8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

GOVERNANCE PRINCIPLES: Towards an International Framework

TECHNICAL INNOVATION

Risk Evaluation Supporting the Framework

Joaquin Ramirez
IAWF & Technosylva

TECHNICAL INNOVATION

SESSION TOPICS

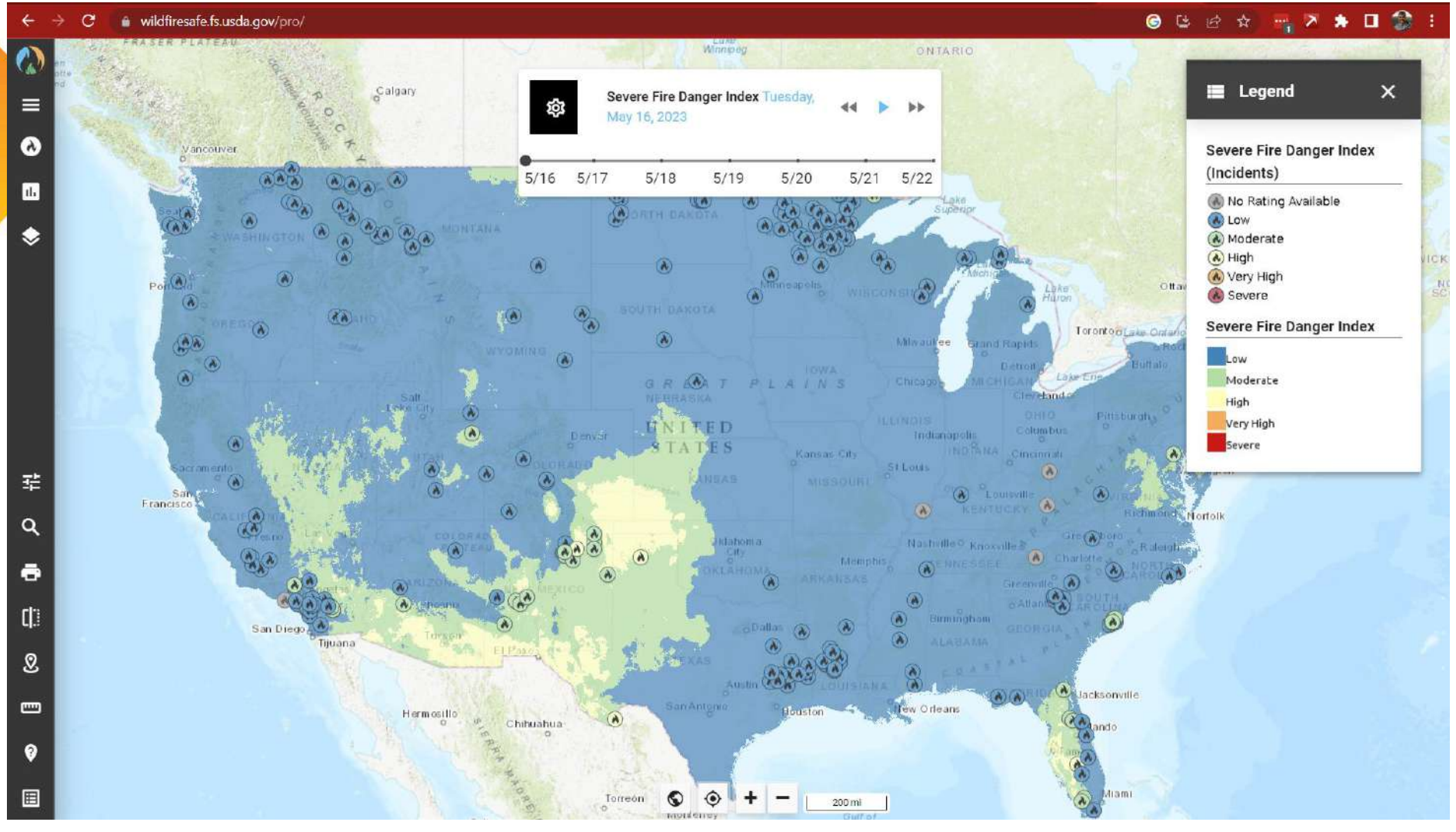
1. Best ways for identifying hazard, exposed elements and their vulnerability, as building blocks for risk assessment.

2. Including predictive analytics and projections under different scenarios and studying how different factors might impact landscape fire risk over time.

8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

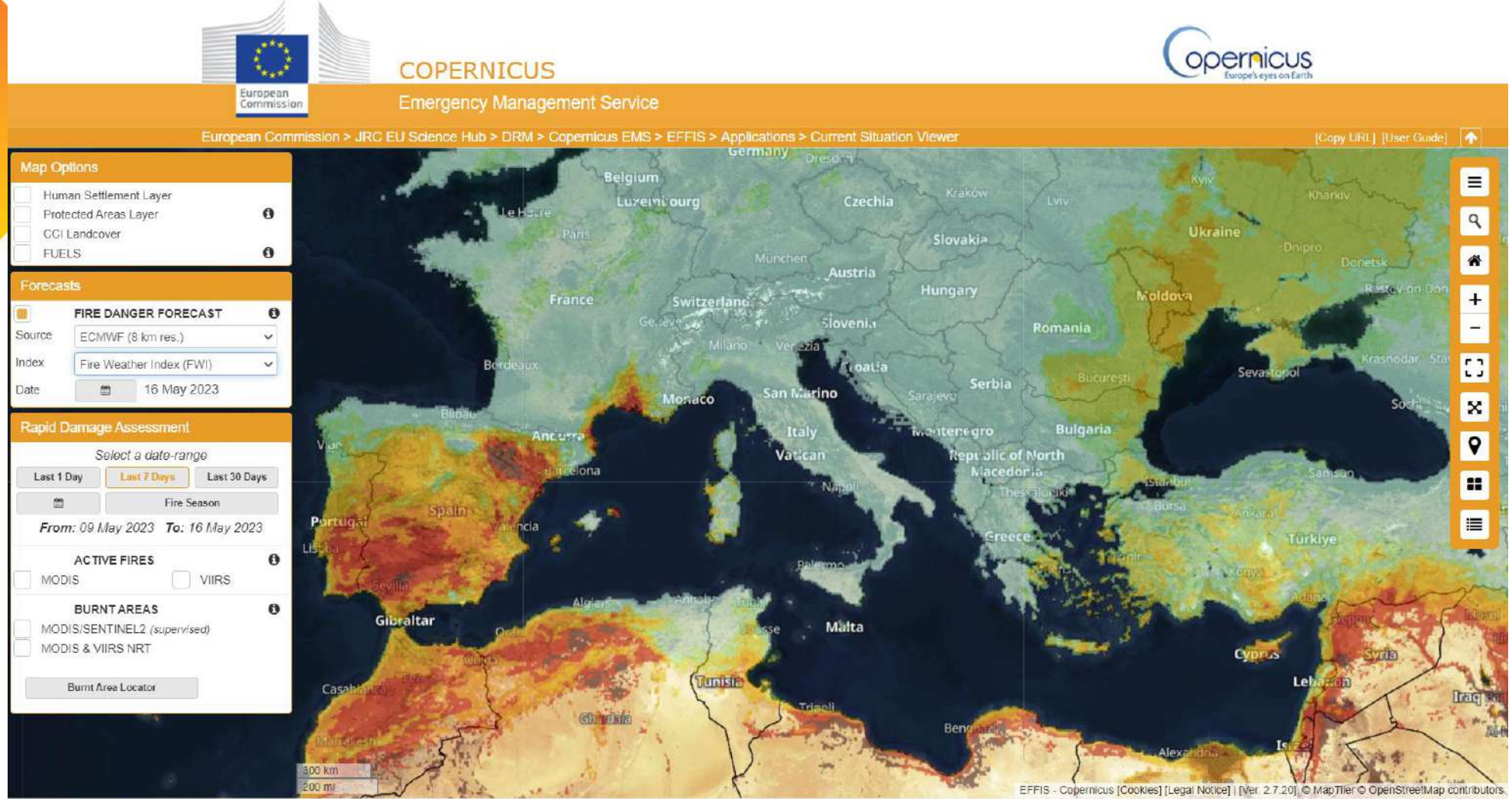
RMRS – FireLab – Matt Jolly : There is More to Smokey's Sign Than You Might Expect on Vimeo

WE ARE GOOD AT COMPUTING DANGER…



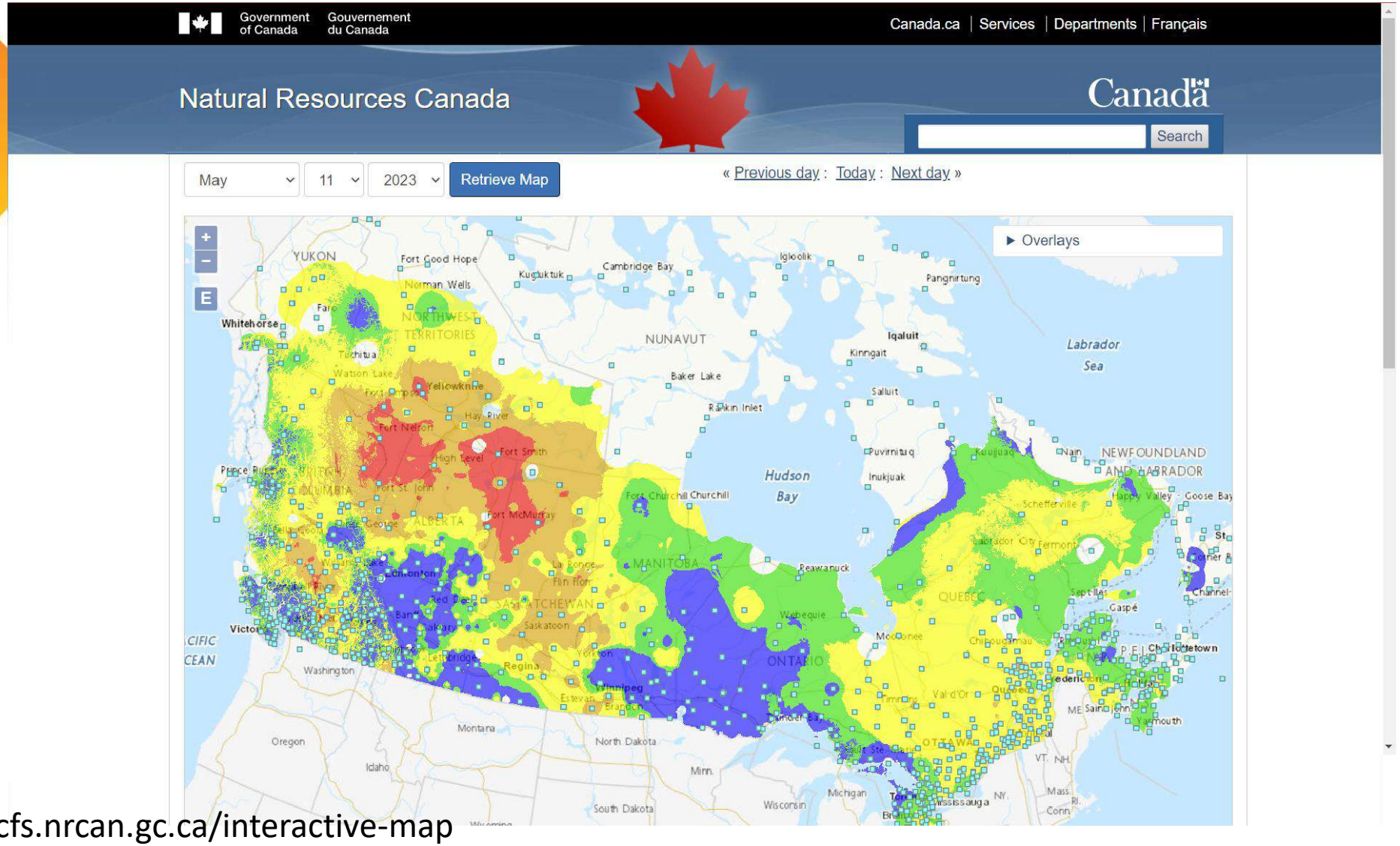
https://wildfiresafe.fs.usda.gov/pro/

WEATHER SERIES ARE LONG ENOUGH



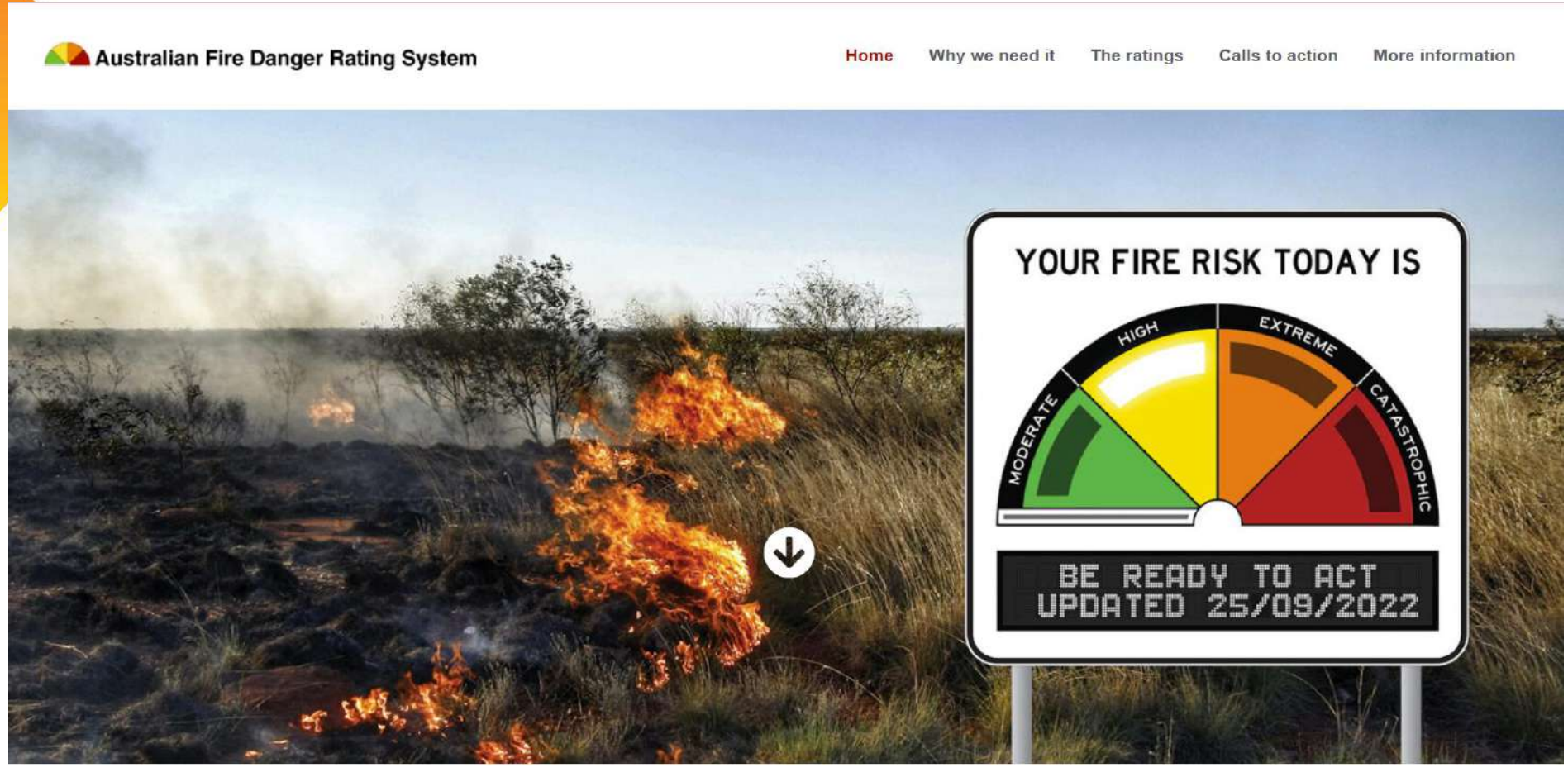
https://effis.jrc.ec.europa.eu/apps/effis_current_situation/index.html

HISTORICAL FIRE OCCURRENCE IS AVAILABLE



https://cwfis.cfs.nrcan.gc.ca/interactive-map

ADAPTED TO CULTURAL CIRSCUNSTANCES AND NEW REALITIES



https://afdrs.com.au/

MODELING WILDLAND FIRE RISK

Should be applicable in all the phases of the Integrated Fire Management Value Chain

Planning

Preparation

Prevention

Pre-suppression

Suppression

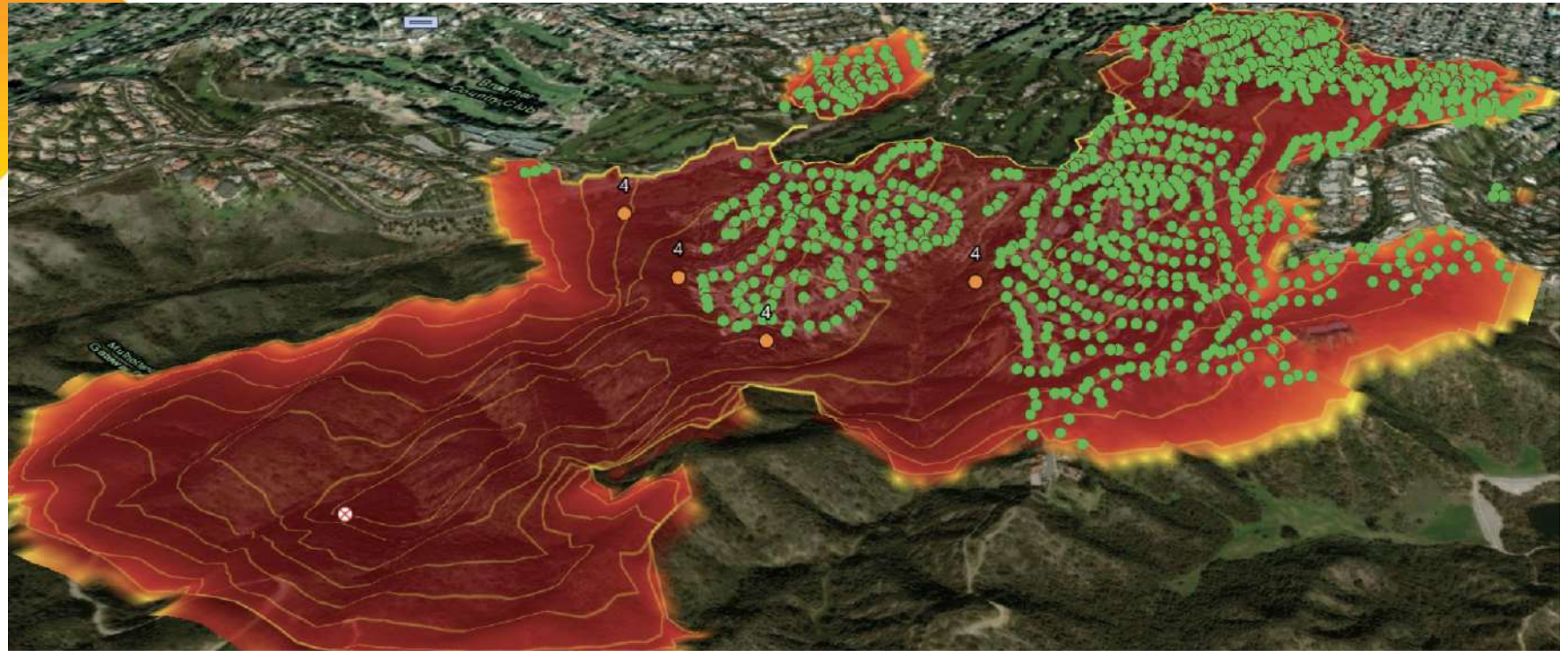
Post-fire

RISK

01. POTENTIAL SOURCE & PROBABILITY OF IGNITION

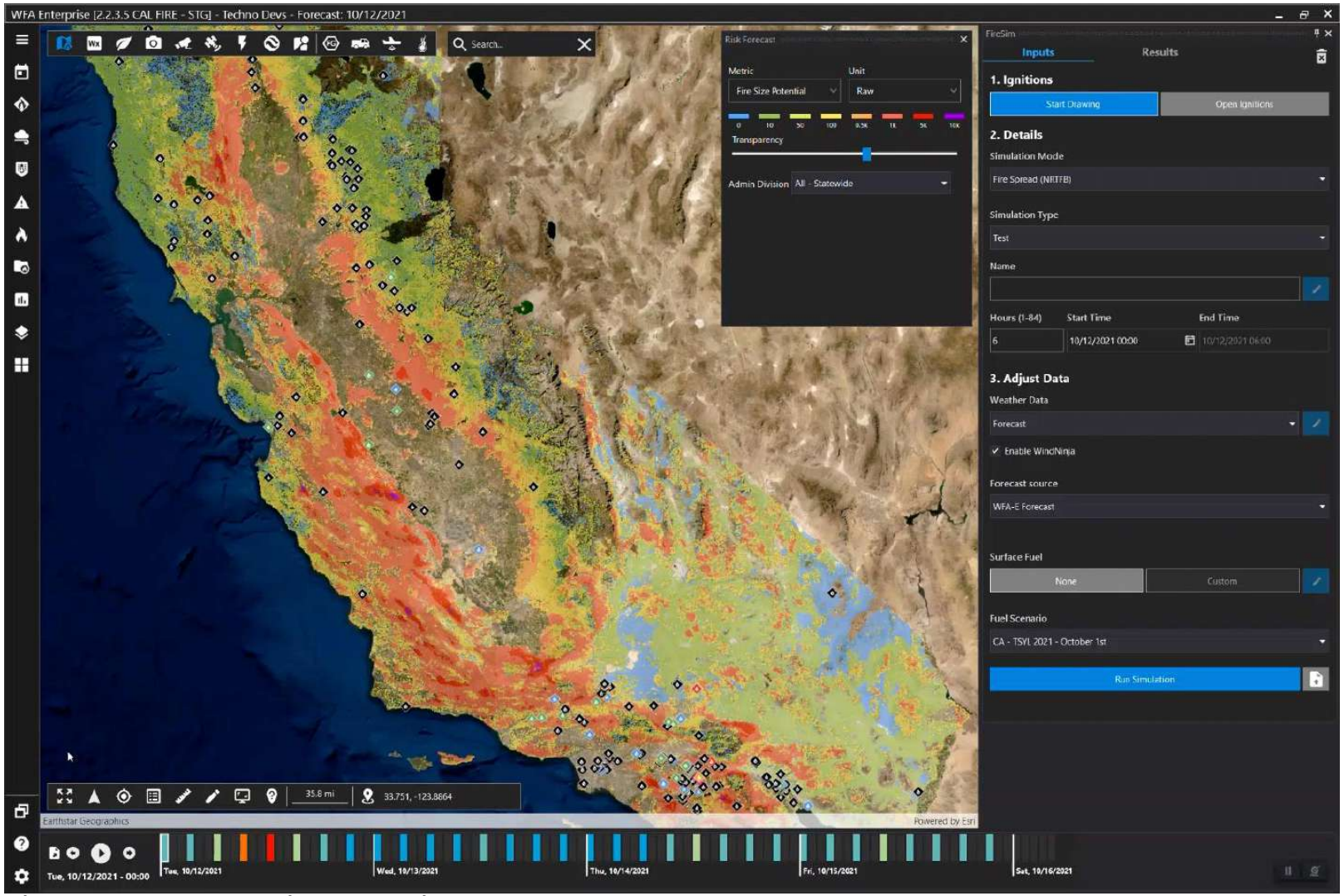
02. POTENTIAL IMPACTS & CONSEQUENCE FROM FIRE THAT OCCURS

The possibility of loss or harm.



Wildfire Risk = The combination of probability of an ignition and the consequences.

…WE NEED NOW TO EVALUATE RISK



https://technosylva.com/products/wildfire-analyst/firecast/

IMPORTANCE OF FIRE SPREAD MODELING.

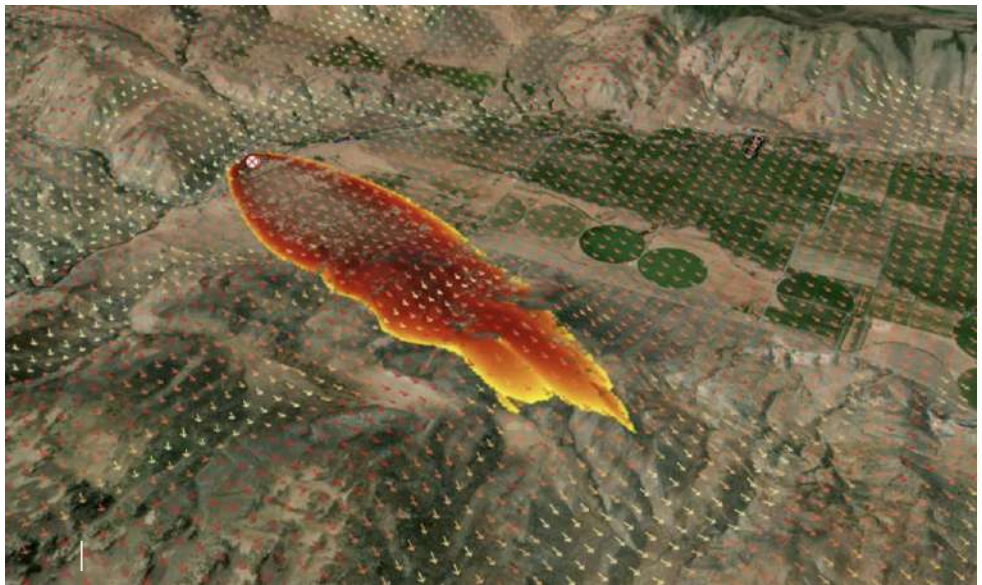
IMPACTS TO:

- Structures & Man-Made Assets
- People & Public Safety
- Critical Assets & Infrastructure

COMPONENTS OF ACCURATE FIRE SPREAD MODELING.

ACCURATE HISTORICAL WEATHER & WEATHER FORECASTS

High resolution, accurate historical and weather forecast data is critical. The freely available public weather data is mostly too coarse or doesn't go out far enough to provide the best results.



LANDSCAPE FUELS & FUEL MOISTURES

More accurate and enhanced fuel moisture and fuel characteristic models allows for more accurate fire spread into WUI areas improving consequence and impact understanding.

VALIDATION IN THE FIELD IS ESSENTIAL!

WE HAVE SPECIFICALLY VALIDATED OVER 2,250 FIRES AND OUR SOFTWARE HAS BEEN USED AND APPLIED OPERATIONALLY TO OVER 30,000 WILDFIRE INCIDENTS SINCE 2019.

What needs to to be validated?

Fuels, fire behavior, forecasted risk, anticipated consequence and impacts.

Why is validation important?

Testing models against reality and observation data to make sure they are accurate and performing so they can be refined and improved.

How we do it?

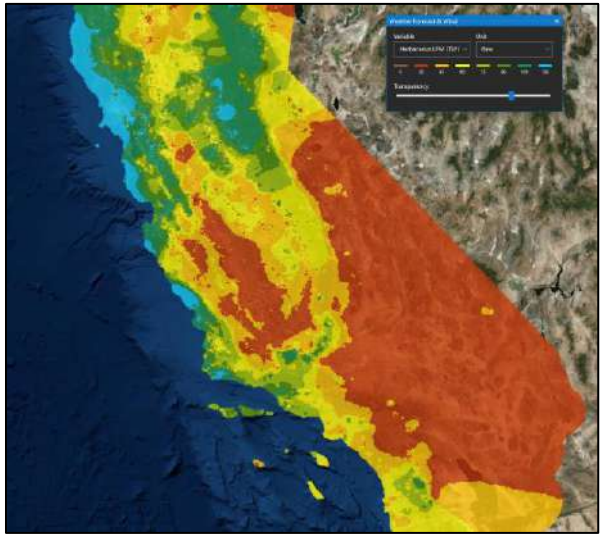
Proven in the hands of CAL FIRE and other fire agencies specialists in the field, integrating DoD FireGuard data, Cameras and publishing peer reviewed papers.

FIRE MODELING VALIDATION IN OPERATIONS WITH CAL FIRE

72,423 sims / >30,000 Incidents / 2700 FireGuard / >300 billions sims from 2020

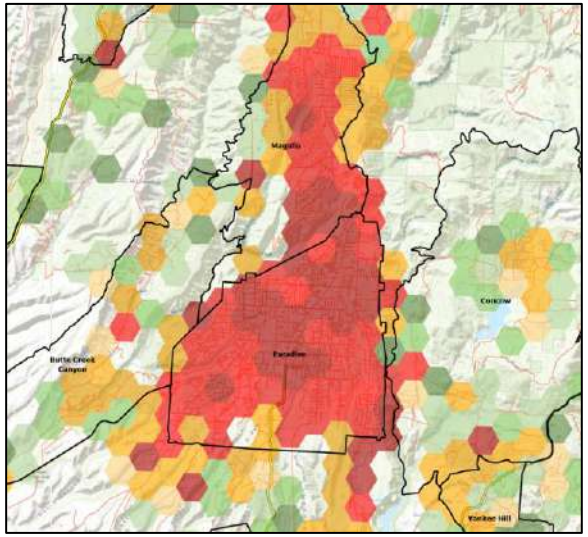
Advanced Data Analytics at Operational Scale

Dead & Live Fuel Moisture

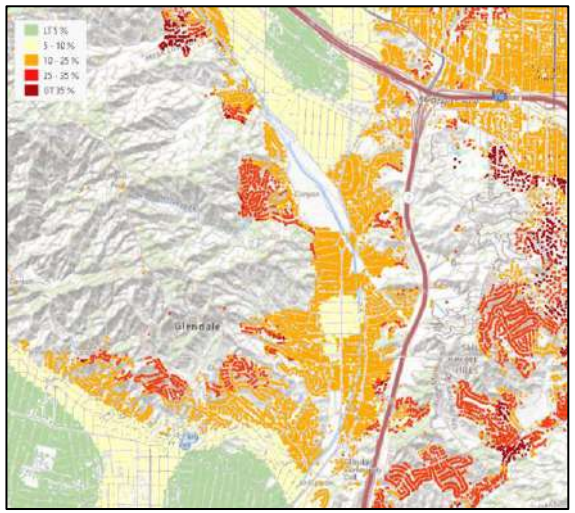


Surface & Canopy Fuels

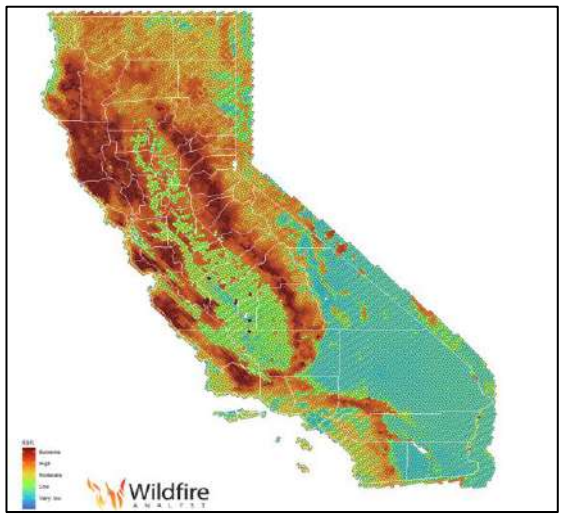
Landscape Exposure & Vulnerability (RAVE)



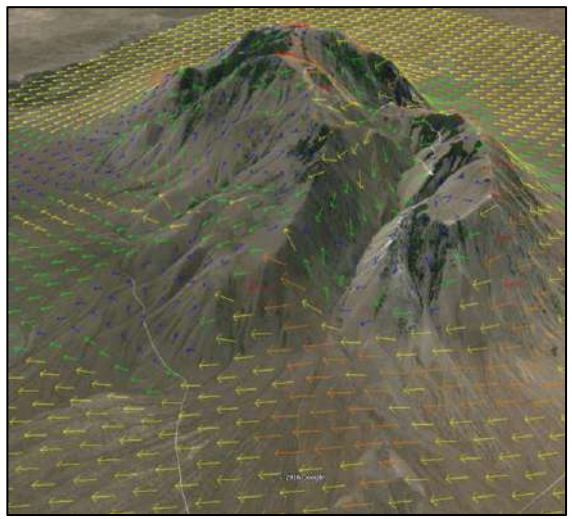
Building Loss Factor



Initial & Extended Attack Index



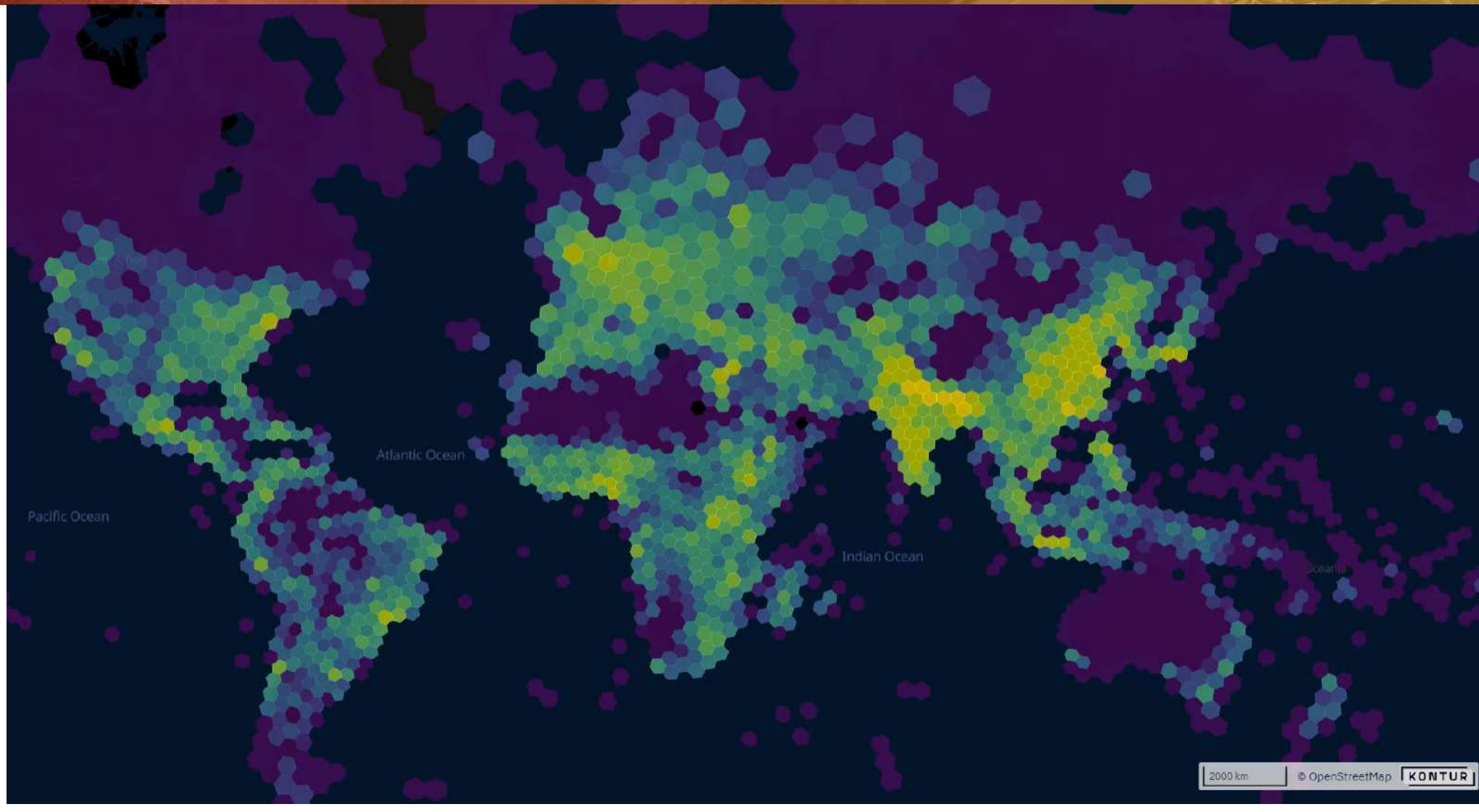
High Resolution Local Winds



Coupled Atmospheric Models

Vulnerable Assets: Population

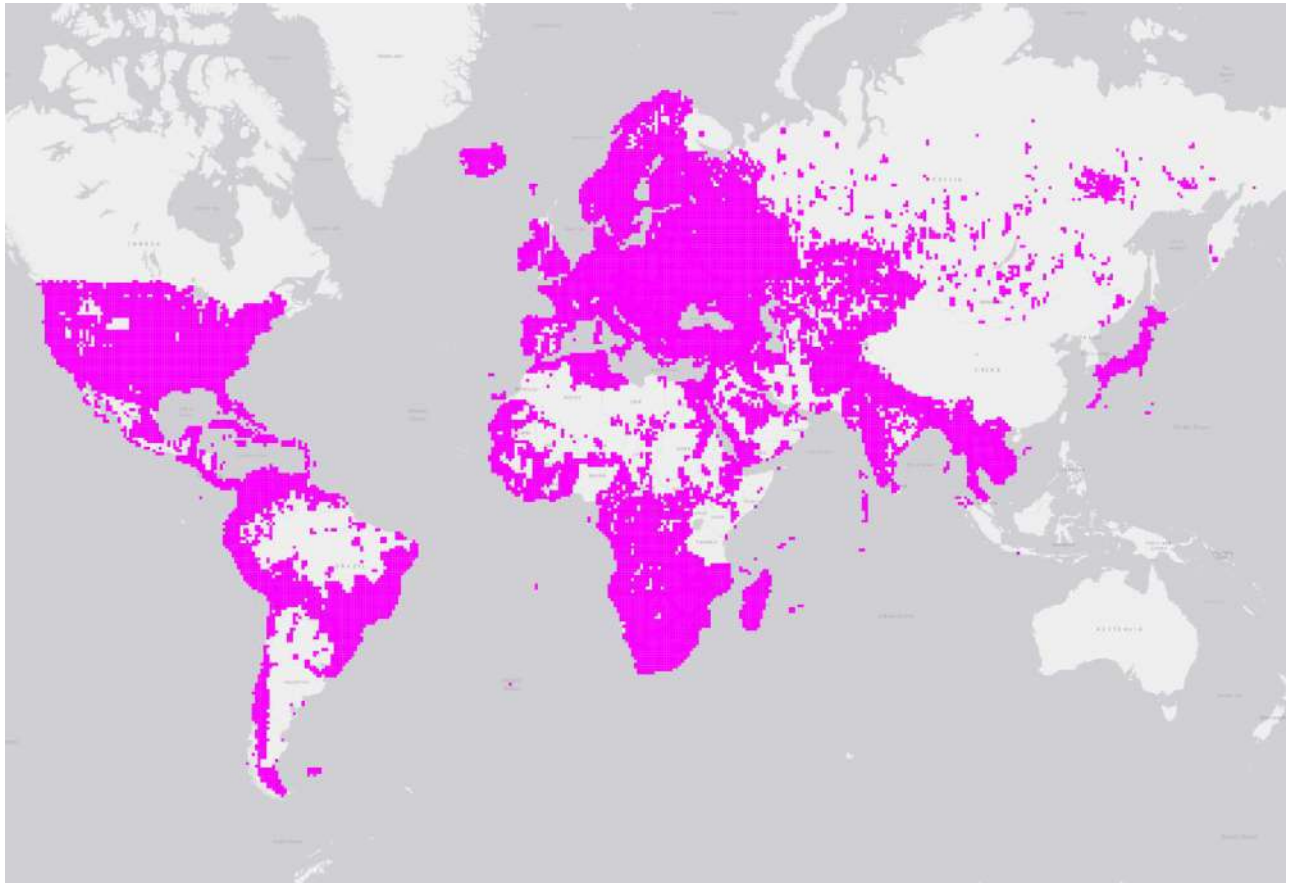
World Population at 400m resolution



https://data.humdata.org/dataset/kontur-population-dataset

Vulnerable Assets: Buildings

On going progress with global buildings dataset based on AI/ML techniques



https://github.com/microsoft/GlobalMLBuildingFootprints

Historic Wildfire Occurrence

MODIS from 2000

VIIRS from 2012

Weather Satellites

Not Enough!!!

https://firms.modaps.eosdis.nasa.gov/

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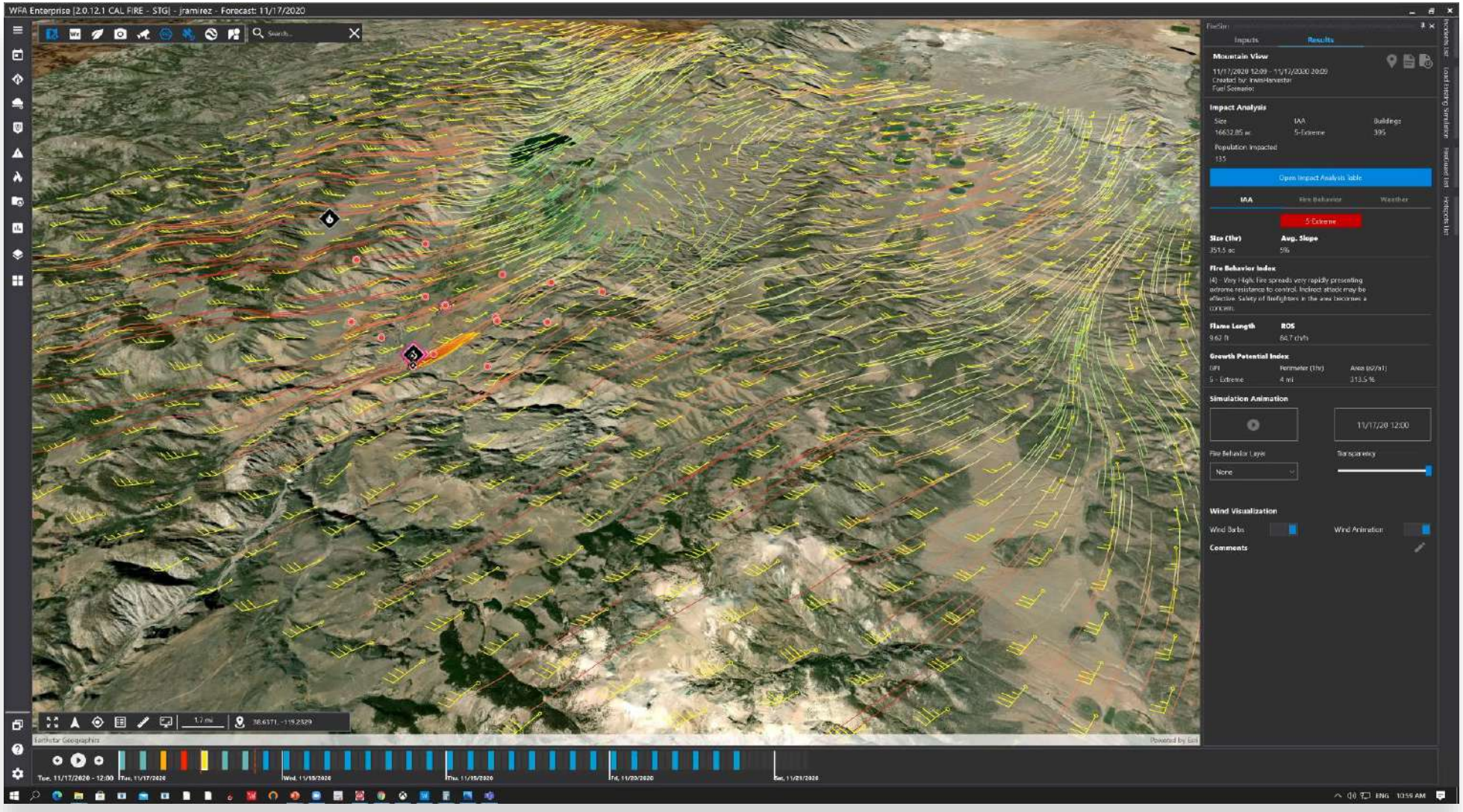
Real Time Wildfire Activity

Commercial constellations

Aerial and UAS Platforms

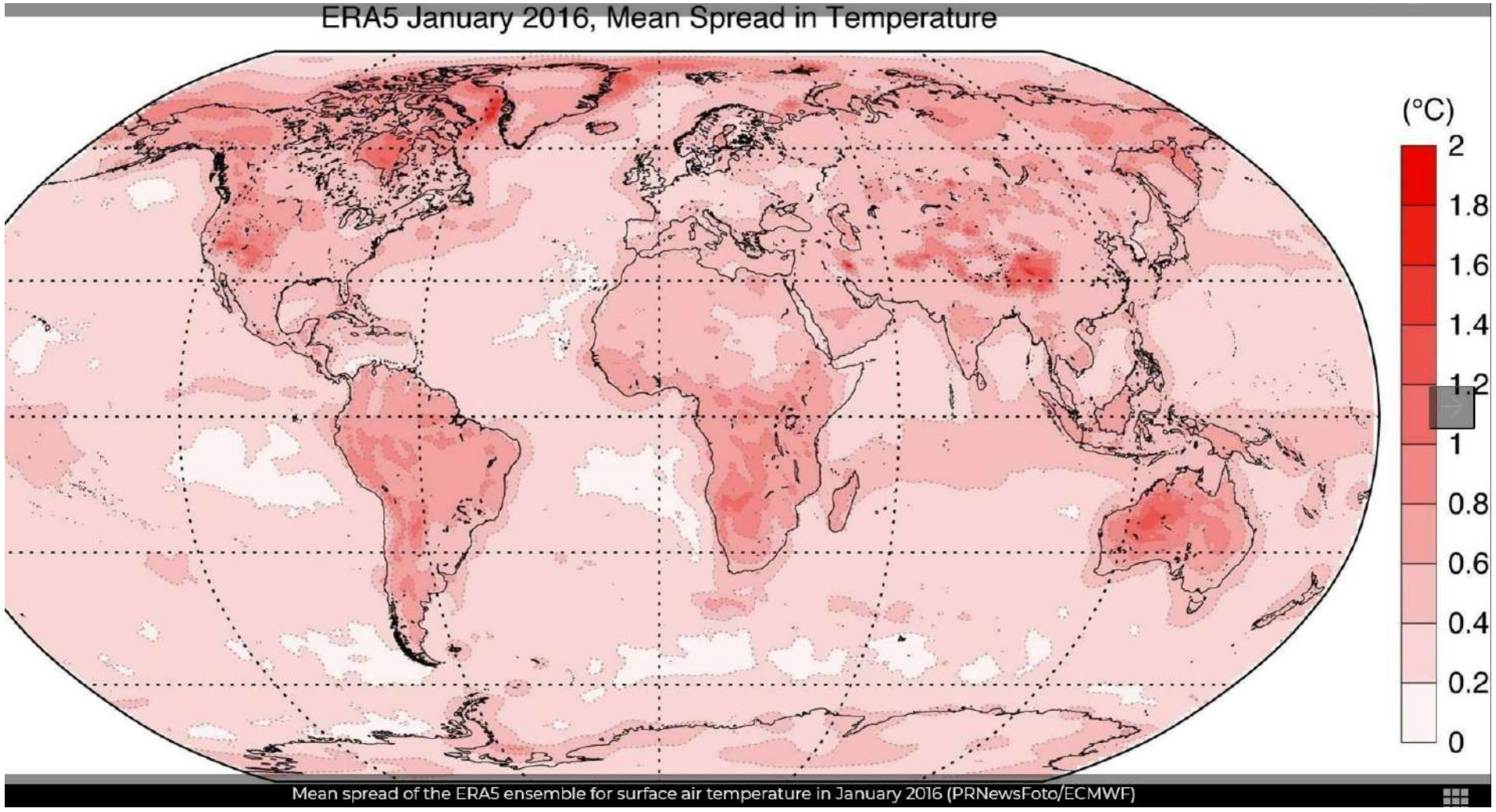
Getting there!



FireGuard tracked all the fire activity in Western US since 2019 at 15 min intervals

Historical Weather Reanalysis

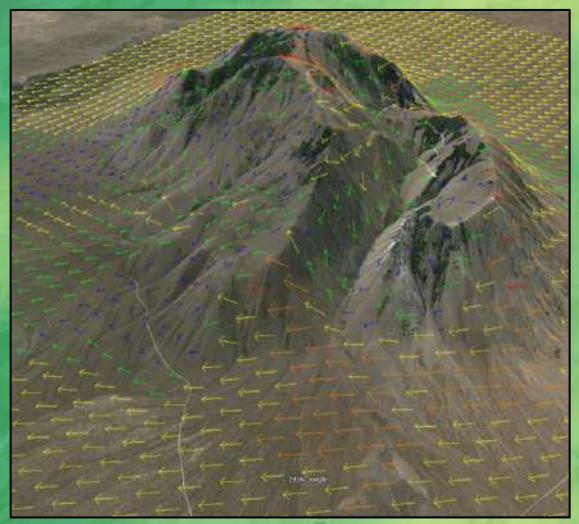
ERA5 hourly data on single levels from 1940 to present
9 km res



https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels

Ultra High Resolution Winds (from 2km to 200m)

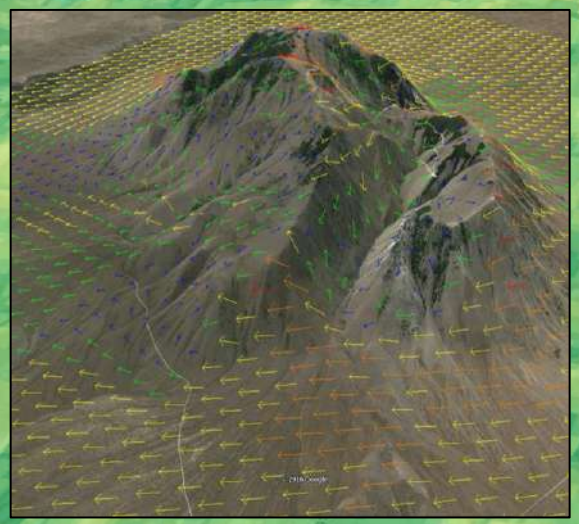
High Resolution Wind



6.4 mi

Ultra High Resolution Winds (from 2km to 200m)

High Resolution Wind

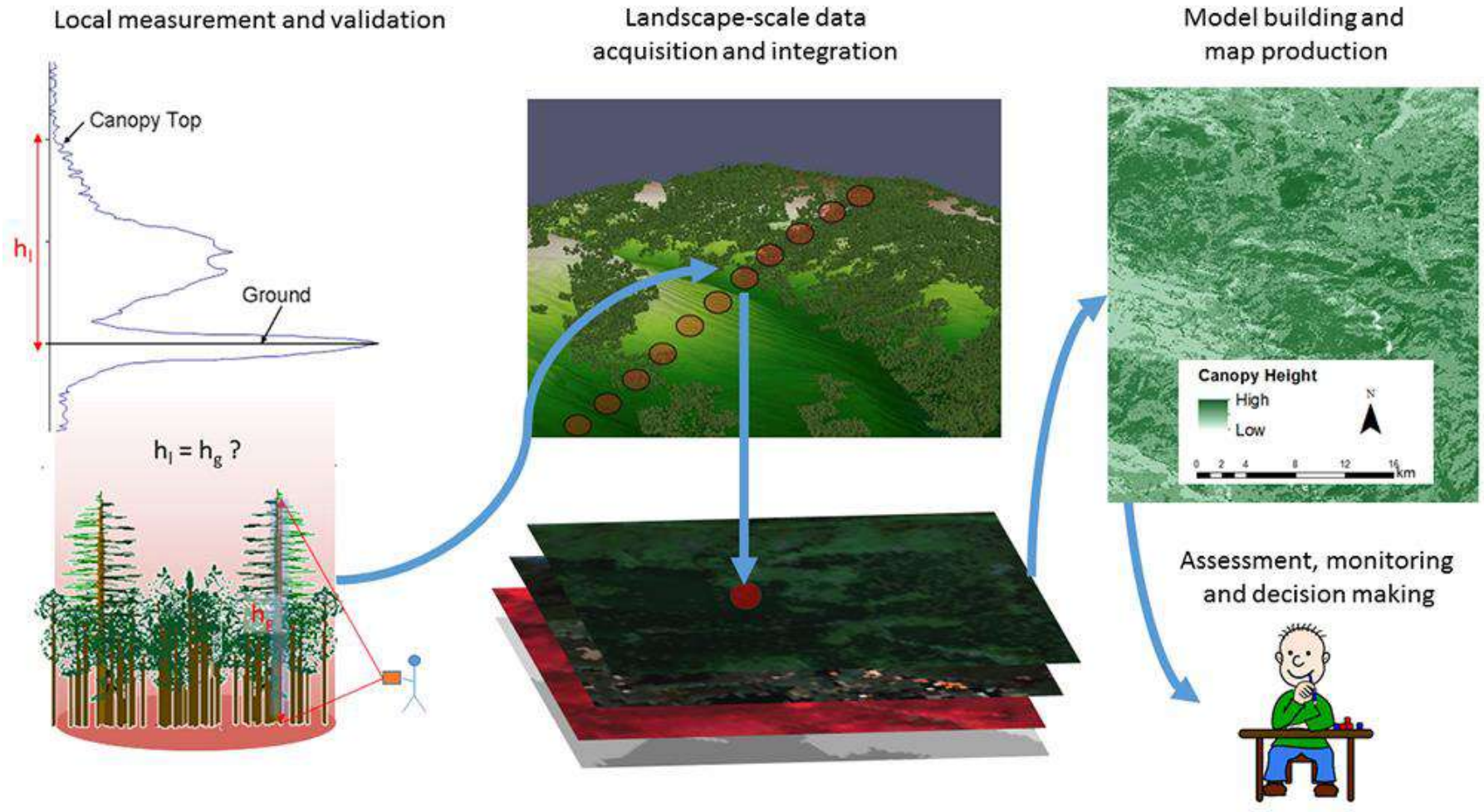


6.4 mi

Global Vegetation Datasets

On top of Optical and SAR missions,

GEDI LiDAR mission extended to 2031

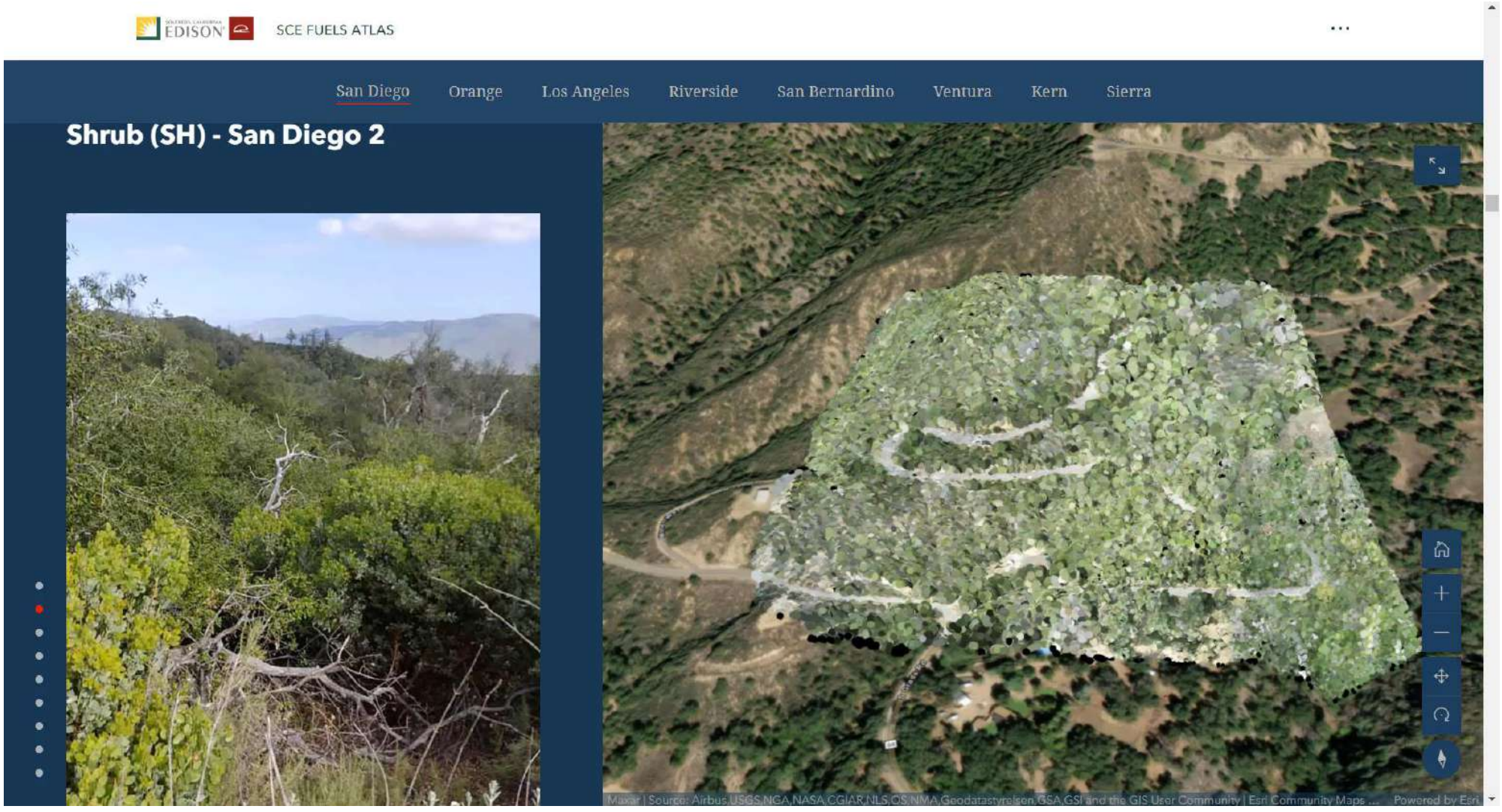


DATA FLOW FOR GENERATION OF GEDI-DERIVED INFORMATION PRODUCTS TO AID MANAGERS AND POLICY MAKERS IN ASSESSMENTS, MONITORING AND DECISION MAKING RELATED TO WILDLAND FIRE. CREDIT: BIRGIT PETERSON.

https://gedi.umd.edu/applications/forest-management-and-carbon-cycling/

LiDAR & MS Imagery at High Resolutions

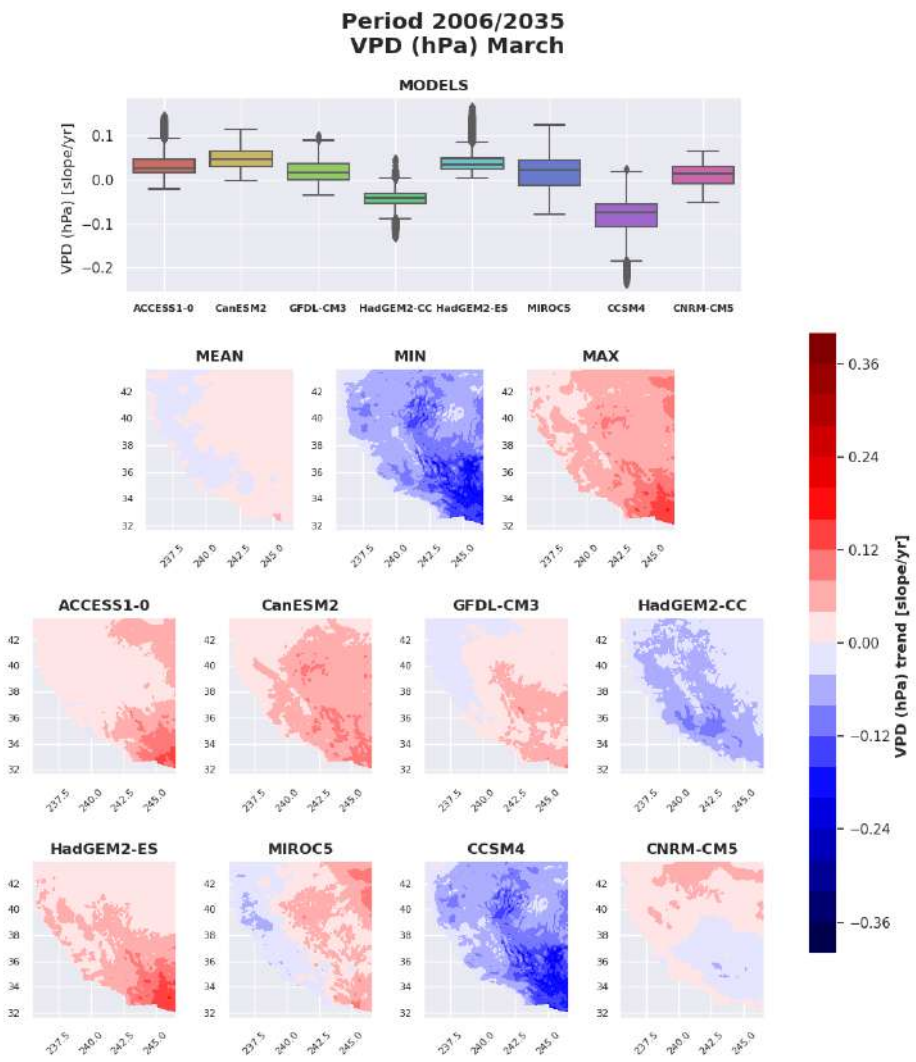
Fuels can be evaluated in a quantitative way with the combination of multispectral sensors and LiDAR from Drone to Space scales

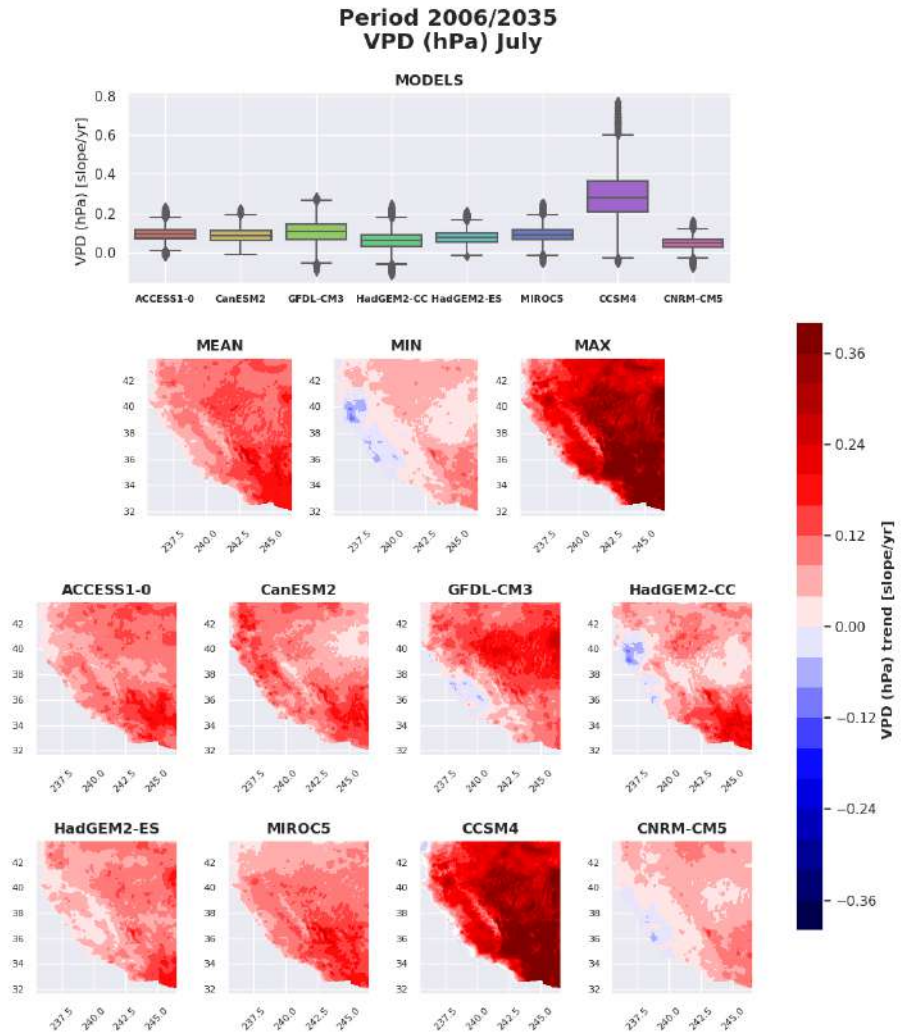


California Fuels Atlas by Technosylva https://bit.ly/Fuels_SCE

Climate Change Scenario Models

CMIP(6) informed models can support future risk scenarios





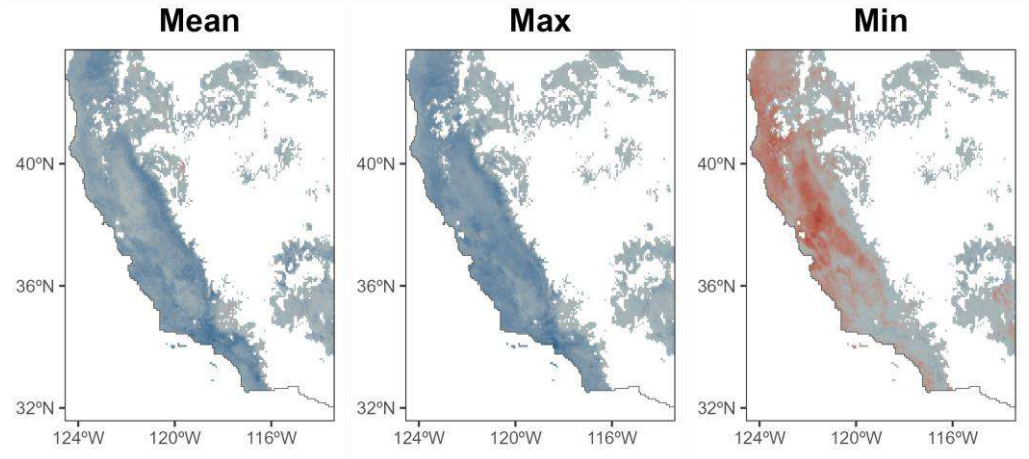
https://wcrp-cmip.org/cmip-data-access/

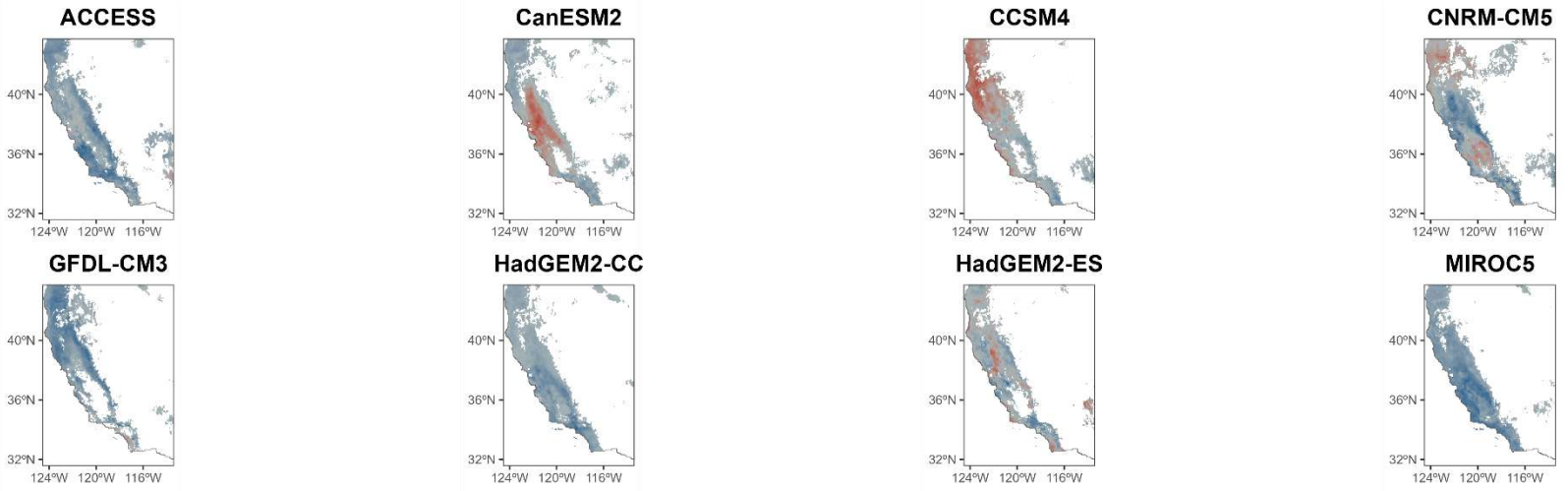
Climate Change Scenario Models

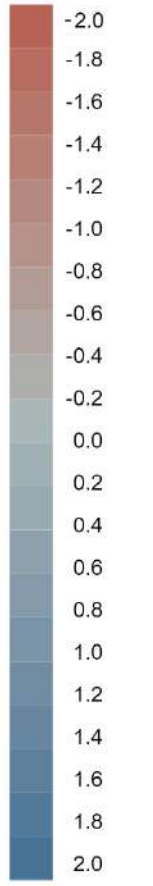
CMIP(6) informed models can support future risk scenarios

Live Fuel Moisture Content
Herbaceous Fuels

February
2006 - 2030







https://wcrp-cmip.org/cmip-data-access/

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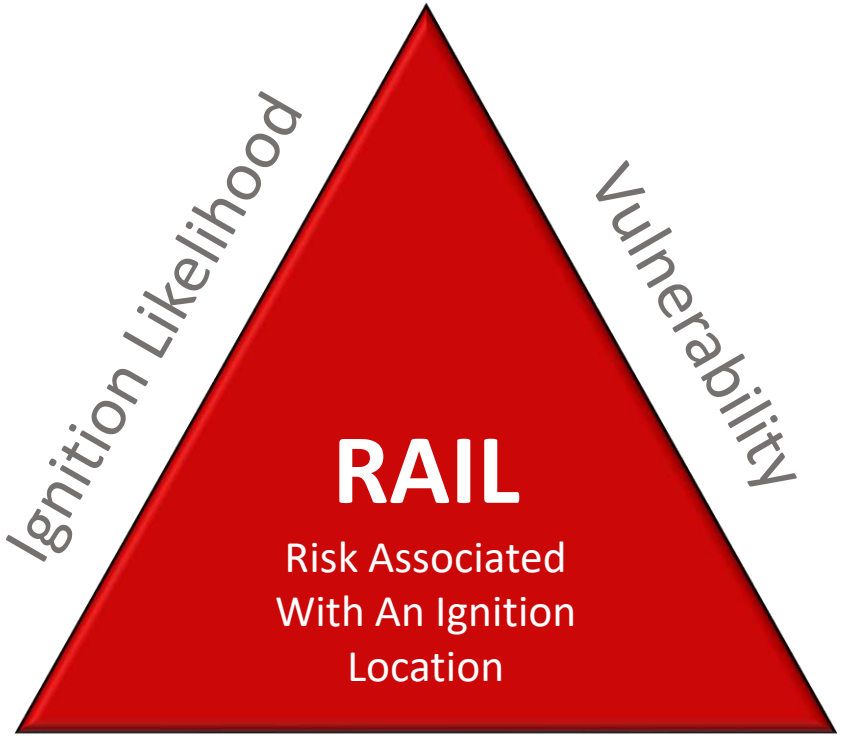
AI/ML for Huge-Data Computing Affordable

FIRE SPREAD MODELING FOR RISK CALCULATIONS

- Scale from local to regional and global
- Using accepted models, that must perform for massive modeling (Montecarlo)
- Input data must be available and at the resolution needed for the decision-making level

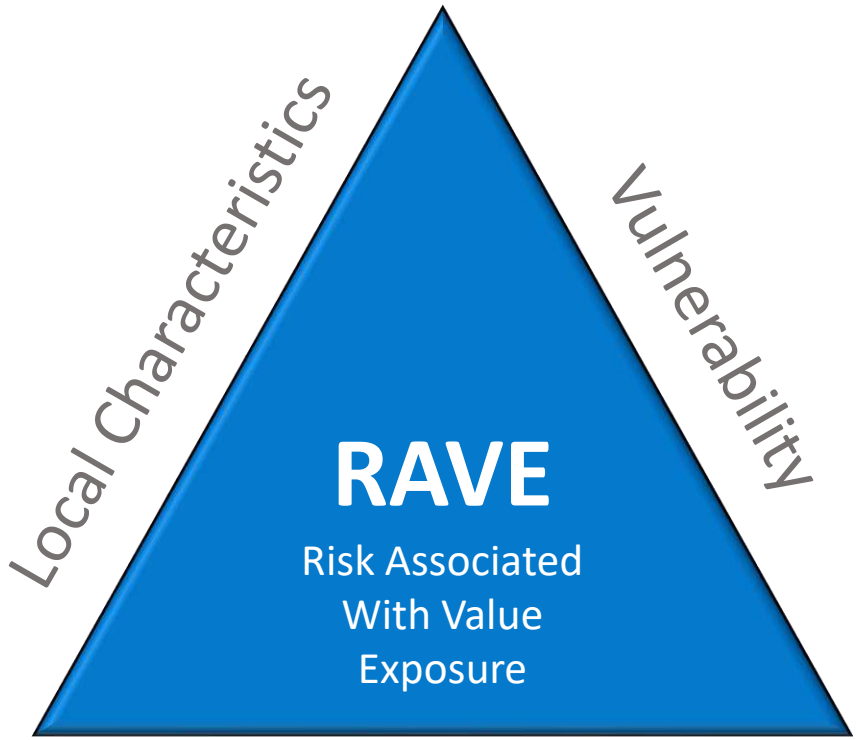
Landscape Risk Modeling



Fire Spread Potential

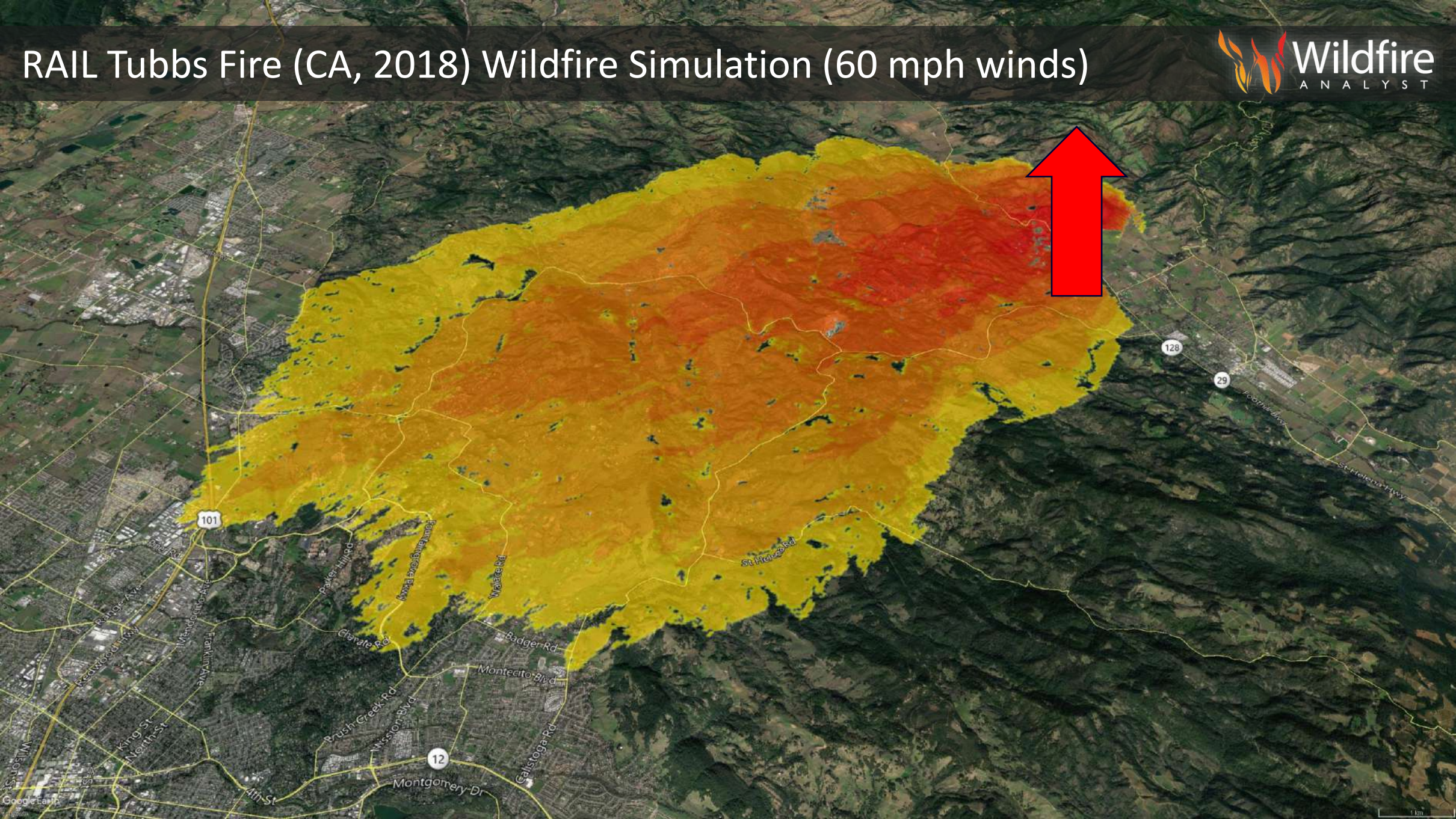
+

Values at Risk Modeling

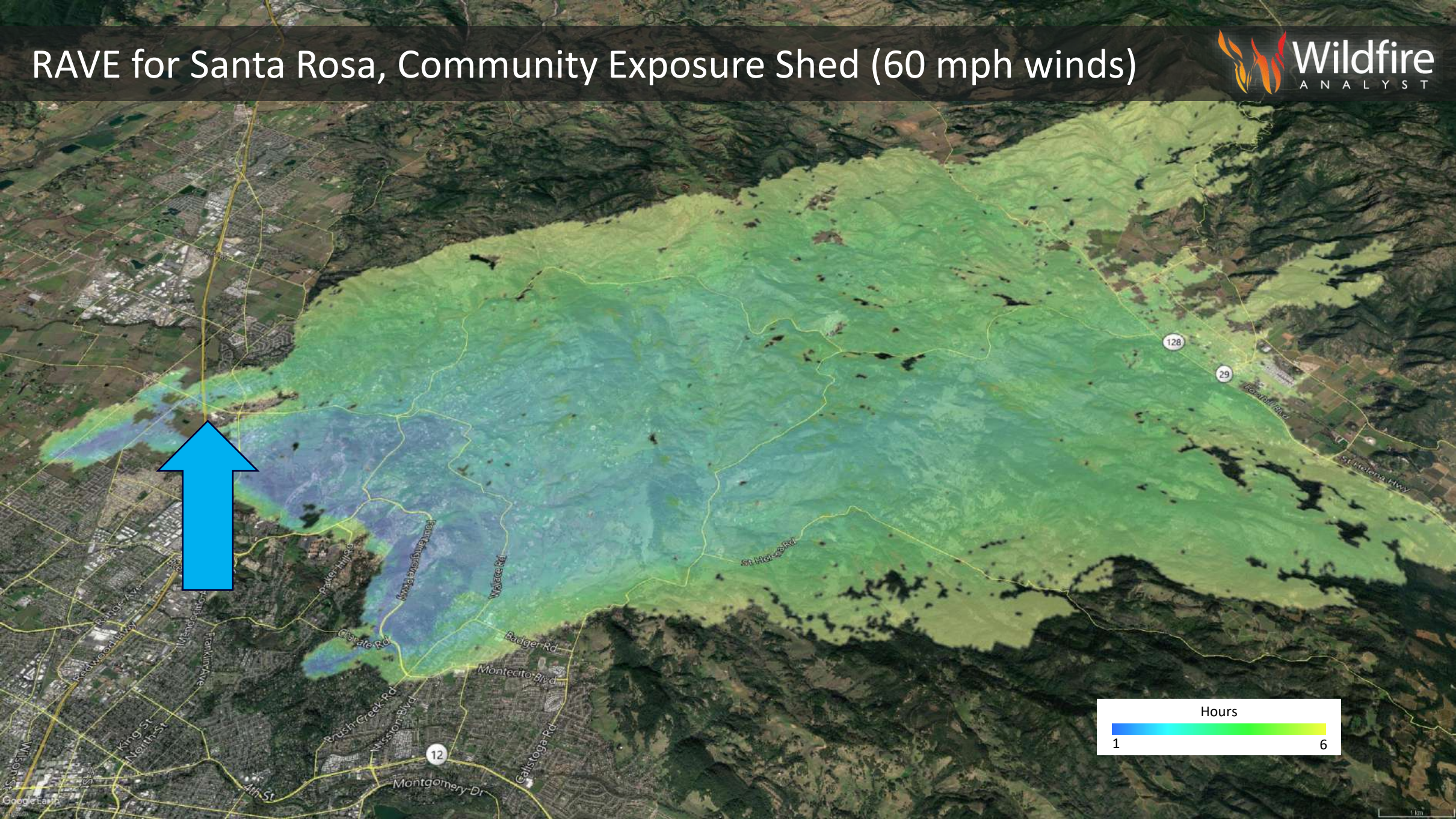


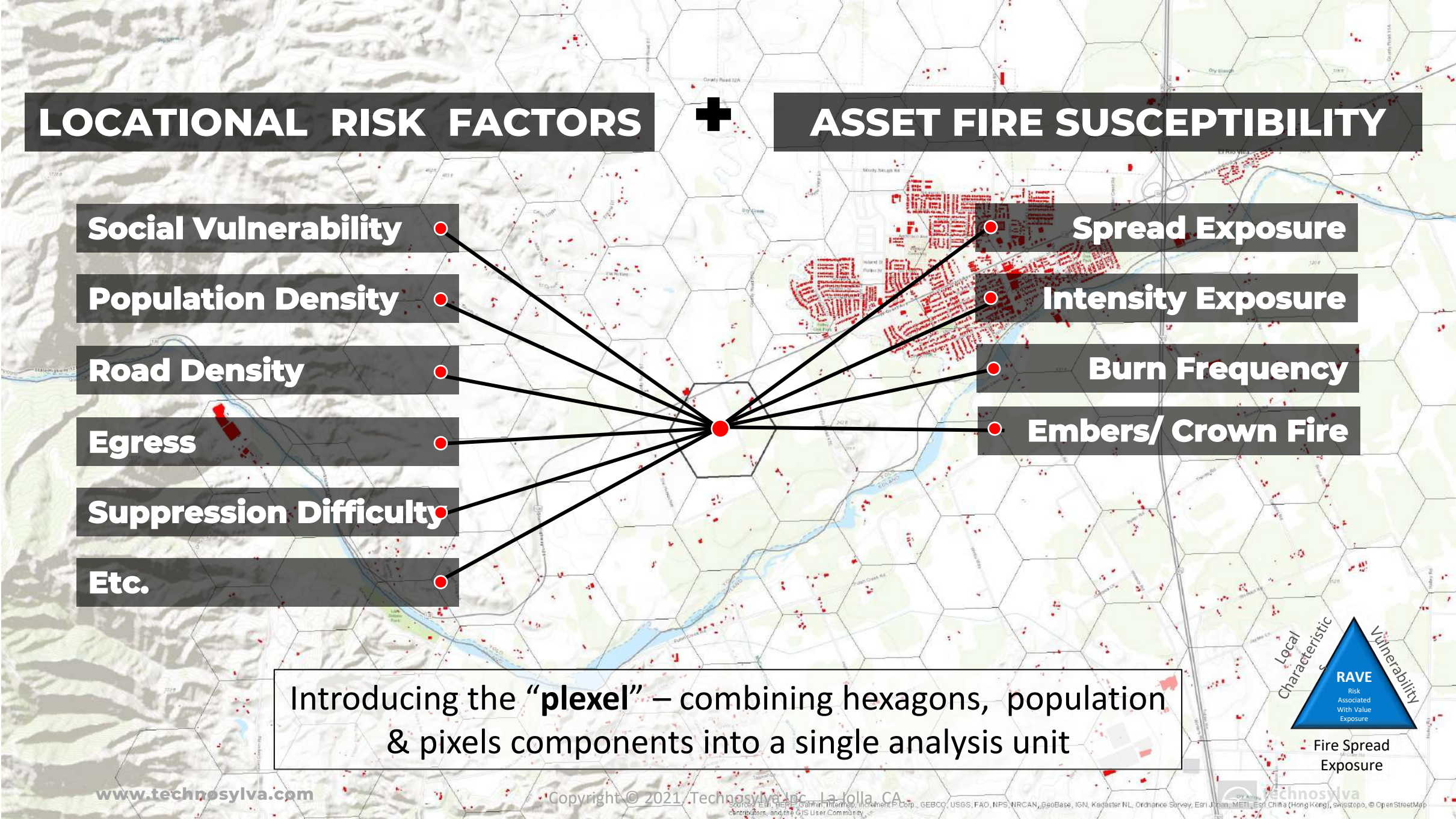
Fire Spread Exposure

RAIL Tubbs Fire (CA, 2018) Wildfire Simulation (60 mph winds)



RAVE for Santa Rosa, Community Exposure Shed (60 mph winds)




LOCATIONAL RISK FACTORS
+
ASSET FIRE SUSCEPTIBILITY
Social Vulnerability
Population Density
Road Density
Egress
Suppression Difficulty
Etc.
Spread Exposure
Intensity Exposure
Burn Frequency
Embers/ Crown Fire
Introducing the "plexel" – combining hexagons, population & pixels components into a single analysis unit
Local Characteristic
Vulnerability
RAVE
Risk Associated With Value Exposure
Fire Spread Exposure
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AND BE READY TO SUPPORT IT

Oregon Capital Chronicle

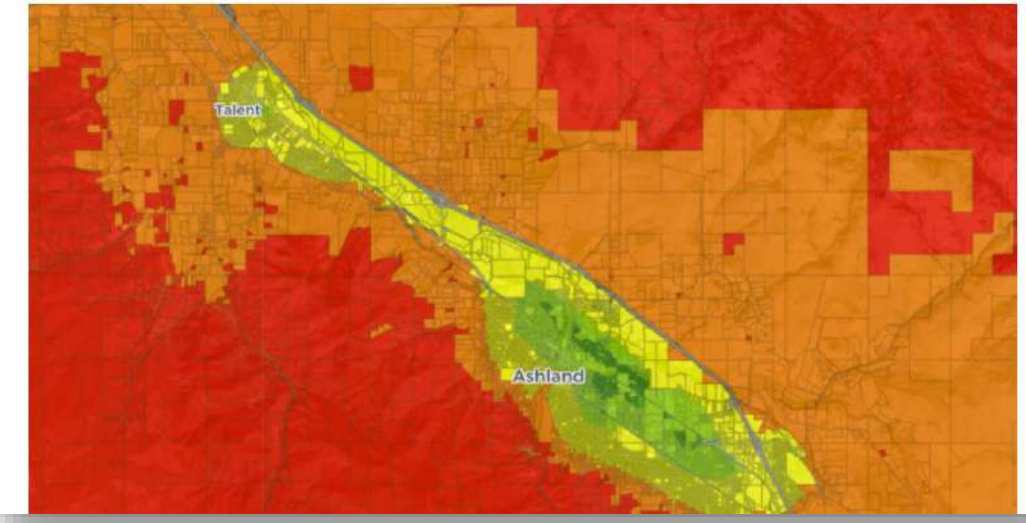
POLITICS ENVIRONMENT EDUCATION ECONOMY HEALTH OREGON'S PEOPLE

ENVIRONMENT POLITICS

State forester rescinds wildfire risk map in response to public, political outcry

Several Republican lawmakers in southern and eastern Oregon said the map was flawed, causing people to lose insurance or face doubled premiums

BY: ALEX BAUMHARDT - AUGUST 5, 2022 6:00 AM



OPB MAY 16, 2023

In The News | Heat wave | Hispanic Serving Institutions | Private flights | Community court | Roland Griffiths

Oregon bill to restrict insurance company use of wildfire risk maps heads to governor

By Jane Vaughan (Jefferson Public Radio)
April 27, 2023 1:01 a.m.

A bill aimed at consumer insurance protections and Oregon's wildfire risk map passed the Oregon House of Representatives on Tuesday. It now heads to Gov. Kotek's desk to be signed into law.

Senate Bill 82 would restrict how insurance companies can use wildfire risk maps. It's in part a response to last summer's controversial map, which outlined wildfire risk at the property ownership level across the state.

Oregon has seen $3 billion of property loss this decade due to wildfire, said Rep. Pam Marsh (D-Ashland).

"What that means is that insurance companies are increasingly looking at their portfolios and evaluating risk. And consumers are increasingly getting notifications that their canceled policies

https://www.opb.org/article/2023/04/26/oregon-passes-bill-restricting-insurance-company-use-of-wildfire-risk-maps/

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CALIFORNIA'S WILDFIRE TECHNOLOGY SOLUTION.

Lessons Learned and Path Forward

CHIEF PHILIP SELEGUE
DEPUTY CHIEL INTEL, CAL FIRE

JOAQUIN RAMIREZ, PHD
PRESIDENT & CTO, TECHNOSYLVA

Cranston Fire, 2018 (Riverside County) • Photo by Levan Badzgaradze

Wildfire Analyst™

Tactical Analyst™

FIREPLANNER

FIRECAST

FIRESIM

TACTICAL ANALYST

Mitigation Planning,
Historical and Future
Scenarios

Planning
Preparation
Prevention

Risk forecast hourly up to
7 days
Initial and Extended Attack

Pre-Suppression
Dispatching

On Demand Real-time
Simulation with Impacts
Model Agnostic

Suppression
Post-Fire

Operational Support
for Active Fire
Situation Awareness

Suppression

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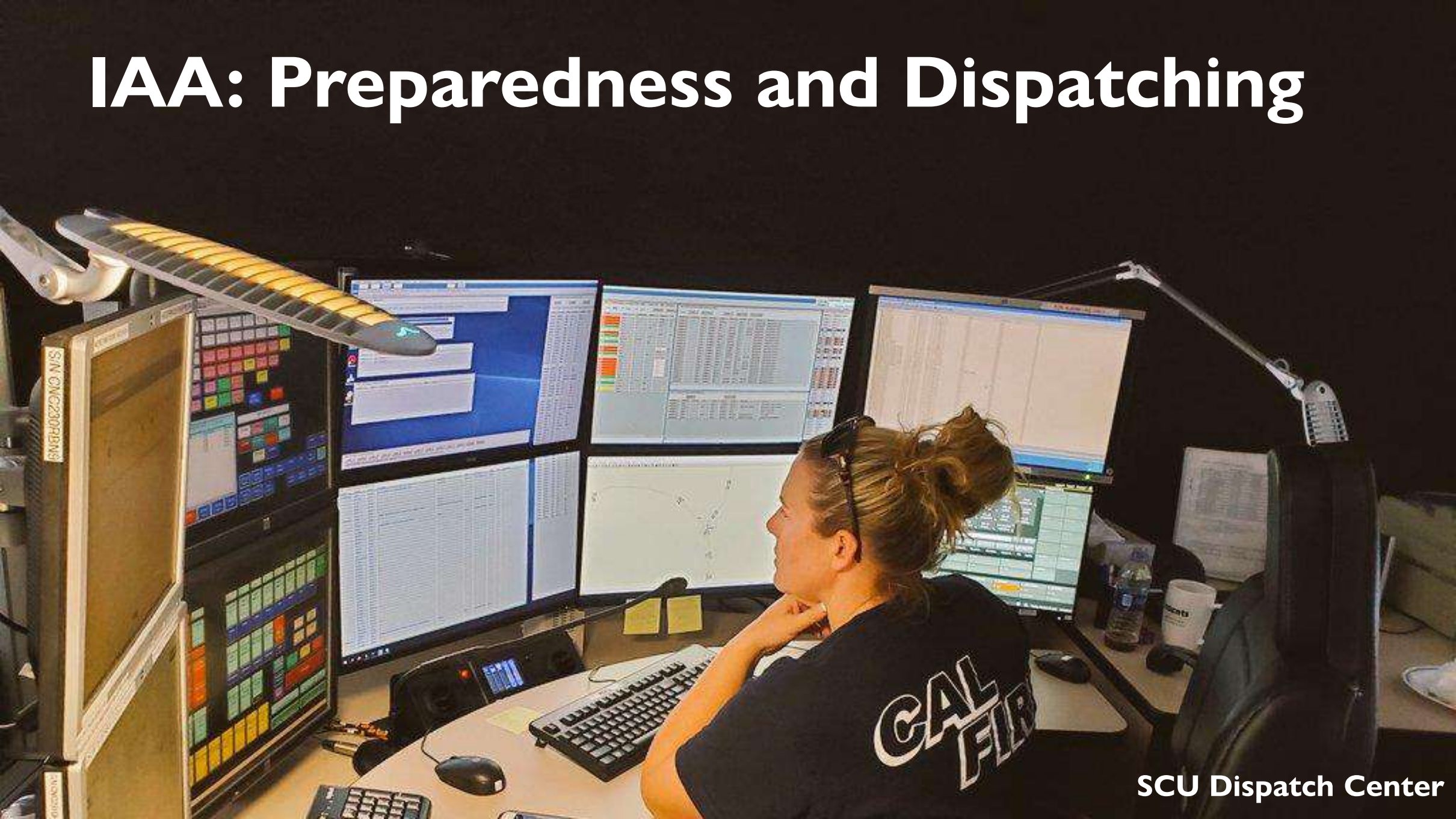
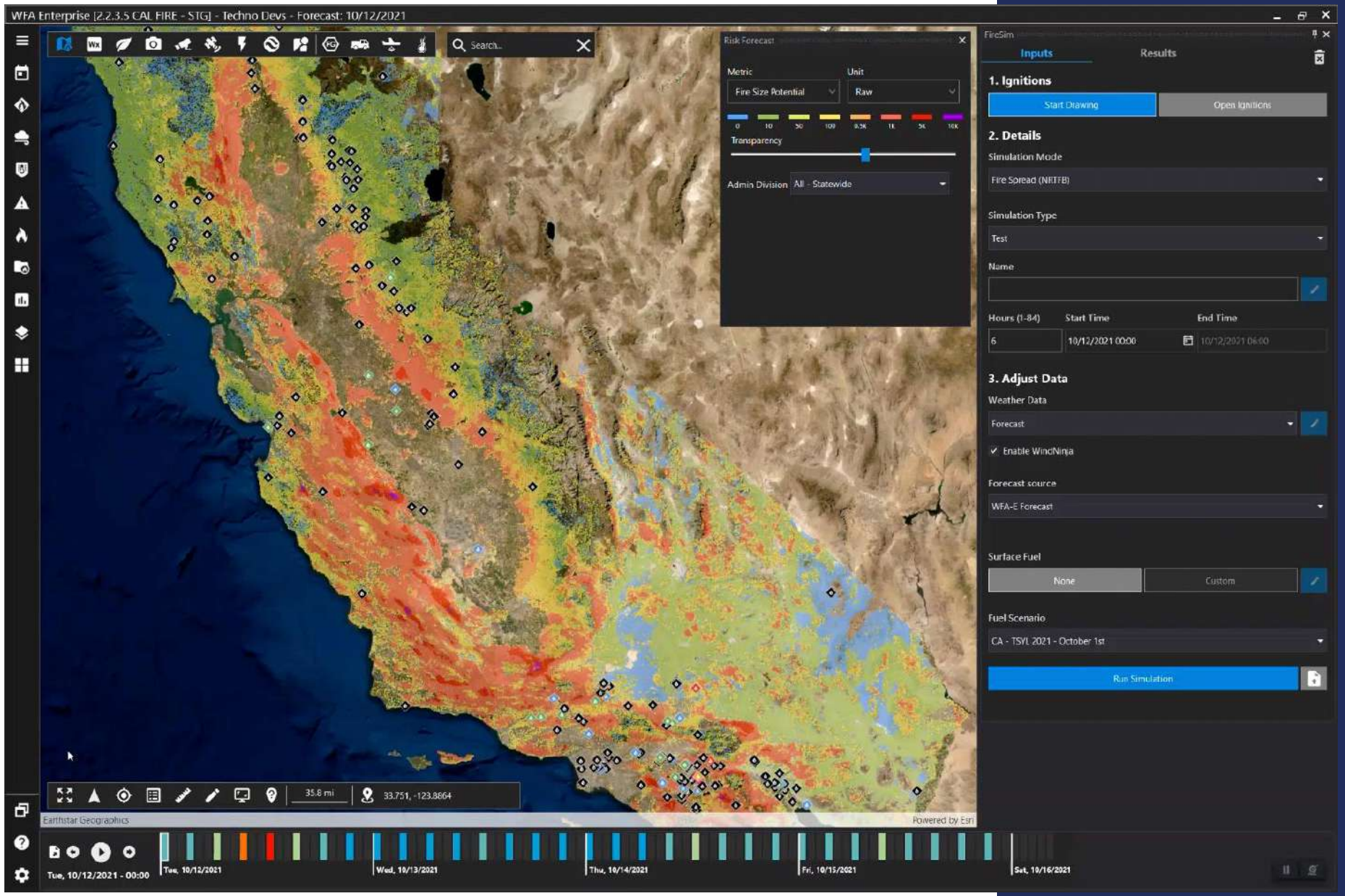
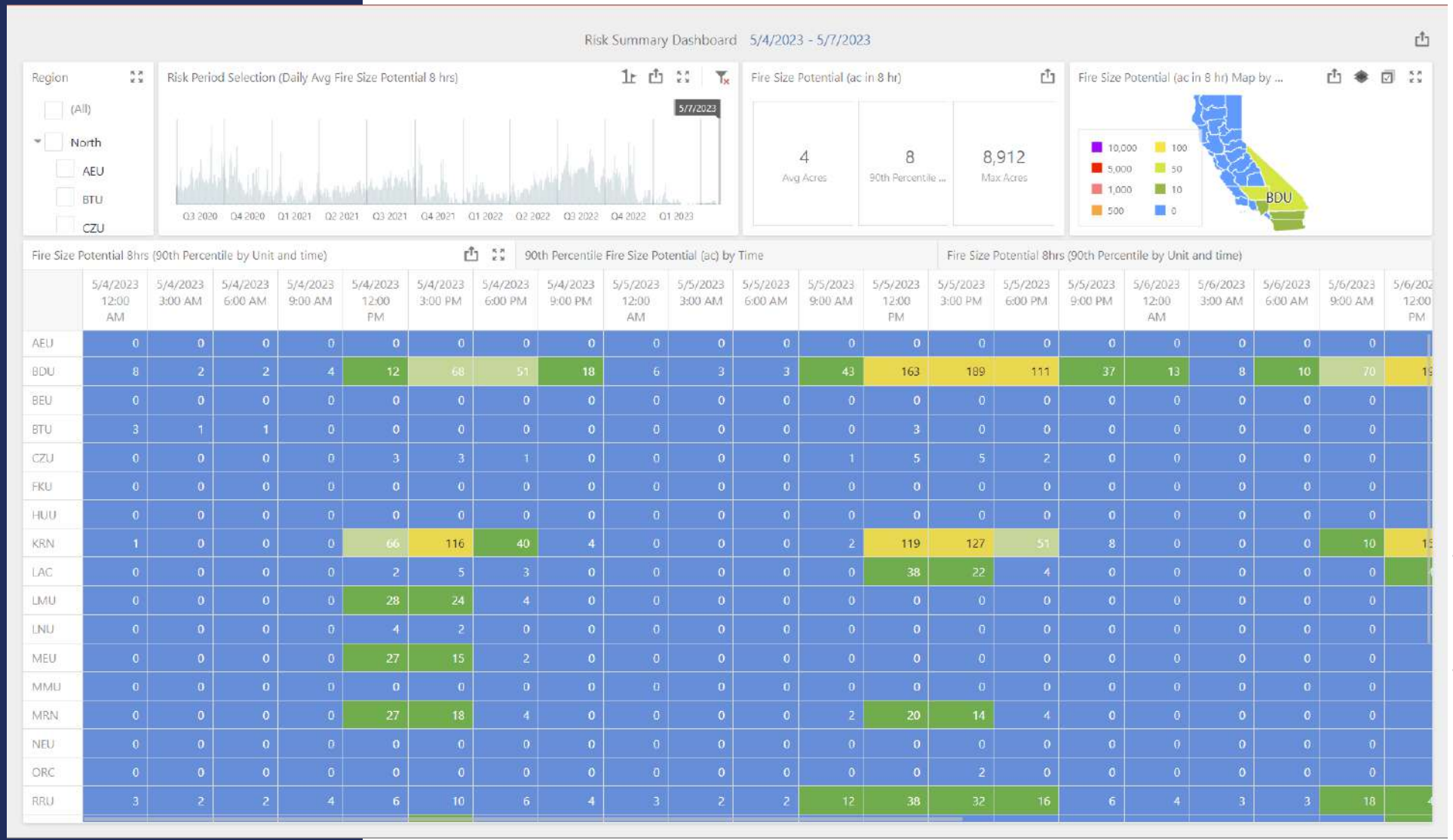
IAA: Preparedness and Dispatching



SCU Dispatch Center

Wildfire risk forecasts are derived daily based on millions of simulations every 3 hours at 500m density grid, providing a 5+ day forecast of fire conditions, supporting Units' preparedness.





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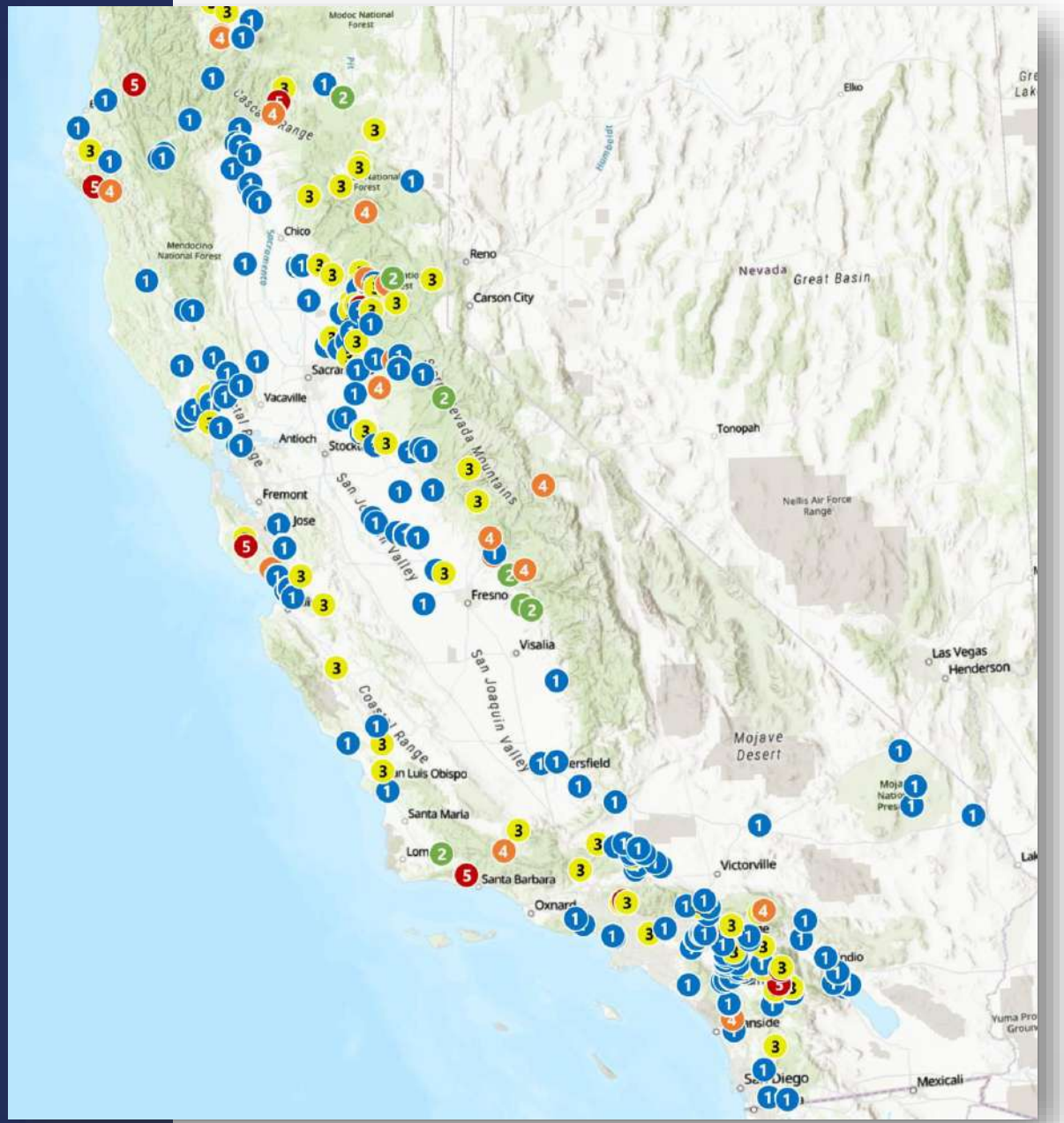
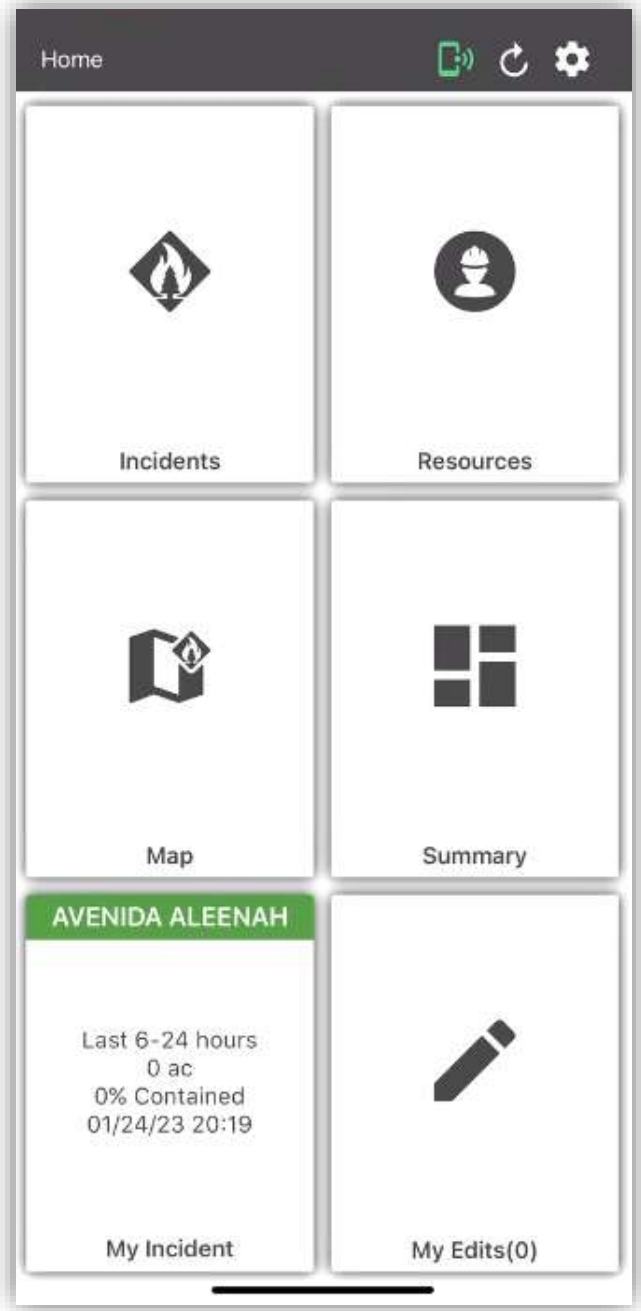
AEU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BDU	8	2	2	4	12	68	51	18	6	3	3	43	163	189	111	37	13	8	10	70	19
BEU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BTU	3	1	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	
CZU	0	0	0	0	3	3	1	0	0	0	0	1	5	5	2	0	0	0	0	0	
FKU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
HUU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
KRN	1	0	0	0	66	116	40	4	0	0	0	2	119	127	51	8	0	0	0	10	15
LAC	0	0	0	0	2	5	3	0	0	0	0	0	38	22	4	0	0	0	0	0	
LMU	0	0	0	0	28	24	4	0	0	0	0	0	0	0	0	0	0	0	0	0	
LNU	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MEU	0	0	0	0	27	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
MMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MRN	0	0	0	0	27	18	4	0	0	0	0	2	20	14	4	0	0	0	0	0	
NEU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ORC	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	
RRU	3	2	2	4	6	10	6	4	3	2	2	12	38	32	16	6	4	3	3	18	4

1

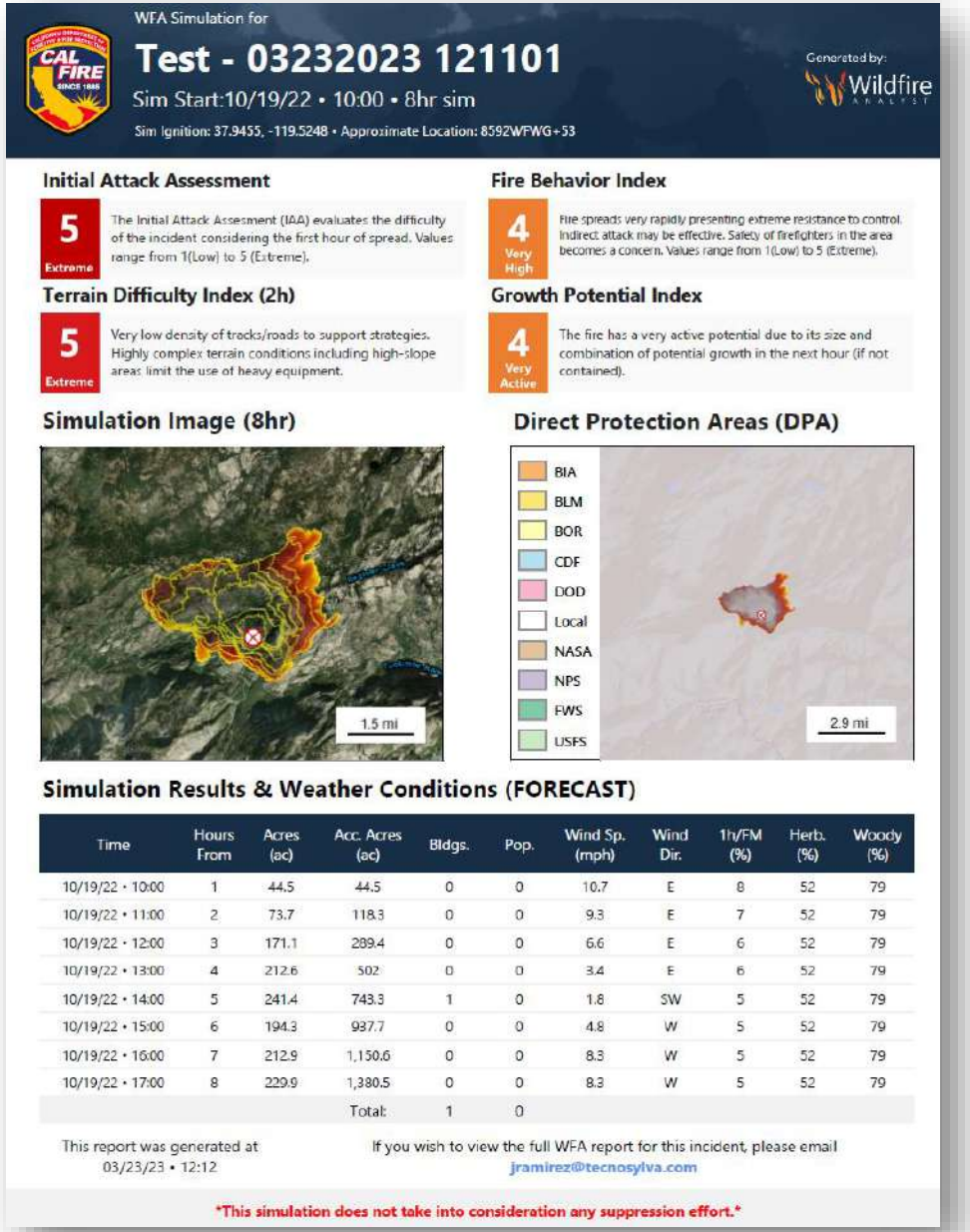
Every Day, IAA metrics based on million of simulations are evaluated and summarized by unit by the Cal Fire Intel Personnel



Every alert, coming from CAD, FireGuard, Hotspots and Lighting Strikes are automatically simulated and evaluated with an Initial Attack Assessment Index from 1 to 5 to provide intel from the detection time to units on the field



Units on the field get a One Page report as soon as the incident gets into the CAD through the Tactical Analyst mobile app



WFA Simulation for

Test - 03232023 121101

Sim Start:10/19/22 • 10:00 • 8hr sim

Sim Ignition: 37.9455, -119.5248 • Approximate Location: 8592WFWG+53

Generated by: Wildfire Analyst

Initial Attack Assessment

5 Extreme

The Initial Attack Assesment (IAA) evaluates the difficulty of the incident considering the first hour of spread. Values range from 1(Low) to 5 (Extreme).

Fire Behavior Index

4 Very High

Fire spreads very rapidly presenting extreme resistance to control. Indirect attack may be effective. Safety of firefighters in the area becomes a concern. Values range from 1(Low) to 5 (Extreme).

Terrain Difficulty Index (2h)

5 Extreme

Very low density of trocks/roads to support strategies. Highly complex terrain conditions including high-slope areas limit the use of heavy equipment.

Growth Potential Index

4 Very Active

The fire has a very active potential due to its size and combination of potential growth in the next hour (if not contained).

Simulation Image (8hr)

Direct Protection Areas (DPA)

Simulation Results & Weather Conditions (FORECAST)

Time	Hours From	Acres (ac)	Acc. Acres (ac)	Bldgs.	Pop.	Wind Sp. (mph)	Wind Dir.	1h/FM (%)	Herb. (%)	Woody (%)
10/19/22 • 10:00	1	44.5	44.5	0	0	10.7	E	8	52	79
10/19/22 • 11:00	2	73.7	118.3	0	0	9.3	E	7	52	79
10/19/22 • 12:00	3	171.1	289.4	0	0	6.6	E	6	52	79
10/19/22 • 13:00	4	212.6	502	0	0	3.4	E	6	52	79
10/19/22 • 14:00	5	241.4	743.3	1	0	1.8	SW	5	52	79
10/19/22 • 15:00	6	194.3	937.7	0	0	4.8	W	5	52	79
10/19/22 • 16:00	7	212.9	1,150.6	0	0	8.3	W	5	52	79
10/19/22 • 17:00	8	229.9	1,380.5	0	0	8.3	W	5	52	79
			Total:	1	0					

This report was generated at 03/23/23 • 12:12

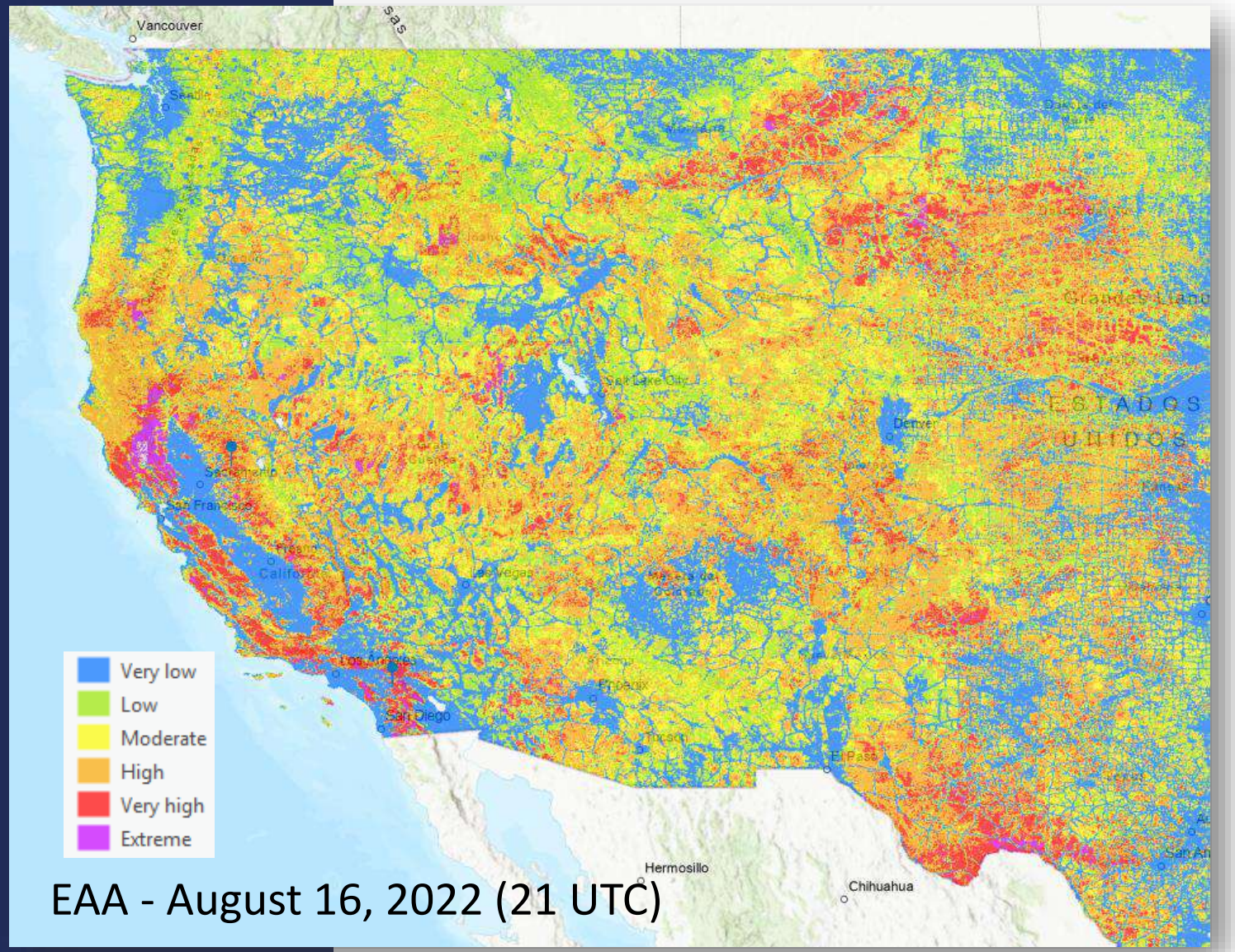
If you wish to view the full WFA report for this incident, please email jramirez@tecnosylva.com

This simulation does not take into consideration any suppression effort.

Units on the field get a One Page report as soon as the incident gets into the CAD through the Tactical Analyst mobile app

EAA: On going Major Incidents

Troy Velin, FBAN at August Complex, Sept 2020



EAA - August 16, 2022 (21 UTC)

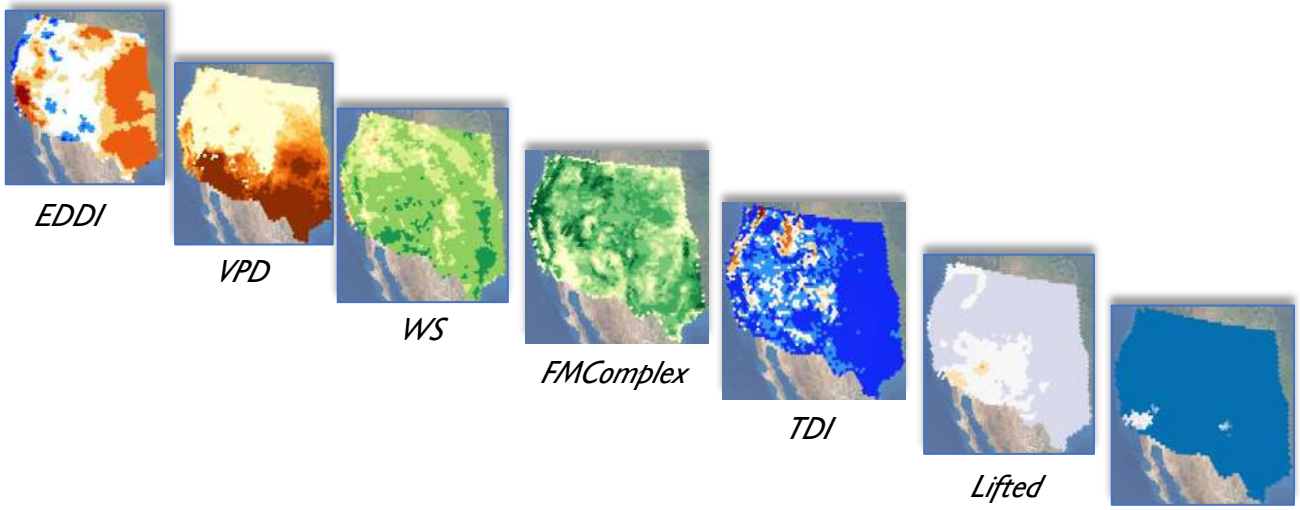
4

Extended Attack Assessment Index supports incidents that escaped Initial Attack, including variables outside of actual quasiempirical models, supported by ML

Extended Attack Assessment Index (EAA)

EAA is based on different parameters such as fuels, drought, meteorology, physiological response of fuels to environmental conditions, as well as instability conditions or the probability of occurrence of convective conditions.

Through machine learning processes and based on VIIRS data for fire activity, we analyzed the contribution of each variable to EAA to improve model's performance.



Wildfire Analyst

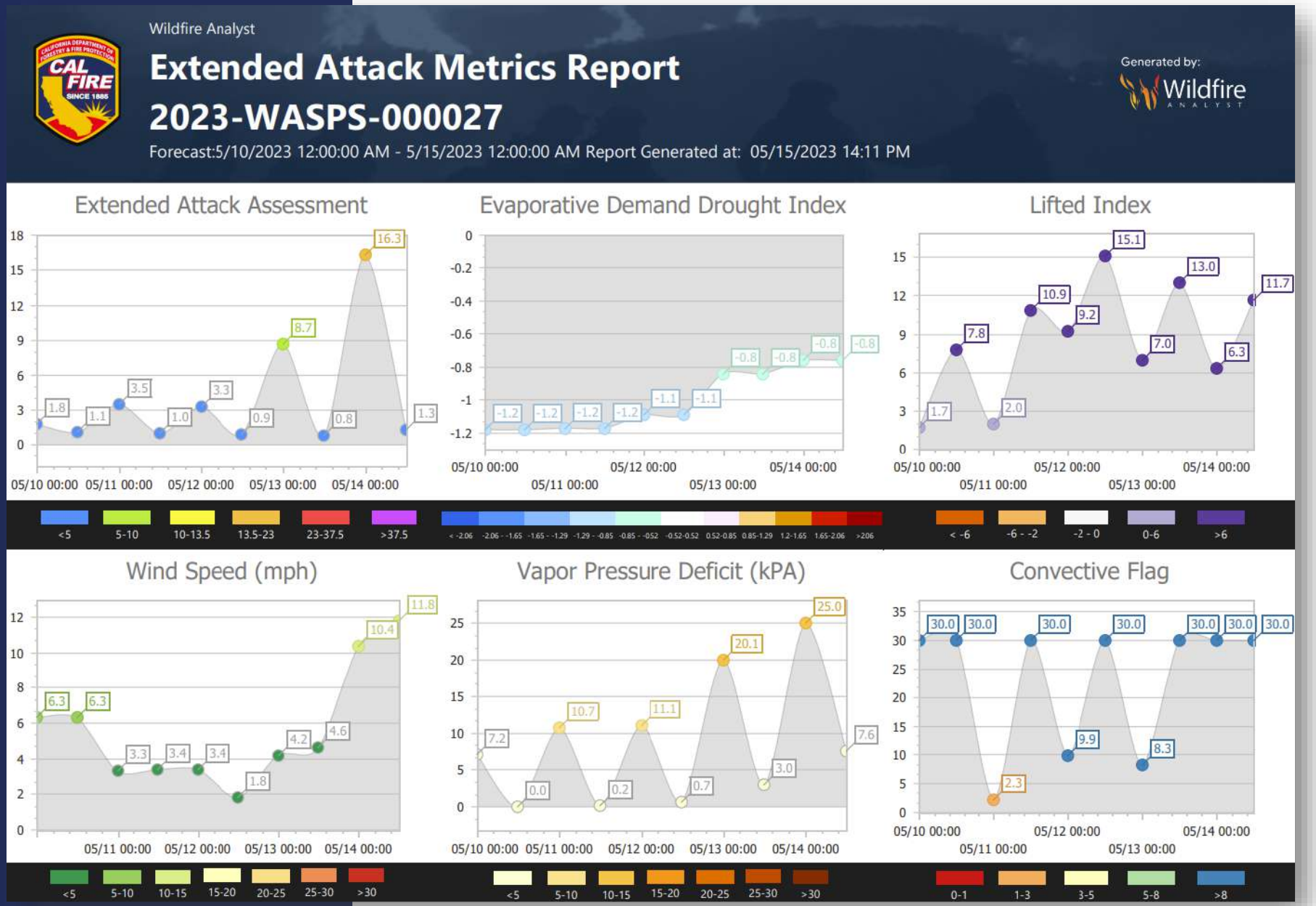
Extended Attack Metrics for Current Incidents

Report Generated at: 05/11/2023 13:59 PM

Generated by: Wildfire Analyst

Incident	Acres	Code	05/11	05/12	05/13	05/14	05/15	05/16	05/17
BIG PINES RX		2023-CAANF-001106	1.2	4.9	10.8	11.3	11.2	12.4	8.9
Butterfly RX		2023-CAPNF-000229	5.6	25.8	27.5	25.1	10.6	22.6	25.6
CANAL	0.01	2023-CARRU-067608	1.7	1.2	1.5	2.4	1.5	1.8	1.4
CASE		2023-CARRU-067559	0.3	0.6	1.2	1.7	1.0	1.0	1.6
CESAR CHAVEZ ST COAC		2023-CARRU-067712	1.0	1.0	0.8	0.9	0.8	0.9	0.9
DESERT		2023-CARRU-067384	1.0	0.6	0.4	0.4	0.4	0.5	0.6
DILLON	0.01	2023-CARRU-068384	0.6	0.4	0.4	0.4	0.4	0.4	0.4
ECC WILLITS	0.01	2023-CAMEU-004906	1.0	2.8	2.4	12.7	14.5	3.3	9.7
EDDIES WORLD YERMO		2023-CABDU-005639	1.1	0.9	0.8	1.0	1.3	1.4	1.1
GAZEBO		2023-CARRU-067315	0.5	1.2	2.2	2.9	1.8	3.1	2.0
GRECO CT SANJ		2023-CARRU-067271	0.3	0.7	1.5	1.7	1.2	2.2	1.4
HWY 128 GEYSERVILLE	0.01	2023-CALNU-008808	1.1	1.7	3.9	8.6	5.1	3.3	7.1
I 15 S/ YERMO RD OFRP		2023-CABDU-004745	1.8	1.4	1.3	1.7	2.2	2.3	1.6
ISLAND	0.1	2023-CATIA-000504	3.5	7.1	16.2	12.8	6.9	12.3	8.8
LAKE		2023-CAMEU-005147	1.3	1.8	4.3	11.9	8.6	11.8	5.3
LASSEN		2023-CAFKU-008936	0.6	0.8	1.2	0.8	1.1	1.0	0.8
MACCELE RD / PINON AV		2023-CABDU-005436	4.3	9.5	11.3	7.8	6.4	9.7	9.6
MEADOW		2023-CAMEU-004788	1.0	2.5	4.2	7.6	7.3	6.6	5.8
Mile Post 10.34	0.1	2023-CAHIA-000323	1.6	2.4	4.1	20.9	22.8	16.0	15.0
MT HAVILA VMP 2023 RX		2023-CATCU-004951	1.5	5.9	9.1	15.8	16.1	16.6	16.1
MURRIETA RD PERR		2023-CARRU-067539	0.4	0.8	1.4	2.2	1.1	1.3	1.4
N POE ST LELS		2023-CARRU-067773	0.7	1.0	2.3	3.2	2.5	2.6	2.7
NBY1		2023-CABDU-005840	0.9	0.7	0.5	0.7	1.4	1.1	0.6
NOB	226.97	2023-CABDF-006515	1.0	4.4	7.6	10.8	11.9	10.4	8.3
OXFORD		2023-CAFKU-008948	0.3	0.3	0.3	0.4	0.5	0.3	0.3
PERRIS BL / SUNNYMEAD BL		2023-CARRU-067426	0.4	0.5	1.4	1.6	1.0	1.8	1.6
POURROY RD MURR		2023-CARRU-068306	0.9	0.7	2.1	3.7	3.1	4.5	2.6
RIVER		2023-CACDD-007057	0.6	0.9	0.9	0.9	1.0	1.2	1.0
RIVERSIDE DR / JOY ST		2023-CARRU-068313	0.8	1.0	2.8	3.9	4.0	4.5	3.8
ROUND	4	2023-CAFKU-009036	3.4	4.0	4.8	5.8	5.7	4.8	4.3
S HIGHWAY 101 HOPLAND		2023-CAMEU-005145	1.5	4.4	7.8	10.1	7.9	6.7	9.9
SEMINOLE DR CABA		2023-CARRU-067634	2.5	7.6	9.0	9.3	7.5	9.2	8.0
SIERRA		2023-CANEU-012195	1.2	1.7	4.7	13.4	15.9	12.3	13.5
SUN GOLD ST / INDIO BL		2023-CARRU-067353	0.4	0.3	0.2	0.3	0.3	0.3	0.3
SUNNYMEAD BL MOVA		2023-CARRU-068391	0.4	0.4	1.5	1.7	1.1	2.3	2.0
UKIAH COUNTRY MANOR UKIAH_VALLEY		2023-CAMEU-005032	1.2	1.7	3.9	11.0	7.4	10.5	4.8
VALLEY CENTER RD NEWBERRY_SPRINGS		2023-CABDU-004872	1.0	0.8	0.5	0.8	1.8	1.3	0.7
WHITE FIR DR MENI		2023-CARRU-068181	0.8	0.9	2.3	3.6	2.9	2.9	2.8
WOOD	0.1	2023-CACND-000478	1.5	2.0	2.6	2.7	3.1	4.0	2.9

At Regional Level, Major Incidents can be evaluated side by side to support preparedness levels and resource allocations



7

Analysts can assess opportunities for individual incidents based on the different metrics in a one stop shop calibrated with historical fire activity

Intel Community bridging the Gap between Science & Operations (CalFire 2021)


Intel Community bridging the Gap
between Science & Operations (CONAF 2015)

8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

GOVERNANCE PRINCIPLES: Towards an International Framework

TECHNICAL INNOVATION

Risk Evaluation Supporting the Framework

Joaquin Ramirez
IAWF & Technosylva