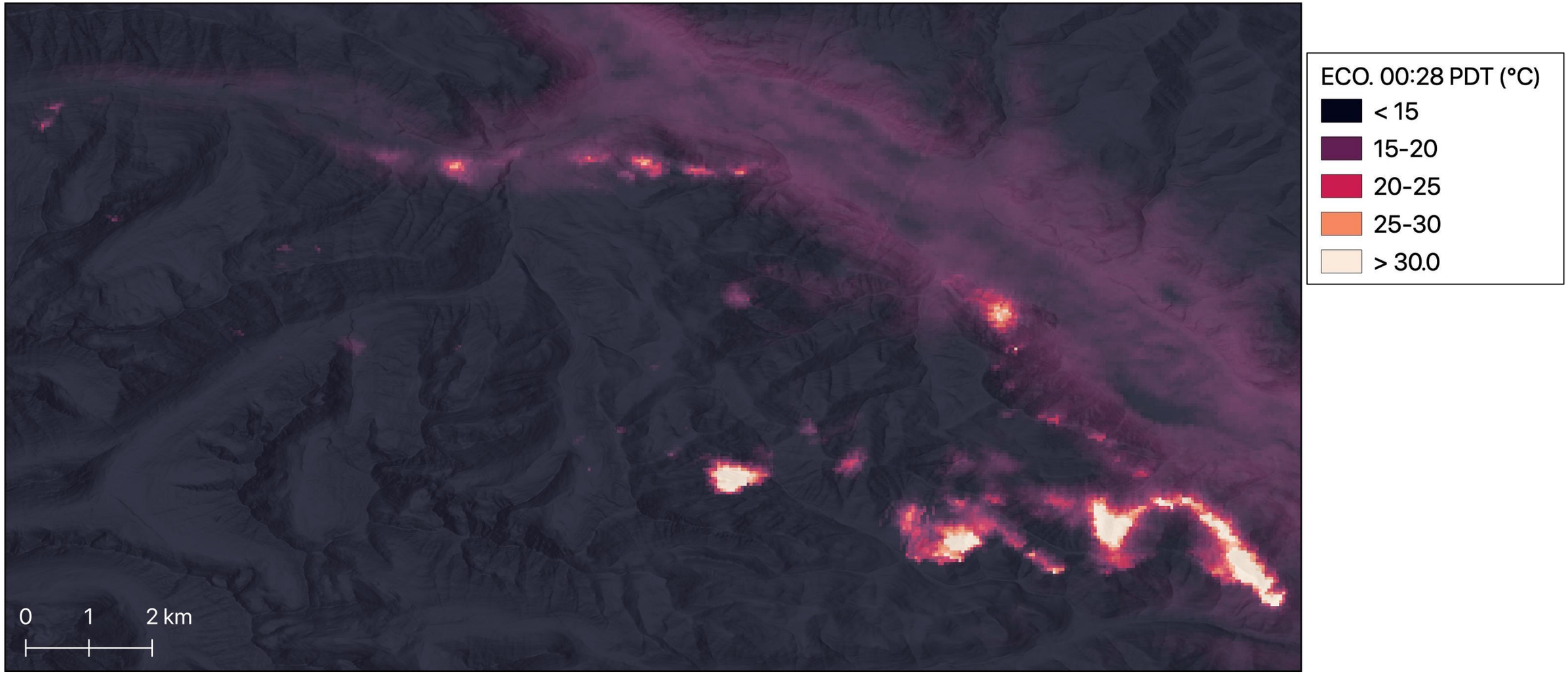
CBERS
(non-U.S.)



VIIRS (MSI)

RADR-Fire: ECOSTRESS over Cedar Creek Fire, WA

July 24, 2021



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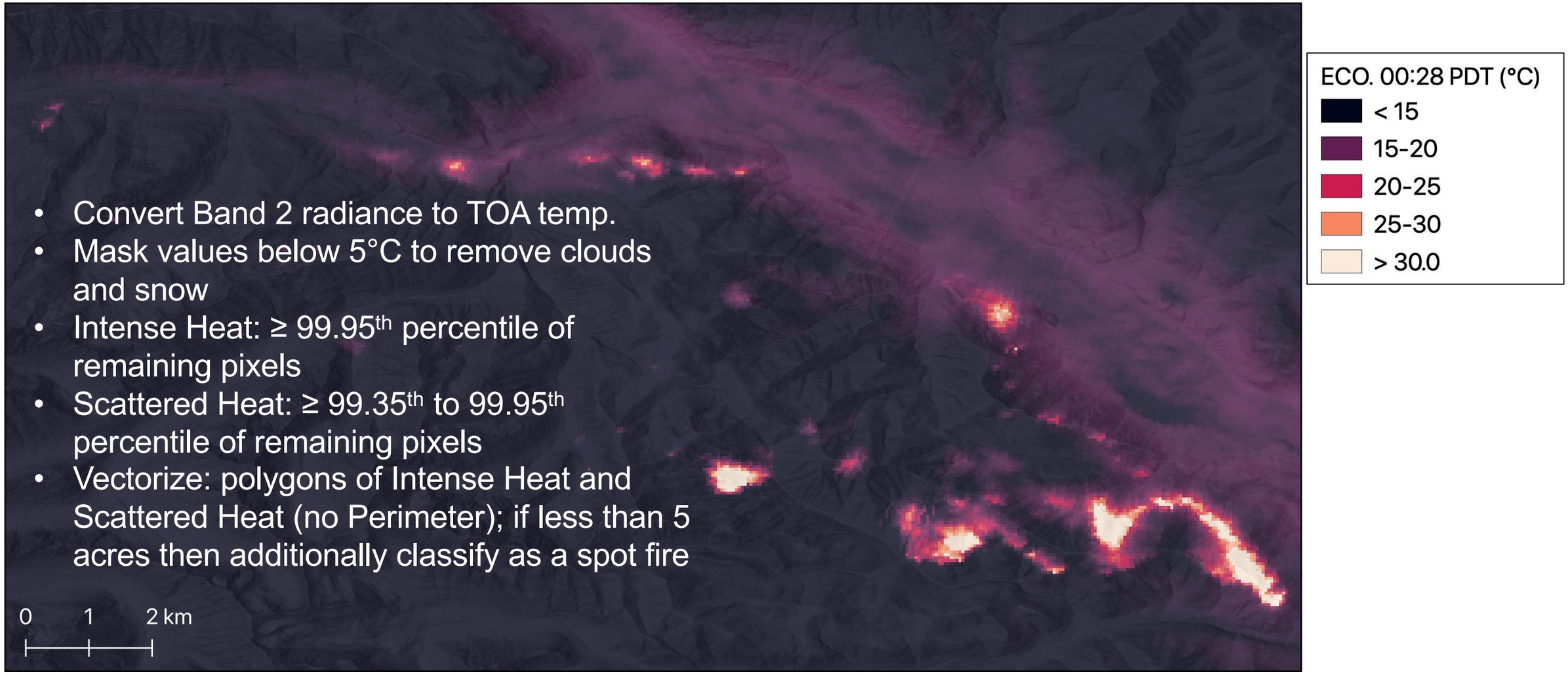

- Convert Band 2 radiance to TOA temp.
- Mask values below 5°C to remove clouds and snow
- Intense Heat: ≥ 99.95th percentile of remaining pixels
- Scattered Heat: ≥ 99.35th to 99.95th percentile of remaining pixels
- Vectorize: polygons of Intense Heat and Scattered Heat (no Perimeter); if less than 5 acres then additionally classify as a spot fire

RADR FIRE

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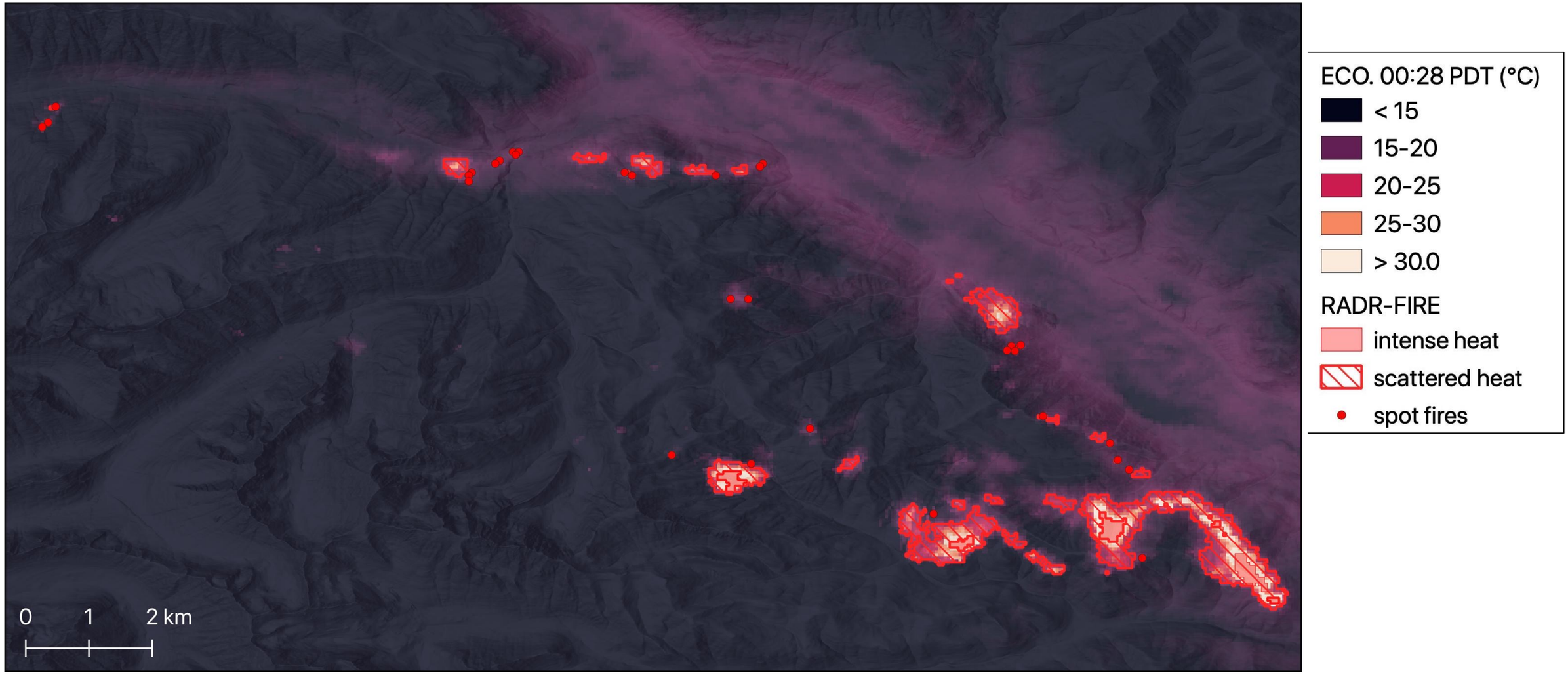

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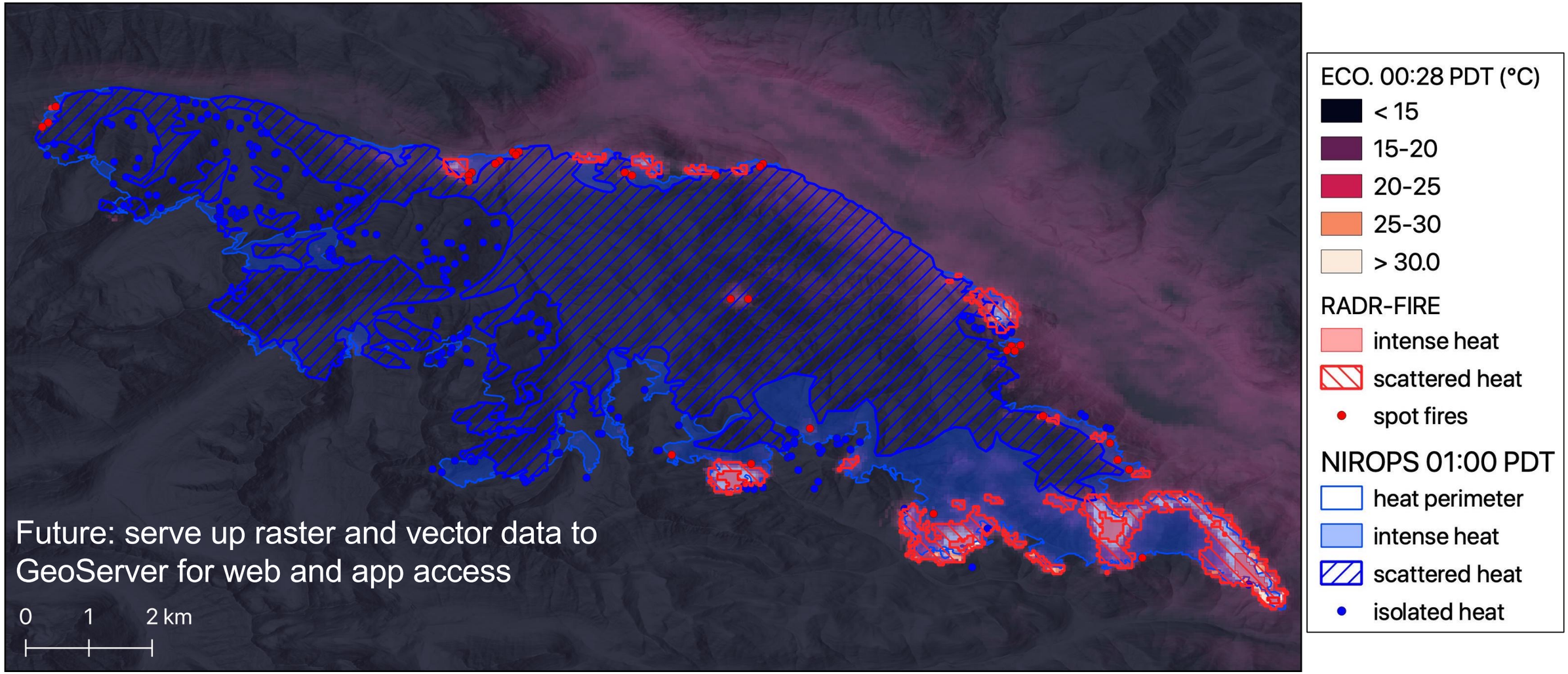

RADR FIRE

What's Coming for RADR-Fire

- General agreement with NIFC to move forward on incorporating RADR-Fire into their wildfire response workflow
  - Preliminary roadmap developed for R&D path forward
- NASA DEVELOP intern starting in June in collaboration with JPL to use ECOSTRESS ET for pre-fire wildfire risk or active fire veg properties
  - Context: local-scale fire modeling is using data that is several years old; Landsat-derived canopy bulk density, canopy height, fuel moisture, soil moisture
- Re-initiate Landsat night-time collections for the western U.S. as previously done by USGS EROS for the 2021 fire season under a science mission
- Potential collaboration with RADR-Fire and ongoing wildfire work at NASA Goddard
- Three PNNL-led special sessions at Pecora Symposium with NASA, USGS, and USFS (Pecora22.org)
  - Active Fire Mapping for Wildfire Geointelligence, Automation and Data Fusion for Wildfire Analysis, and Enhancing Mapping Standards for Active Wildfire