

Data, Science and AI at OroraTech

Allison Merritt

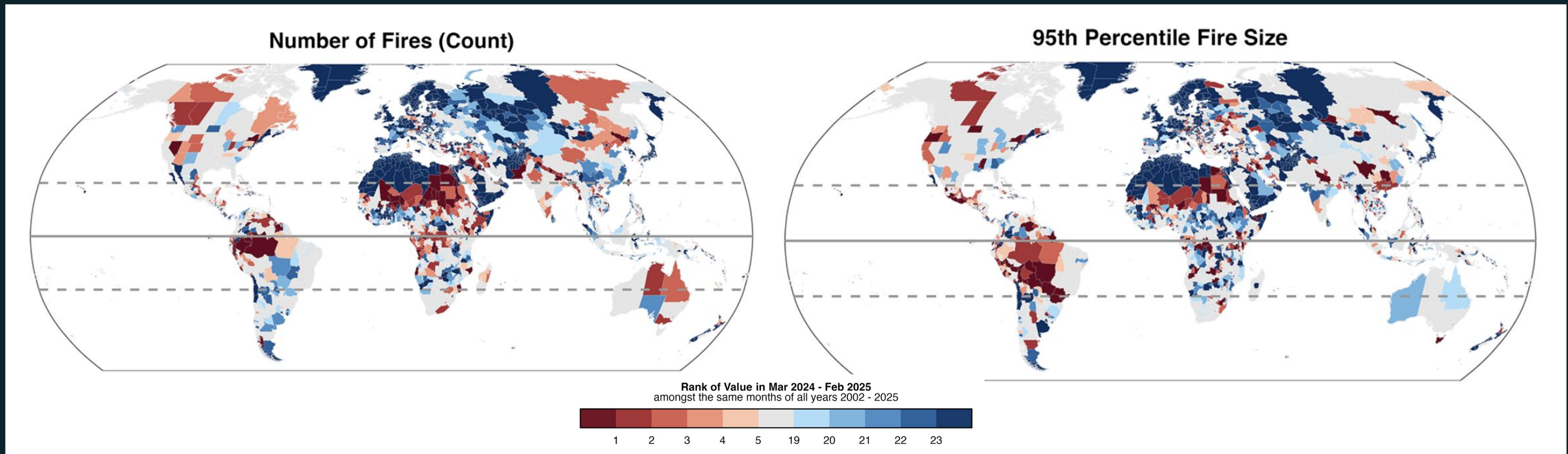
OroraTech **WiDS Regensburg 2026**



Global wildfire trends in the past 2 decades

~40% increase in the extents of forest fires

~2x increase in the intensity of globally extreme forest fires



Wildfire Detection

From the forest floor to Orbit: an ecosystem* of monitoring technologies



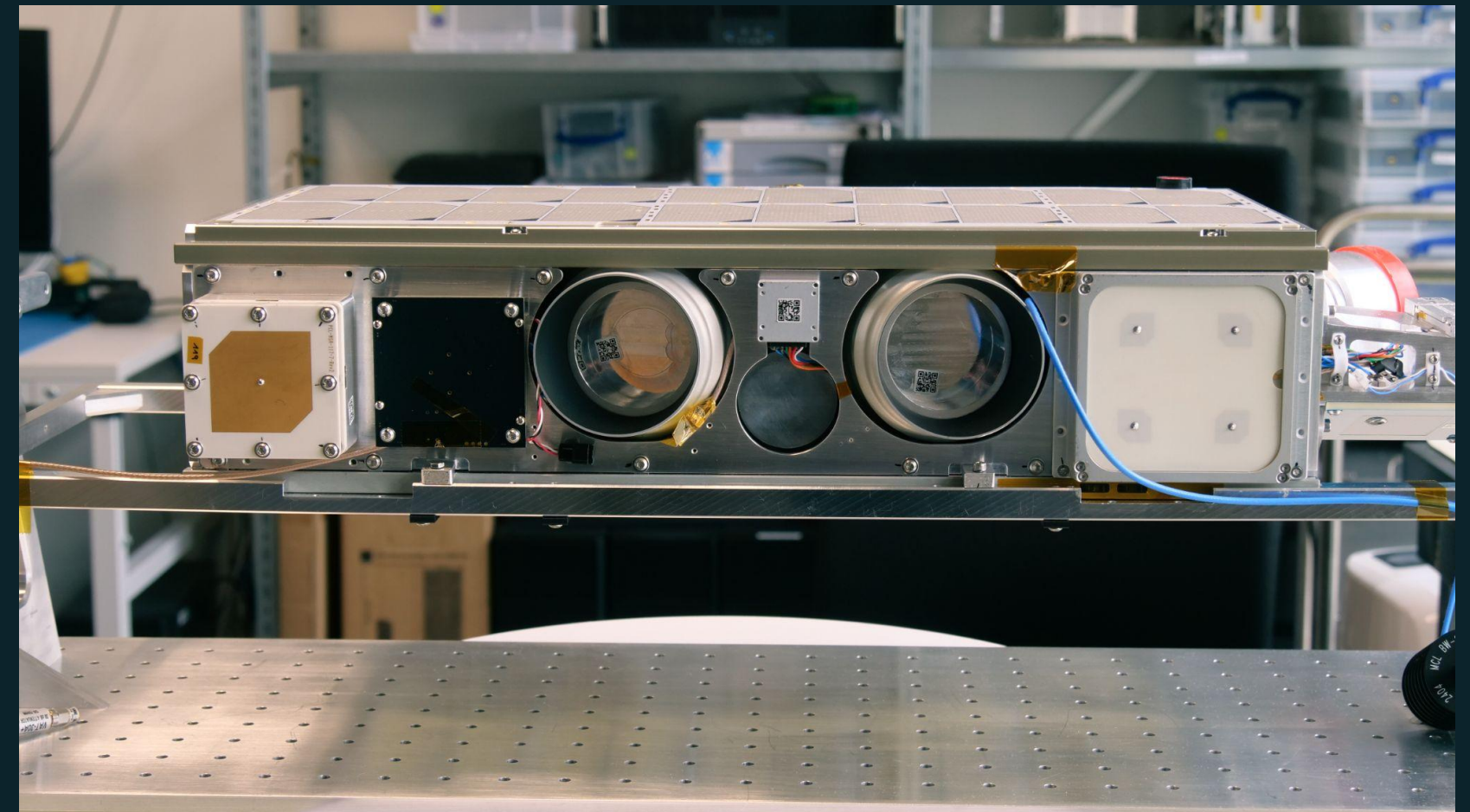
Hi, we're OroraTech

Specialising in low-latency wildfire detection

Founded in 2018

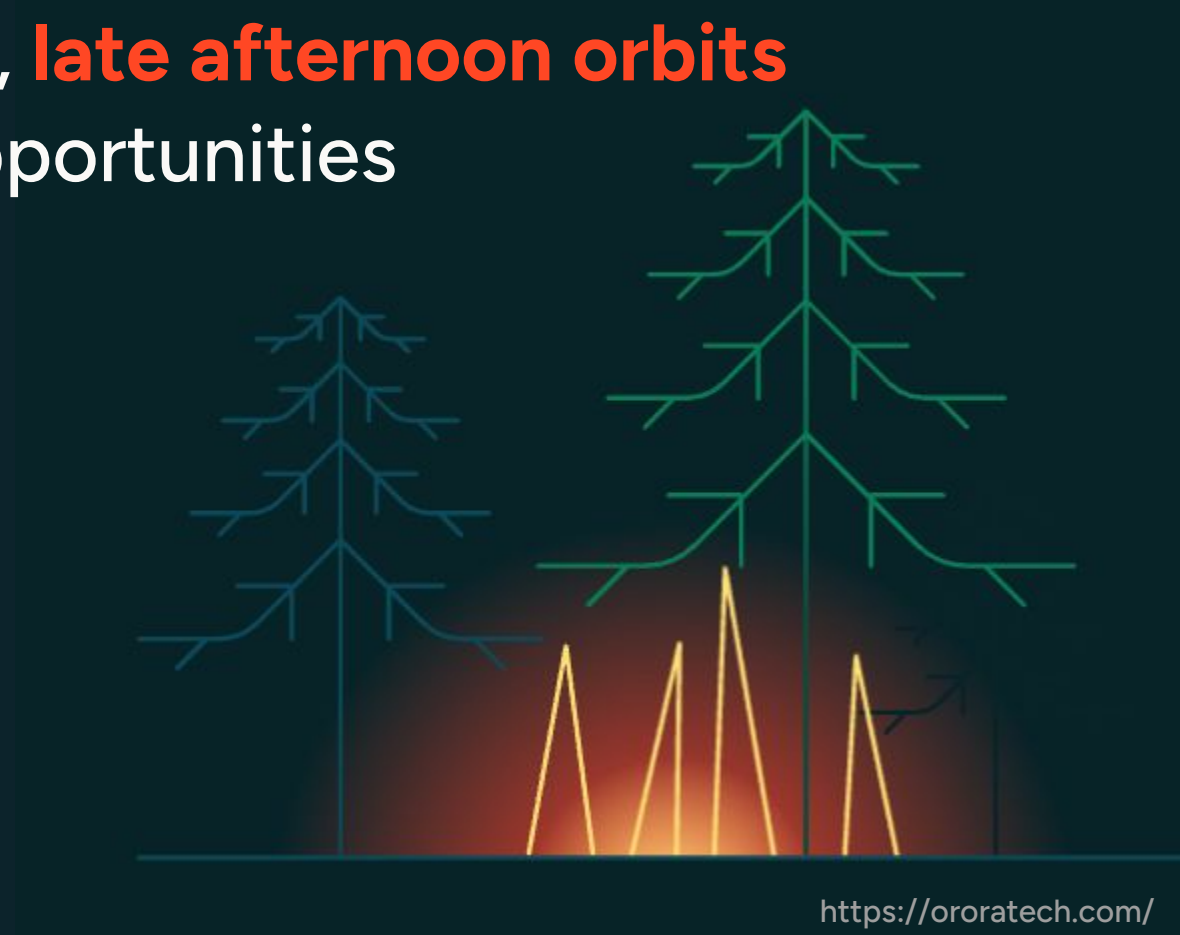
Specialised in wildfire detection and thermal Earth Observation data products:

- top-of-atmosphere measurements
- land surface temperature
- active fire detection
- fire spread
- short-term fire risk
- ... and more!

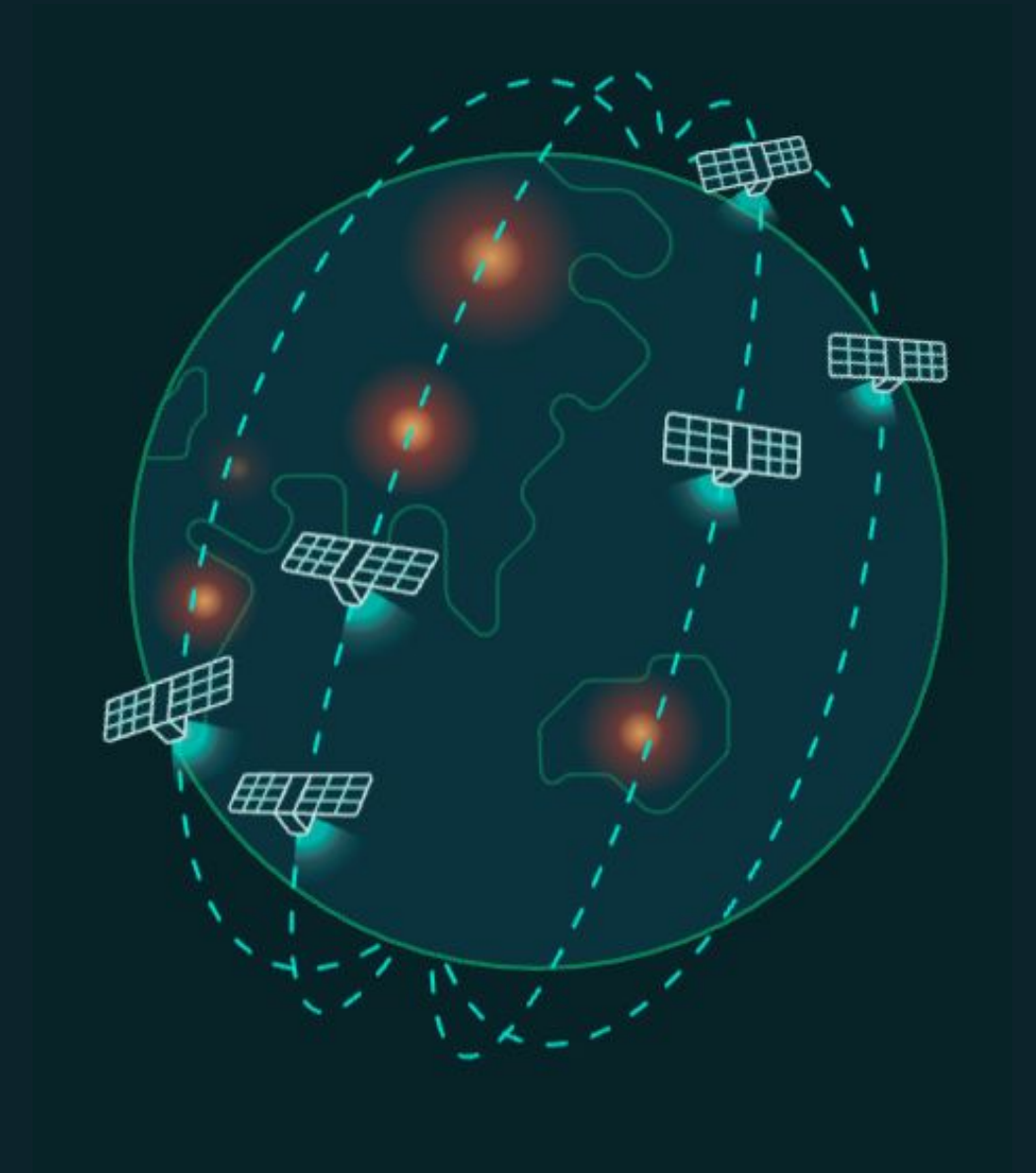


Wildfire Detection at OroraTech

- 19 satellites in orbit (more planned!), each carrying 2 TIR sensors with MWIR and LWIR bands
- Spatial resolution 200 m, swath 410 km
- Low-Earth, Sun-synchronous, **late afternoon orbits** to maximize fire detection opportunities

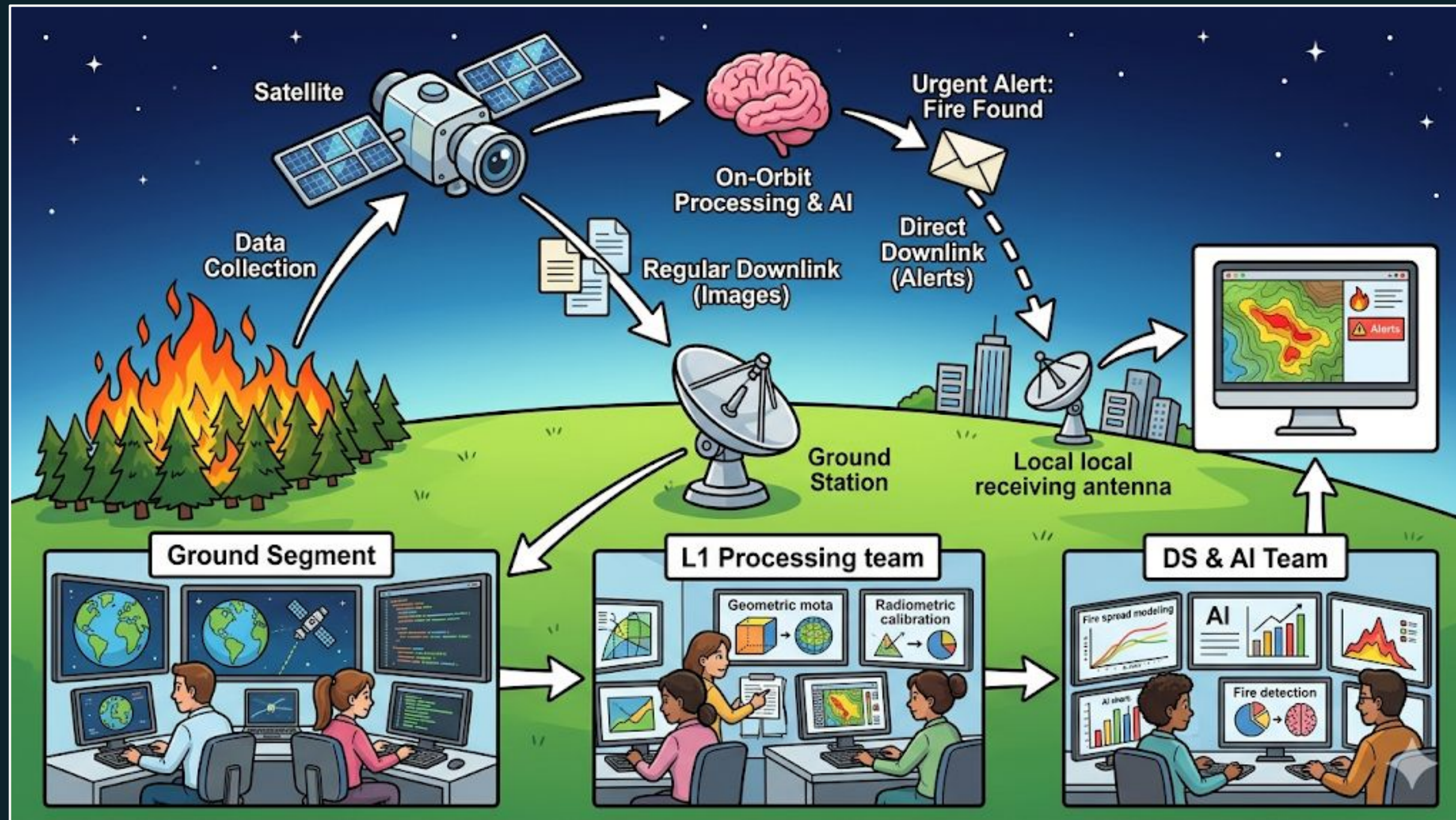


<https://ororatech.com/>



Journey of a photon

How we go from data collection to wildfire insights

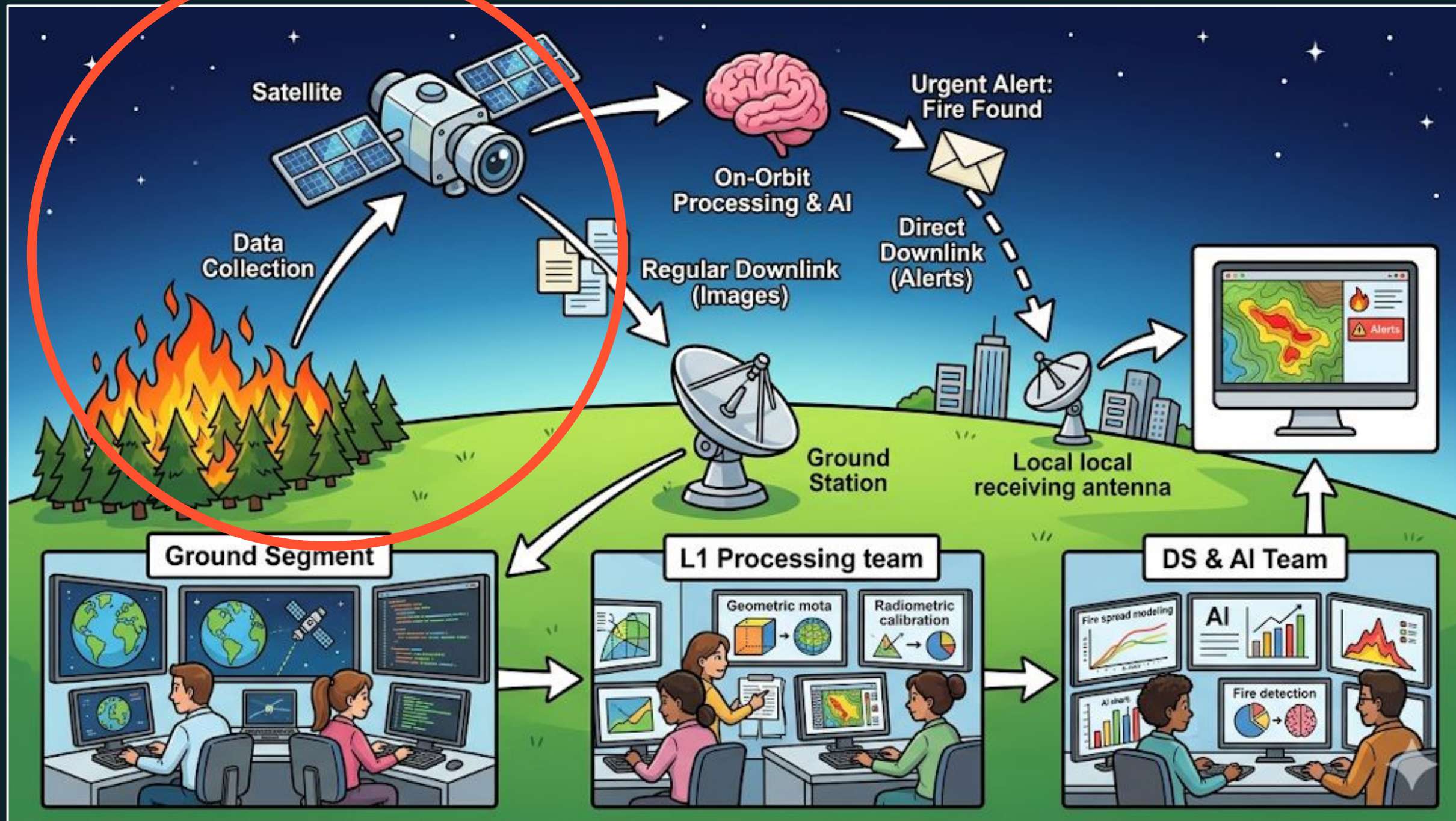


Created using Gemini



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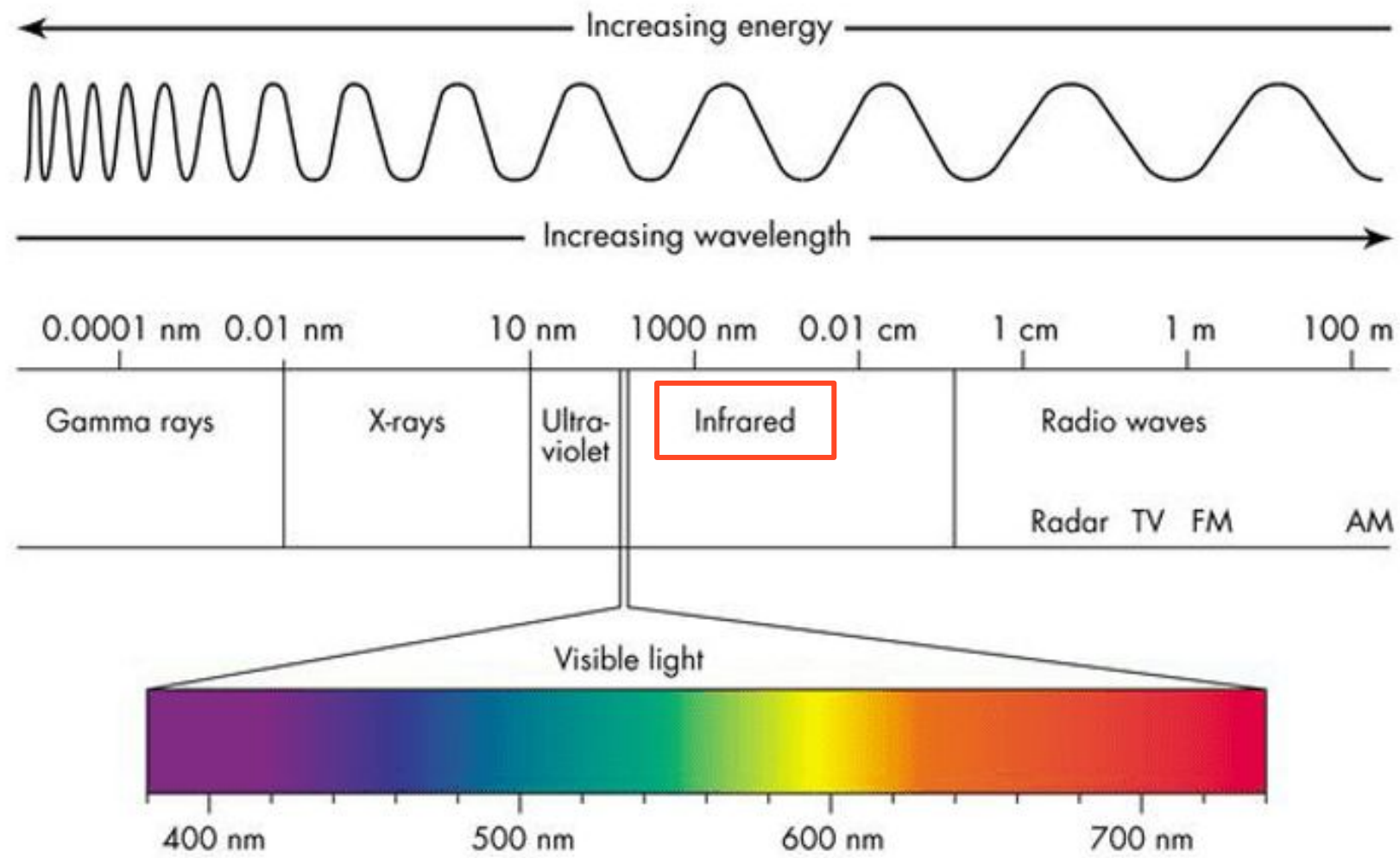


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“Seeing” heat

Anything with a temperature produces thermal infrared emission

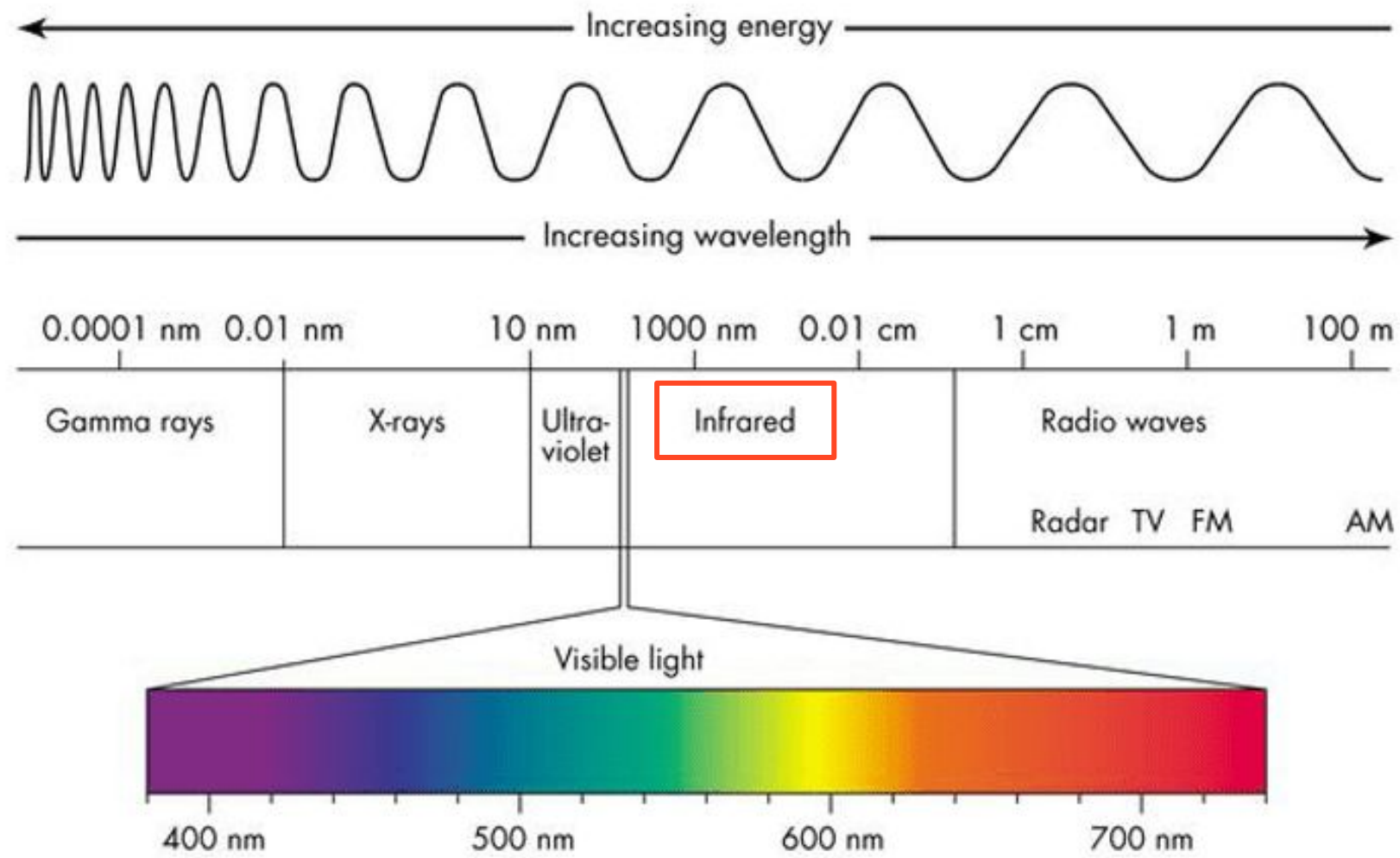


<https://online-learning-college.com/knowledge-hub/gcses/gcse-physics-help/electromagnetic-spectrum>



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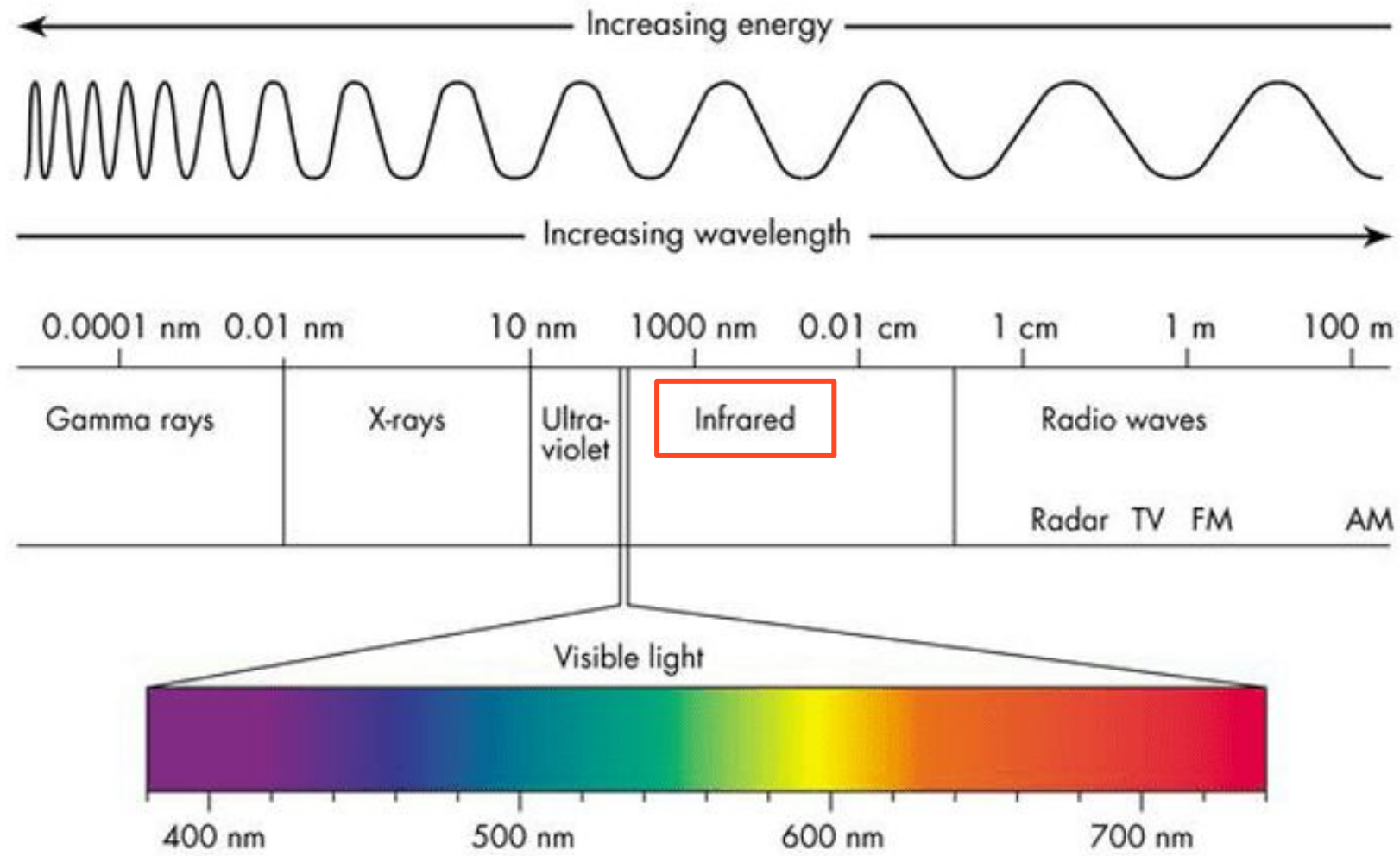


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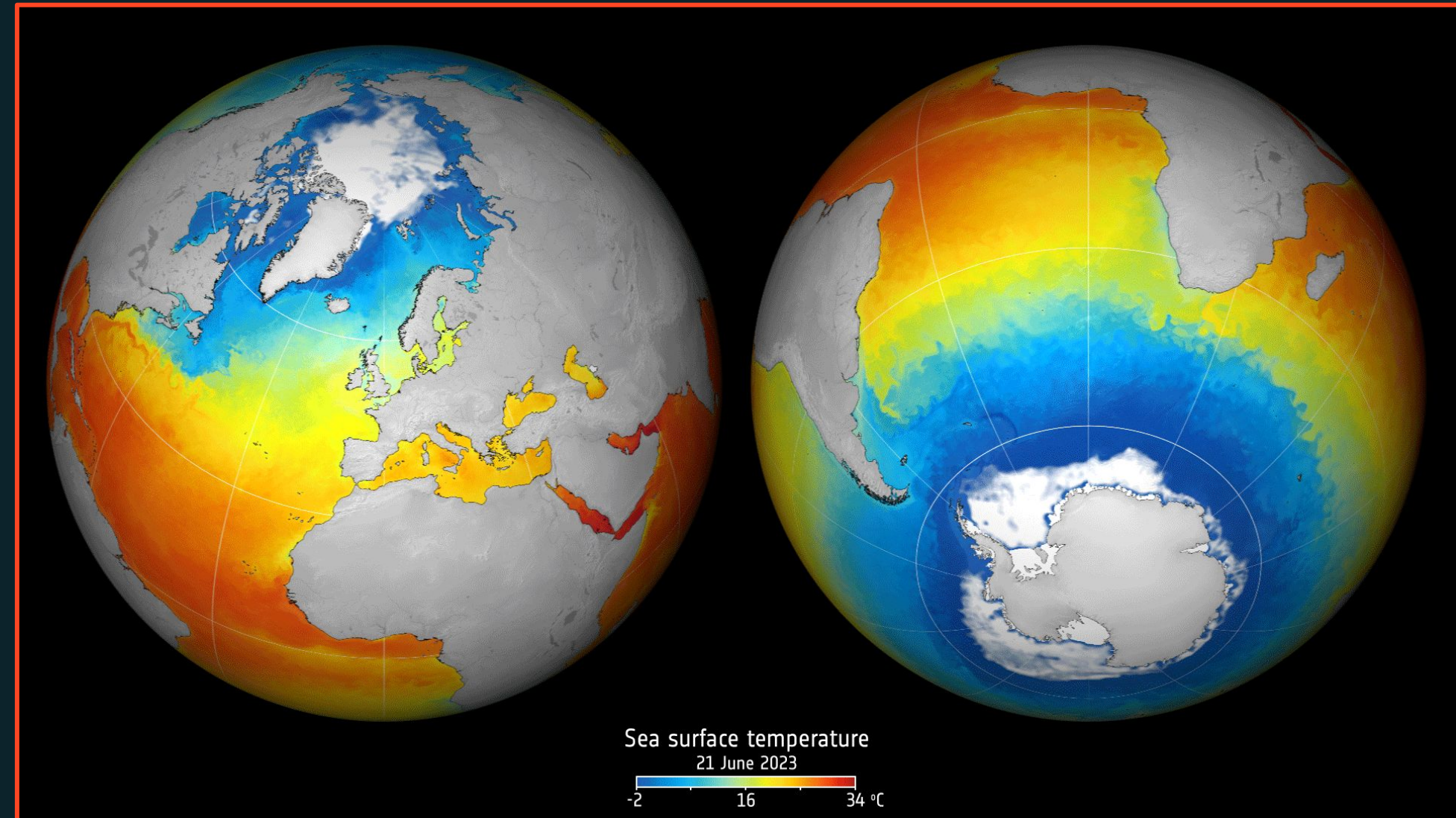


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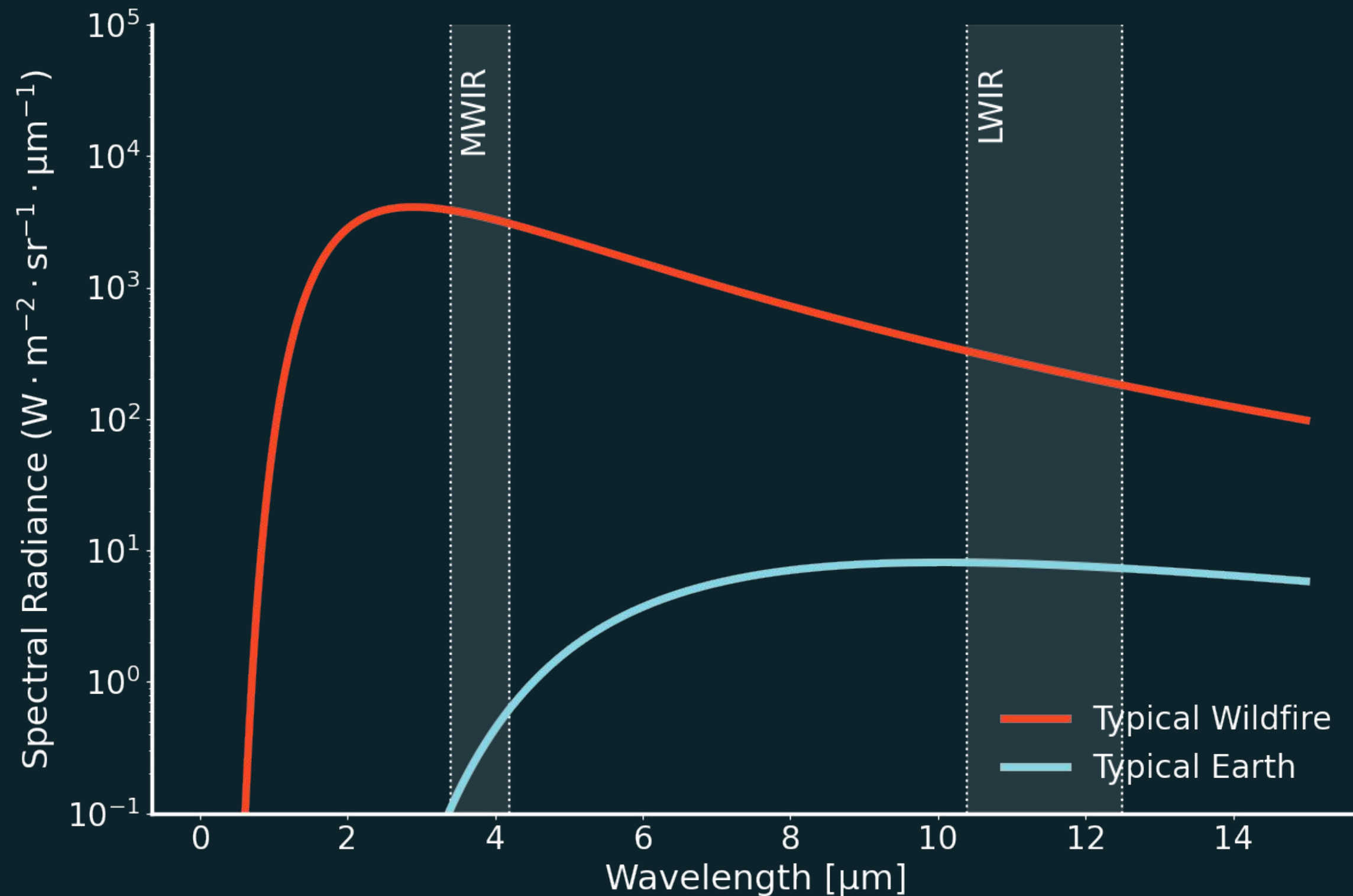


https://www.esa.int/ESA_Multimedia/Images/2025/04/Global_sea_surface_temperature



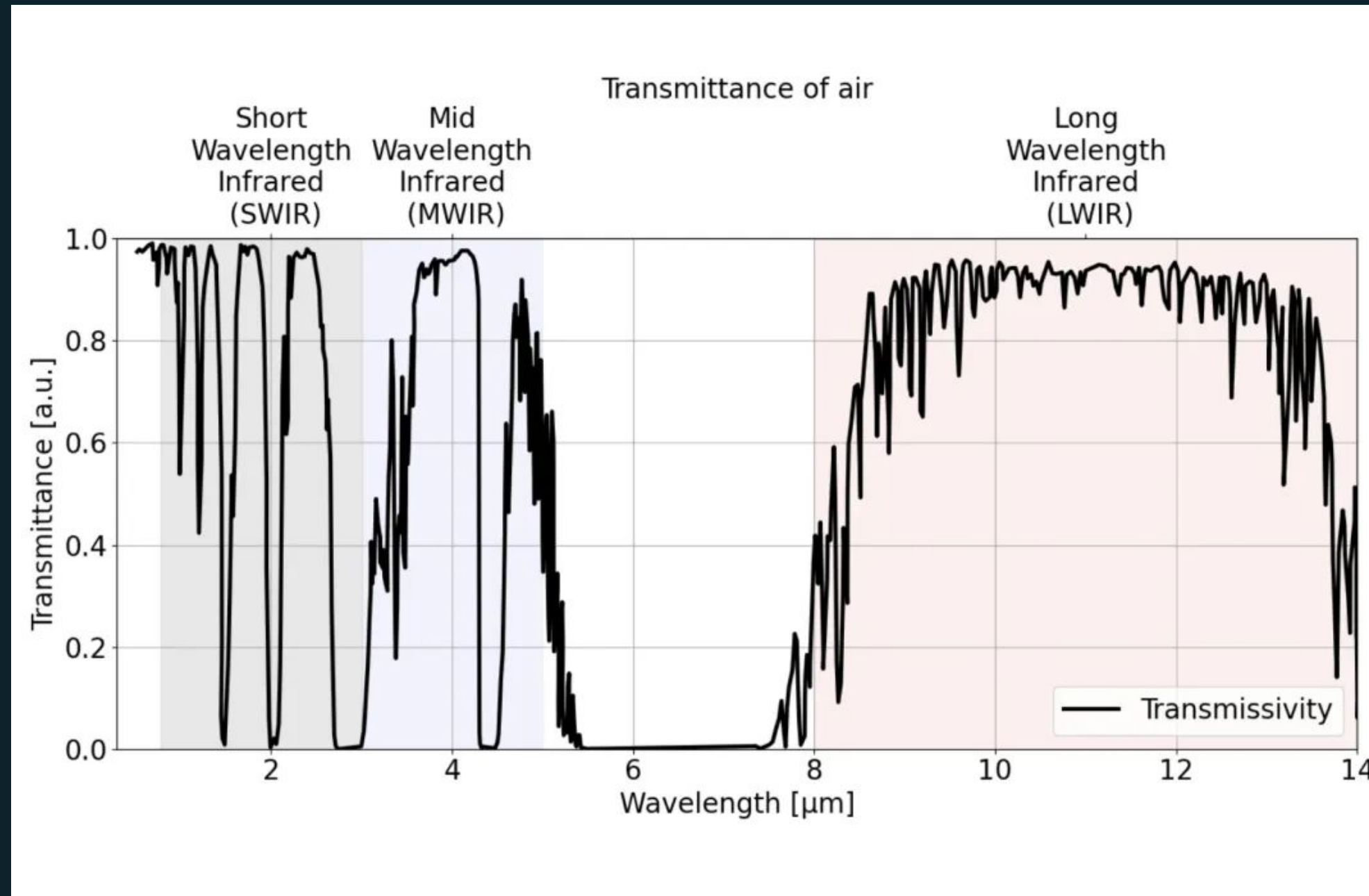
Thermal band selection

The amount of emitted radiation depends on temperature



Thermal band selection

Thermal IR bands are carefully selected to see through the Earth's atmosphere

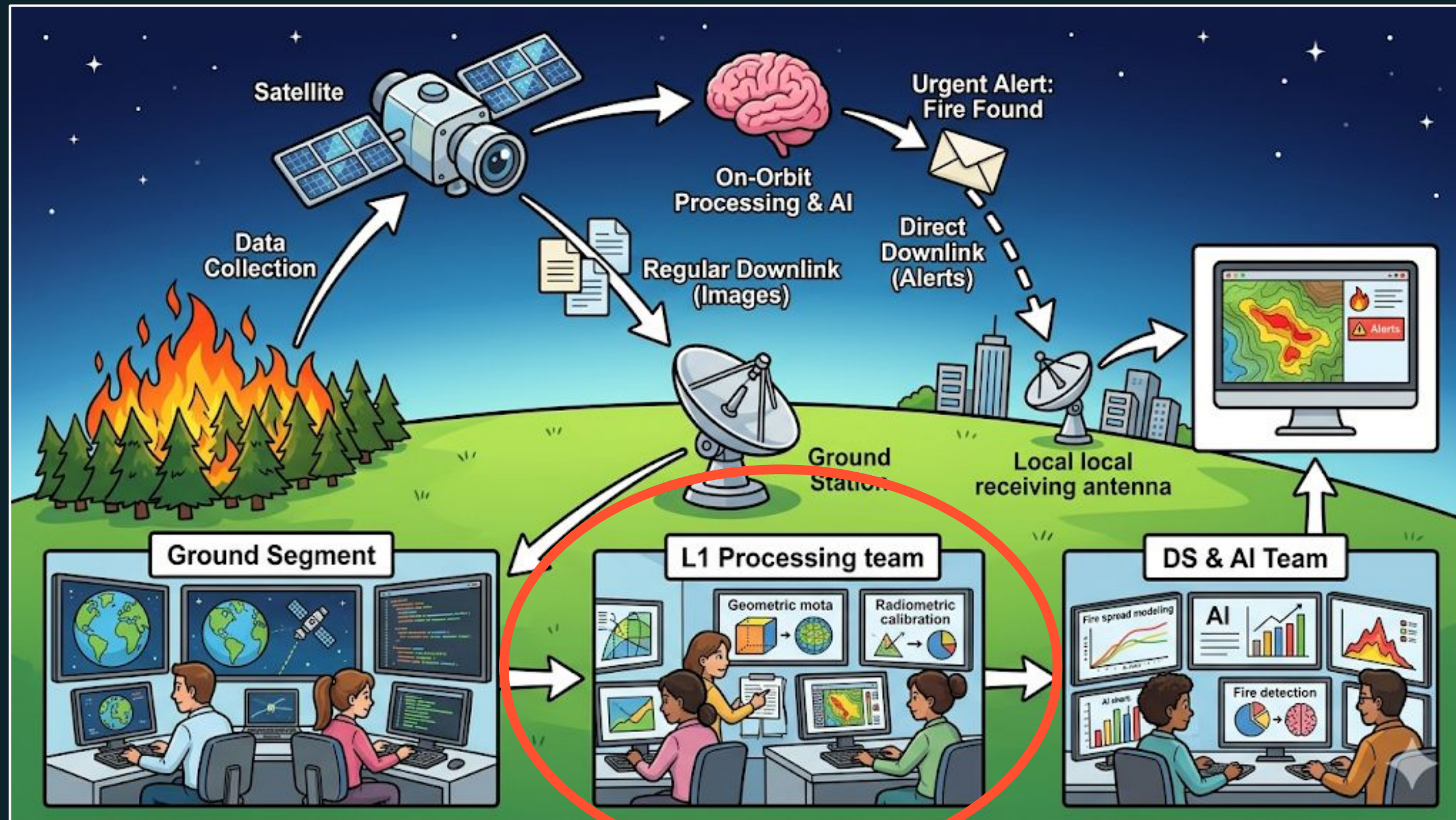


<https://optris.com/us/lexicon/atmospheric-windows/>



Journey of a photon

How we go from data collection to wildfire insights



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Radiometric calibration

Converting raw measurements into physically meaningful values



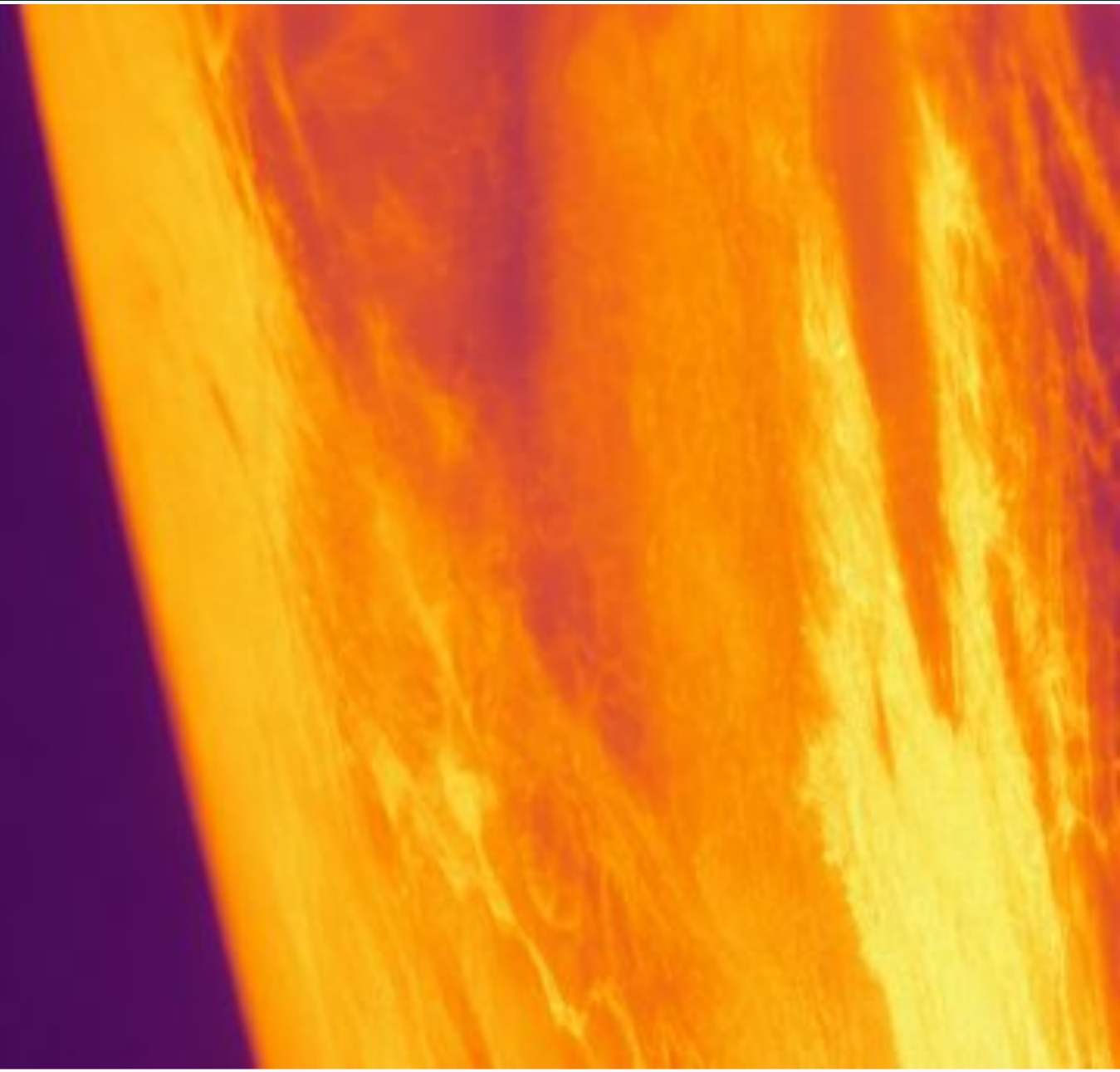
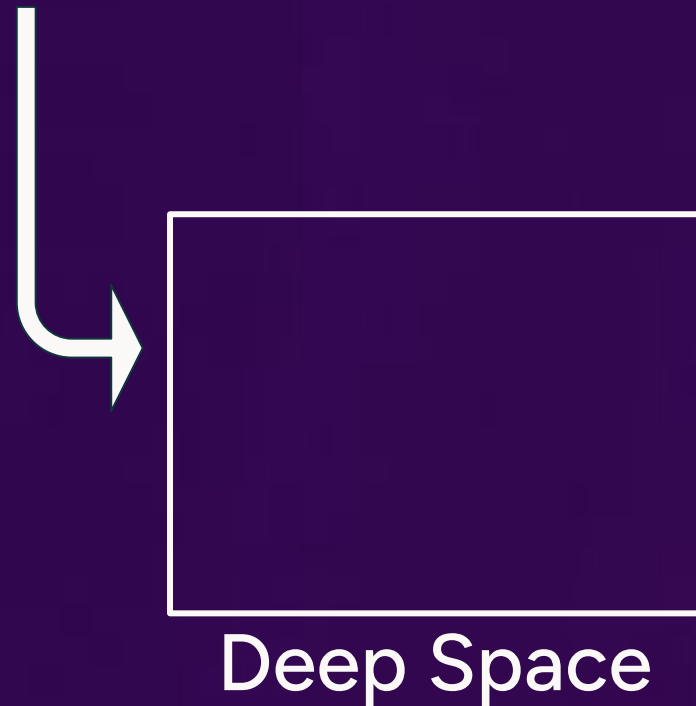
<https://ororatech.com/resources/news-blog/ororatech-achieves-first-light-from-the-kepler-network>



Radiometric calibration

Converting raw measurements into physically meaningful values

Our satellites **emit thermal radiation**, which needs to be removed in order to isolate the signal we want to measure



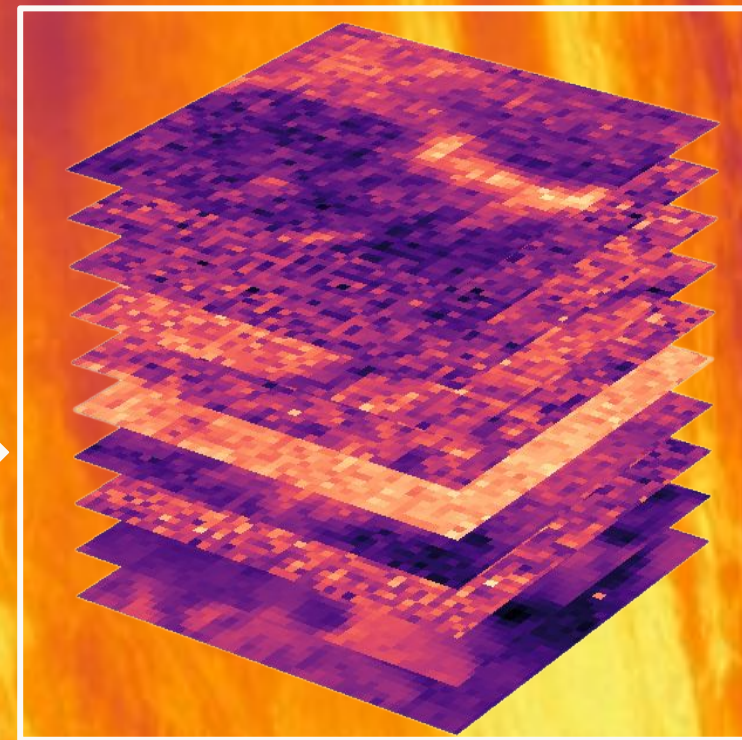
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Radiometric calibration

Converting raw measurements into physically meaningful values

Not all pixels are created equal – **differences in responsivity** need to be characterized



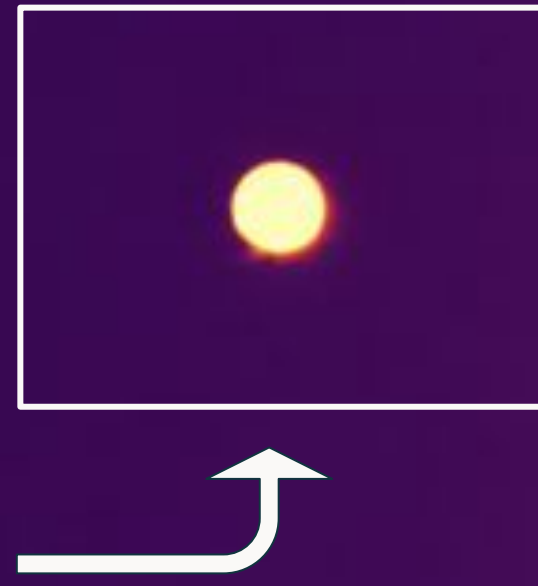
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Radiometric calibration

Converting raw measurements into physically meaningful values

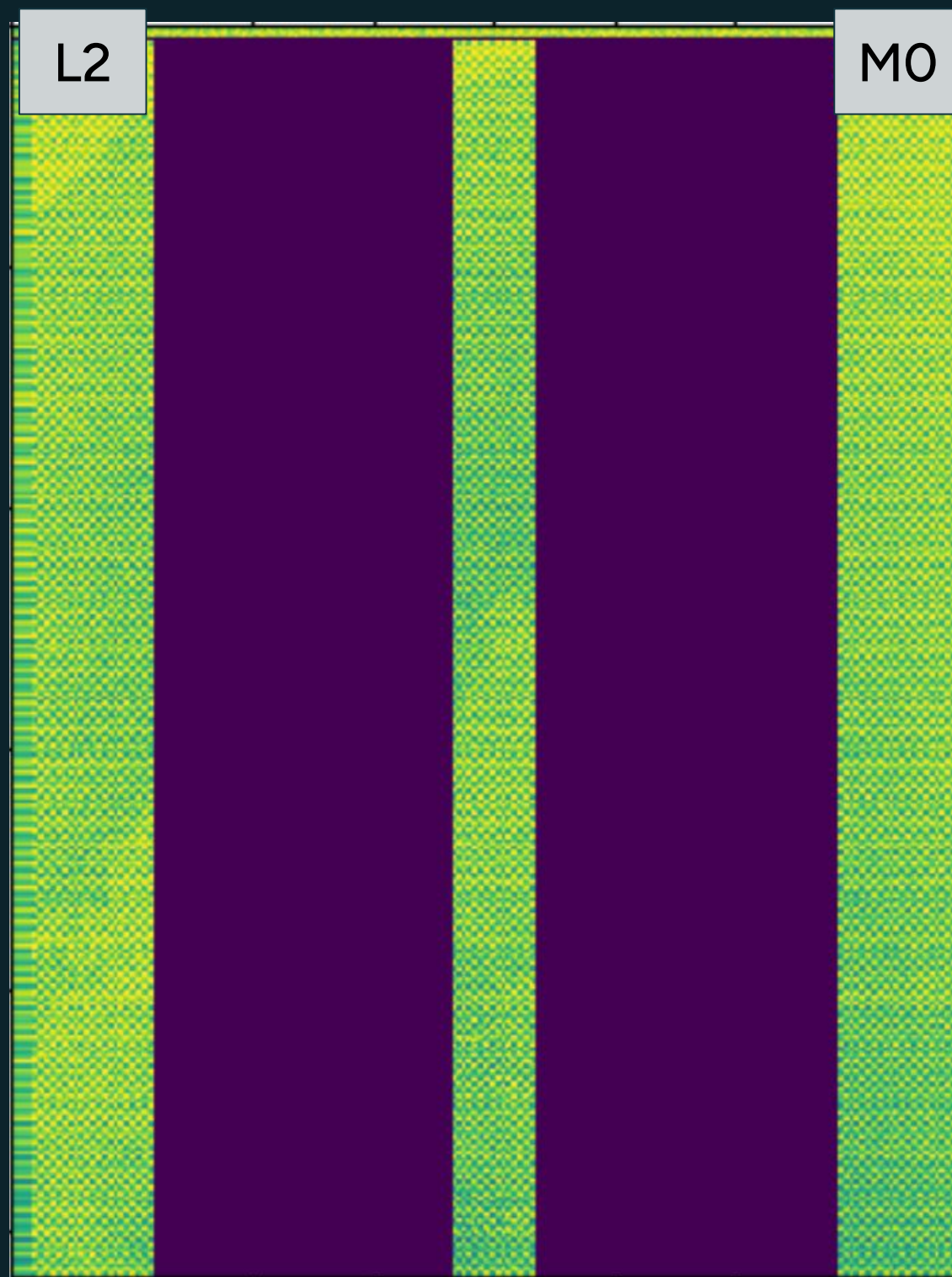
Conversion from raw digital numbers to **physical units**, derived from lunar observations compared with a thermophysical model



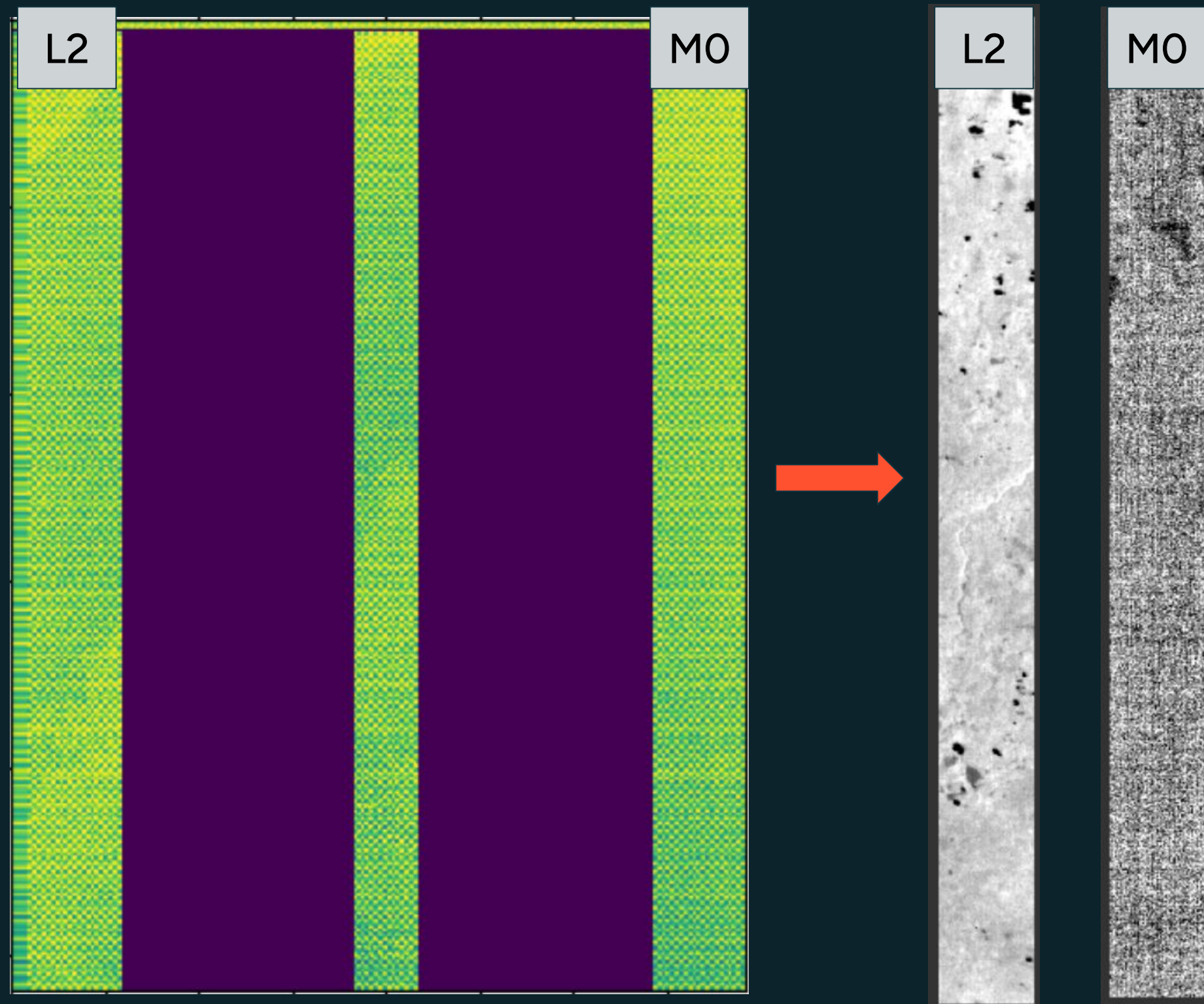
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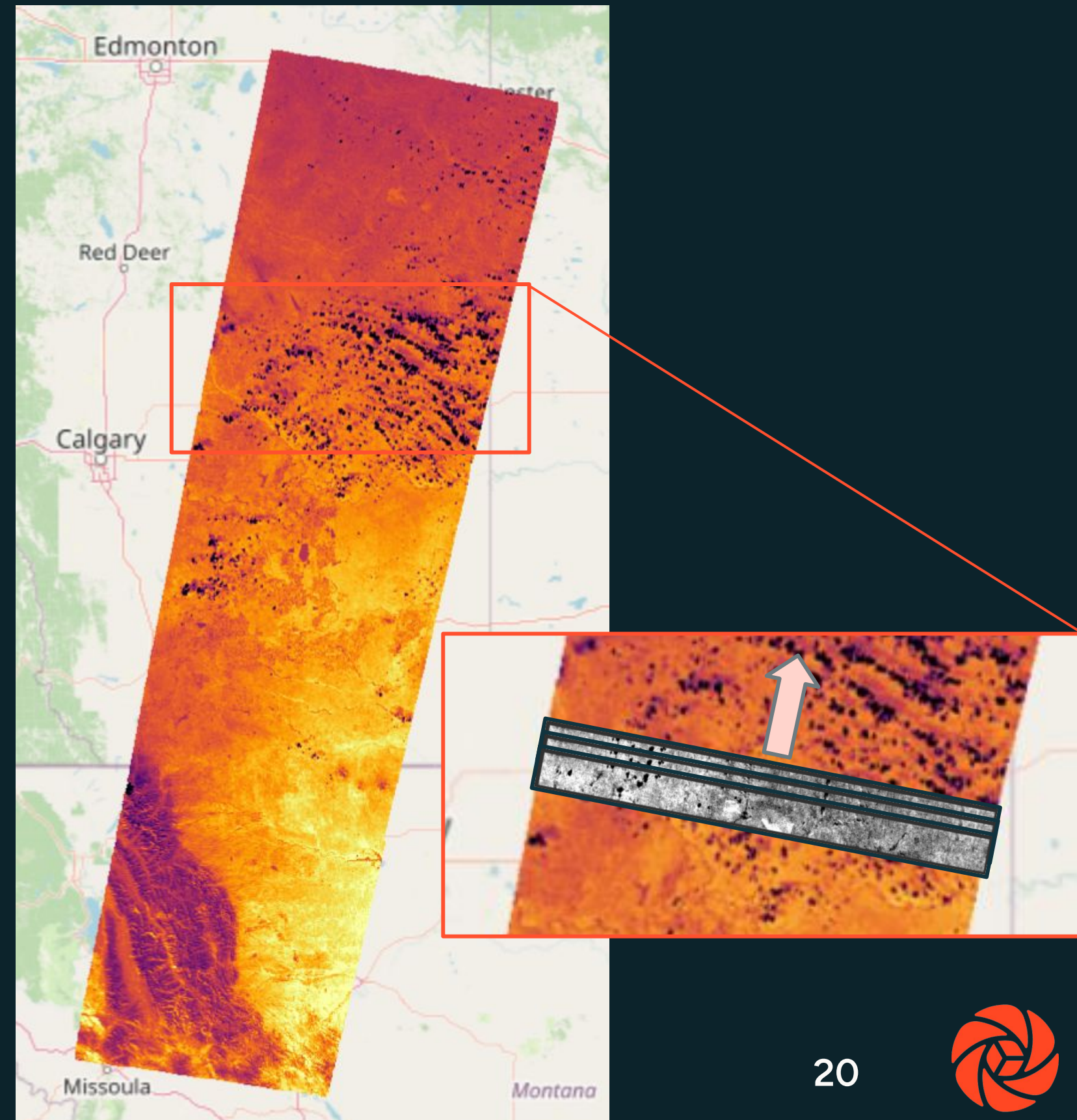
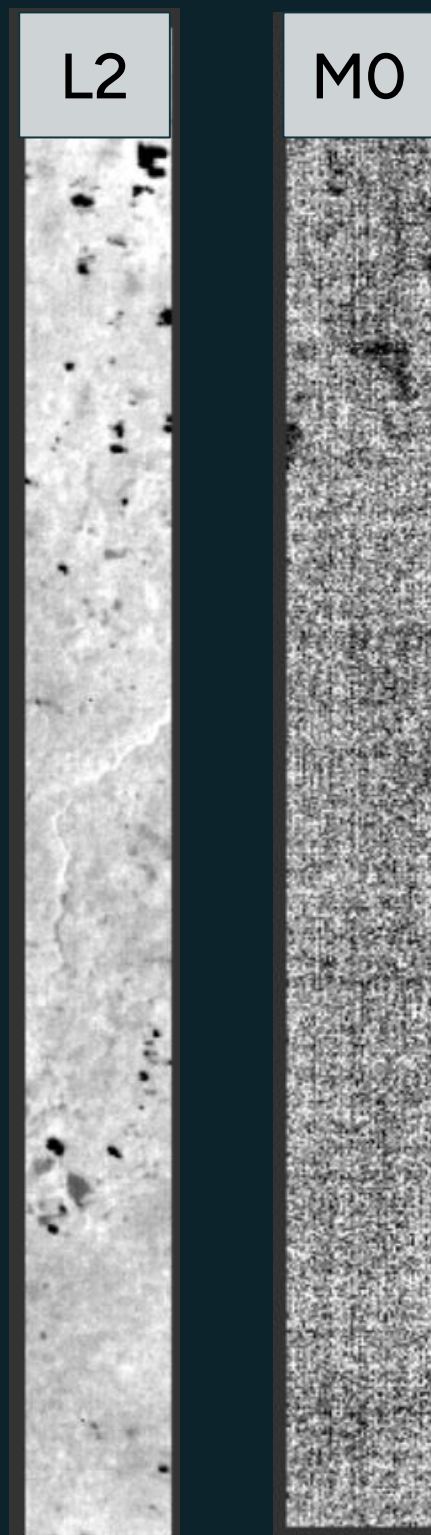
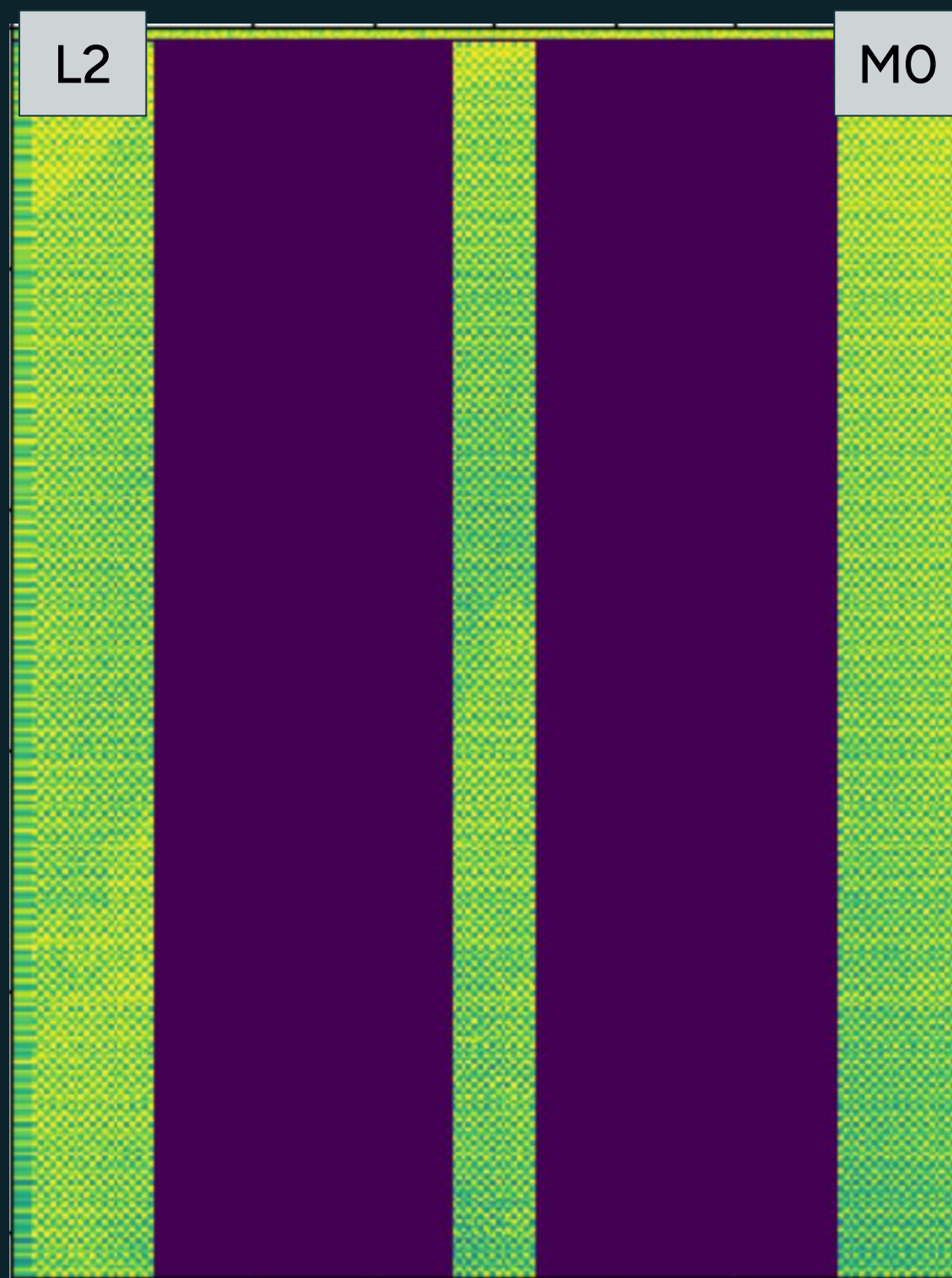
From raw data...



... to physical units ...

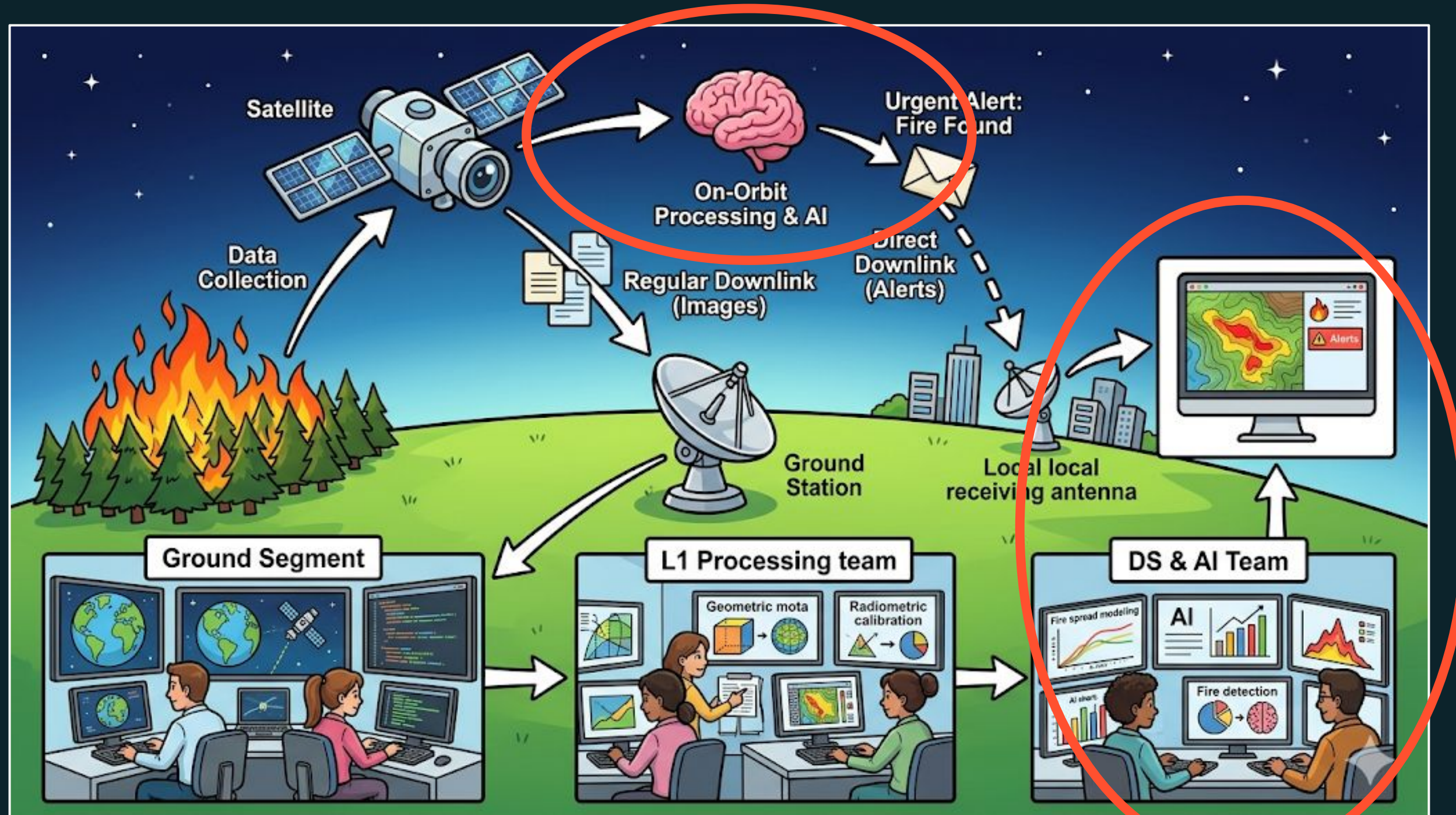


... to ready-to-use images



Journey of a photon

How we go from data collection to wildfire insights



Created using Gemini



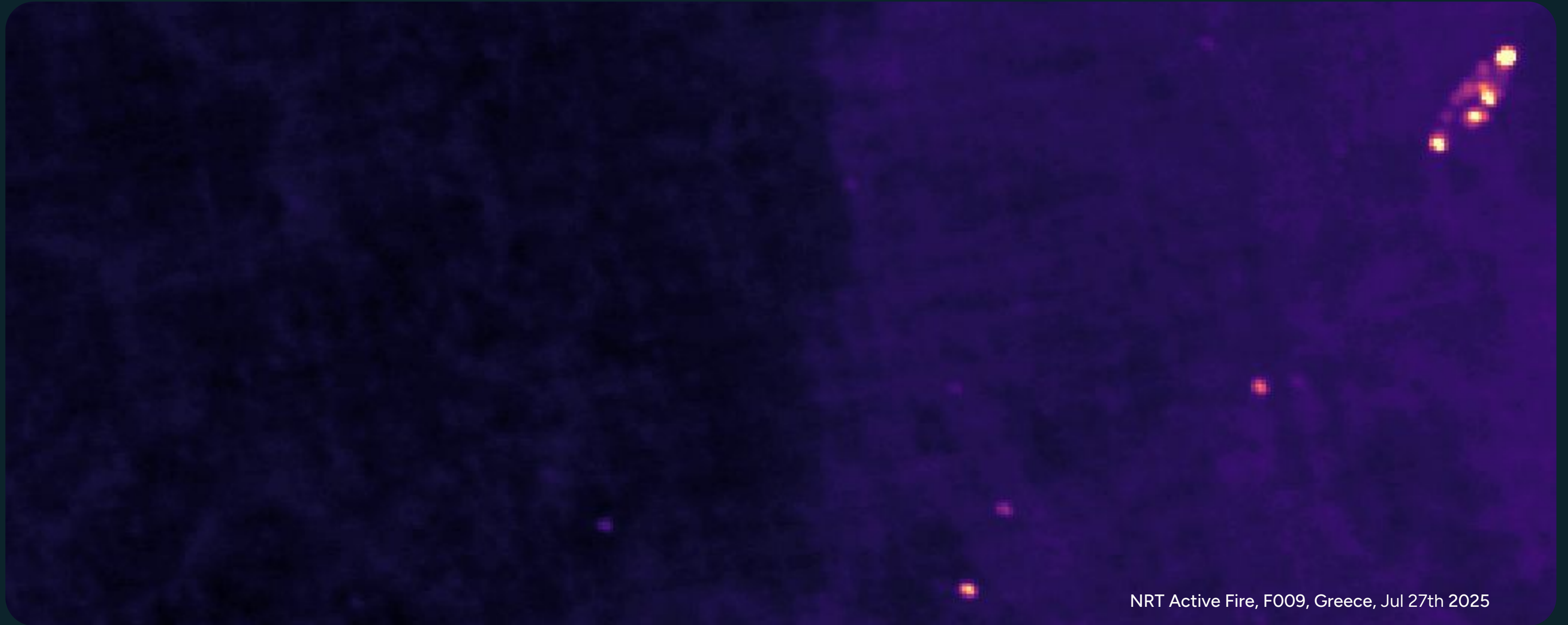
Where are Fires Currently Burning?

Aggregated and Near Real Time Active Fire



Fire Detection

Classifying hotspots

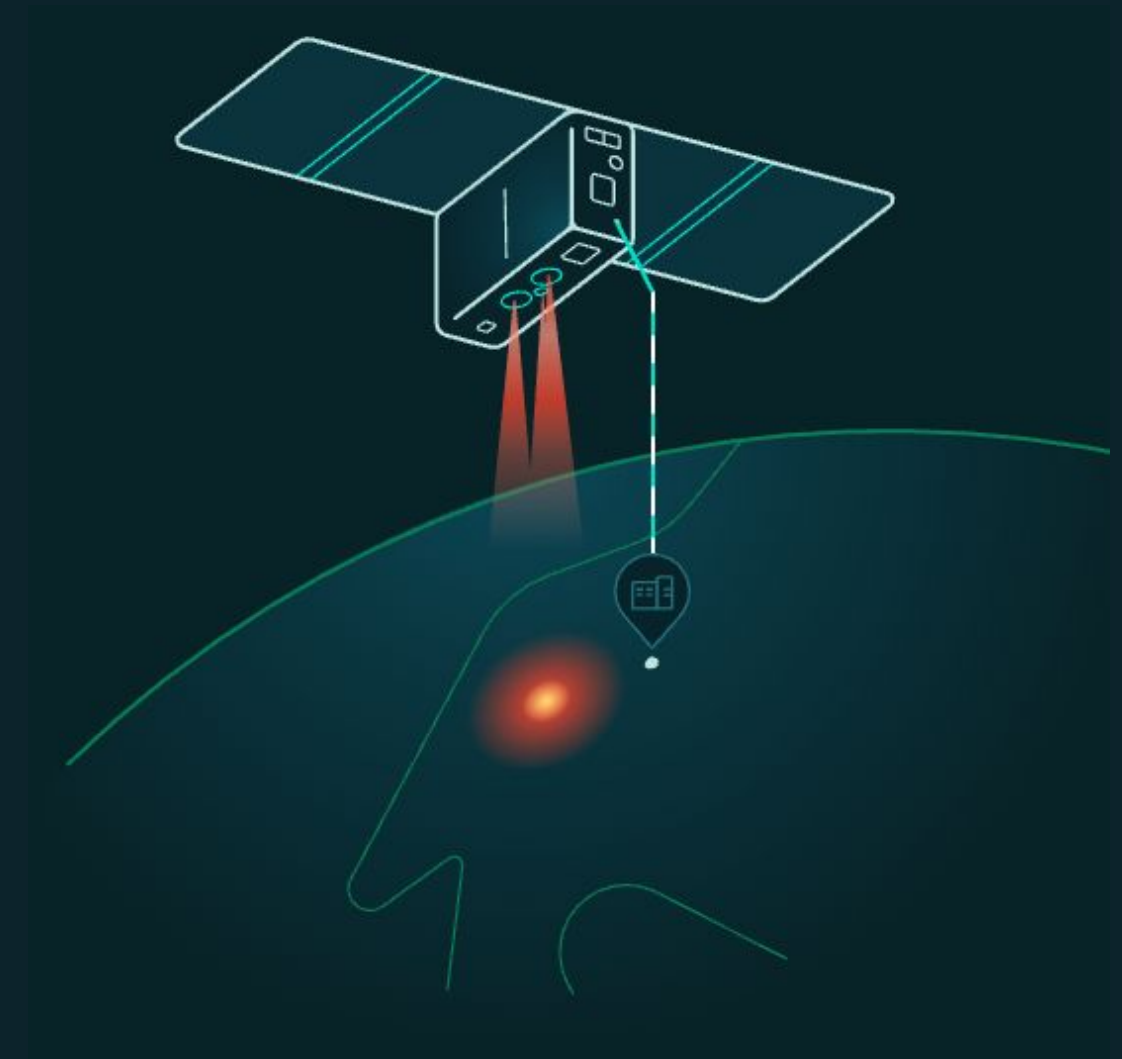


Fire Detection

Classifying hotspots

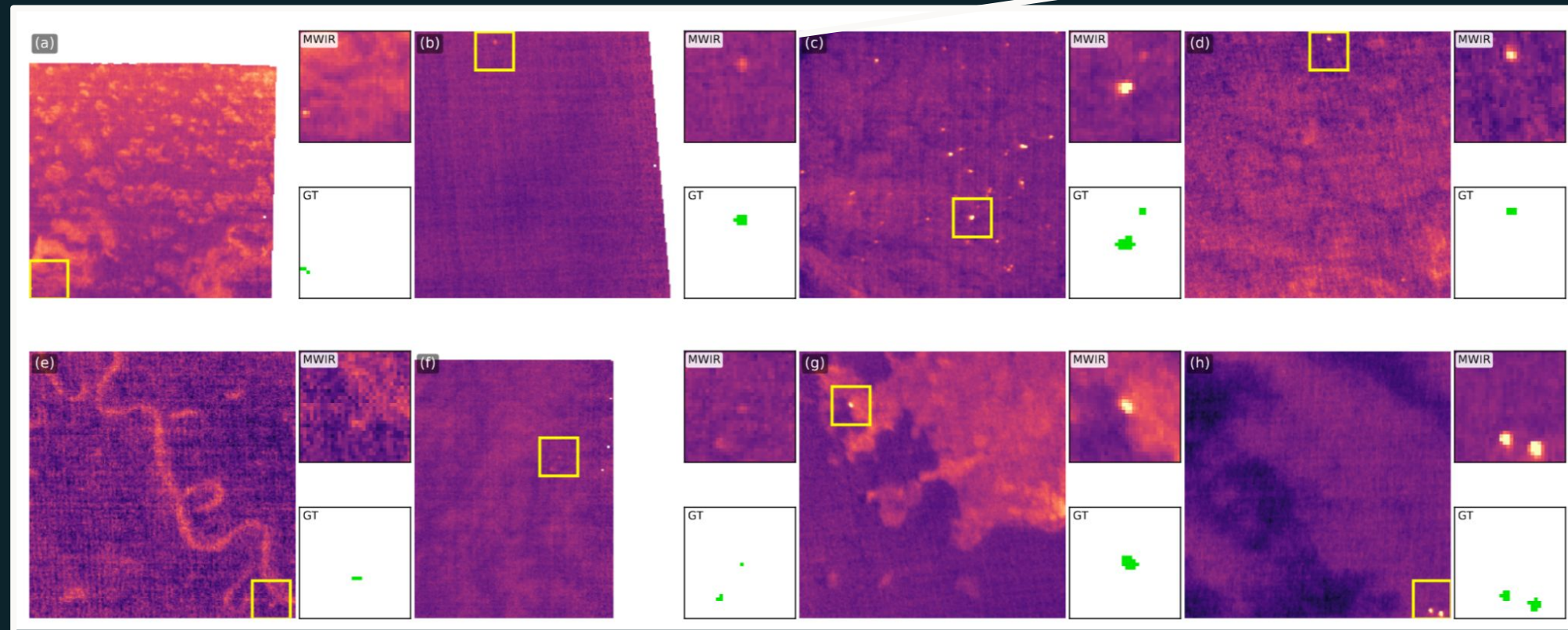
Our challenge: **on-orbit, real-time** wildfire detection

On-orbit processing means that **inference is run on board** the satellites, significantly constraining the resource budget



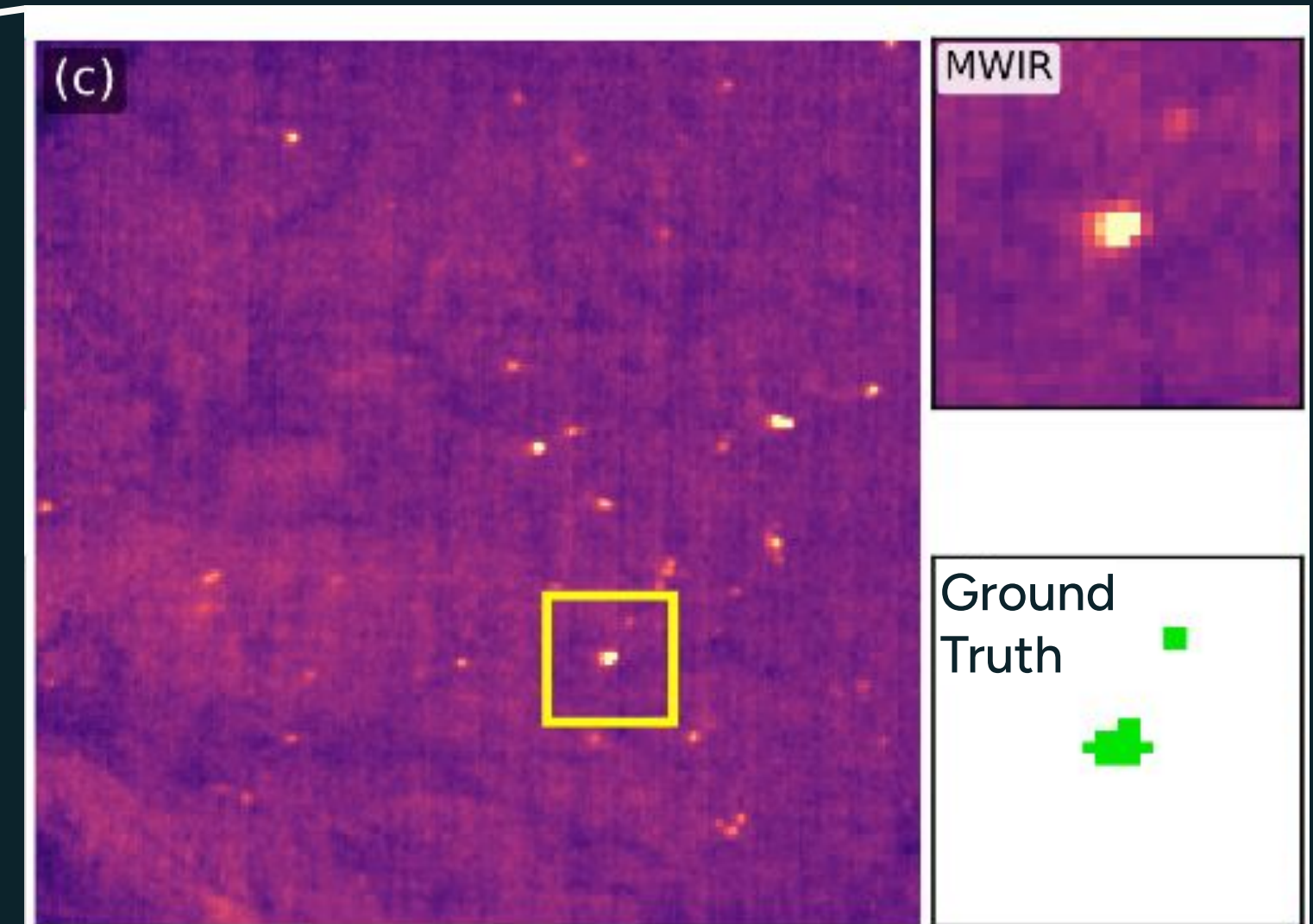
Fire Detection

Classifying hotspots



Early stage fires are small (single or sub-pixel) and rare (extreme class imbalance)

Example of manually labelled MWIR

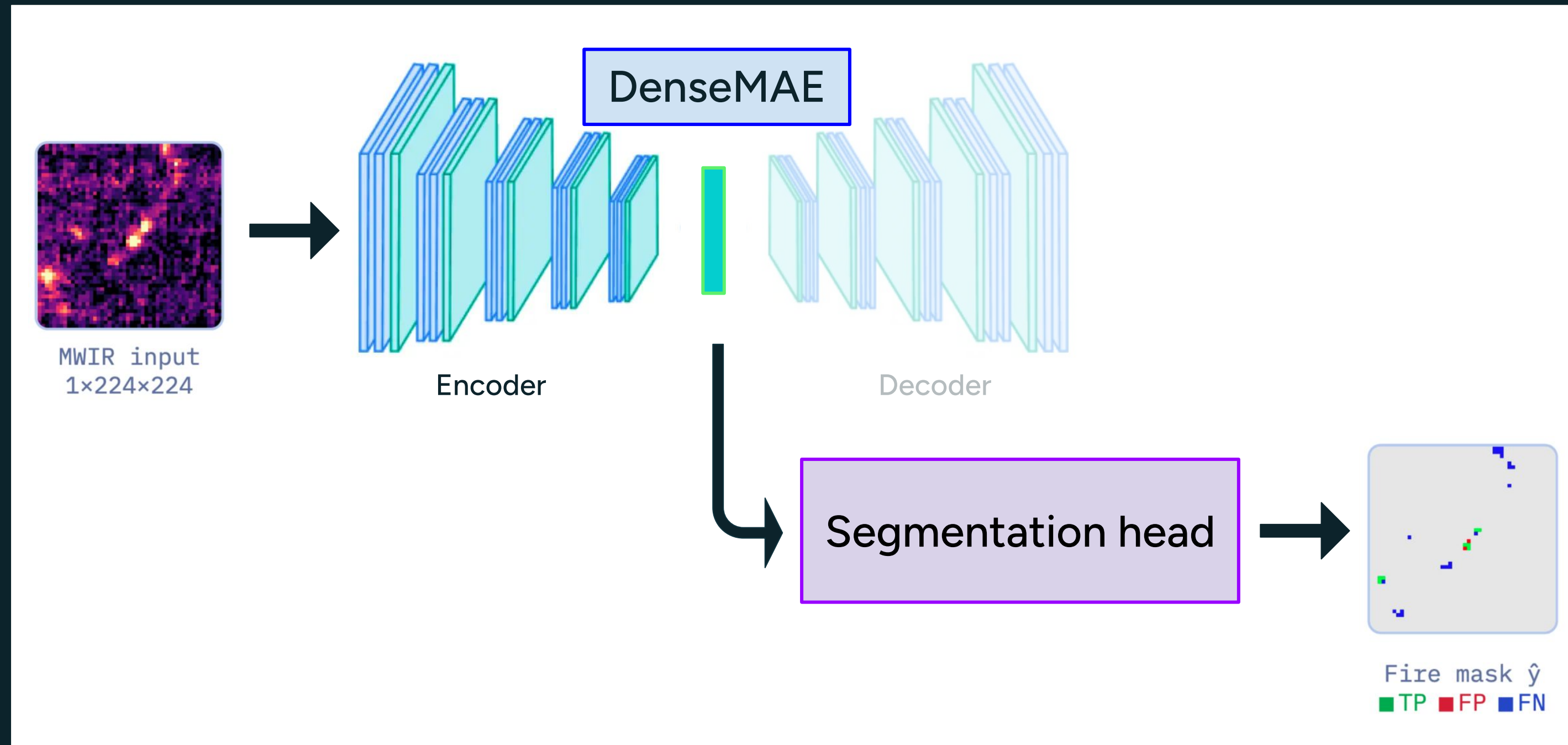


Uncalibrated, transitioning to calibrated



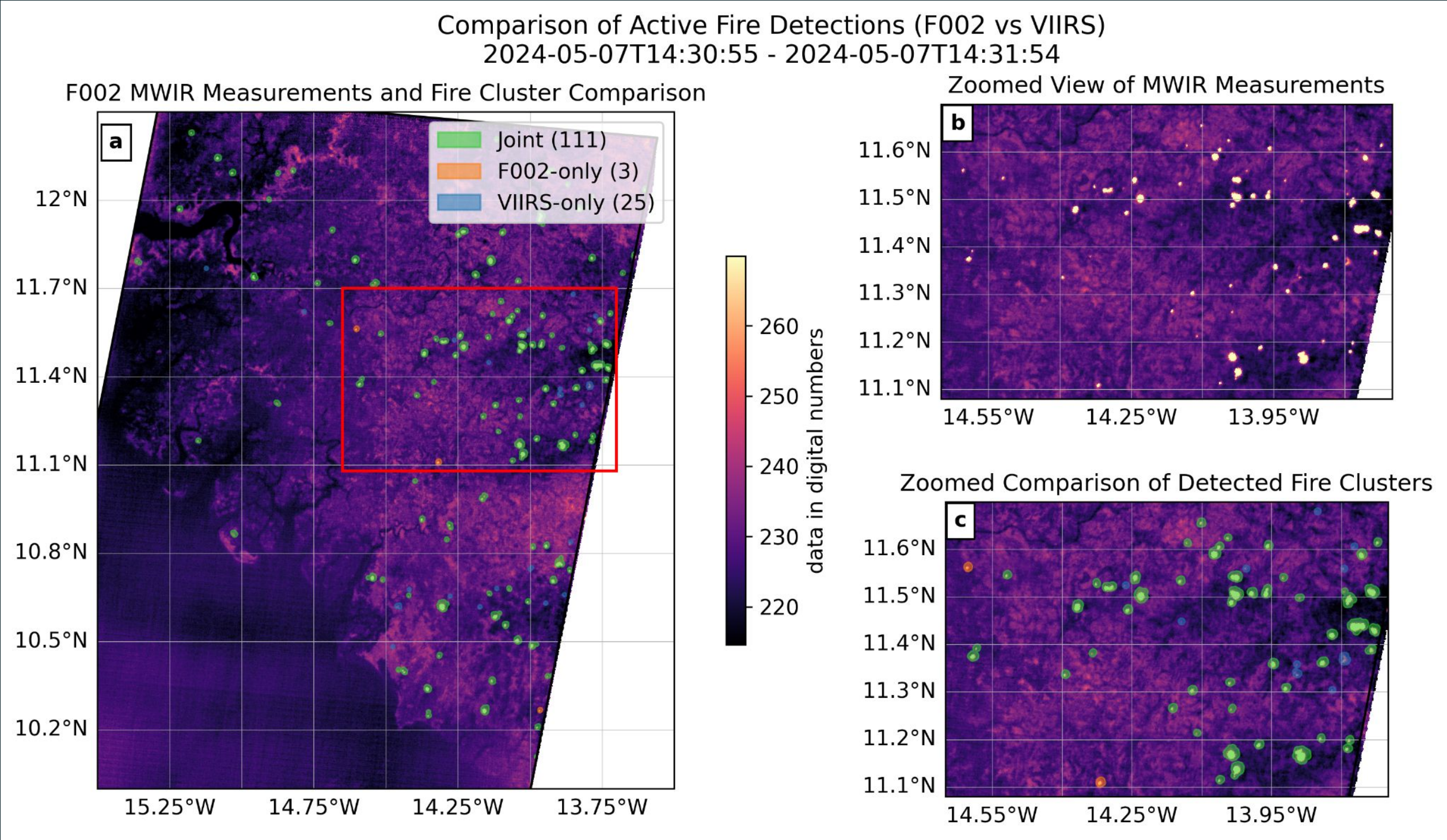
Fire Detection

Classifying hotspots



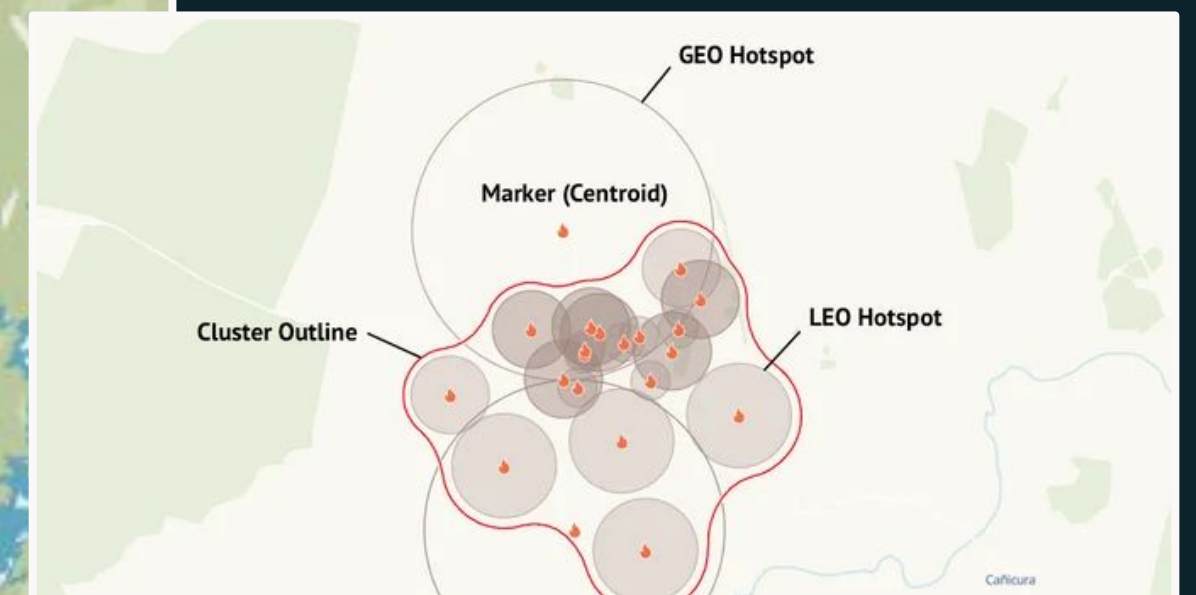
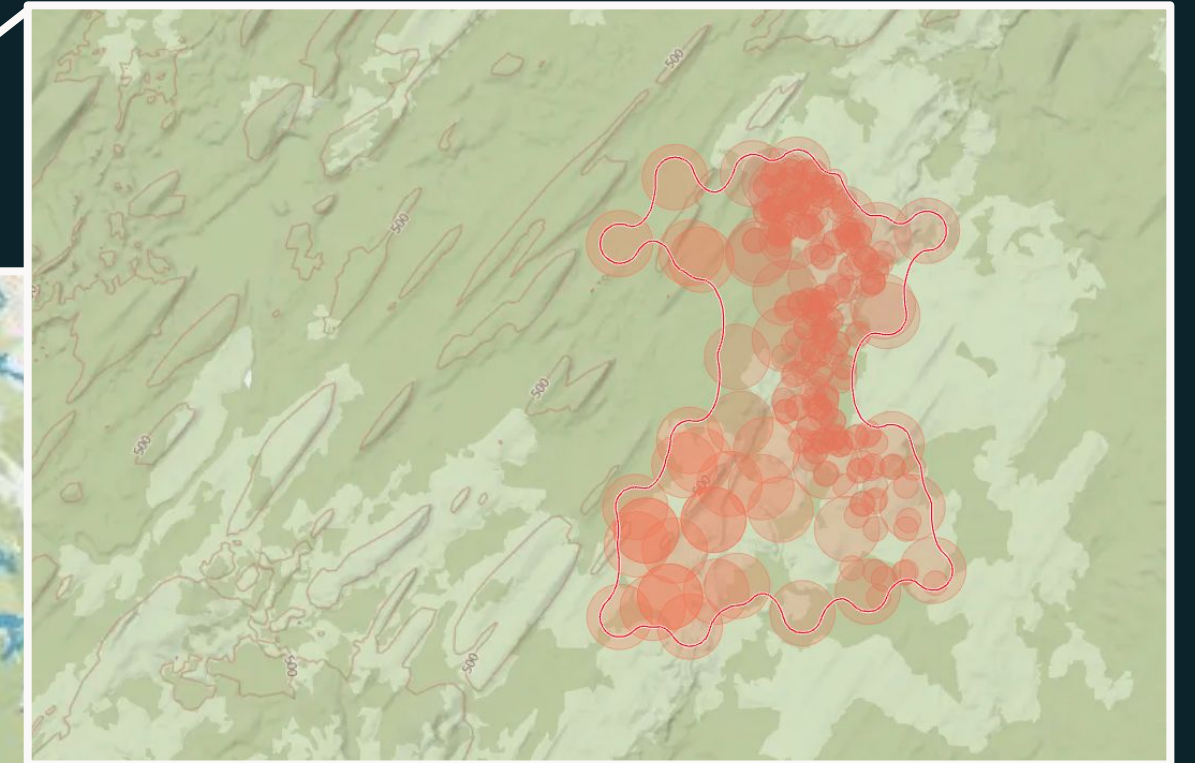
Fire Detection

Classifying hotspots



Wildfire Solution

Spatial-Temporal Clustering of Hotspots



OroraTech satellites + public satellites

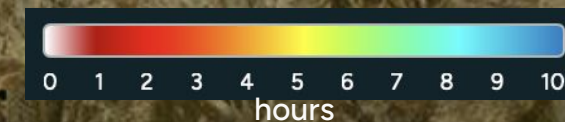
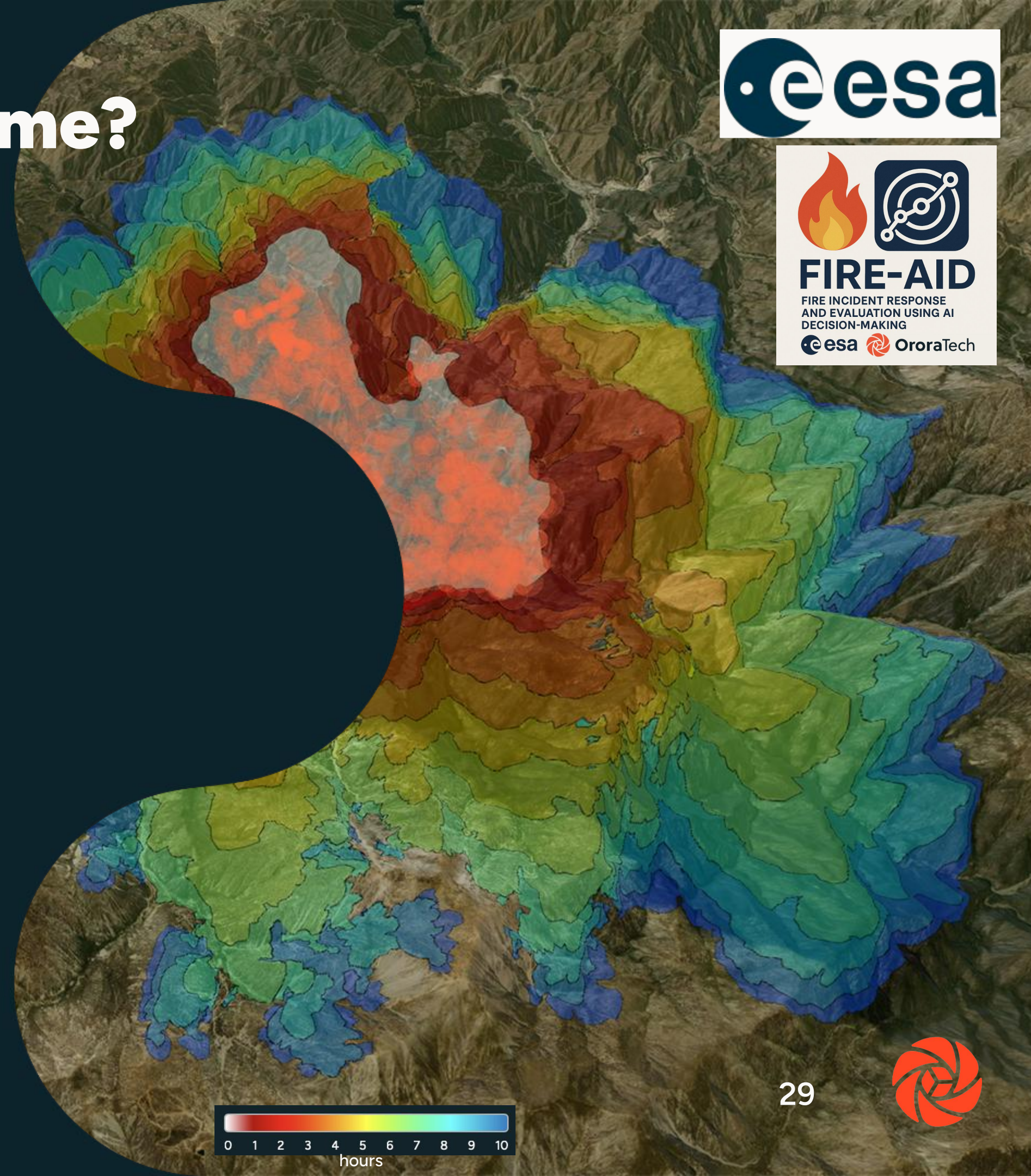


How will Fires Evolve over Time?

Forecasting fire perimeter growth



OroraTech



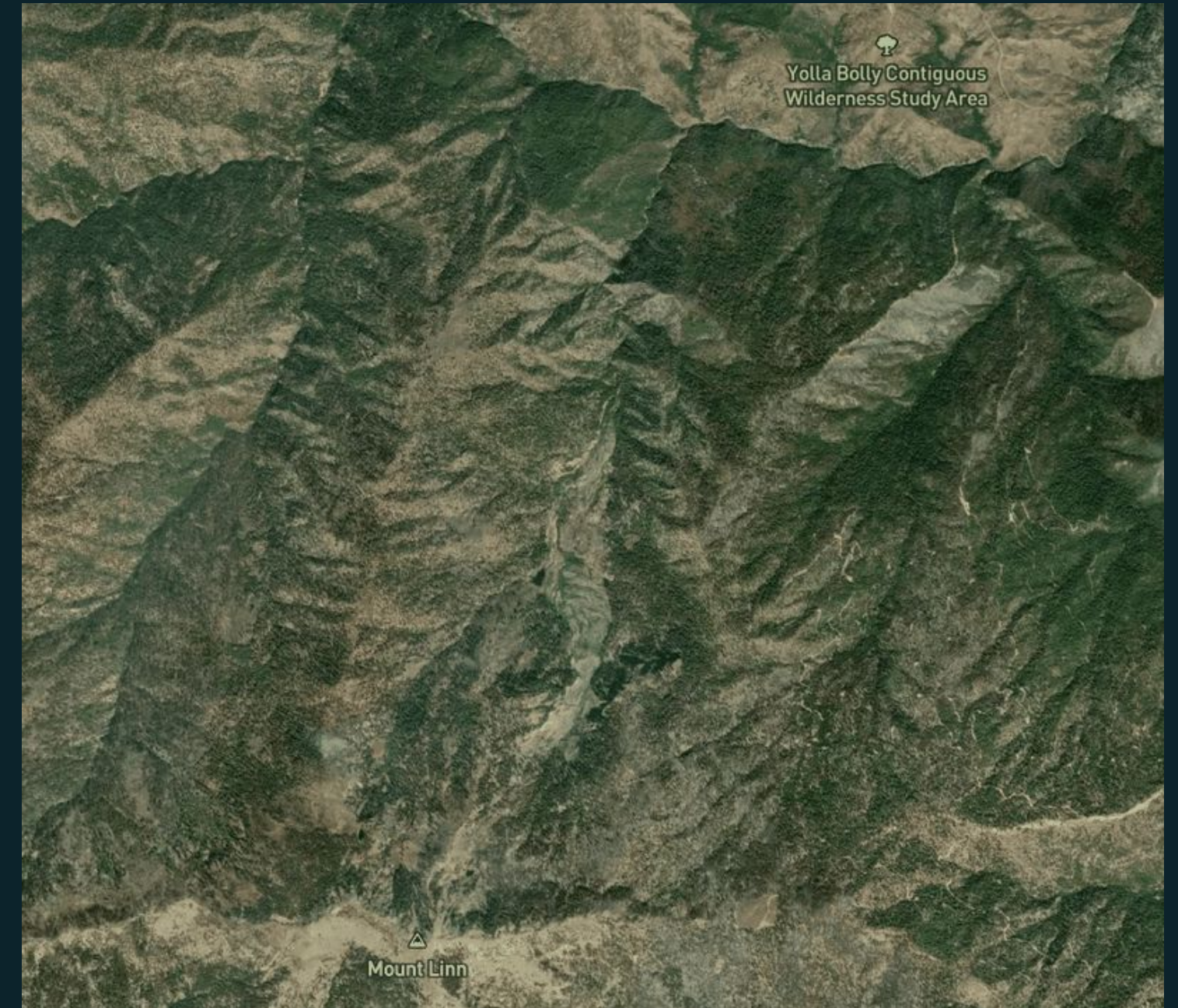
29



Predicting fire spread

OroraTech Aggregated Active Fire dataset

- Wildfire Solution: OroraTech satellites + public satellites
 - Training subset: 5,000 wildfire events across the United States between 2020 and 2025



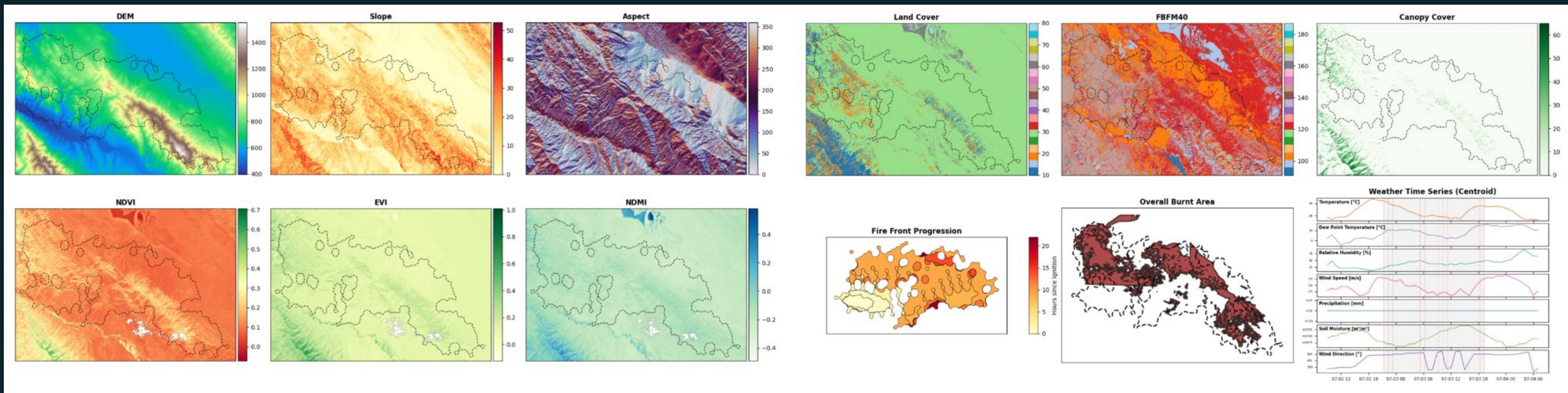
Hotspot detections in OT Wildfire Solution,
Yolly-Bolly Middle Eel Wilderness in Tehama County, Calif.
2023 Aug. 15 - 5pm Aug. 18 7am



Predicting fire spread

Enriching the dataset with key wildfire drivers

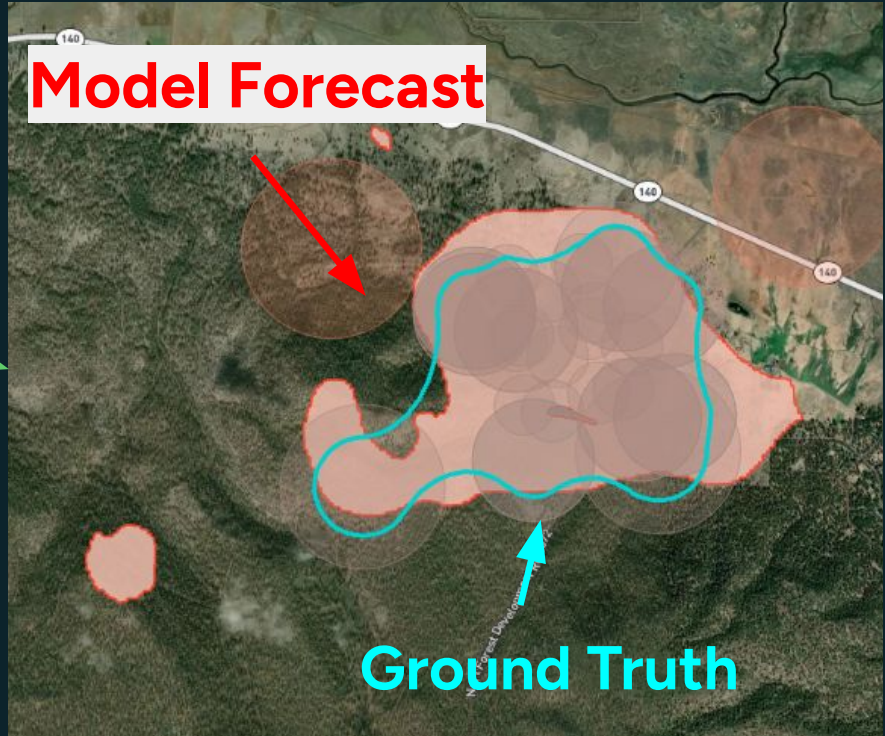
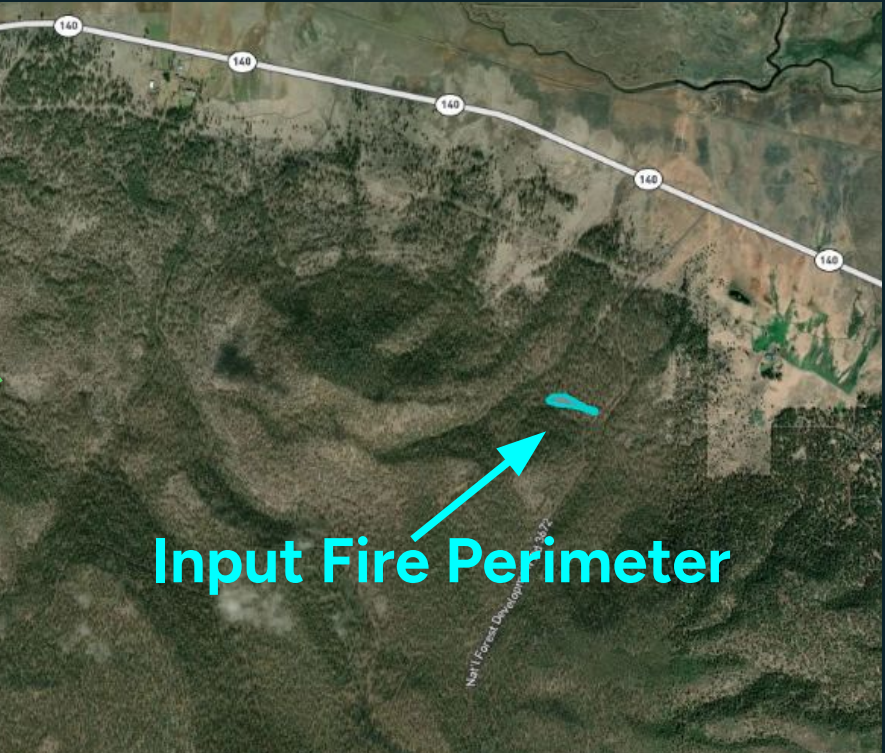
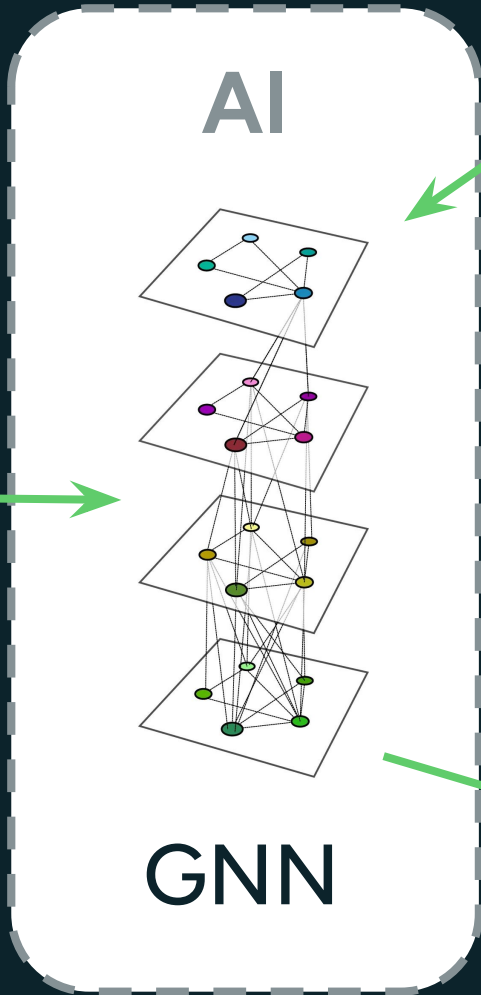
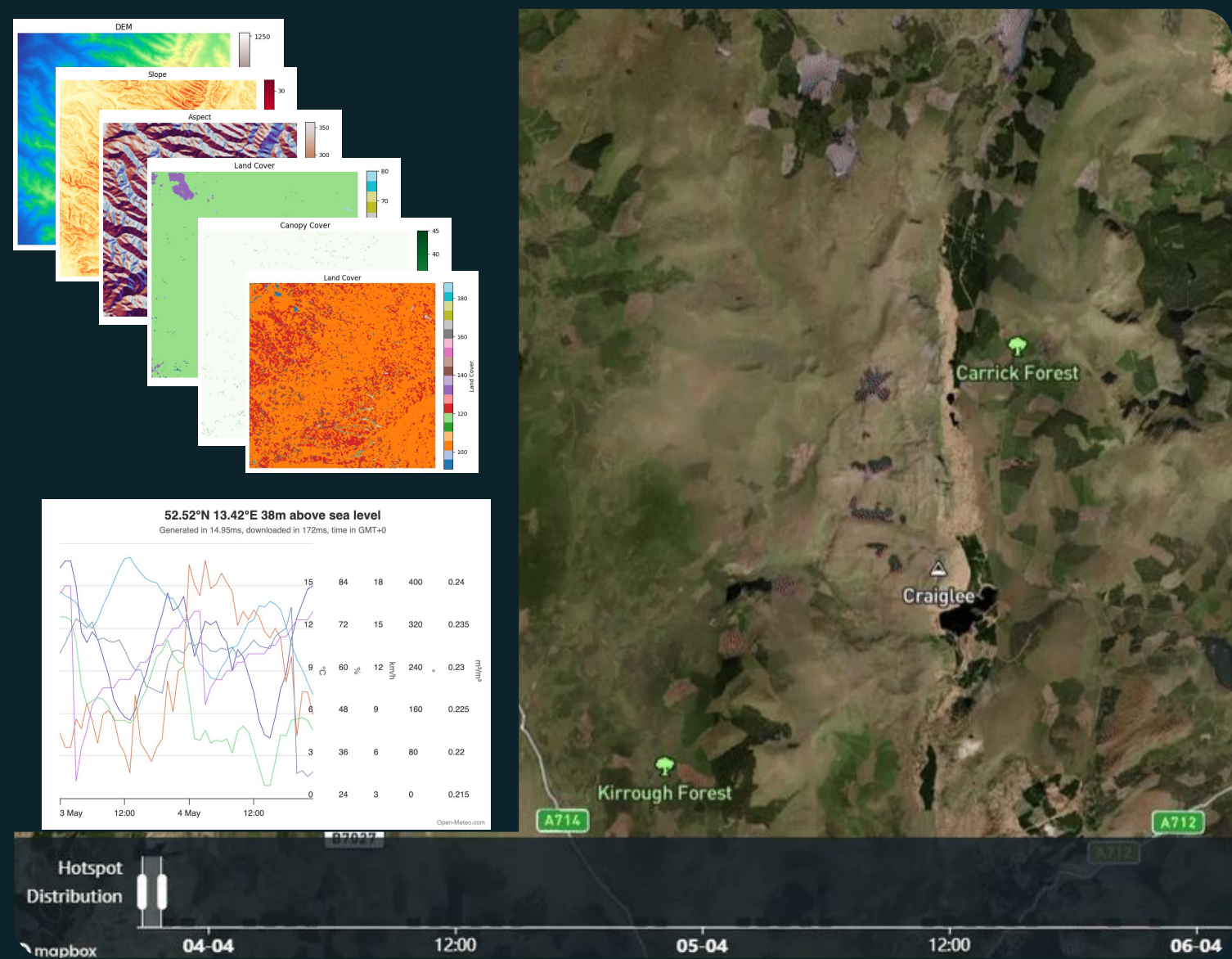
Elevation, terrain, land cover, vegetation health, fuel moisture, weather ...



Predicting Fire Spread

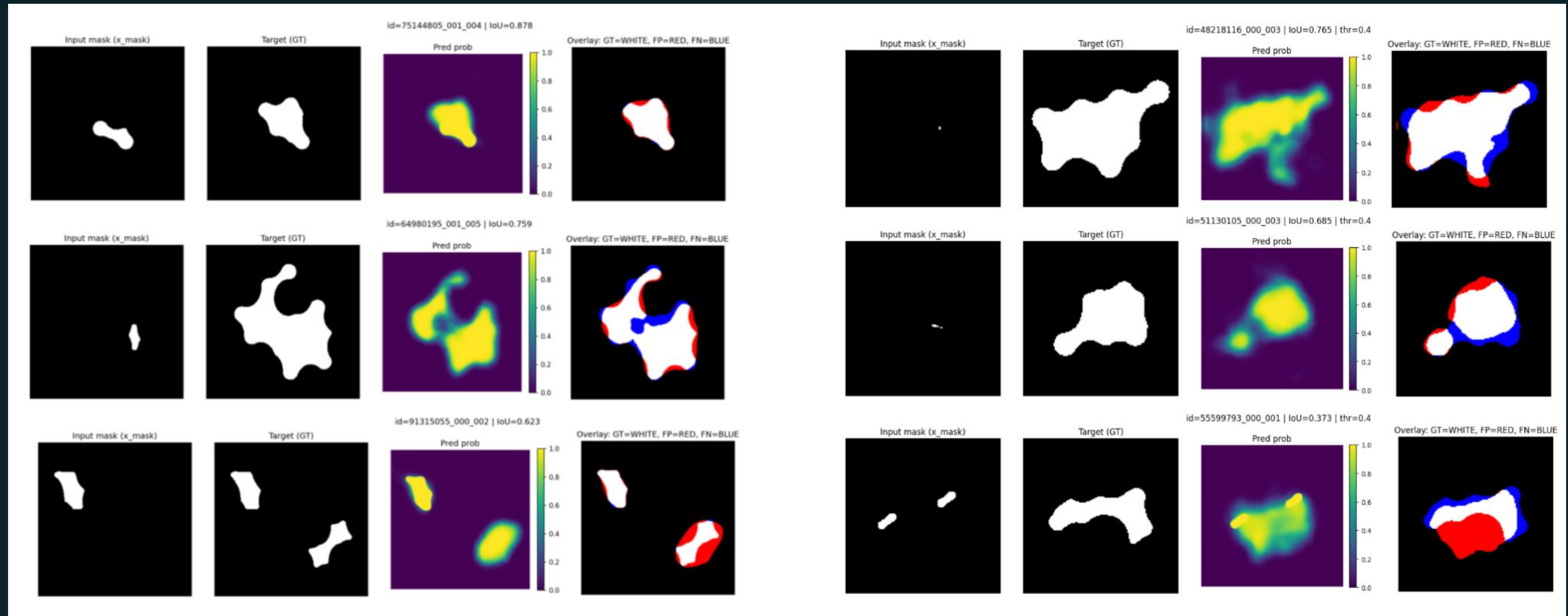
Spatio-Temporal Graph Propagation Network

Learning Fire Behavior from observed fire propagation data



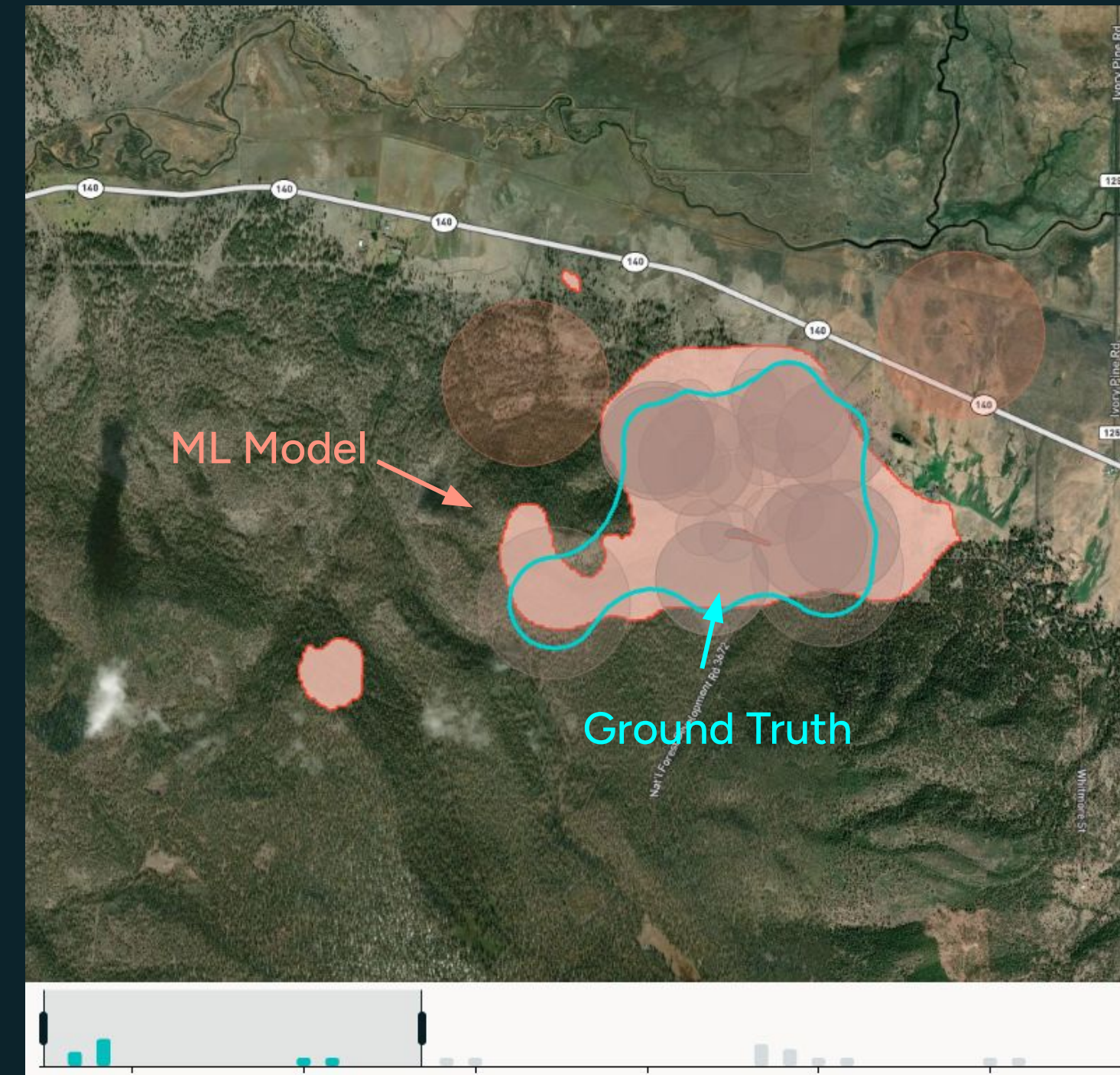
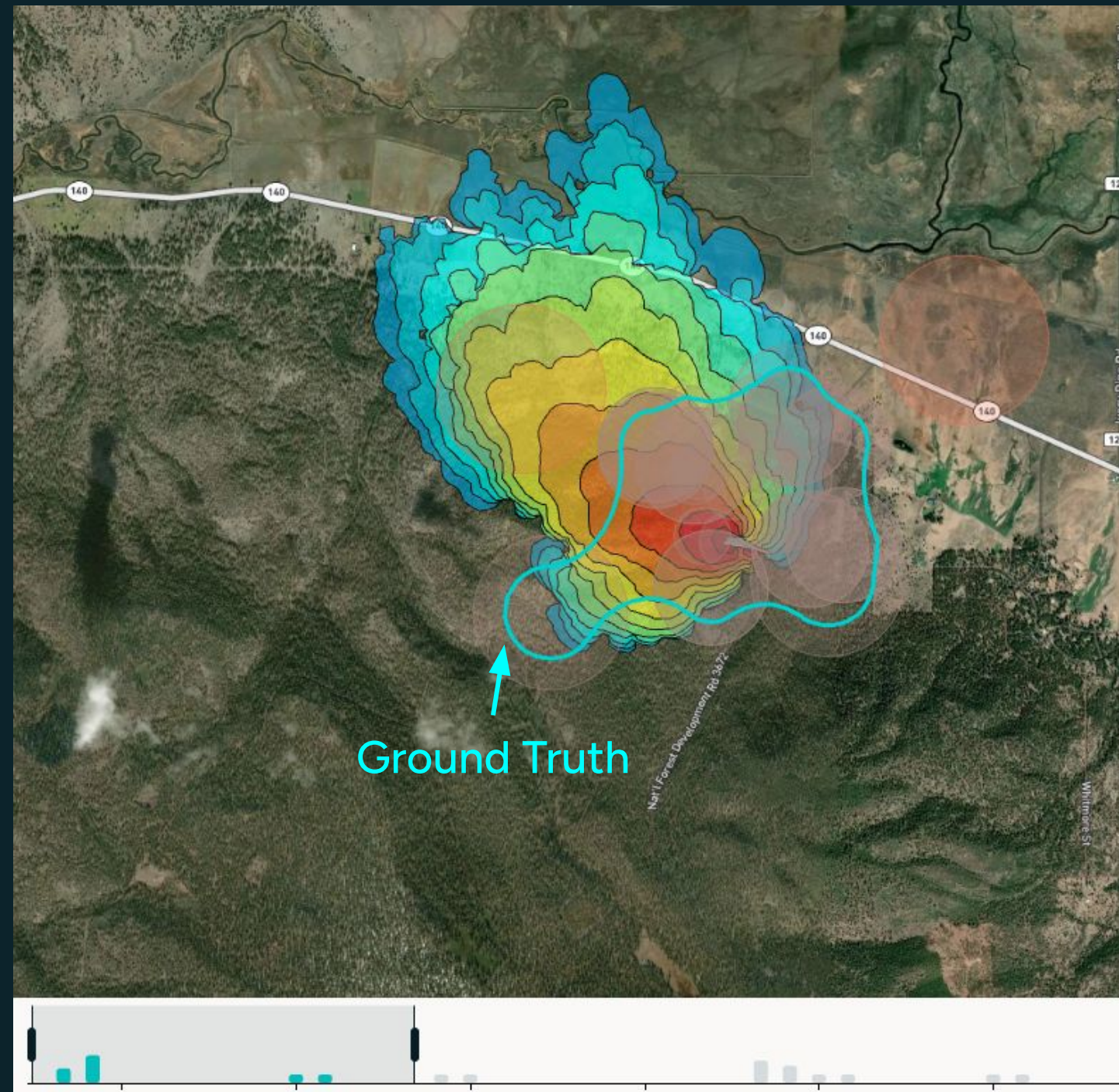
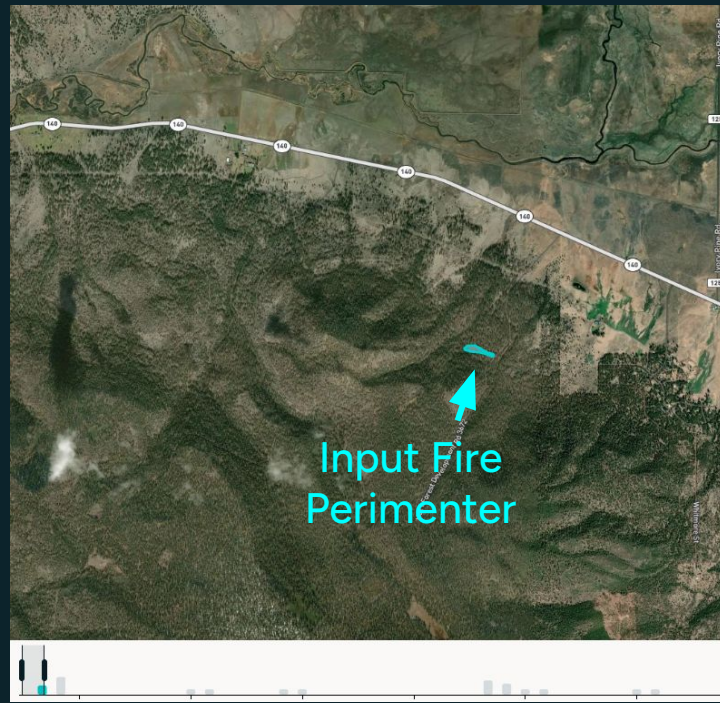
Predicting Fire Spread

Spatio-Temporal Graph Propagation Network



Predicting Fire Spread

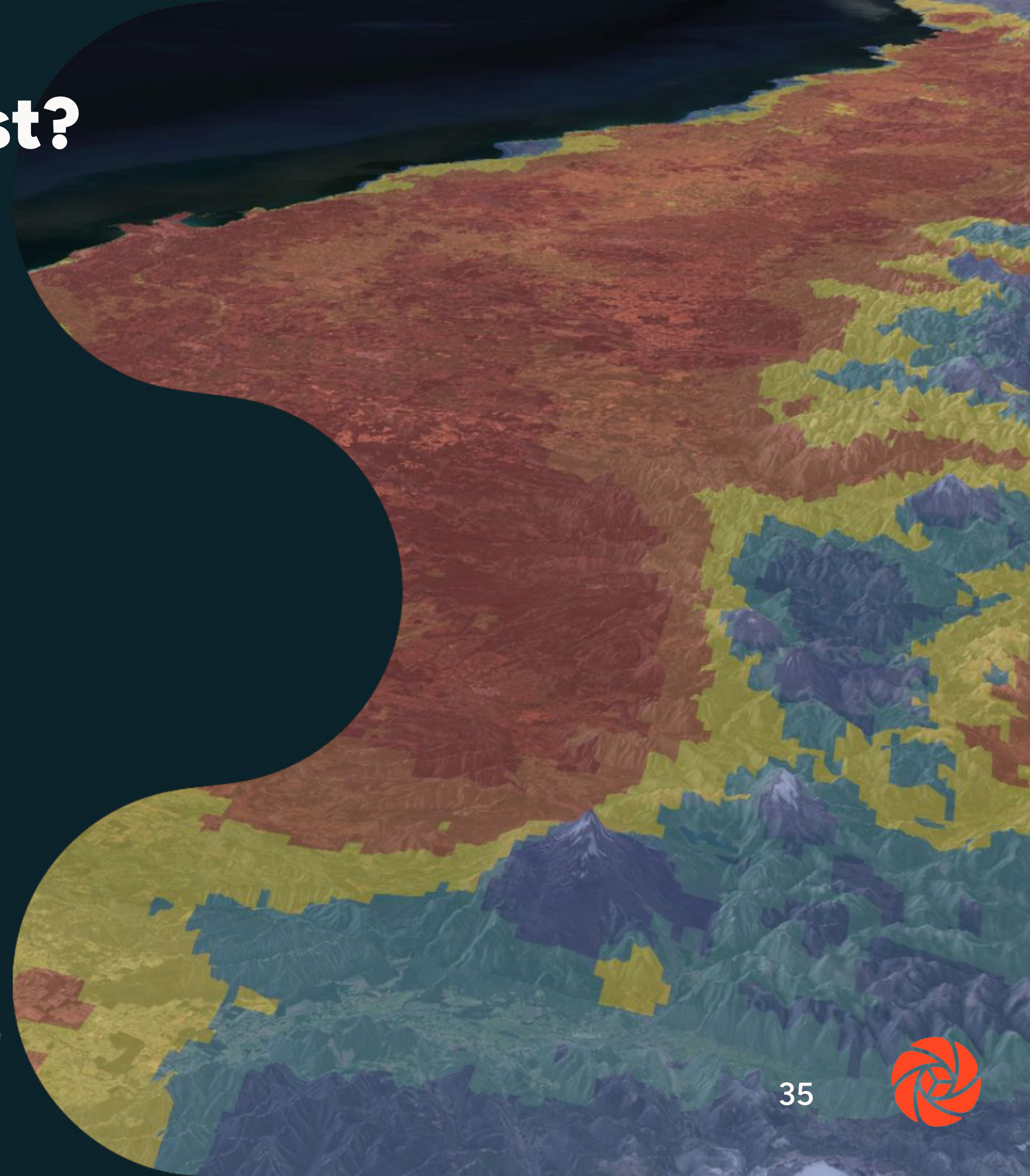
Comparison with semi-empirical Rothermal model



Where is Fire Risk the Highest?

Short Term Fire Hazard

OroraTech

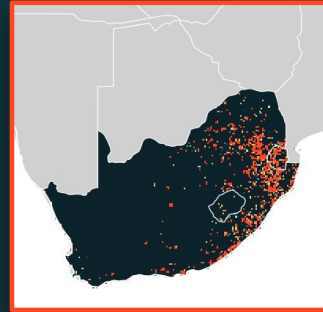


Predicting Fire Hazard

Hybrid AI Model

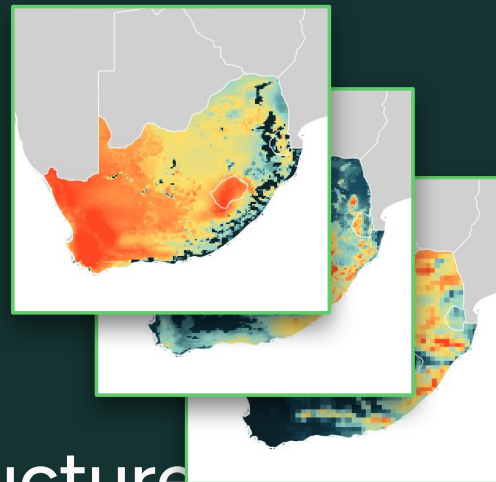
Ground Truth

- OT Active Fire Cluster data

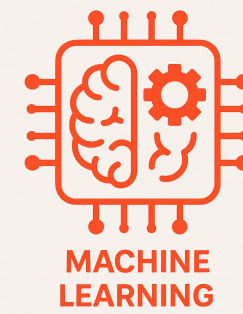


Input Data

- Environmental data
 - ERA5 climate data
- Geospatial data
 - Elevation derivatives
 - Land cover fuel maps
- Geo-demographic data
 - Population and infrastructure
- Large scale spatiotemporal dynamics

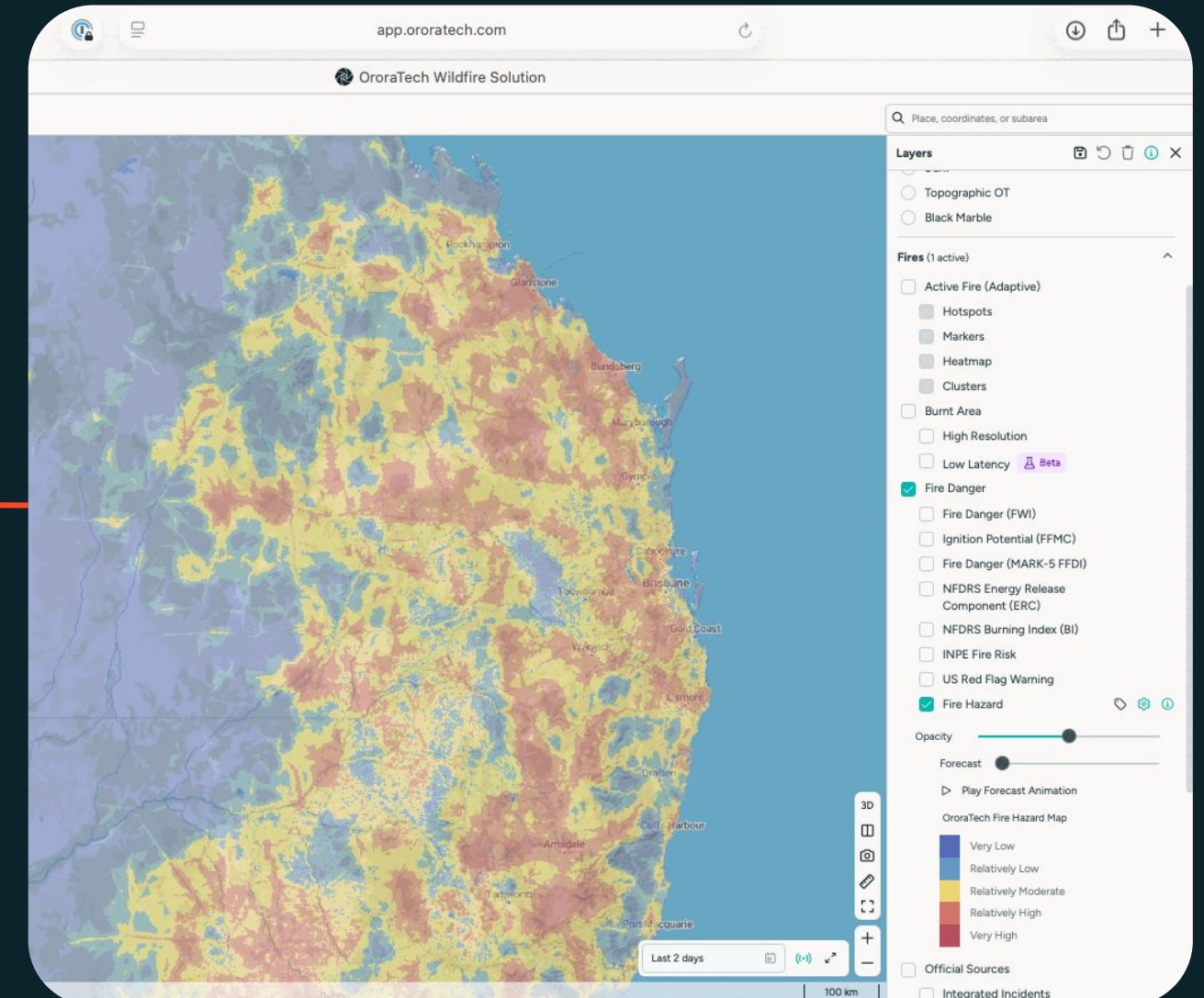


AI



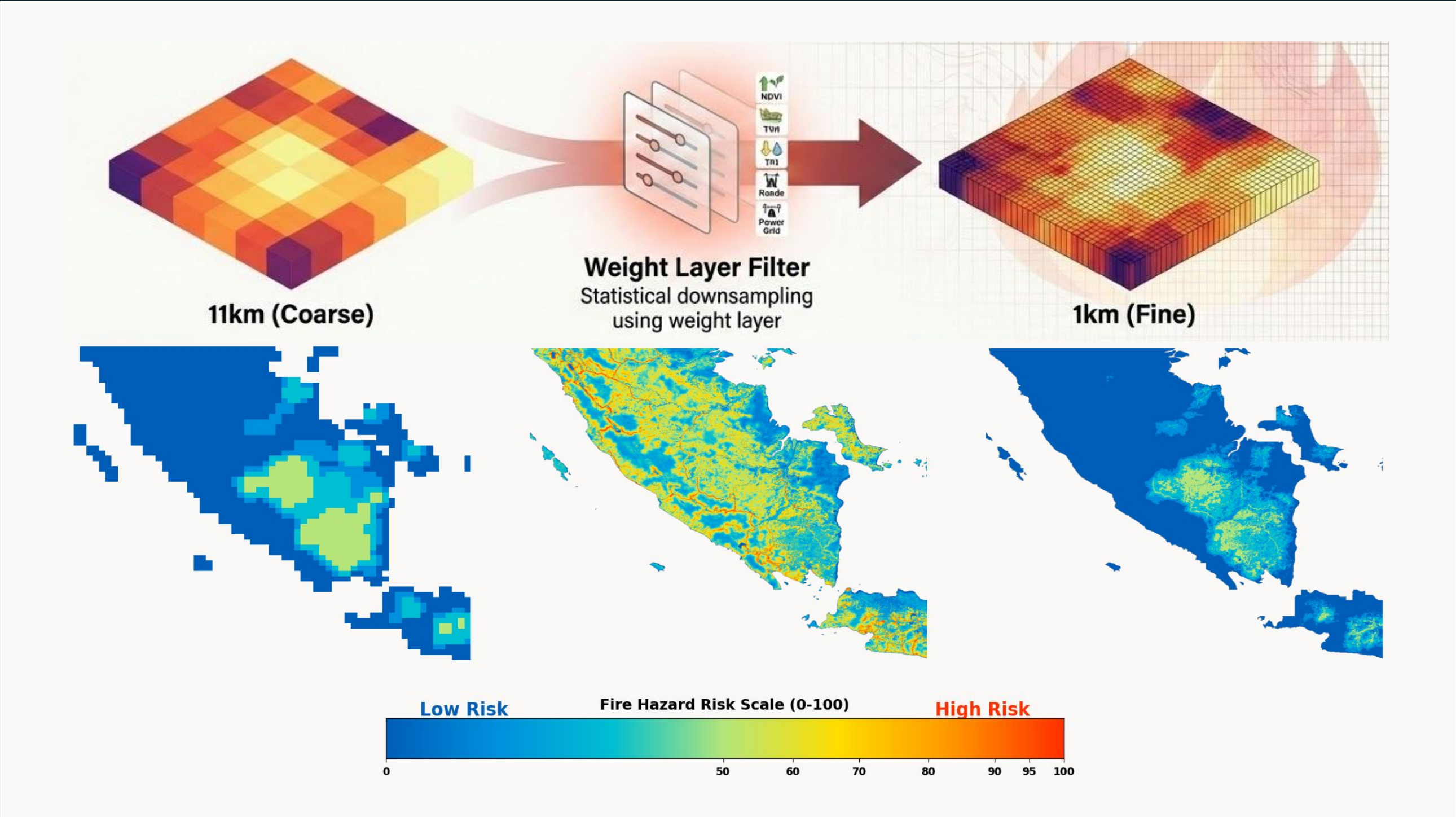
MACHINE LEARNING

4-day Forecast



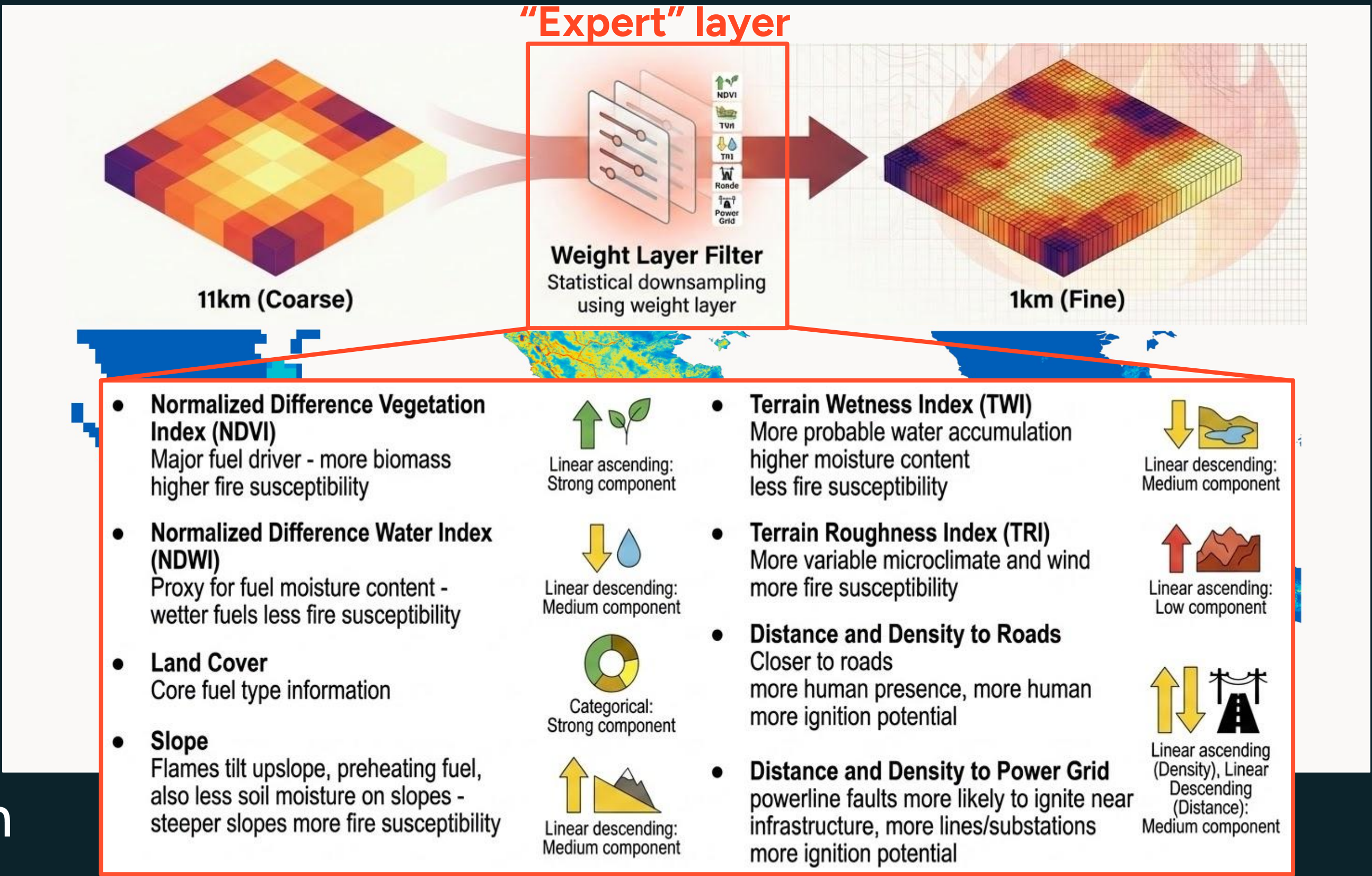
Short-term Fire Hazard

Hybrid AI model



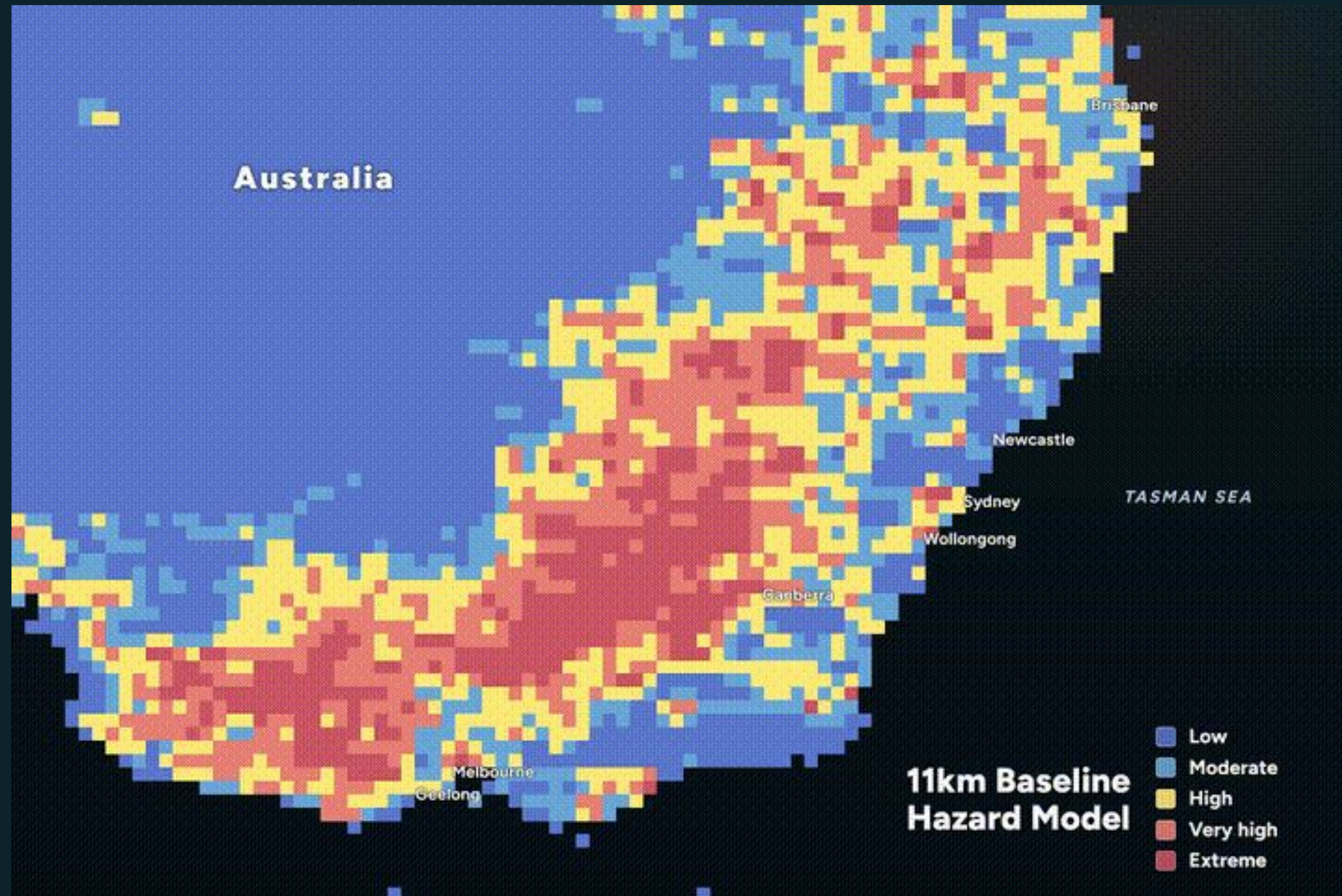
Short-term Fire Hazard

Hybrid AI model



Short-term Fire Hazard

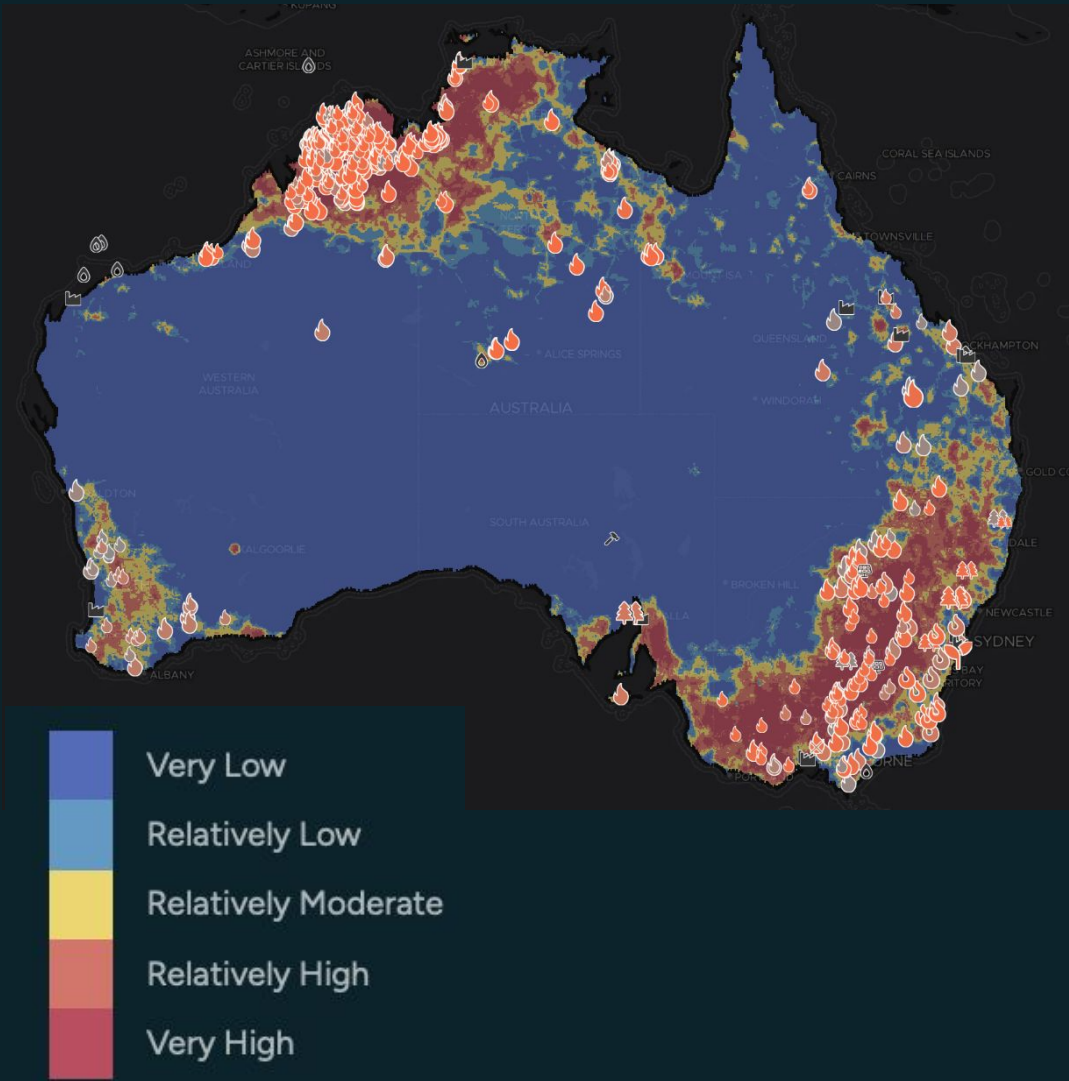
Hybrid AI model



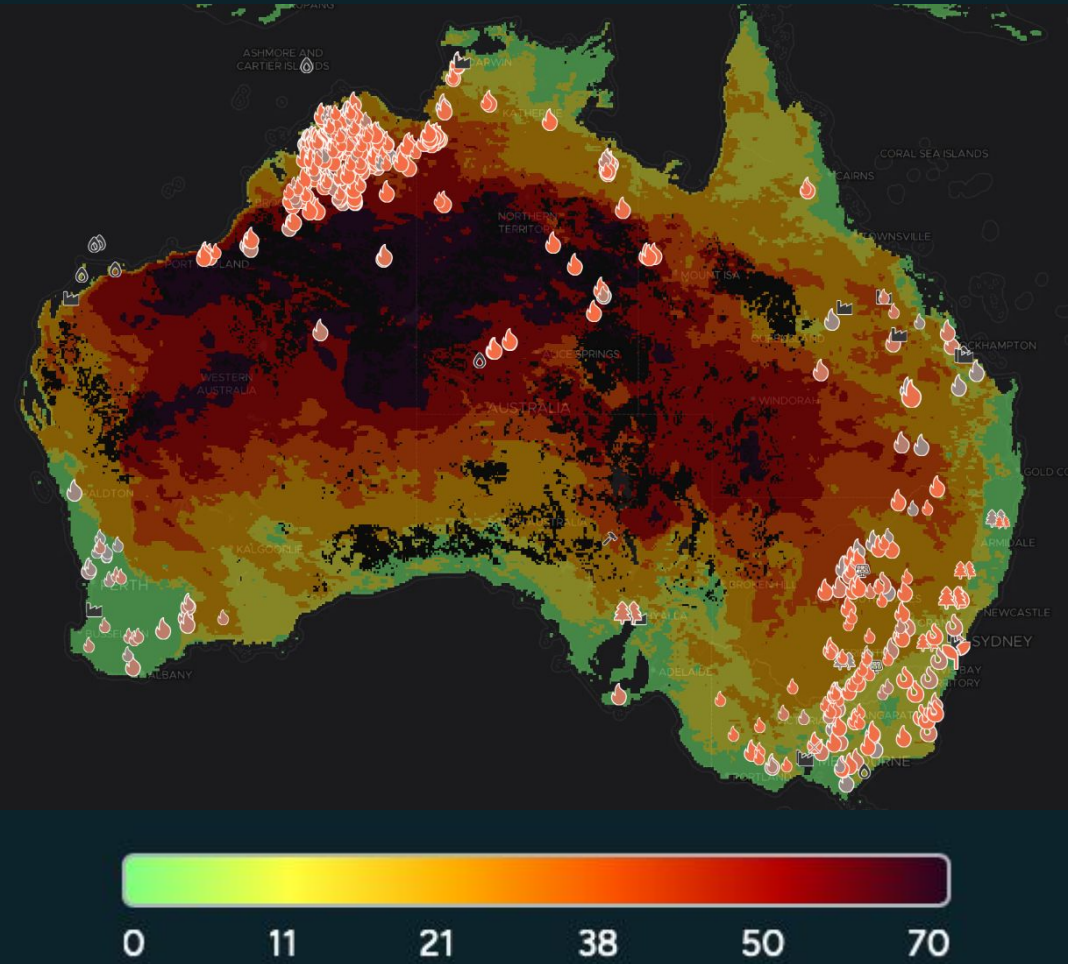
Short-term Fire Hazard

Hybrid AI model

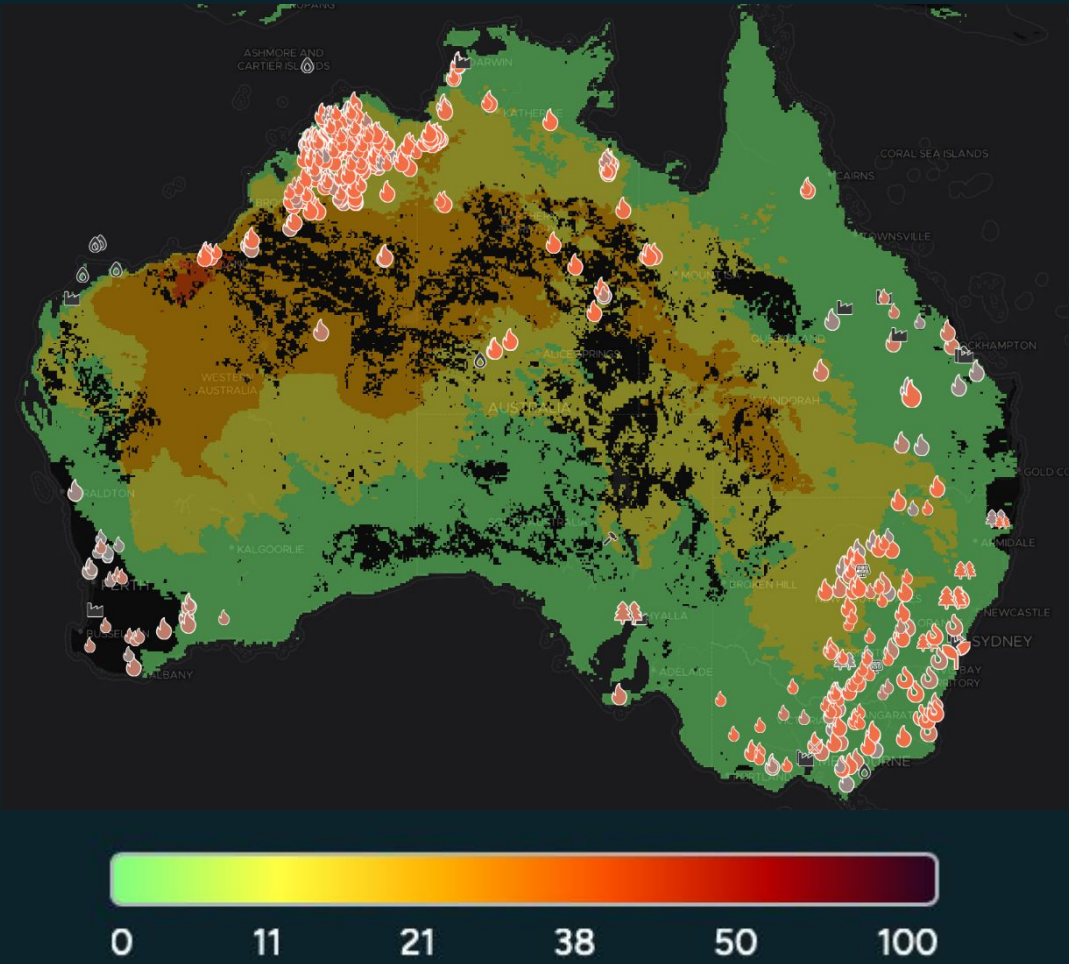
OroraTech Short Term Fire Hazard



Fire Weather Index

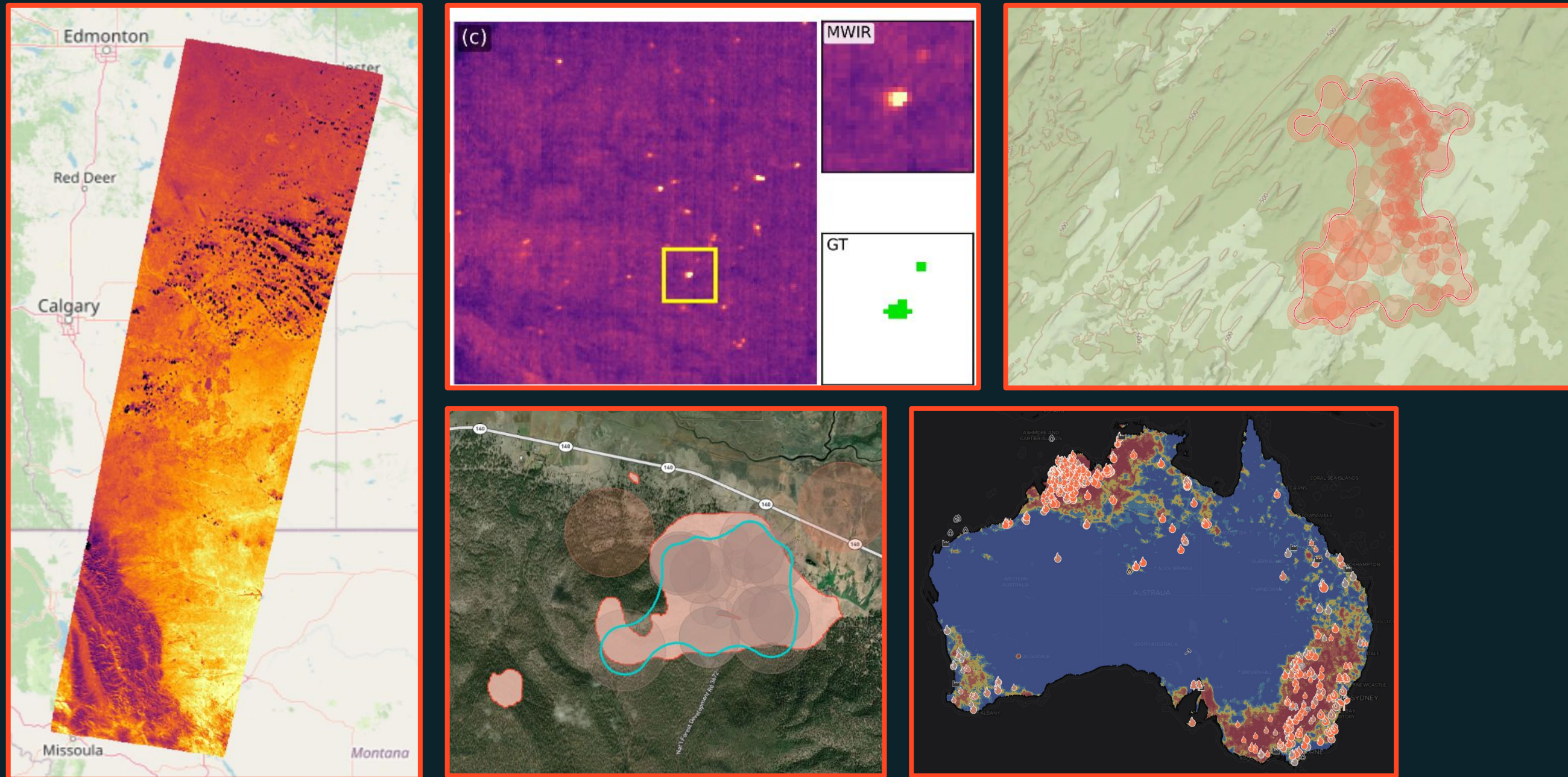


McArthur Forest Fire Danger Index



Data, Science and AI at OroraTech

From data collection to fire detection, fire behavior, and more!



Thank you!

Interested in working with our data?

