WILDFIRE-FIRST CONSTELLATION

A non-profit satellite system providing low-latency, high-resolution, broad coverage data to better inform wildfire fighting strategies, and better understand the impact wildfires have on carbon and climate.

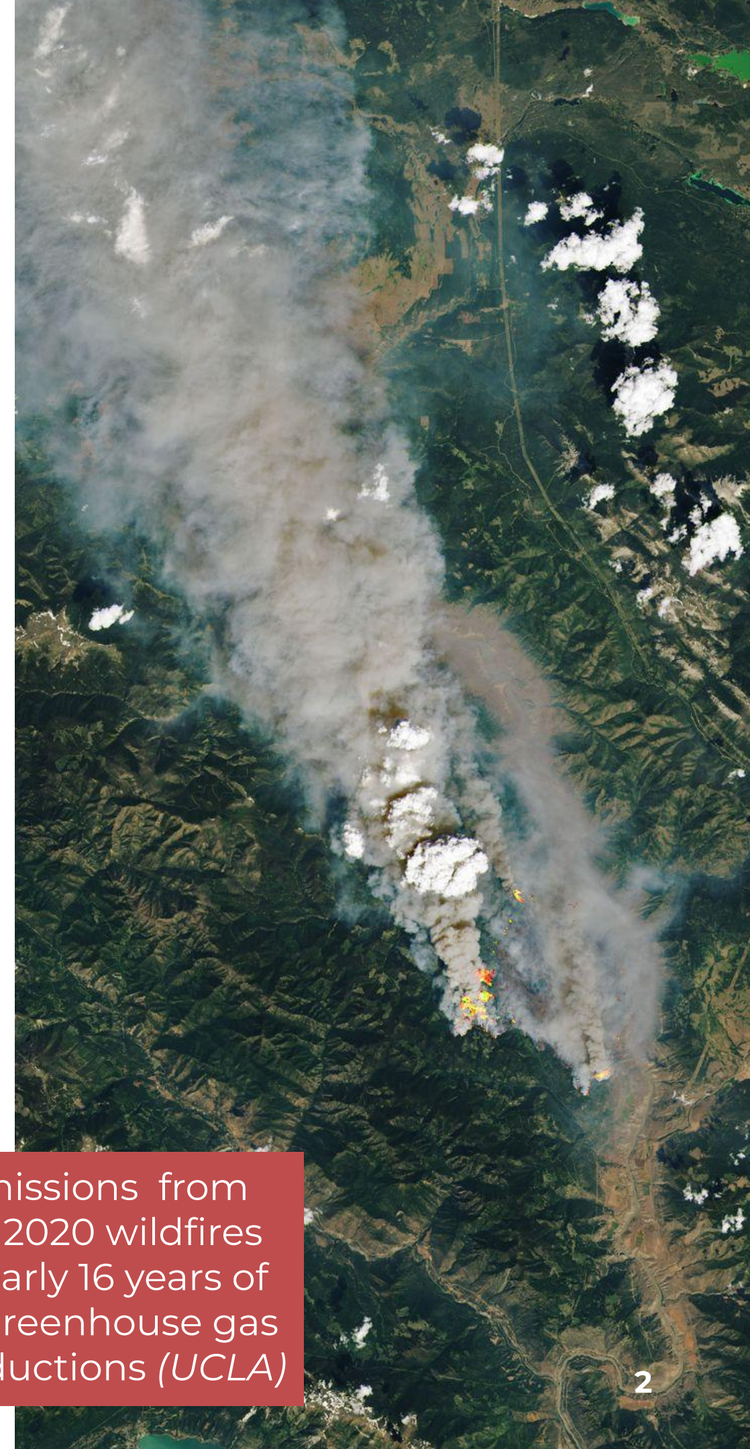
NOVEMBER 30, 2022

FIRESAT MISSION

A wildfire-focused satellite system that will provide a **consistent**, **accurate**, and **comprehensive** view of fire activity - transforming detection, monitoring, and forecasting across the globe with near real time data from wildland fires, available directly to those who need it

PROJECT GOALS

1. **Drive down life and community loss** by enabling a more rapid fire response and more informed deployment of resources to combat wildfires early.
2. Monitor to improve our understanding of **climate impacts of wildfires** globally: **carbon emissions** and fire intensity impacts.
3. Support **“good fire”** strategies by providing up to the minute **temperature maps** within planned and unplanned burns to determine good fire from bad.



Carbon emissions from California’s 2020 wildfires negated nearly 16 years of the state’s greenhouse gas emission reductions *(UCLA)*

EXPERTISE & PROJECT PORTFOLIO

SPONSOR

EDF ENVIRONMENTAL DEFENSE FUND™

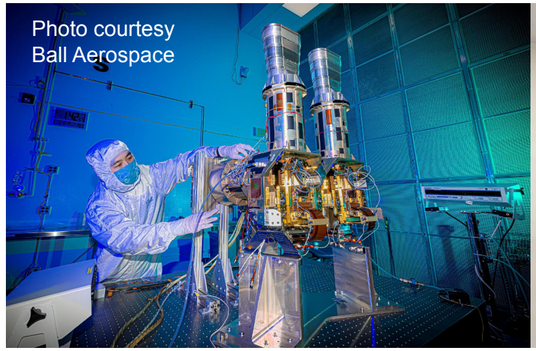
The Environmental Defense Fund is a Non-Government Organization (NGO) US-based nonprofit creating innovative, science-based solutions to critical environmental challenges.

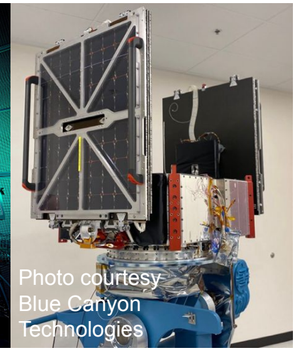
Chief Scientist engaged and working within the community around theory of change

&

MethaneSAT™

EDF currently sponsoring & overseeing $100M+ satellite project nearing launch





EXPERIENCED TEAM

Fire Expertise + **Space Expertise**

Team of 20+ scientists and engineers, balanced between wildland fire and satellite specialities, dedicated to mitigating the adverse effects of wildfires in a changing climate.

CAL FIRE – California Department of Forestry & Fire Protection – Since 1885

RESOURCES *for the* FUTURE

USDA Forest Service – U.S. Department of Agriculture

Wildland Fire Management & Mitigation Commission

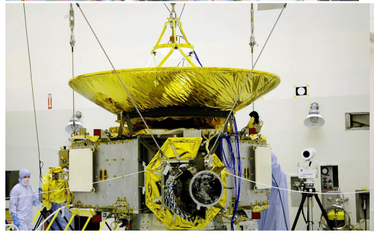
Office of Science and Technology Policy

Preparedness & Response

Skybox Imaging

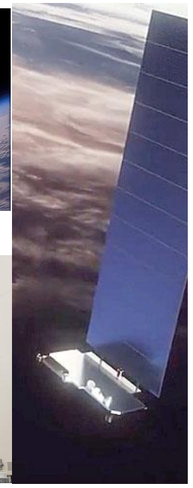
SkySat

Suomi National Polar Orbiting Satellite



New Horizons

SBIRS



Starlink

FUNDERS

Philanthropies committed to solving the wildfire crisis for the betterment of our planet and people.

GORDON AND BETTY MOORE FOUNDATION

Google.org

SCHMIDT FUTURES

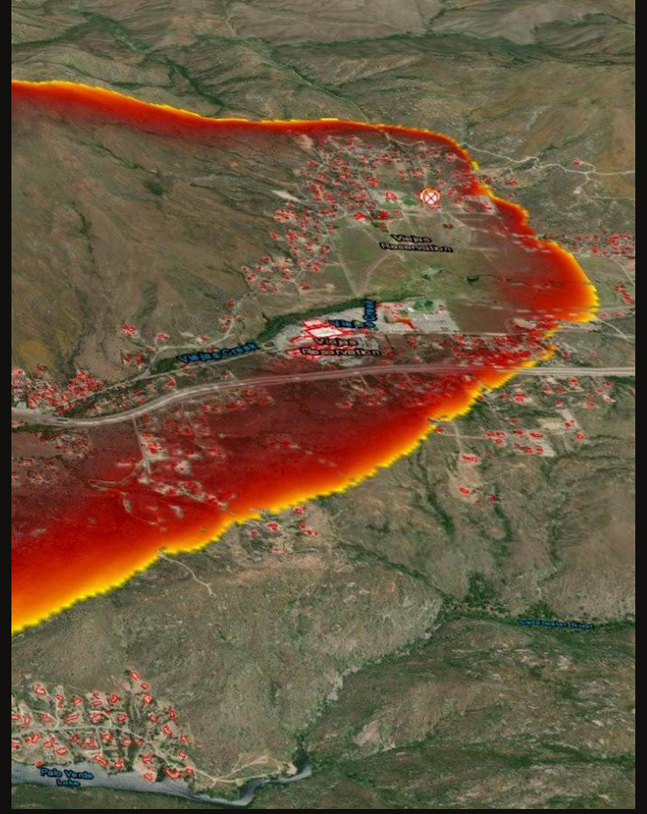
MINDEROO FOUNDATION

USERS

PRIMARY

Incident Command

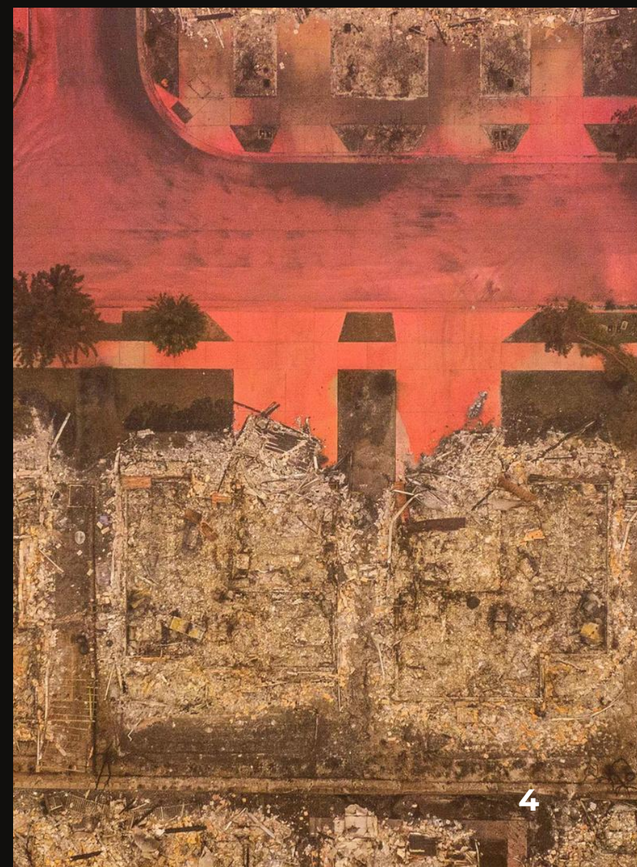
User Need: Precise and accurate location of fire starts for resource deployment. Low false positives on detects with high fidelity of georeferenced location. Perimeter and intensity monitoring.



SECONDARY

Carbon / Climate Impact Scientists

User Need: Accurate global carbon stock monitoring correlated to fires with the greatest impact yearly. Post-fire land analysis.



PRIMARY

Frontline

User Need: Accurate and reliable real time data, particularly around new detections and fire growth stages (first 10 minutes - 12 hours)

SECONDARY

Modelers (Fire Scientists)

User Need: Continuous global monitoring of all fire stages for more accurate predictions of fire start conditions, fuel sources, growth, decay, and regrowth post-fire.

BASELINE SYSTEM ATTRIBUTES

WILDFIRE-FIRST SYSTEM

- Spectral bands optimized specifically for wildfire with low false positive rate
- Spatial resolution is designed for early fire detection and perimeter mapping
- Temporal sampling optimized for detecting ignition and fire monitoring

NEAR-REAL TIME

- Onboard real-time fire detection
- Low-latency ‘fast path’ fire alerting through intersatellite communications
- Last-mile alerting system (SMB or IoT messaging)

LOW FRICTION DATA FUSION

- Mapped data products delivered < 1 hour after collection (model assimilation, perimeter tracking)
- Products published in familiar GIS formats via standard cloud APIs
- Key early integrations with data platforms (Intterra, Google Earth, etc)

BASELINE DESIGN

Accurately detect new fire starts, project fire growth, and understand fire impact through near-continuous monitoring of all regions with a constellation of 50+ Low-Earth Orbiting (LEO) satellites

BASELINE DESIGN

Accurately detect new fire starts, project fire growth, and understand fire impact through near-continuous monitoring of all regions with a constellation of 50+ Low-Earth Orbiting (LEO) satellites

Better equip first responders with 10+ updates on fire progression during the critical first 2-hours, allowing for earlier containment

5 observations per hour

BASELINE DESIGN

Accurately detect new fire starts, project fire growth, and understand fire impact through near-continuous monitoring of all regions with a constellation of 50+ Low-Earth Orbiting (LEO) satellites

Better equip first responders with 10+ updates on fire progression during the critical first 2-hours, allowing for earlier containment

Increased capabilities remove guesswork when deploying response resources along major highways, rivers, and ridgelines.

- Average 80m resolution
- Ability to detect hotspots 5-7m across

BASELINE DESIGN

Accurately detect new fire starts, project fire growth, and understand fire impact through near-continuous monitoring of all regions with a constellation of 50+ Low-Earth Orbiting (LEO) satellites

Better equip first responders with 10+ updates on fire progression during the critical first 2-hours, allowing for earlier containment

Increased capabilities remove guesswork when deploying response resources along major highways, rivers, and ridgelines.

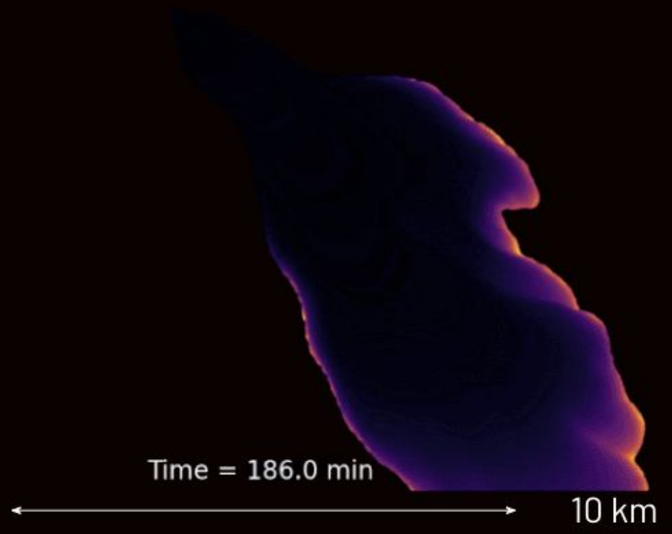
- Average 80m resolution
- Ability to detect hotspots 5-7m across

Multi-spectral observations:

- see fires when smoke obscures ground and aerial observations
- identify false positives, increase confidence for resource deployment
- observe intensity variations within a large fire
- allow for continual observation of a fire, day or night

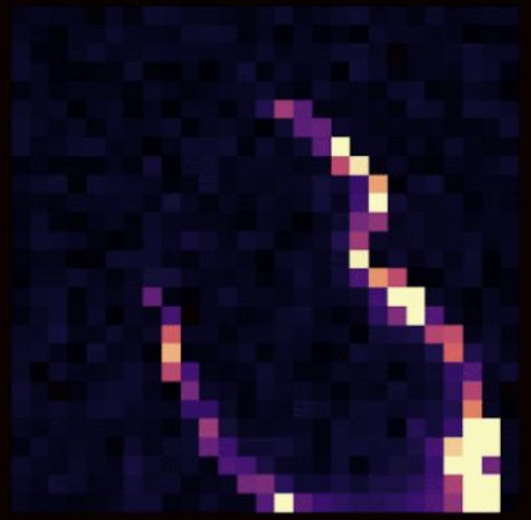
Simulated Scene Observations

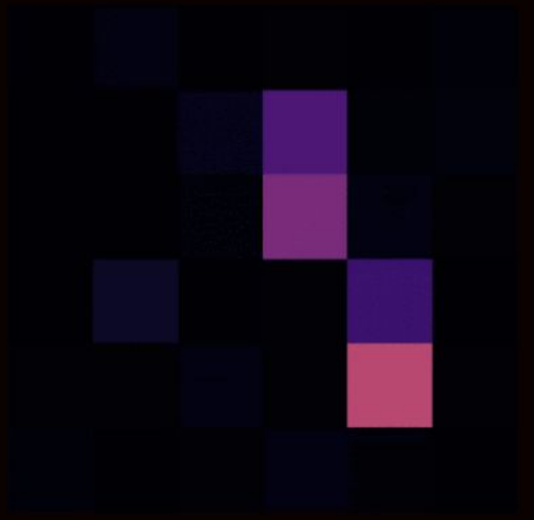
Raw Temperature, No Delivery Latency



FireSAT
80m (avg)
15 min

VIIRS
375m
12hr
(3hr shown)





GOES-R
2km
5 min

A CORE PIECE OF A COMPREHENSIVE WILDLAND FIRE MANAGEMENT SYSTEM

FRONTLINE SUPPORT

- Last mile distribution
- Adoption strategy
- Process & training support

COMMUNITY

- Early education curriculum
- Public notification
- Next generation systems

TECHNOLOGY*

- Remote sensing
- Satellite constellation
- Communications

DATA

- Analysis
- Dissemination & distribution
- Fusion with other data sources

SUSTAINMENT

- Operational Management
- Research & Development
- Innovation & incremental improvement

POLICY

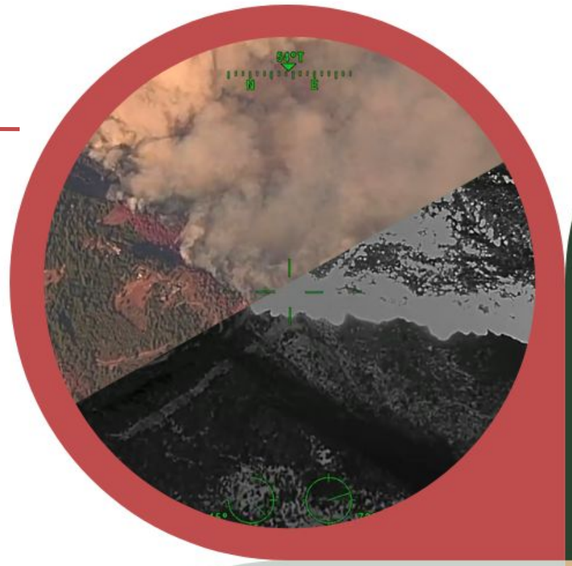
- Local jurisdictions
- Federal
- Global

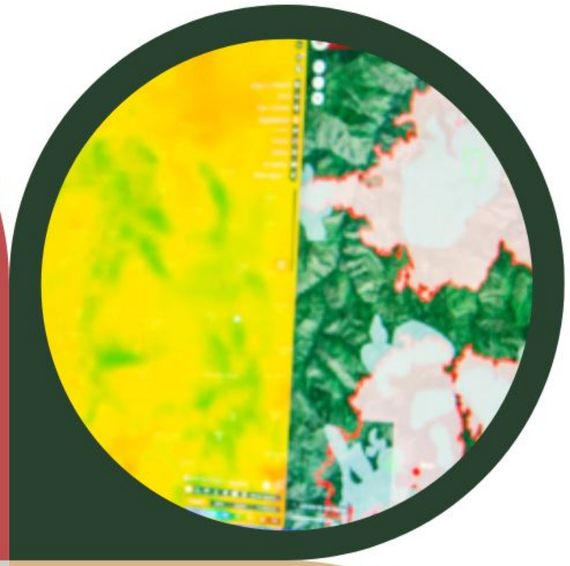
*EDF Study is focused on technology feasibility and solution roadmap

FIRESAT: ONE PART OF THE REMOTE SENSING ECOSYSTEM

Aircraft Observations

Rapid intelligence and surveillance in visible and IR during initial attack of major fire activity.
Modeling of fire spread.





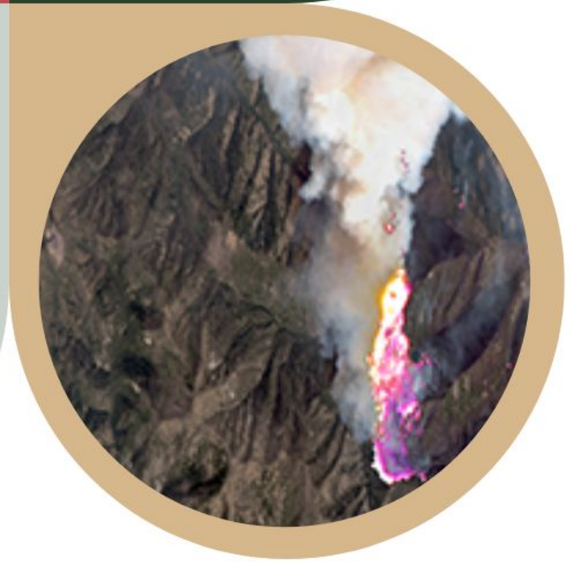
FireGuard

Multi-sensor

Detection and monitoring of wildfire activity from national assets. Heat mapping, persistent data products of fire location, shape, and directionality.

Ground-Based Cameras

Live camera footage monitoring landscape for early detection of wildfire activity and situational awareness in remote areas



FireSat

Satellite

Provides low-latency, global coverage of fire detections and intensity maps across multiple spectral wavelengths.

PROJECT STATUS & FUTURE STEPS

Objective: To generate better data that provides a truly comprehensive view of wildfire activity and its impacts to carbon and our climate across the state and around the world.

BUILD TEAM | **UNDERSTAND & DEFINE** | **DESIGN** | **BUILD PROTOFLIGHT** | **IMPLEMENT AND DEPLOY**

JUNE 2021
Convene team driven to make an impact in an escalating crisis

JANUARY 2022
BEGIN USER & ENGINEERING STUDY
Consult community of frontline responders to co-develop design

OCTOBER 2022
COMPLETE USER & ENGINEERING STUDY
Feasibility study produced system requirements - based on direct inputs from the fire community

TODAY
OPERATIONAL PLANNING & DESIGN
Engaging fire community to drive operational utility, system effectiveness, reliability, standards, data fusion needs, and robustness.

2025 (Q2)
3 PROTOFLIGHT SATELLITES
Build and launch the first 3 satellites of the constellation to collect data early and modify system with end users

2026
Full system deployed in 4 years, providing a critical improvement in wildfire detection and response

OPEN DISCUSSION: COMMUNITY FEEDBACK ON BENEFIT AND IMPACTS FOR REAL TIME OPERATIONS

TOPIC 1:

Do you feel that the FireSat system, as described, could be used to reduce *effective* response time?

Do you think these observations could:

- Increase the probability of containment (within a given initial attack or response period)
- Help minimize the total number of acres burned for fires that escape initial containment?

TOPIC 2:

Can you think of a specific incident where if this data, would have been available, it could have potentially prevented an initial response delay, inappropriate or insufficient initial response, or more efficient deployment of resources?

What about an incident where this data would have assisted firefighting efforts following initial response?

THANK YOU

EMAIL: INFO@EDFFIRESTUDY.ORG

APPENDIX

FRONTLINE - USER NEEDS
NEAR REAL TIME INFORMATION

New detections (Incipient / Stage 1 Fires):

- GPS of fire starts (lat, lon) in under 15 minutes (preferably 5)
- Georectified image of new fire detected in under 60 minutes

Monitoring existing (Growth/Stage 2):

- Tracking of existing fires in first 12 hours (frequent revisit)
- Detect how fast and what direction the fire is moving

Global:

- Detect fire starts and monitor fire growth in wildland forests, scrublands, grasslands, and deserts (covers US Firesheds and global megafire biomes from 2021)

Resource and Communication:

- Need to know where people are (responders, civilians)
- Communication system to disseminate intelligence information

Sources:

- Multi-band IR capability MWIR (3 - 5 µm) and LWIR (8 - 14 µm) required, other bands such as SWIR, NIR, VIS are desirable
- Need to be able to detect through smoke plumes (day & night)

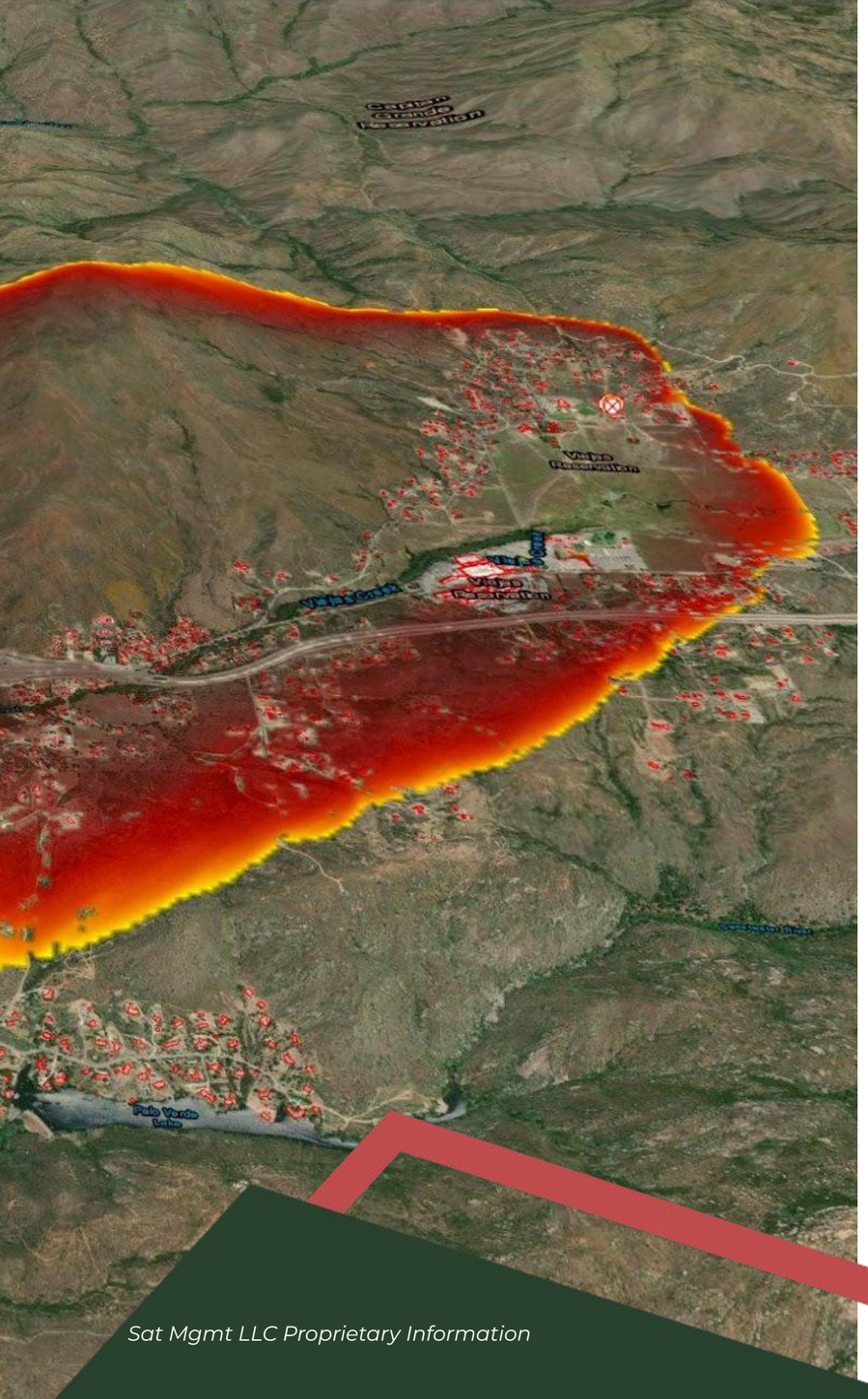
INCIDENT COMMAND - USER NEEDS
RESOURCE MANAGEMENT

Resources are extremely limited so a system with a false positive rate at or higher than 10% is unusable (goal: 5%)

Need to understand at the start of the fire where to deploy resources to a location with 10-20m resolution and corresponding georeferenced accuracy at the same resolution

Monitor fire:

- Perimeter mapping
- Understand impact region at full scale (1-400 km^2) at 1-hour cadence
- Intensity map across impacted region



MODELERS - USER NEEDS
FORECAST GROWTH OF FIRE

Fuel Sources:

- Map and identify dense/continuous fuels
- Dead fuel moisture

Fire stage monitoring:

- Growth (Stage 2) and Fully Developed (Stage 3) to assist fire response efforts
- Decay (Stage 3), Mop Up for verified containment and impact
- Post-fire monitoring for regrowth (at location) and smoke / public health tracking (off-location)

Monitor globally for known megafire start conditions (particular focus on ‘high risk’ global geographies): hot, dry, windy

Data Access:

- Data should be collected and provided in multiple formats and sources to integrate in with modeling software (specifics in work)
- Imagery shall be provided in both its raw (collected) and processed (interpreted) and as an imagery mosaic in lossless compression format within 6 hours

CLIMATE SCIENTIST - USER NEEDS
IMPACT ASSESSMENT

More accurate global carbon monitoring by understanding global carbon stock and its associated carbon emissions through fire

- Greenhouse gas species of interest emitted by wildfire include CO2, CH4, and N2O
- Measure particulate matter emitted from fire

Precise measurements of which fires generate the greatest emissions on a yearly, global basis

Post-fire land analysis: understanding fire severity (matter consumed, tree mortality, etc), post-burn carbon impact (CO2 emissions increase as a function of time after fire), and restoration and regrowth after fire

Forests are often used as stocks for carbon offset projects. But if wildfires become larger and more prevalent, then those offset projects may be lost or significantly underperform. Understanding how to properly model and protect such projects will be important.