Wildfire Detection and Persistent Surveillance: Assessing Capabilities to Address Remote Sensing Gaps

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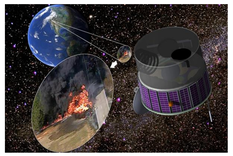
PROBLEM STATEMENT

Detection: The capability to quickly detect wildfire ignition is lacking in most U.S. geographic areas limiting extinguishment in the high-risk wildland-urban interface (WUI)

Persistent surveillance: Lack of persistent (24/7, all condition) wildfire monitoring for incidents limits wildfire situational awareness for decision-makers responsible for firefighter and public safety

APPROACH

- Conducted analysis of alternatives of current (2024) and future capabilities (out to 2034) in ground, air and space domains to address detection and persistent surveillance gaps
  - *Space: U.S. and international government, and commercial systems*
  - *Ground; focused on mature-technology fixed cameras*
  - *Air; included UAVs (small and large) and manned aircraft*
- Evaluated each system's contribution and performance of the combined system of systems







KEY FINDINGS - SPACE

- Current space-based capabilities (2024) have no effective utility for detection, minimal for surveillance
- Government and commercial space capabilities will leap forward in wildfire detection and surveillance by 2030 – bespoke commercial wildfire systems in development could be a game-changer

U.S. & International Government Satellites

JPSS (VIIRS)* GOES-R (ABI)ᵒ & GeoXO (GXI)

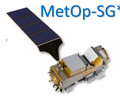


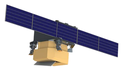


WildFireSat* Sentinel-3*



MetOp-SG* EWS-EO/IRᵒ





Commercial Satellites *(examples)*

Bespoke Wildfire Systems†

MUON

ORORA TECHNOLOGIES

High Resolution Imagery‡

MAXAR BLACKSKY

Spatial Resolution		
VHR	<10m	‡
HR	10 - 99m	†
MR	100 - 999m	*
LR	≥1km	o

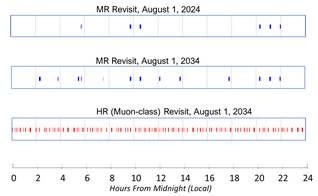
2024 Average Revisit (Minutes)

Geographic Region	VHR	MR
Western US	75	187
Alaska	150	120
Hawaii	93	249

2034 Average Revisit (Minutes)

Geographic Region	VHR	HR	MR	MR+HR	MR+HR 2034-2024 Change
Western US	39	12	94	10	-177
Alaska	71	14	61	11	-109
Hawaii	47	20	128	17	-232

"Day in the Life" Revisit Use Case (Bend, Oregon)

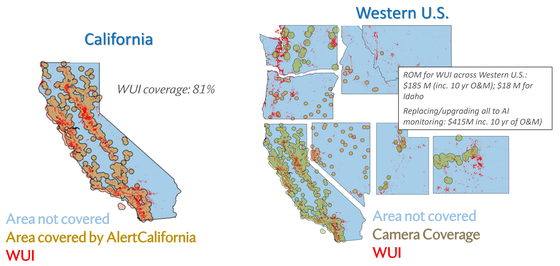


- GEO capabilities do not address gaps
- Average revisit time of government (MR) systems expected to be approximately halved by 2034
- New bespoke commercial wildfire capabilities slated to be available by 2030 offer opportunity to significantly close surveillance gap.

KEY FINDINGS – GROUND

- Fixed, AI-enabled wildfire camera systems provide value for very fast detection and notification (i.e., within minutes of ignition) – widescale deployment across WUI in fire adapted ecosystems enabled by AI would significantly benefit public safety

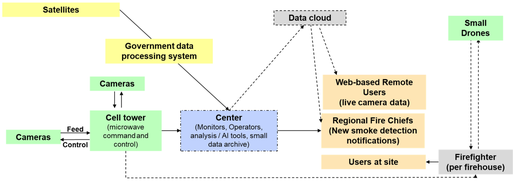
Fixed, Ground-based Wildfire Cameras



AlertWildfire cameras located on mountain peaks can scan an area of up to 1000 km² in 2 minutes – they are negatively impacted by weather

Expanding wildfire cameras to cover full WUI in fire prone areas and evolving with a central, autonomous detection and notification system can provide fast detection, at fire-impacted-state level

Concept of Operations

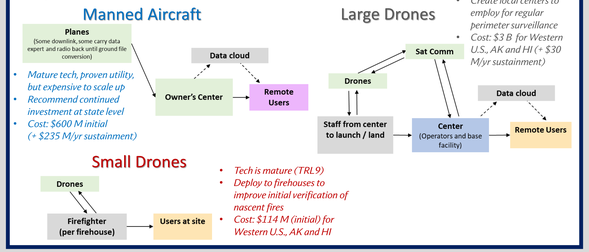


Gap Mitigation

- Expand camera networks for early fire detection, while growing AI tools for fast, automated, highly reliable detection
- Use common centers where possible for system cost savings
- Expanding manned planes and large drone costs across 8 western states, AK, and HI make this an expensive mitigation ($6.5 B for 10 years)

KEY FINDINGS - AIR

- Large UAVs and manned aircraft are mature and highly capable, but unaffordable to significantly scale up to address persistent surveillance gaps across U.S. during peak fire season



RECOMMENDATIONS

- Expand deployment of ground-based, AI-enabled fixed wildfire cameras at across WUI in high-risk, fire adapted regions (i.e., Western U.S.)
  - *Consider federated approach (state/local programs augmented by sustained Federal funding)*
  - *ROM Cost (proliferate cameras): $185 M (incl. 10 yr O&M)*
  - *ROM Cost (comprehensive AI upgrades): $415 M (incl. 10 yr O&M)*
- U.S. Government Partner with commercial offerors to accelerate full deployment of potentially game-changing, commercial wildfire satellite constellations
  - *ROM Cost: $55 - $100 M/yr*
- Establish a **National Combined Wildfire Forecast and Threat Intelligence Center** to pool compute, accelerate research transition to ops, and provide timely, authoritative wildfire intelligence equitably across U.S.

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