Wildfire Assessment including ECOSTRESS

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PNNL-SA-165675

PNNL is operated by Battelle for the U.S. Department of Energy

Present Needs for Wildfire Response

- Data
  - Collects in addition to traditional aircraft data
  - 10x10m ground sample distance
- Timing
  - Availability within 24 hours
  - Less reliance on humans digitizing from airborne imagery
- Automation
  - Algorithms
    - ✓ Fire perimeter, Scattered Heat, Intense Heat, Spot Fires
  - Parallelization of downloads and algorithm processing
  - Early fire detection
  - Fire behavior modeling
- Products
  - Shapefiles not rasters – lower bandwidth option
  - Standardized map products
  - API access

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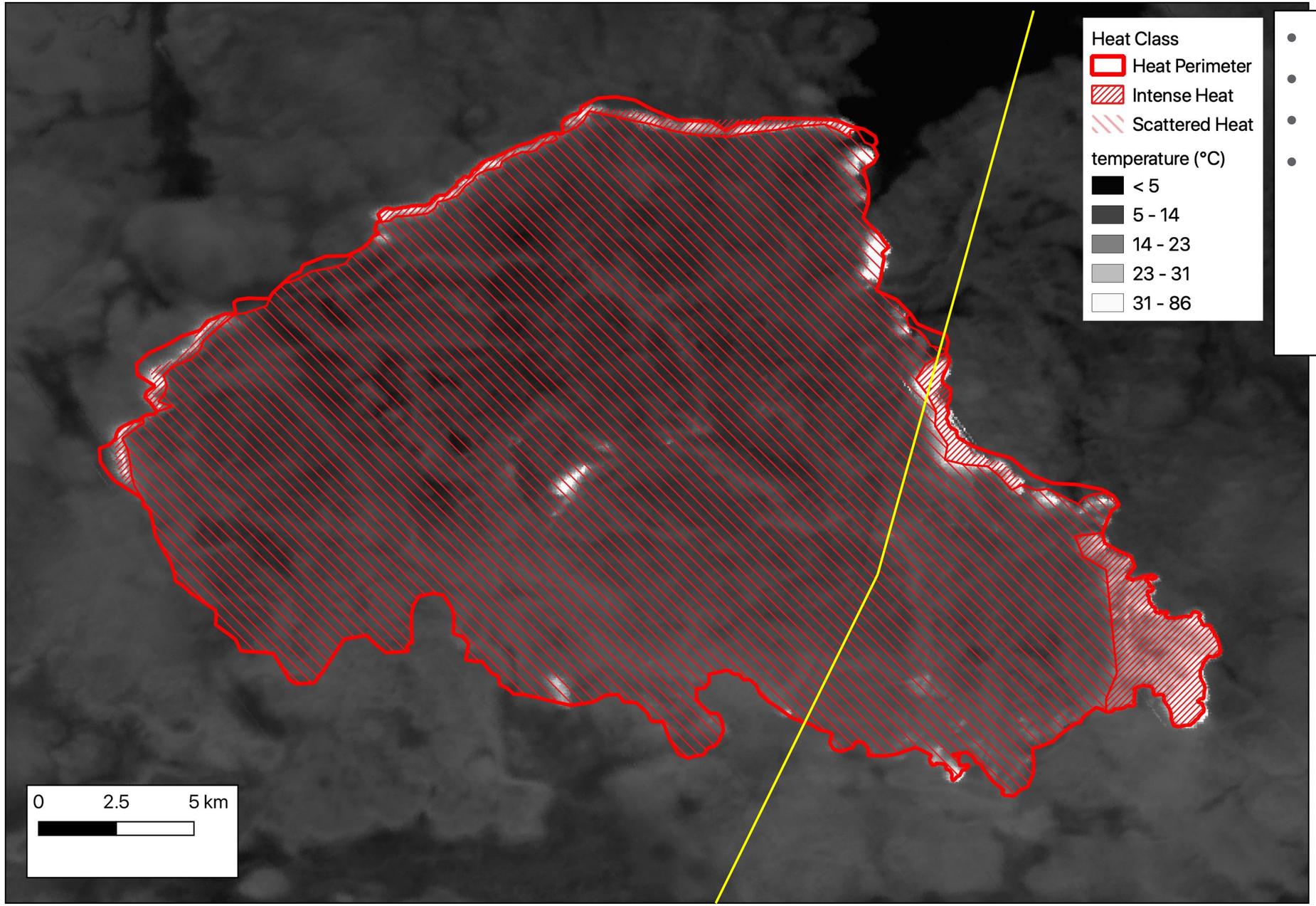
Bootleg Fire: July 12, 2021 00:13 PDT



- Data
- Timing
- Automation
- Products
  - Heat Perimeter
  - Intense Heat
  - Scattered Heat
  - Spot Fires

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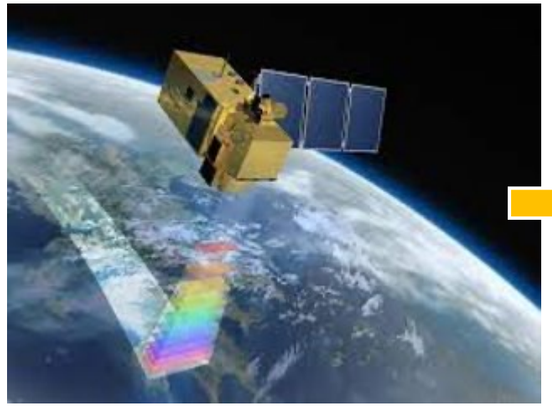
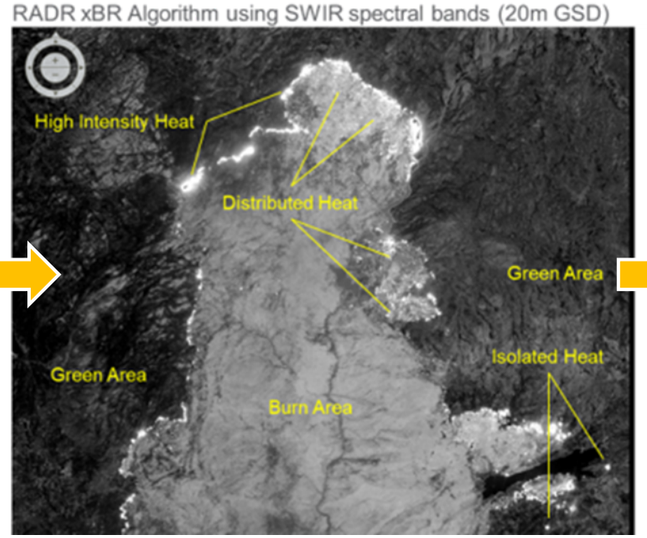
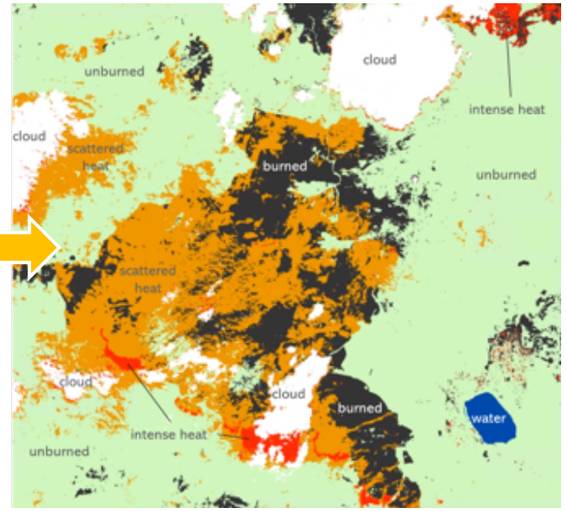
Rapid Analytics for Disaster Response - Wildfire (RADR-Fire)

- Initiated by the White House in 2020 and currently sponsored by the DoD JAIC on behalf of DOE-AITO and the First Five Consortium
  - Automated, end-to-end, cloud-based, open-data solution that retrieves and utilizes specialized imagery from numerous high-resolution (<30 m) earth observation satellites
  - Provide situational awareness on the active fire front, spot fires, scattered heat, post-burn intensity, and unburned areas
  - Time-series results disseminated via website, mobile app, and web services





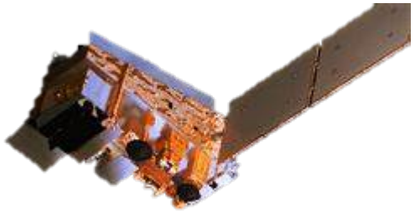


Satellite Sensors Evaluated

Sentinel-2 (MSI)

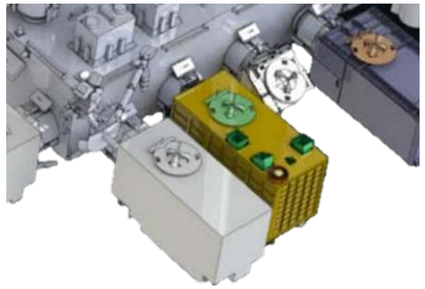
Sentinel-1 (SAR)

Sentinel-3 (MSI+)

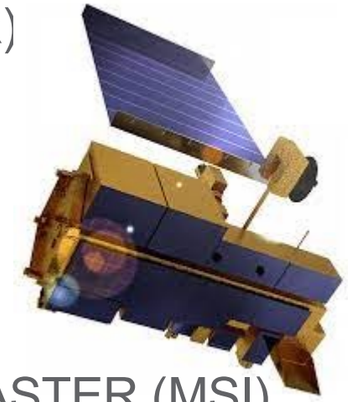


VIIRS (MSI)

GOES (MSI)



GEDI (LiDAR)



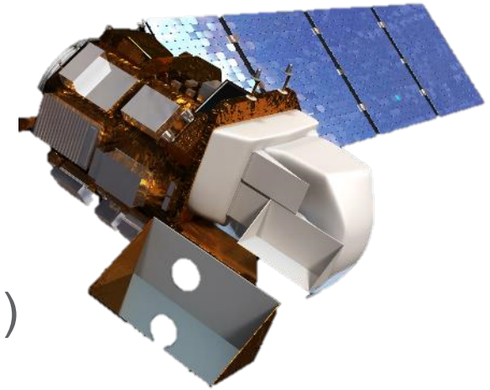
ASTER (MSI)

AWiFS (MSI)
LISS-III (MSI)

ECOSTRESS (MSI)

CBERS

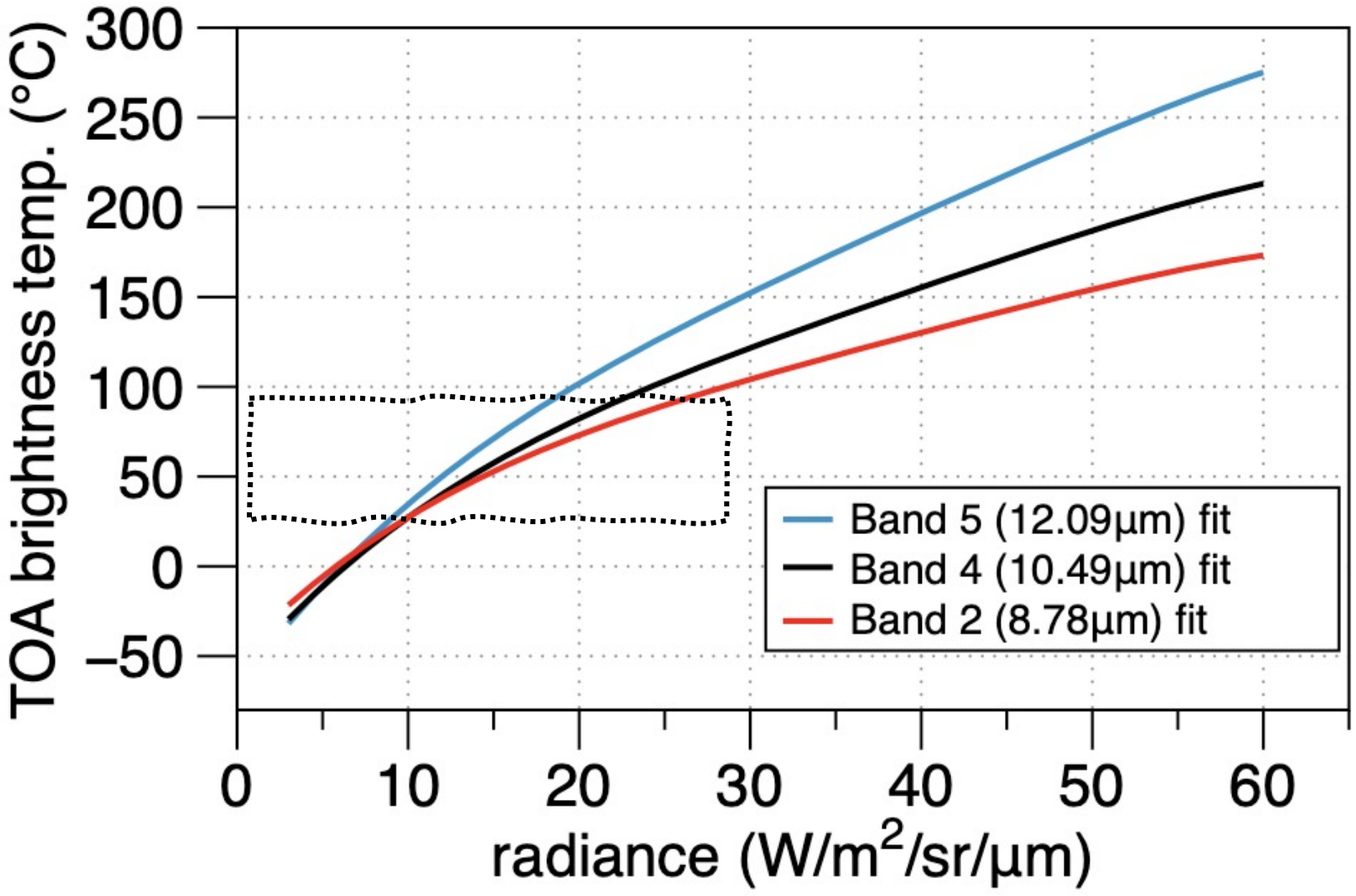
Landsat-7 (MSI)



Landsat-8 (MSI)

ECOSTRESS Workflow

- Data
  - Area: GeoJSON from corner coordinates, verify with NIFC data API that a fire is in the area, download data for timeframe that includes pre-fire conditions
  - NASA AppEARS request for the Band 2 radiance data



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ECOSTRESS Workflow

- Data
  - Area: GeoJSON from corner coordinates, verify with USFS API that a fire is in the area, download data for timeframe that includes before-fire conditions
  - NASA AppEARS request for the Band 2 radiance data
  - Convert Band 2 radiance to top-of-atmosphere brightness temperature
- Automation & Products
  - Mask values below 5°C (removes clouds)
  - Intense Heat: ≥ 99.95th percentile of total pixels
  - Scattered Heat: ≥ 99.35th to 99.95th percentile of total pixels
  - Vectorize: polygons of Intense Heat and Scattered Heat (no Perimeter)
    - ✓ Calc. area of polygons, sieve those less than 5 acres = Spot Fires (point features of either intense or scattered heat, useful for visualizations at larger spatial scales)
  - Determine local time of image for coordination with other NIFC/NIROPS datasets
  - Download corresponding GOES-16 cloud mask layer for same area
  - Pending: make products visually and programmatically available on fire.radr.pnnl.gov

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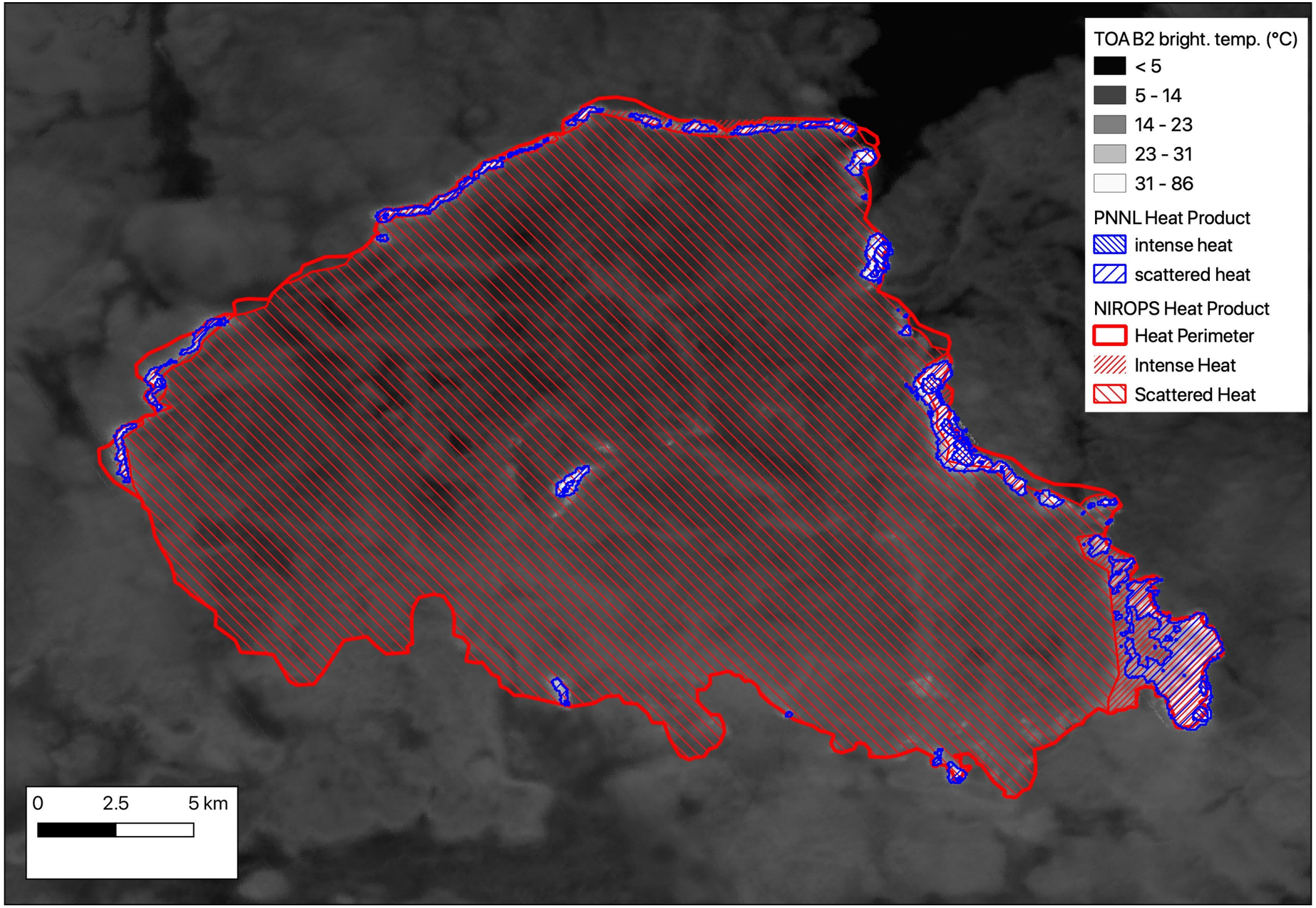

00:13am

08:20am

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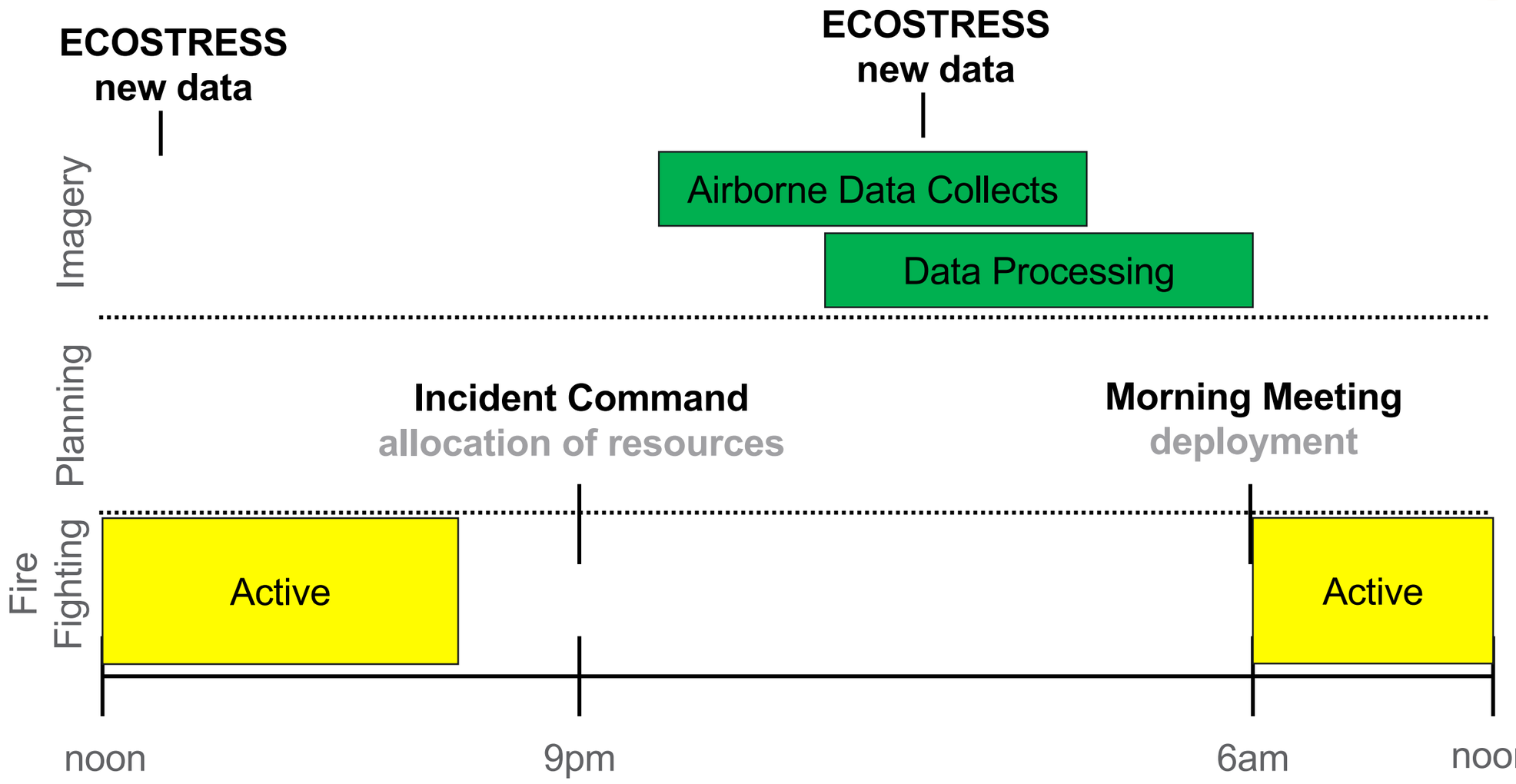
Fire Timeline: More efficient in how fires are managed



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Summary: Benefits, Challenges, and Concerns

- Benefits of ECOSTRESS
  - Revisit time - sometimes twice-daily!
  - The GSD is valuable for wildfire - our objectives are aimed <=30-m GSD
  - Now-solid geographic alignment and lack of sensor streaking
- Challenges for wildfire applications
  - No SWIR band – USGS turned on Landsat8 nighttime and the SWIR band has proven to be incredibly useful
  - Partial coverage –need to convey that only a spatial subset of the fire was imaged
  - Lack of ground truth with quantifiable heat classes
- Needs and Concerns
  - Latency – about ~12h to NASA AppEARS (24h to USGS; Sentinel-2 is about 5h, L8 is 6-8h)
  - NASA AppEARS requests are limited to 2 at a time; USFS NIFC/NIROPS via https://inciweb.nwcg.gov/ noted 183 actively monitored fires on August 10
    - ✓ USGS Machine-to-Machine returns metadata but not raster data
  - Emissivity values seem low or our calibration values are outdated
  - Some acquisitions will remain ‘suspect’ to interpret
    - ✓ Early morning after sunrise scenes in complex terrain (Colorado)
    - ✓ Fire fractional area: small fire over large region; large fire over small region

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