SEMINARIO INTERNACIONAL
PLANIFICACIÓN Y PREVENCIÓN DE INCENDIOS DE PAISAJE Y EL ROL DE LA RESTAURACIÓN POST INCENDIOS
Santiago, Chile, 20 y 21 de junio 2019

Ministerio de Agricultura
Gobierno de Chile
Chile en marcha
Conaf
Initiative 20x20

Enabling Wildfire Risk Forecasting

Requirements, Challenges, Achievements & Lessons Learned

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WORLD RESOURCES INSTITUTE

Supported by:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
based on a decision of the German Bundestag




risk

noun

Possibility of Loss or Harm (damage)

forecast

noun

Prediction of future events

USING RISK METRICS TO SUPPORT KEY DECISIONS

Enhanced Decision Making

Wildfire risk modeling provides critical information to support key decision making during extreme weather conditions. This information can significantly enhance firefighter safety, public safety, reduce risk to assets, and quantify risk for specific areas.

Better information means more informed decision making.

Firefighter & Public Safety

Quickly informing first responders and the public about the current situation & on-going status

Power Shutoff

Identifying asset risk supports decisions to de-energize those assets with high spread & impact potential

EOC Activation

Identifying when significant wildfire risk exists can enhance decisions when to activate your EOC

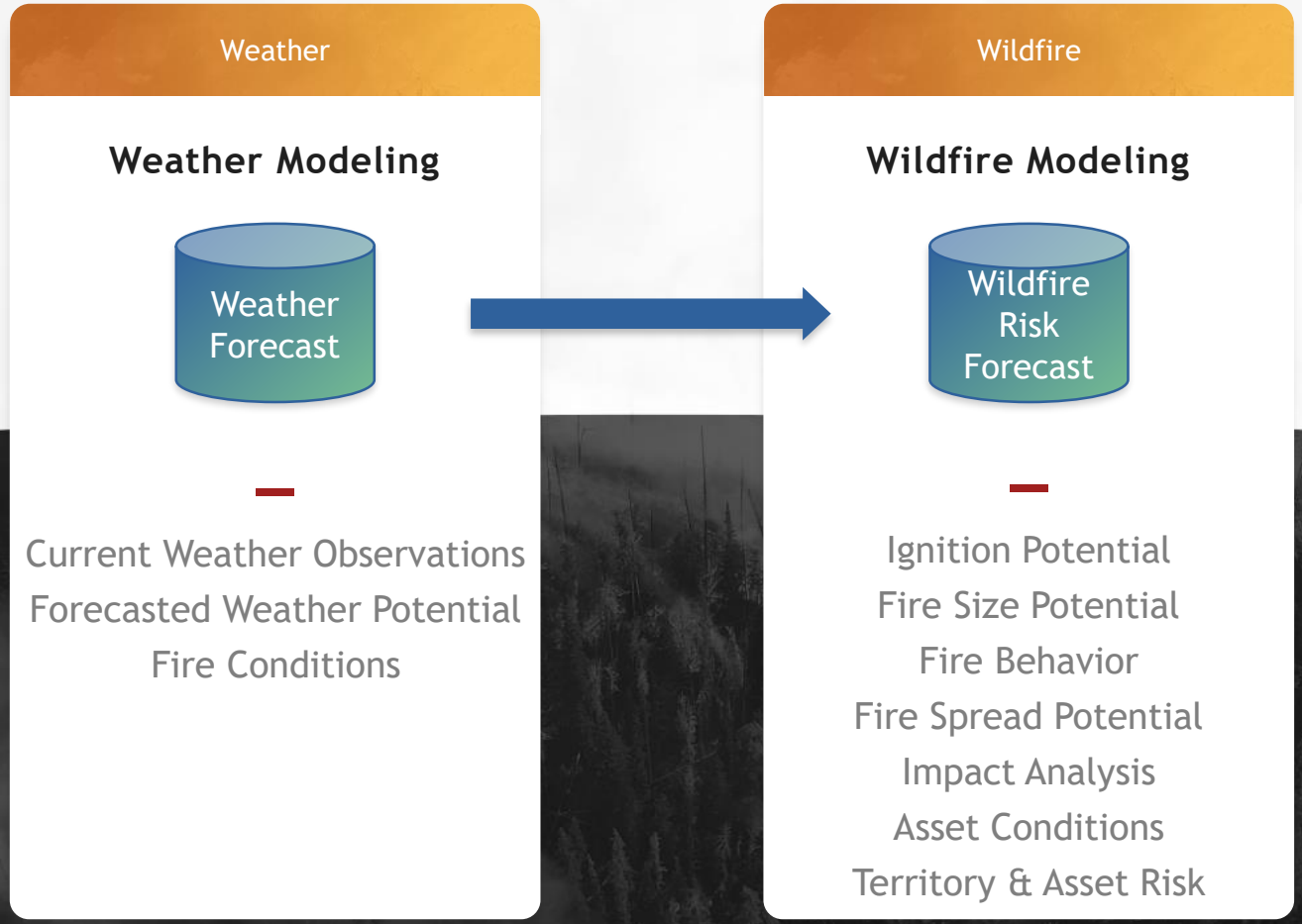
Enhanced Communication

Proactively communicating risk situations with partners, stakeholders, customers and the public

Staging Crews & Equipment

Pre-positioning crews and resources to mitigate risk in areas where the highest risk exists

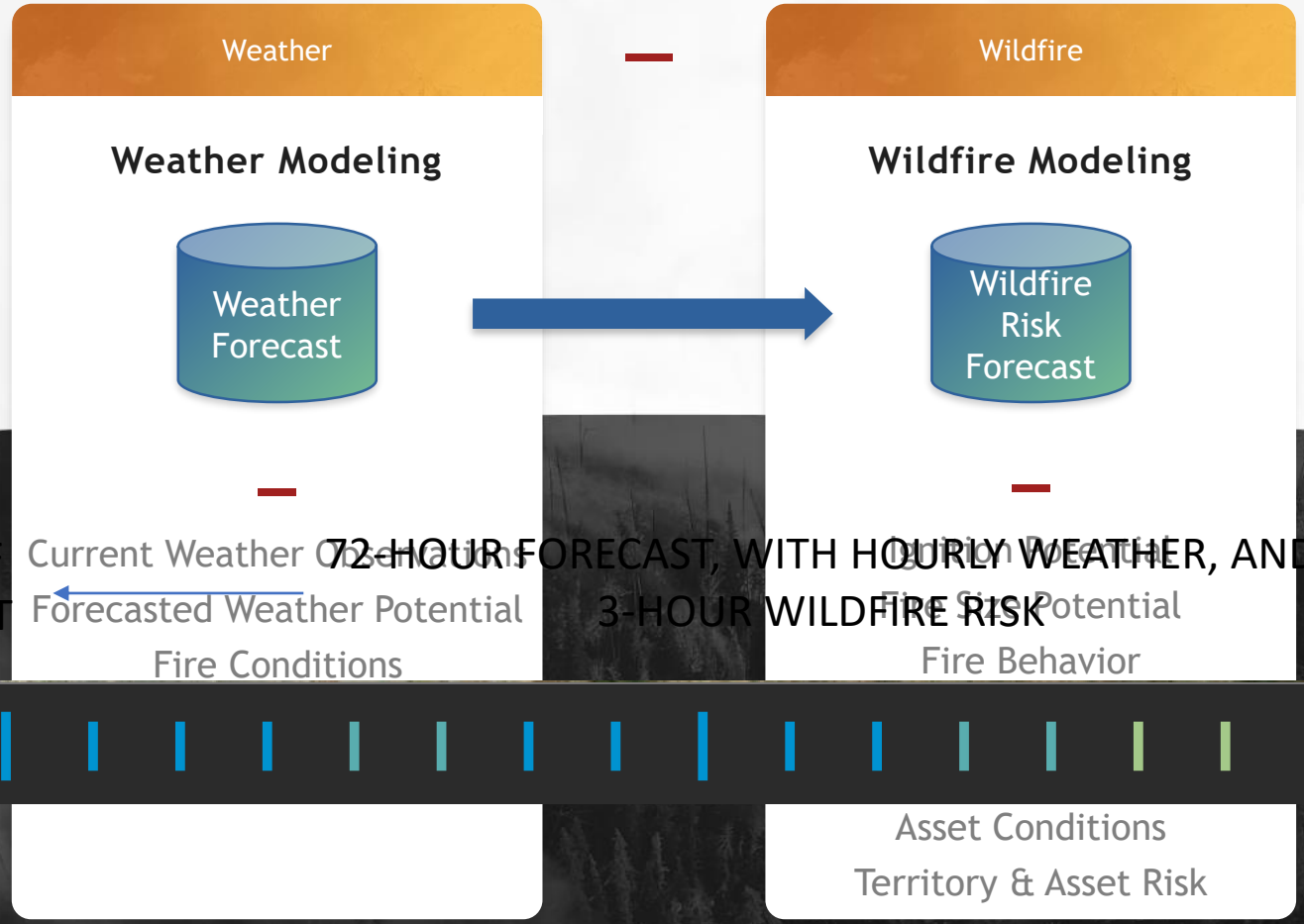
From Weather Modeling to Wildfire Modeling

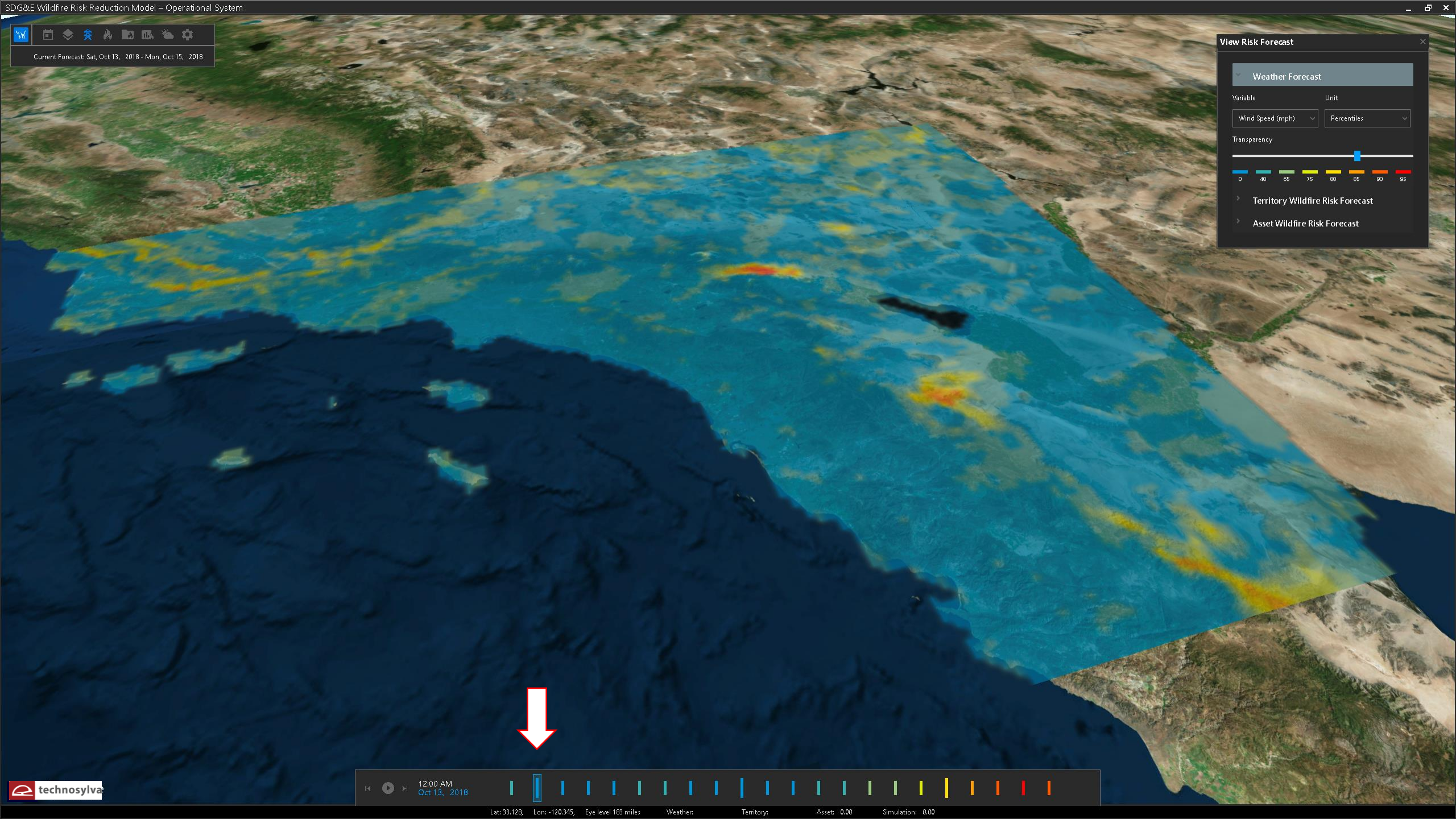


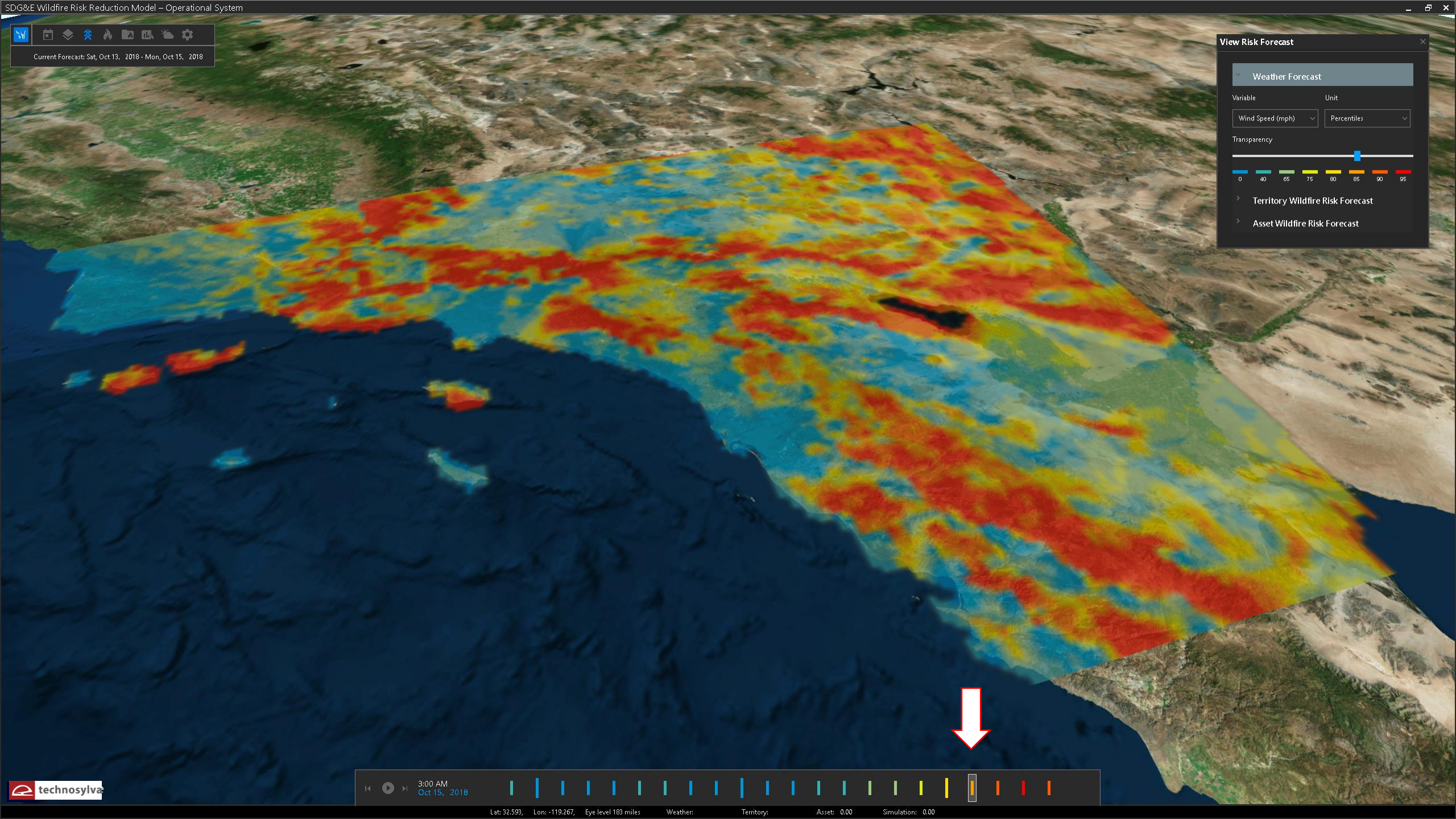
Challenges for a Wildfire Risk Forecast

1. Daily or even hourly weather forecast data
2. Continuous, gridded weather data
3. Good landscape data – fuels & LFM
4. Very large datasets – in & out
5. Run a “gzillion” fire simulations
6. HPC computing resources
7. Manage temporal data
8. Intuitive software interfaces

From Weather Modeling to Wildfire Modeling




SDG&E Wildfire Risk Reduction Model – Operational System
Current Forecast: Sat, Oct 13, 2018 - Mon, Oct 15, 2018
View Risk Forecast
Weather Forecast
Variable
Unit
Wind Speed (mph)
Percentiles
Transparency
0
40
65
75
80
85
90
95
Territory Wildfire Risk Forecast
Asset Wildfire Risk Forecast
12:00 AM
Oct 13, 2018
technosylva
Lat: 33.128,
Lon: -120.345,
Eye level 183 miles
Weather:
Territory:
Asset: 0.00
Simulation: 0.00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Wind Speed (mph)
Percentiles
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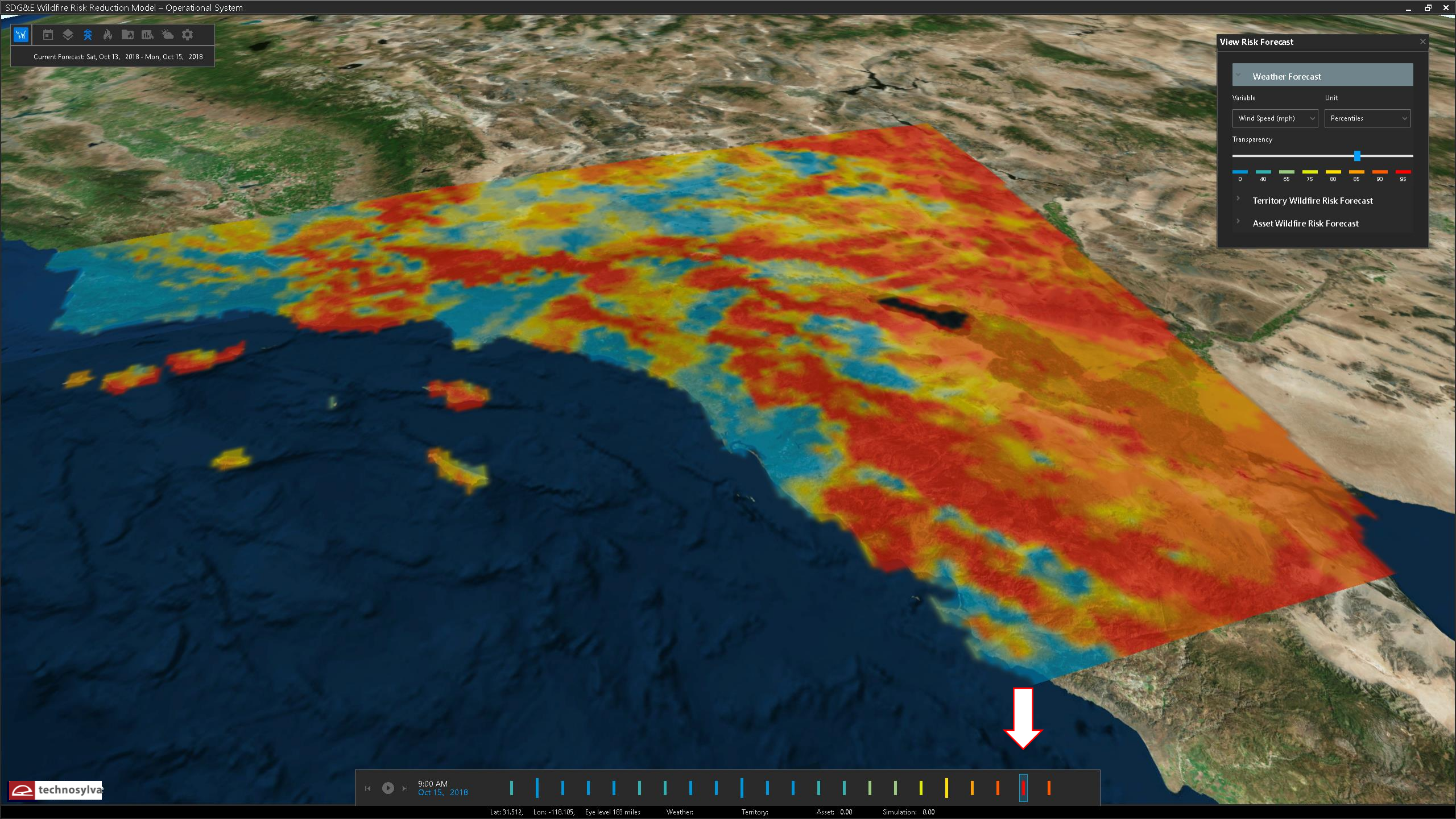
Territory Wildfire Risk Forecast
Asset Wildfire Risk Forecast
3:00 AM
Oct 15, 2018
technosylva
Lat: 32.593, Lon: -119.267, Eye level 183 miles
Weather:
Territory:
Asset: 0.00
Simulation: 0.00


SDG&E Wildfire Risk Reduction Model – Operational System
Current Forecast: Sat, Oct 13, 2018 - Mon, Oct 15, 2018
View Risk Forecast
Weather Forecast
Variable
Unit
Wind Speed (mph)
Percentiles
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95
Territory Wildfire Risk Forecast
Asset Wildfire Risk Forecast
9:00 AM
Oct 15, 2018
technosylva
Lat: 31.512,
Lon: -118.105,
Eye level 183 miles
Weather:
Territory:
Asset: 0.00
Simulation: 0.00

KEY ELEMENTS OF DETERMINING WILDFIRE RISK

Essentials for Wildfire Risk Forecasting

To obtain a wildfire risk forecast we need the following essential elements.

The missing ingredient has been the ability to spread fires from many potential ignition locations.

Not one fire. A gzillion fires.

Likelihood of Ignition

Identifying potential or probability for ignition - where and when will a fire start?

Fire Spread

Where will the fire spread?

Consequence

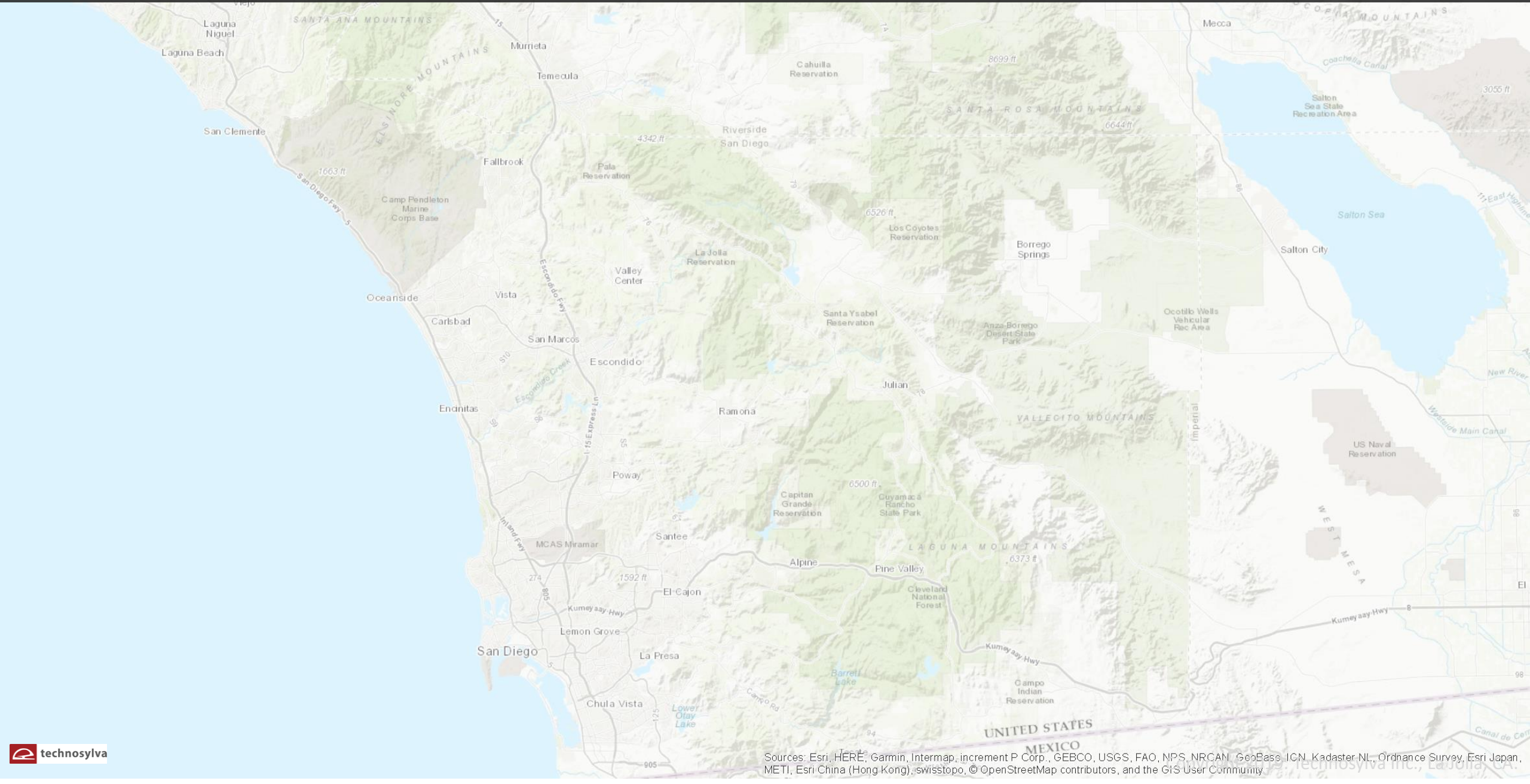
What will the impacts and damage be from the fire spreading?

This video shows a simulation of the first 12 hours of a potential fire in the Soledad Mountain (San Diego) under hypothetical conditions.

It was created with Wildfire Analyst in a simulation that took 3 seconds to run, using actual fire models created in the USFS FireLab.

www.wildfireanalyst.com

Wildfire Risk Forecasting – SD County



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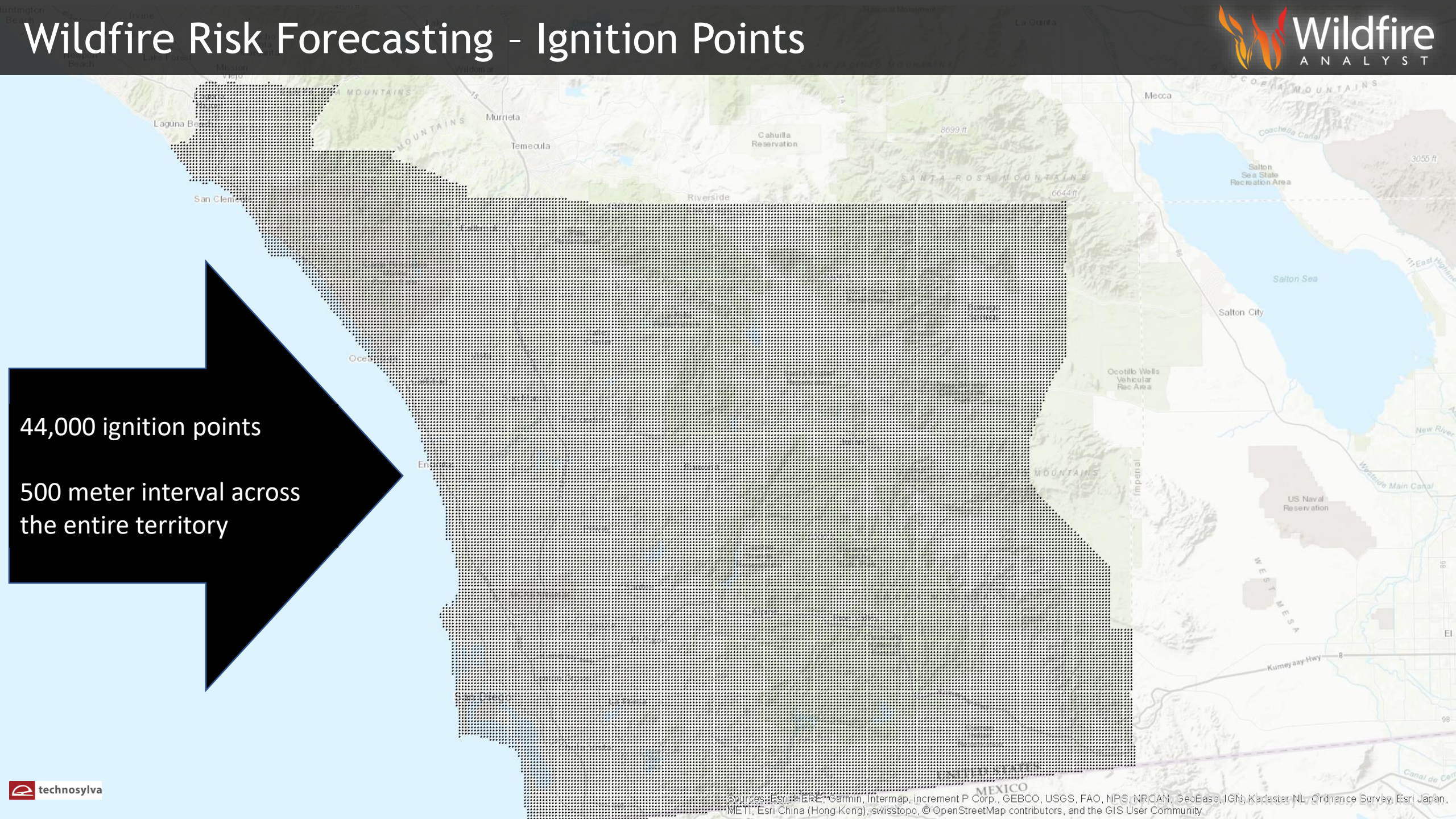
Wildfire Risk Forecasting – Ignition Points



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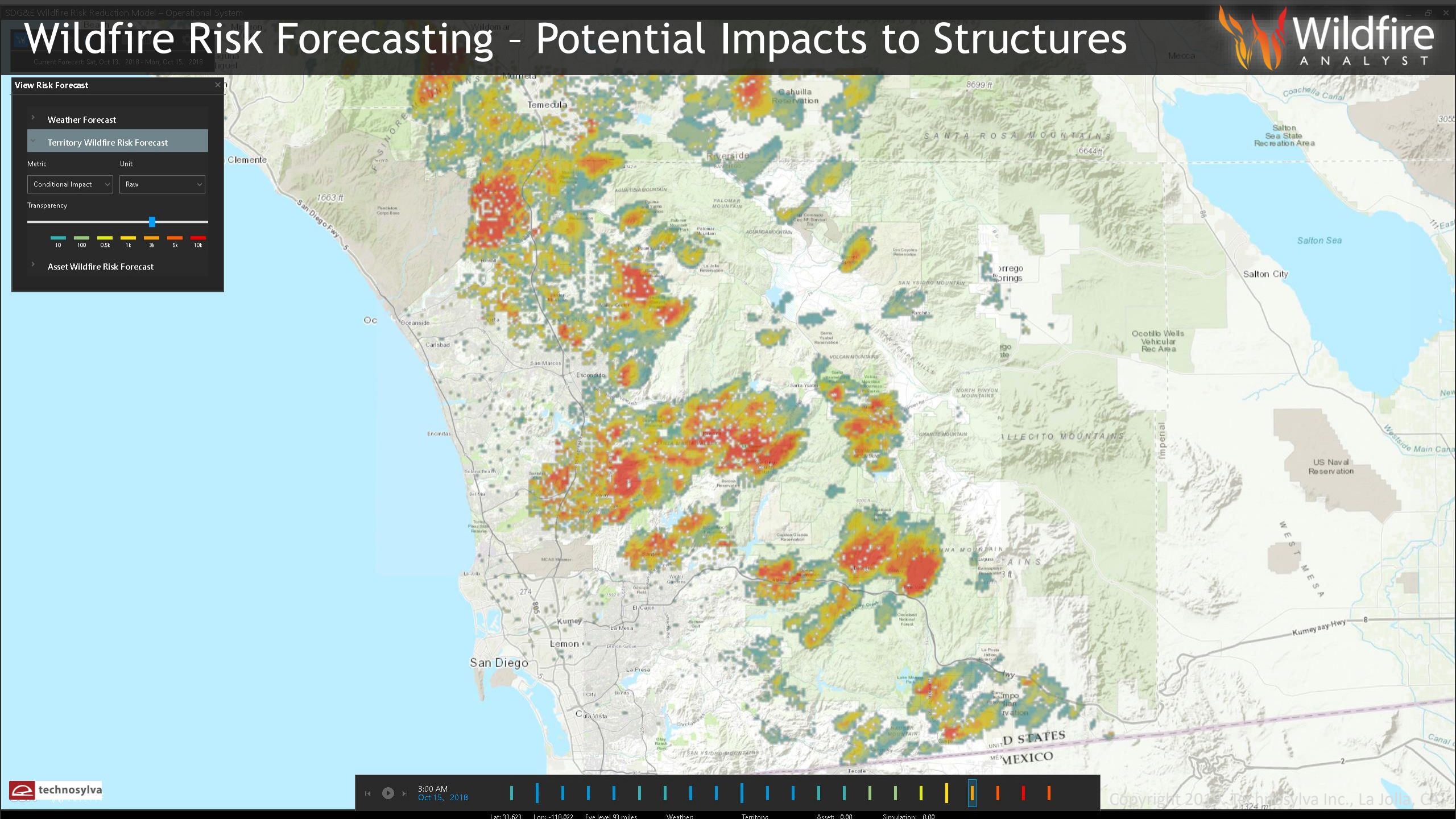
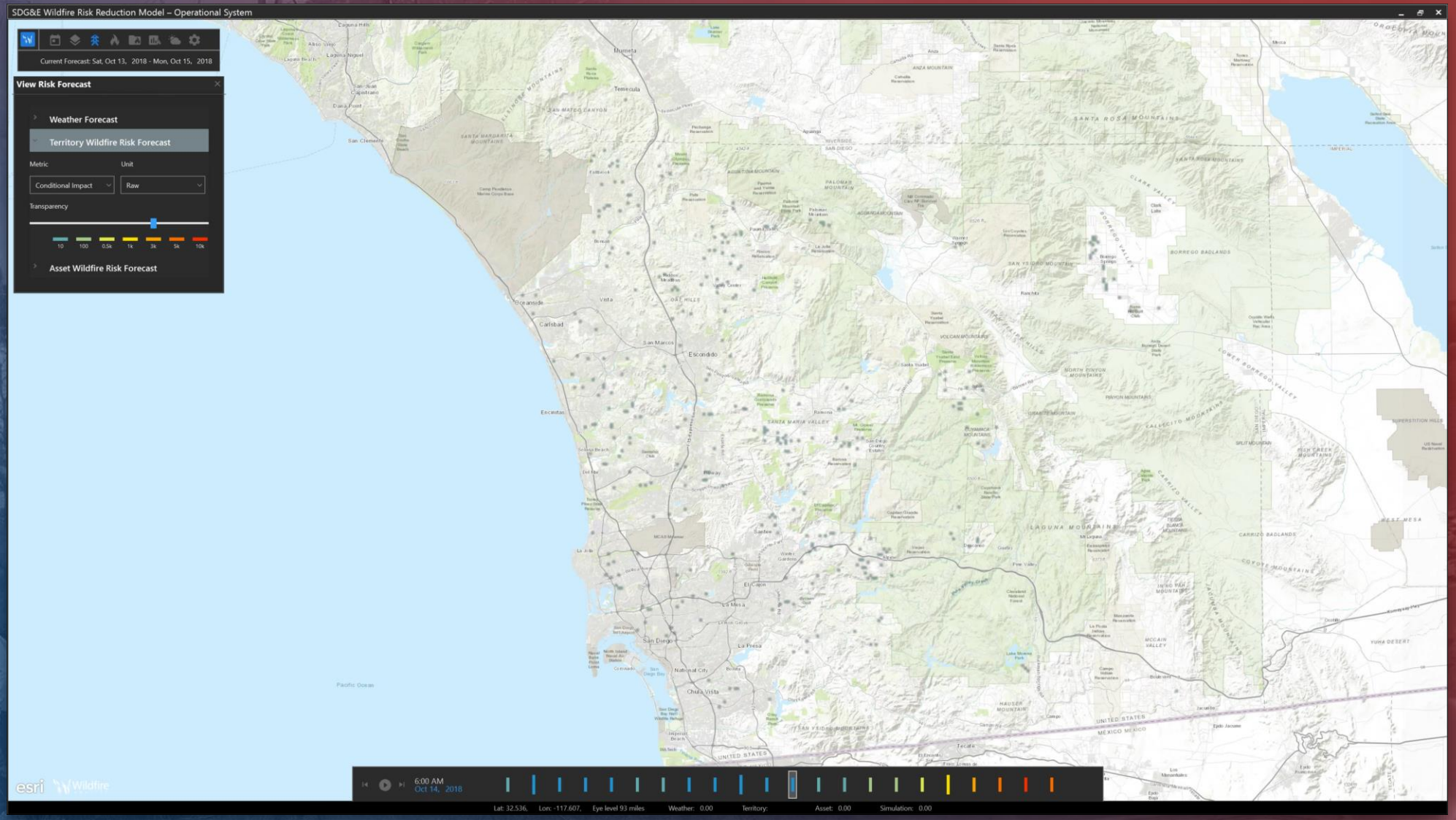
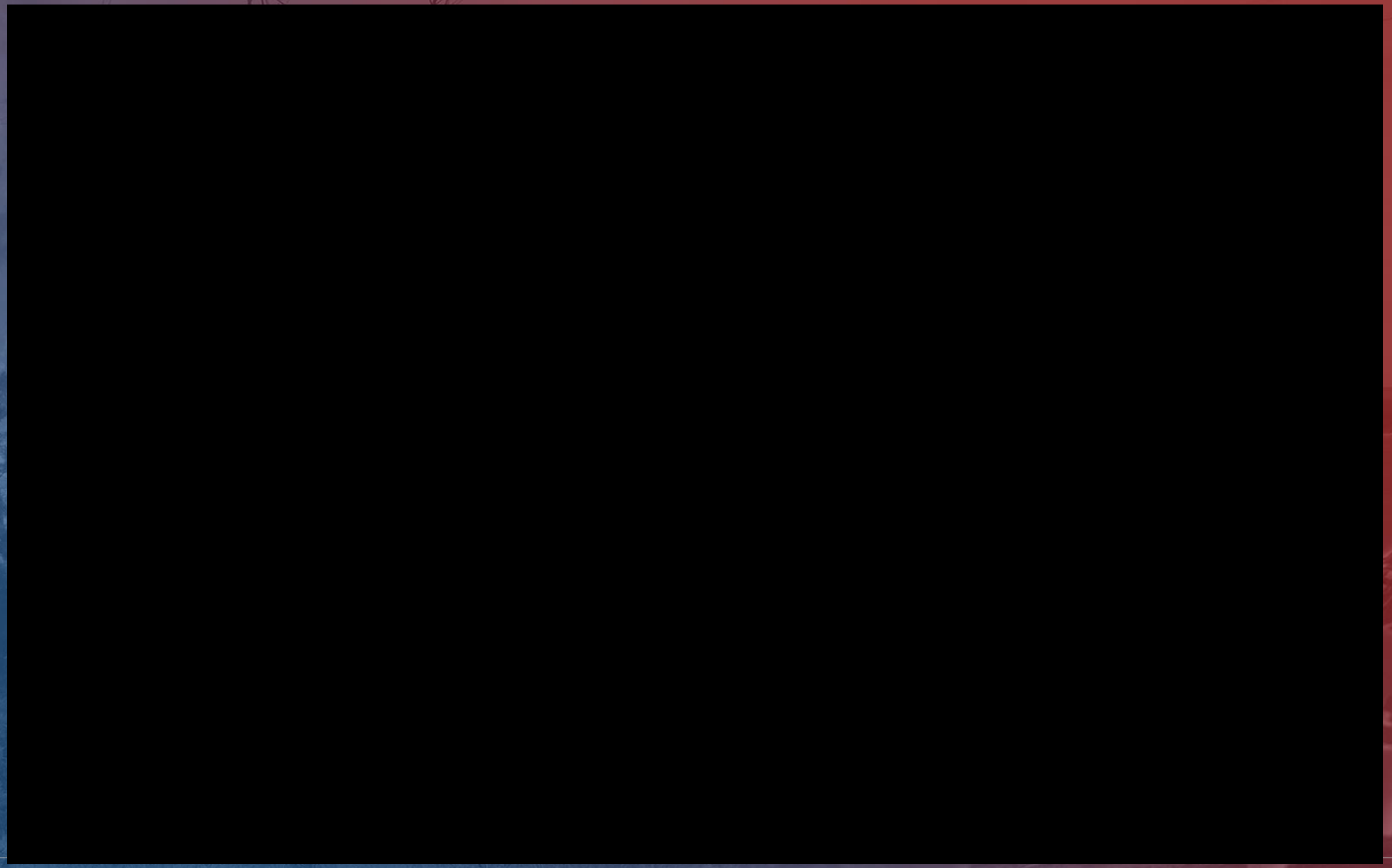
Wildfire Risk Forecasting - Potential Impacts to Structures

Wildfire ANALYST



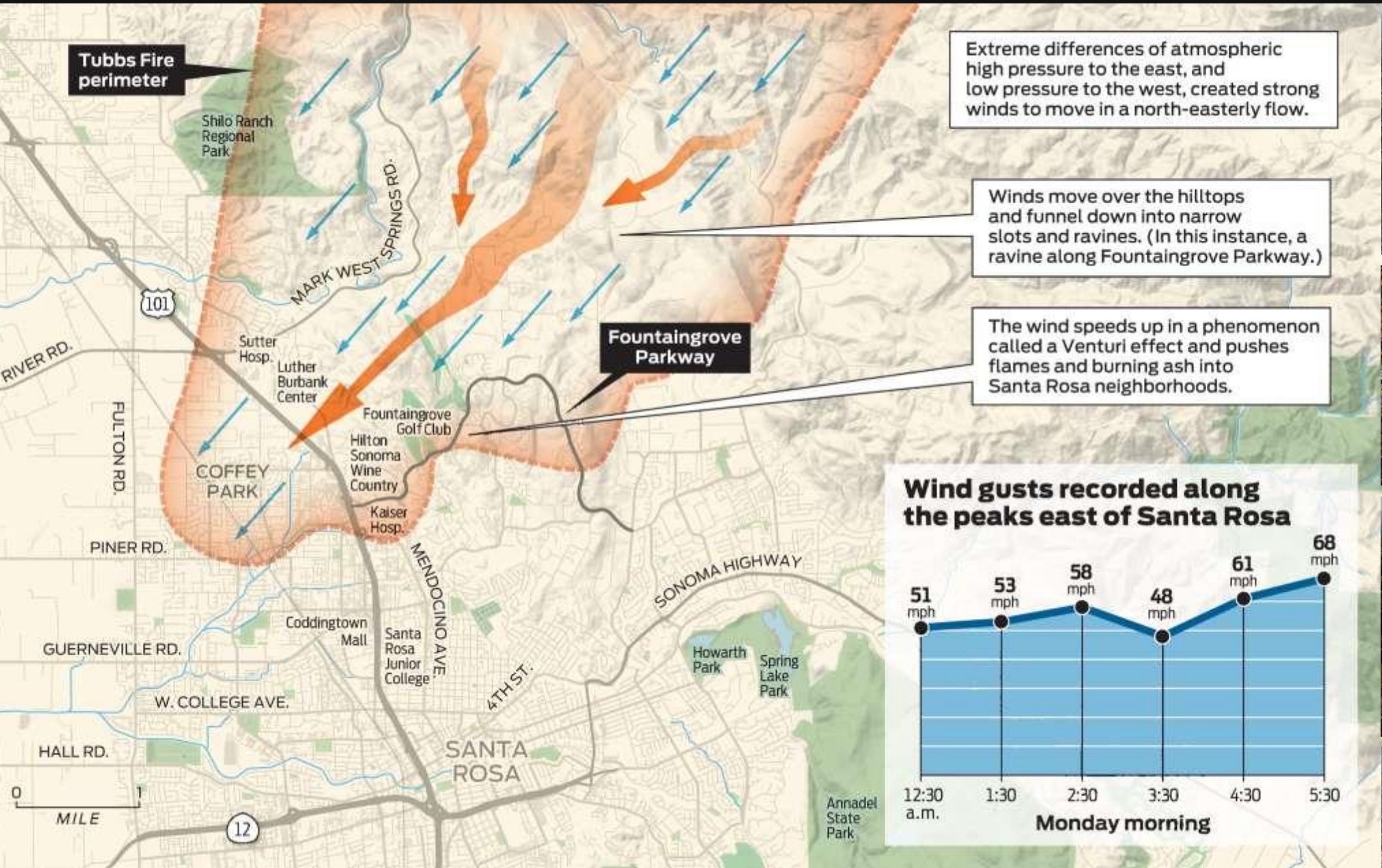
Potential Impact to Structures

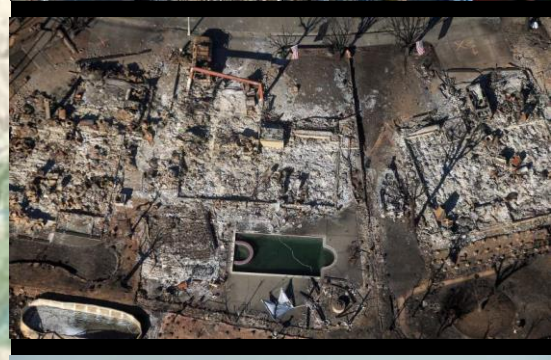




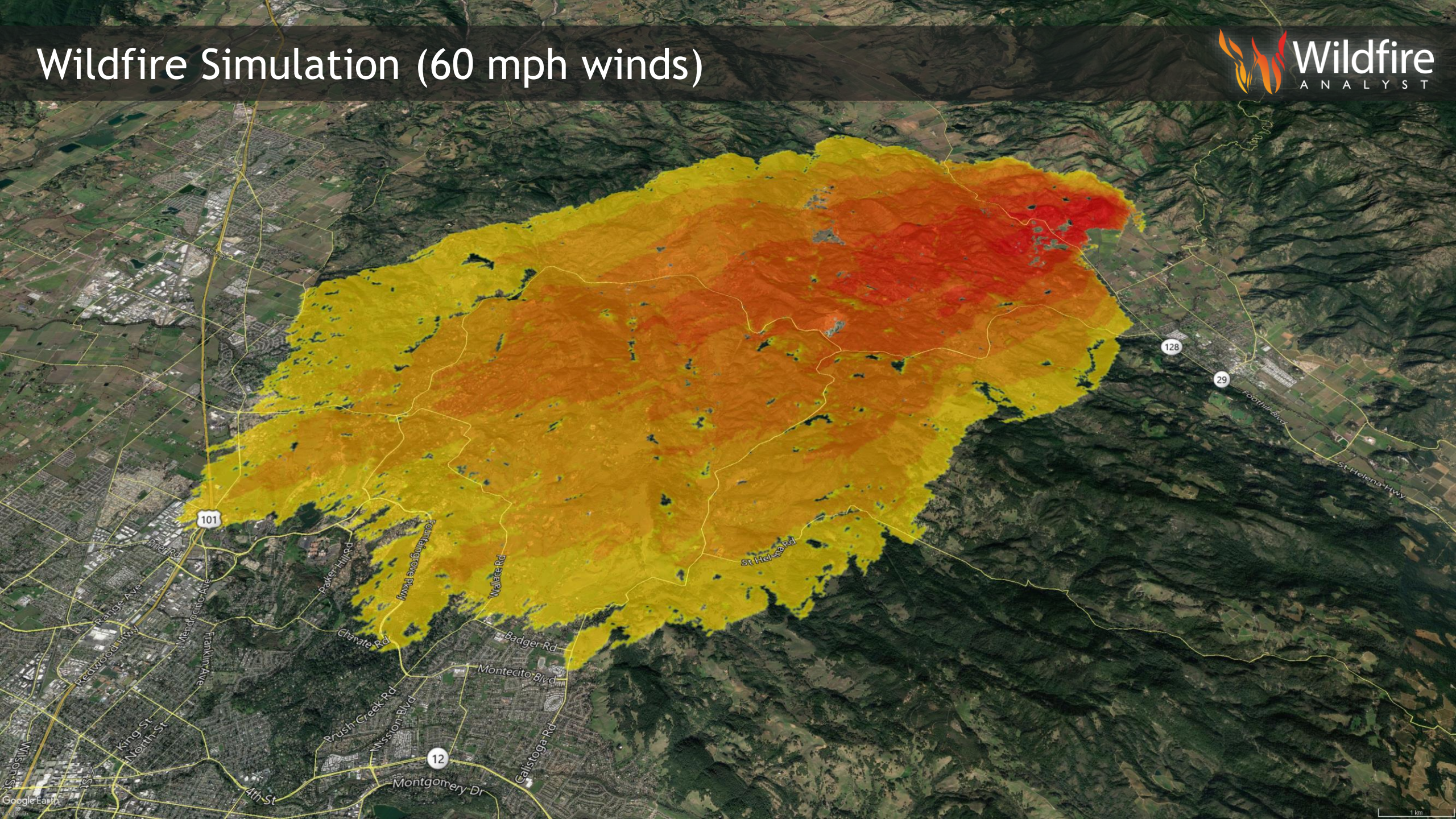
Tubbs Fire (Santa Rosa, Oct 2017)_

Wildfire ANALYST

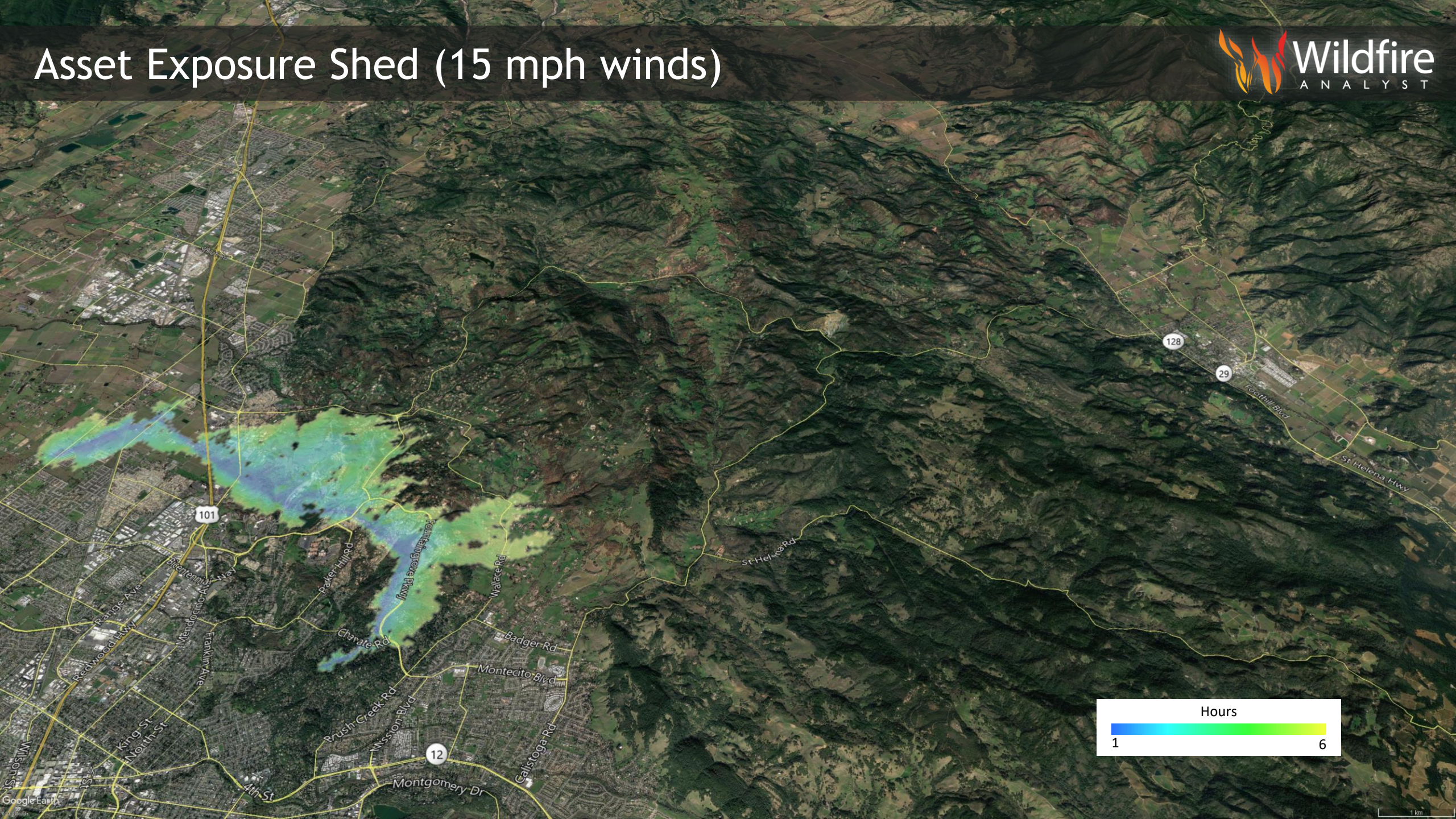




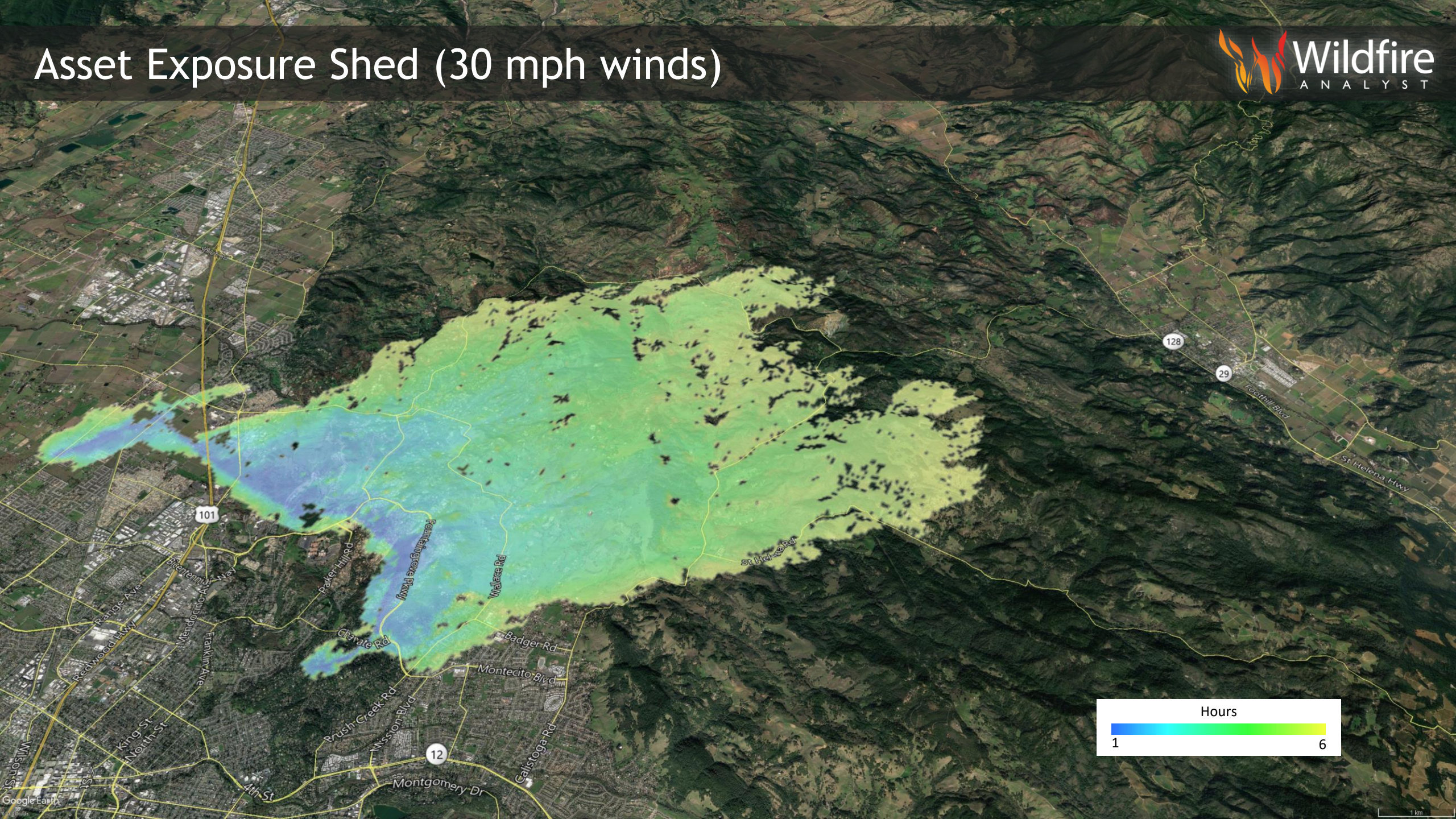
Wildfire Simulation (60 mph winds)



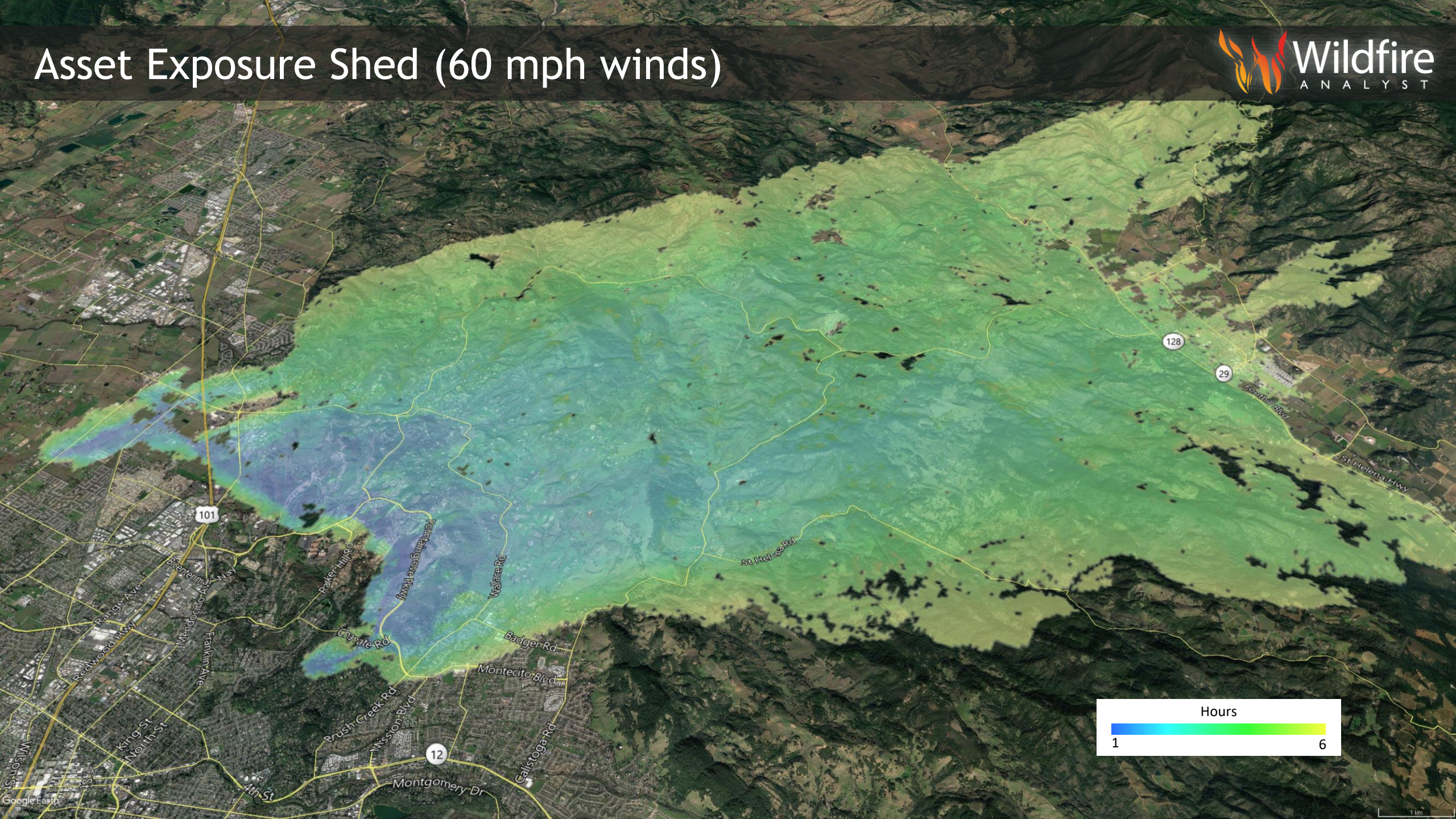
Asset Exposure Shed (15 mph winds)

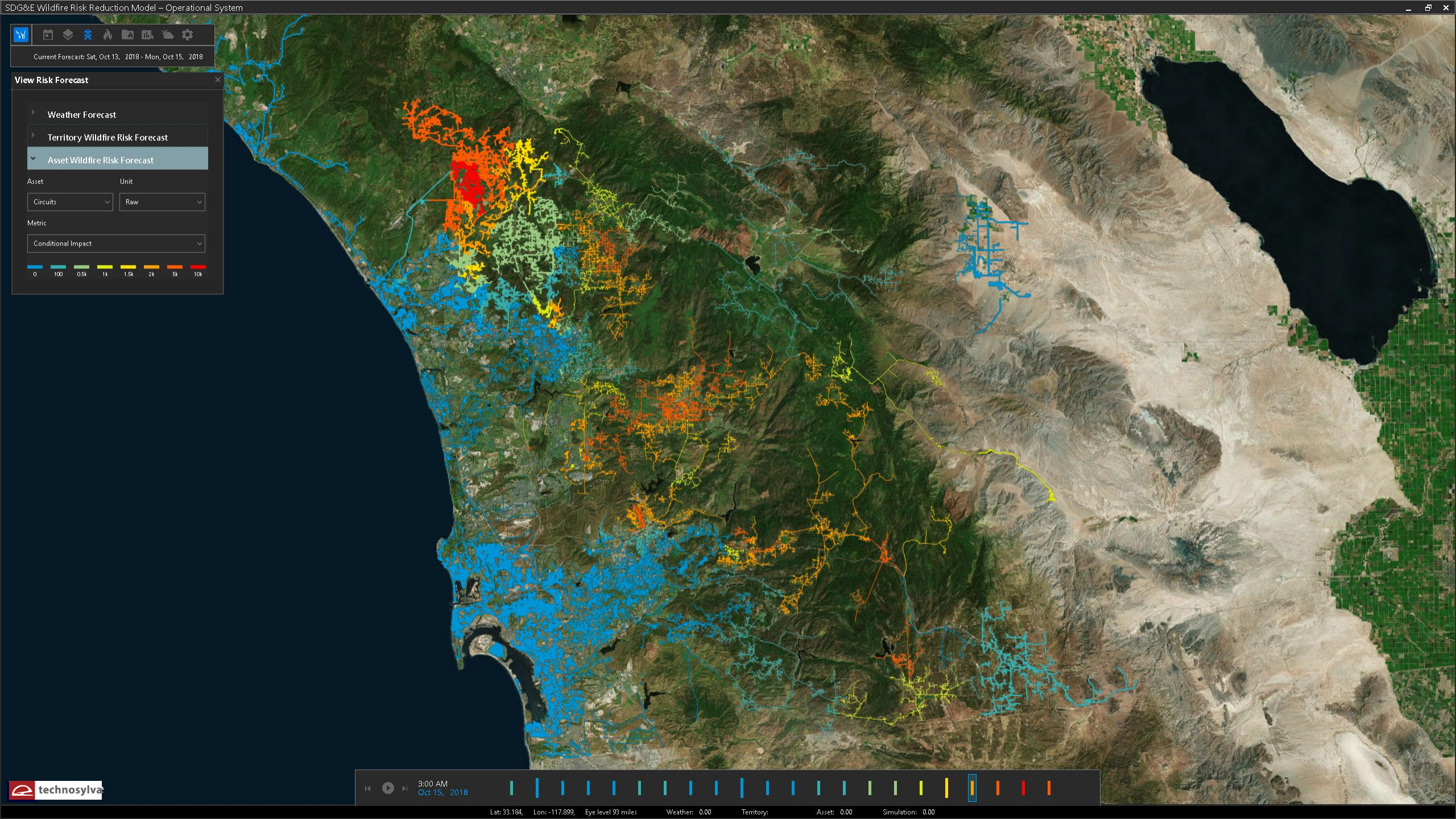


Asset Exposure Shed (30 mph winds)

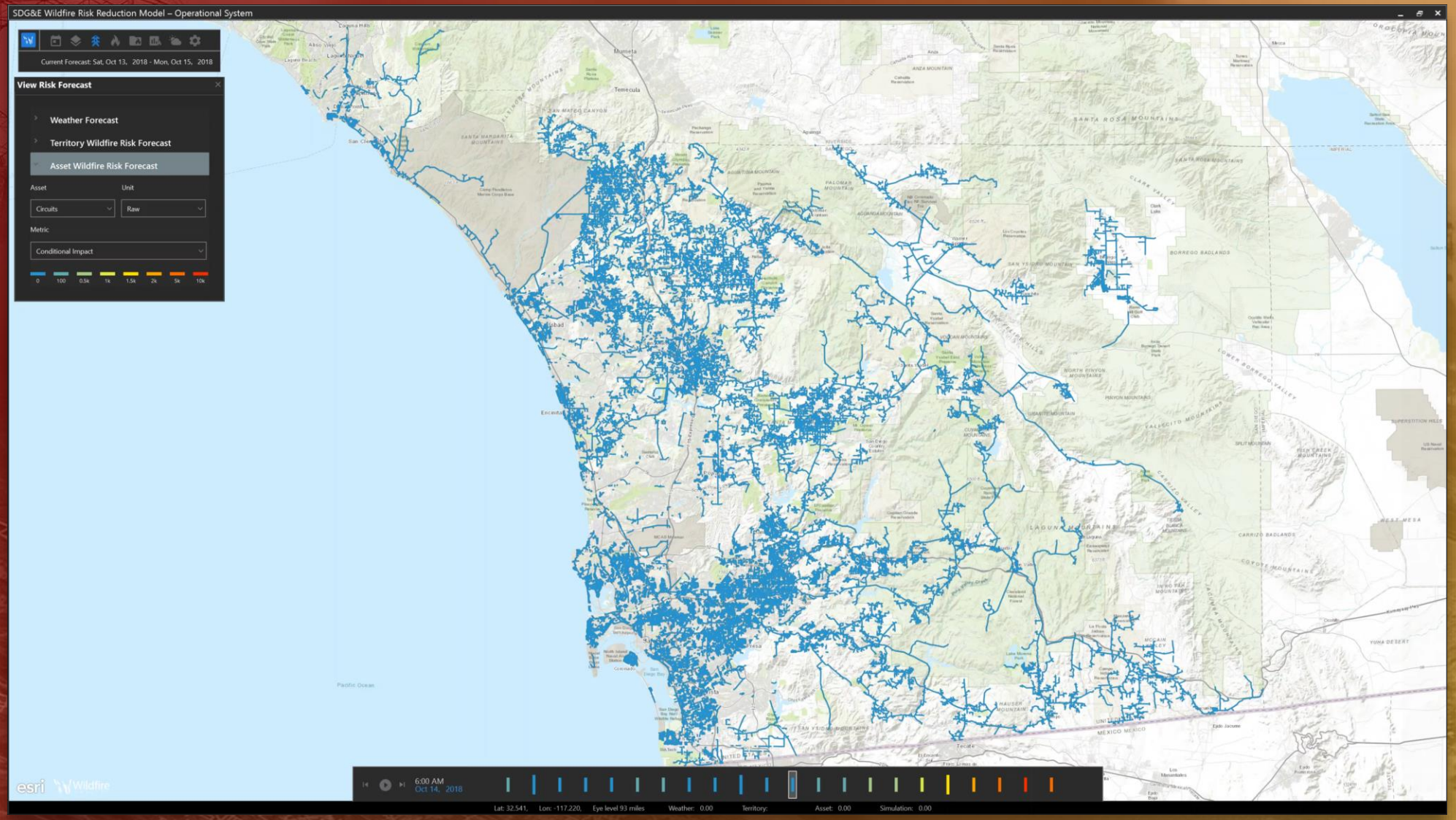


Asset Exposure Shed (60 mph winds)



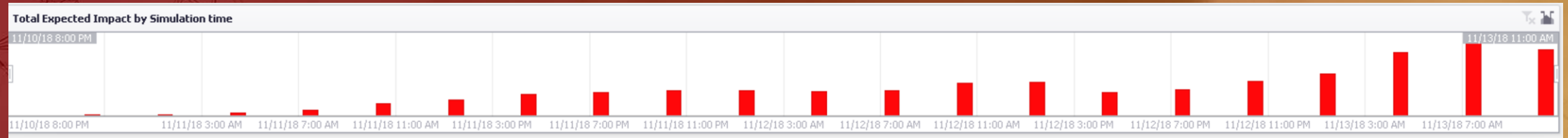

SDG&E Wildfire Risk Reduction Model – Operational System
Current Forecast: Sat, Oct 13, 2018 - Mon, Oct 15, 2018
View Risk Forecast
Weather Forecast
Territory Wildfire Risk Forecast
Asset Wildfire Risk Forecast
Asset
Circuits
Unit
Raw
Metric
Conditional Impact
0
100
0.5k
1k
1.5k
2k
5k
10k
3:00 AM
Oct 15, 2018
technosylva
Lat: 33.184,
Lon: -117.899,
Eye level 93 miles
Weather: 0.00
Territory:
Asset: 0.00
Simulation: 0.00

Circuit Wildfire Risk



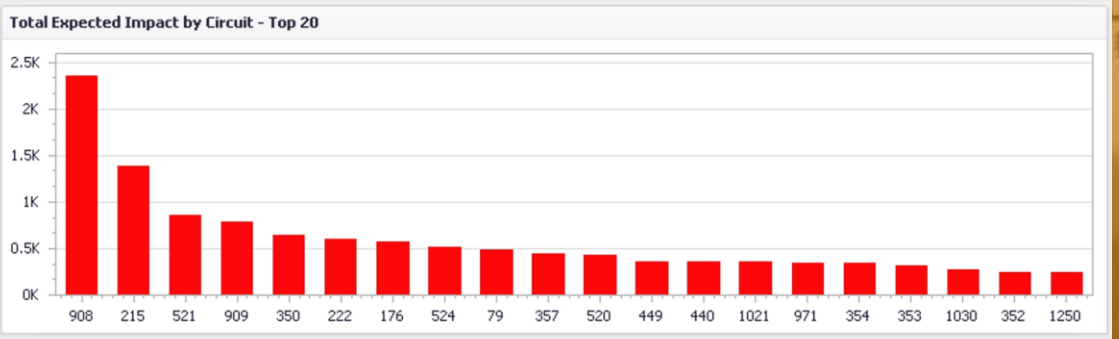
Circuit Risk Summary

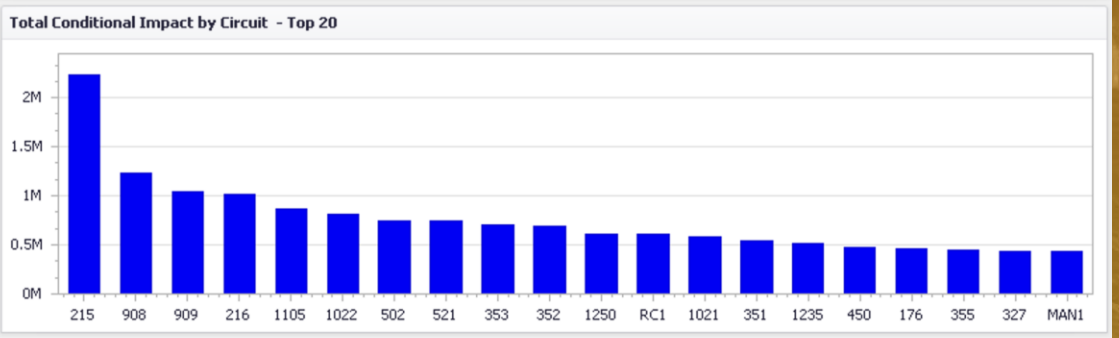
Wildfire ANALYST

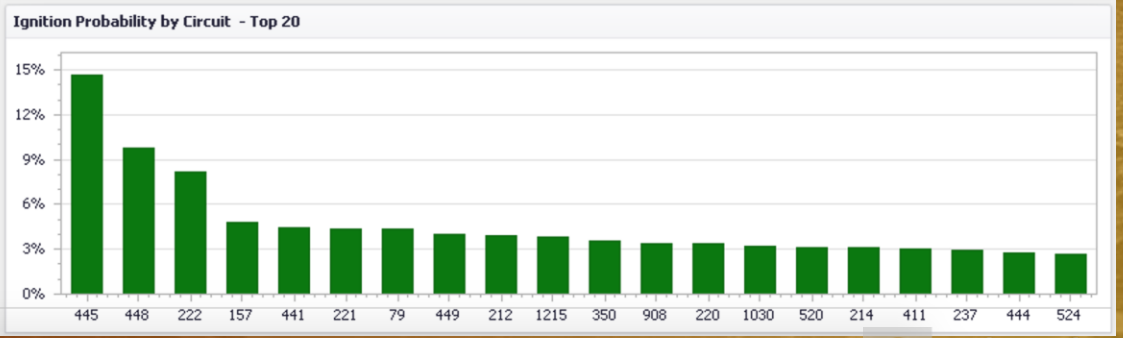


Impact by Circuit

Circuit	Date & Time	Conditional Impact (Total)	Ignition Potential	Expected Impact (Total)
908	11/11/18 2:00 AM	1,063	0.08%	0.813
908	11/10/18 8:00 PM	1,203	0.07%	0.845
908	11/10/18 11:00 PM	1,465	0.09%	1.3
908	11/11/18 5:00 AM	4,727	0.07%	3.33
908	11/11/18 8:00 AM	15,558	0.07%	10.5
908	11/11/18 11:00 AM	23,539	0.10%	23.8
908	11/11/18 2:00 PM	51,477	0.07%	37.5
908	11/12/18 8:00 AM	60,491	0.11%	67.3
908	11/11/18 5:00 PM	76,457	0.10%	78.1
908	11/12/18 11:00 AM	73,401	0.11%	78.7
908	11/11/18 8:00 PM	80,224	0.11%	91.5
908	11/12/18 5:00 AM	60,863	0.15%	92.6
908	11/12/18 2:00 AM	55,791	0.20%	113
908	11/12/18 11:00 PM	75,442	0.15%	113
908	11/11/18 11:00 PM	62,057	0.18%	113
908	11/12/18 8:00 PM	71,826	0.16%	117
908	11/12/18 5:00 PM	62,386	0.19%	118
908	11/12/18 2:00 PM	77,262	0.16%	124
908	11/13/18 2:00 AM	73,338	0.18%	129
908	11/13/18 11:00 AM	102,553	0.28%	292
908	11/13/18 5:00 AM	98,393	0.35%	341
908	11/13/18 8:00 AM	106,497	0.39%	412
215	11/11/18 2:00 AM	536	0.02%	0.115
215	11/10/18 8:00 PM	789	0.02%	0.166
215	11/10/18 11:00 PM	721	0.02%	0.175
215	11/11/18 5:00 AM	2,624	0.02%	0.556
215	11/11/18 8:00 AM	22,924	0.02%	4.98
215	11/11/18 11:00 AM	39,979	0.03%	11.4
215	11/11/18 2:00 PM	77,092	0.02%	17.7
215	11/12/18 8:00 AM	71,178	0.04%	28.3
215	11/11/18 5:00 PM	114,878	0.03%	36.1
215	11/12/18 11:00 AM	134,712	0.03%	37.6
215	11/12/18 5:00 AM	87,599	0.05%	43.8
215	11/11/18 8:00 PM	140,995	0.03%	47.5
215	11/11/18 11:00 PM	111,530	0.05%	58.9
215	11/12/18 5:00 PM	127,947	0.05%	62.4
215	11/12/18 2:00 AM	96,562	0.06%	62.4







Circuit Risk Profile

Wildfire ANALYST

Impact by Circuit

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REAL-TIME SIMULATIONS OF FIRE SPREAD AND IMPACTS

On-Demand Wildfire Simulation Analysis

- Real-time modeling is also available to support individual fire analysis. The spread of a fire is simulated in seconds, showing the extent of a fire, and potential assets at risk.
- Responders can quickly determine where a fire is likely to spread, and the possibility of containment given the characteristics of the fire, such as rate of spread, flame length, and fireline intensity.
- Impact analysis is conducted automatically with each simulation to aid decision makers in understanding the possible consequences of a specific fire.
- Multiple simulations can be conducted with results being provided in a 3-D map environment within seconds. This facilitates actionable intelligence to decision makers.

Wildfire Spread Simulations

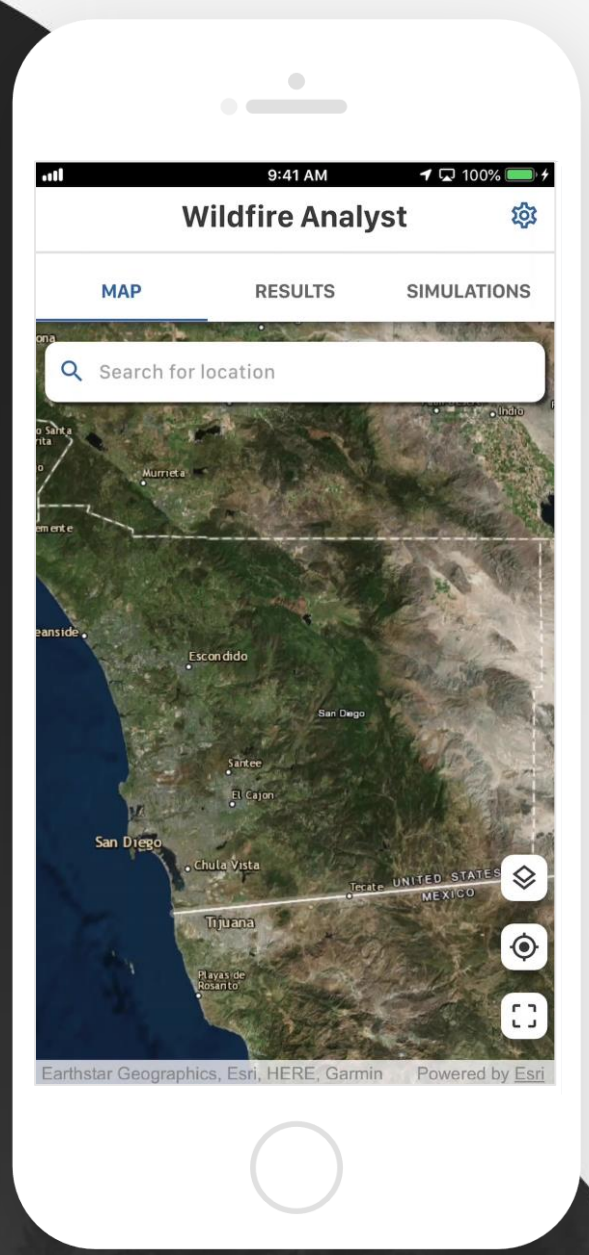
Calculation of the time of arrival for user defined ignitions based current fuels and weather parameters.

Likelihood of Containment Analysis

Based on the fire behavior characteristics the possibility of containment is automatically calculated.

Wildfire Impact Analysis

Impacts to structures, population and critical facilities is automatically calculated for each simulation.

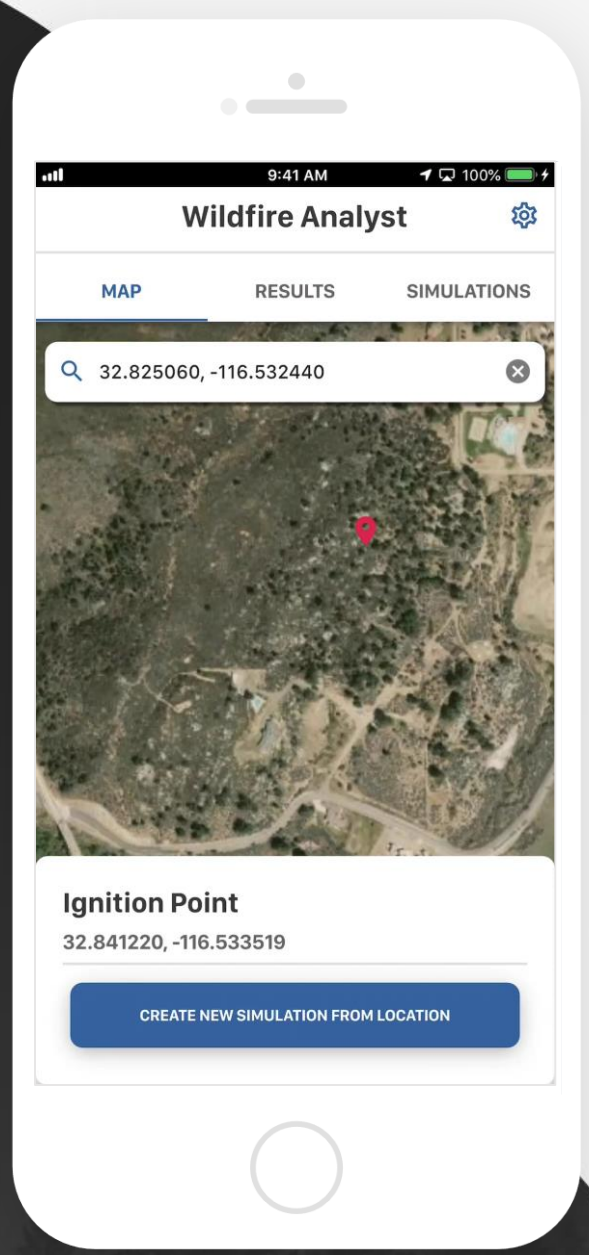


ON-DEMAND FIRE BEHAVIOR ANALYSIS

1. Defining an Ignition Point

It is simple to define an ignition point by using any combination of:

- Address search
- Place name search
- Lat/Long coordinates
- Circuit ID search
- Using map



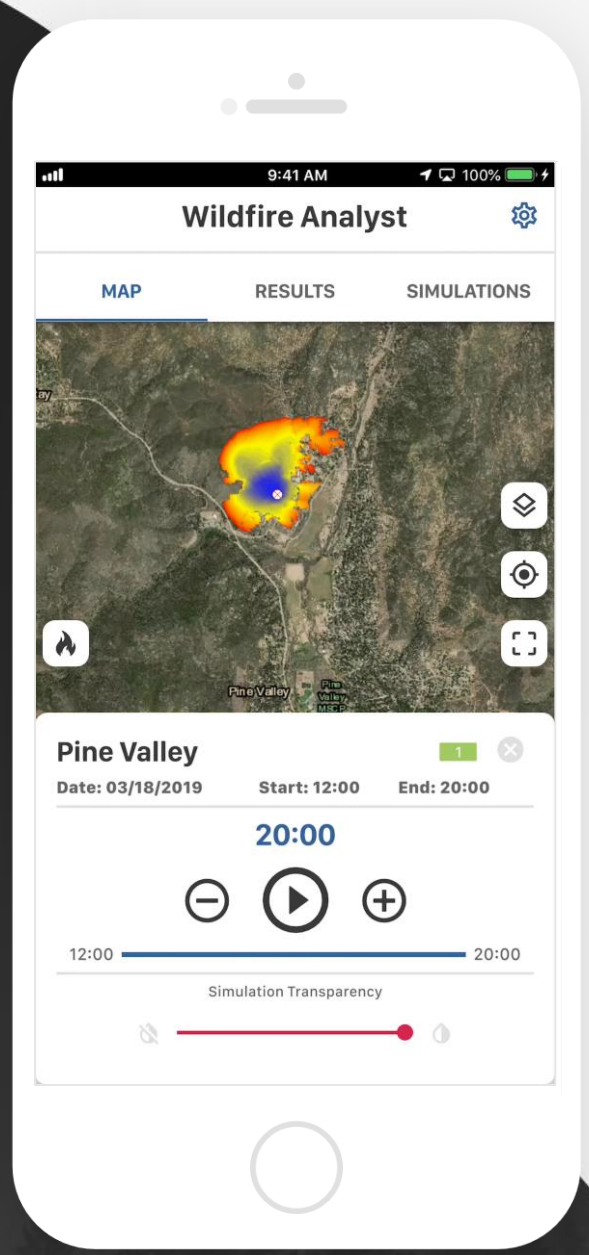
ON-DEMAND FIRE BEHAVIOR ANALYSIS

2. Creating a Simulation

Once the ignition location is defined the Lat/Long is automatically displayed and you can adjust the point by editing the Lat/Long, or by simply holding your finger on the map.

The app is ready to create a simulation using pre-defined preferences right away.

This minimizes the inputs required allowing the user to quickly submit a simulation request.



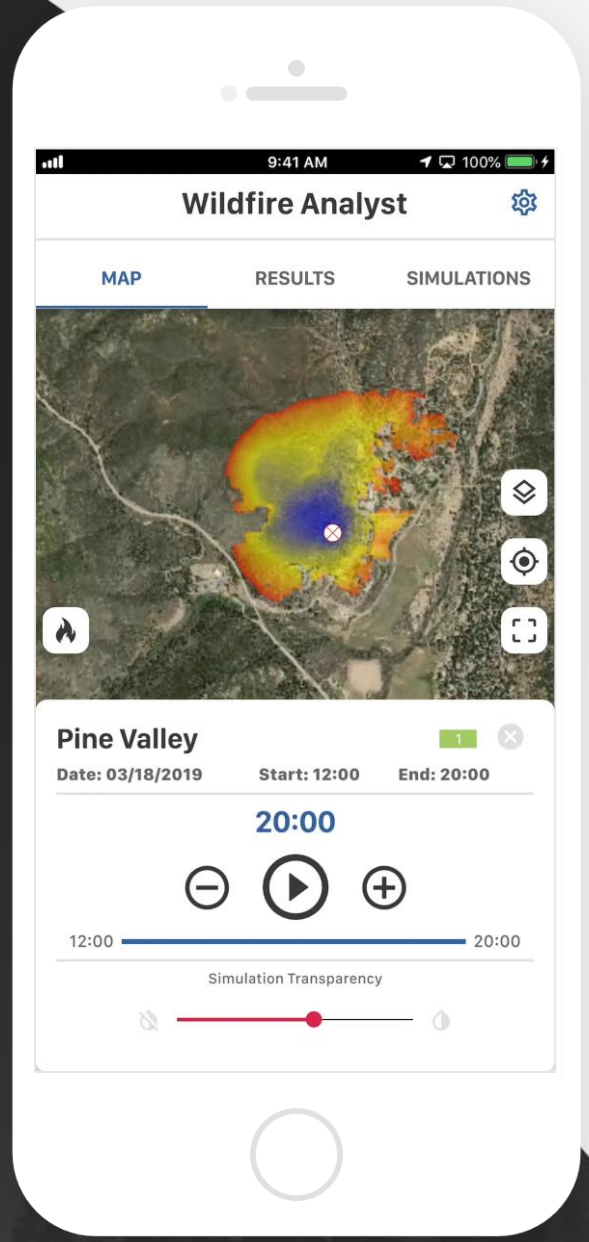
ON-DEMAND FIRE BEHAVIOR ANALYSIS

3. Viewing the Simulation

Once the simulation is completed it is automatically downloaded to the phone, and the map zooms to the simulation extent.

Tools are provided to:

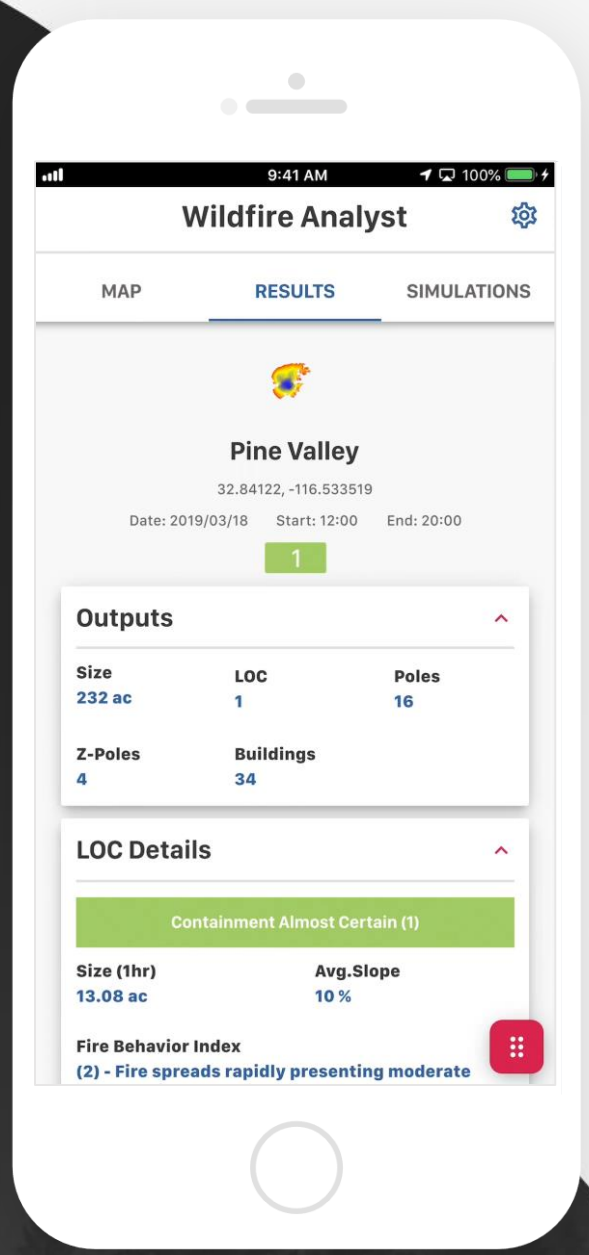
- Animate the simulation
- Manually increment the simulation time steps
- Zoom in/out on the map
- View other Fire Behavior outputs



ON-DEMAND FIRE BEHAVIOR ANALYSIS

4. Viewing Impacts & Results

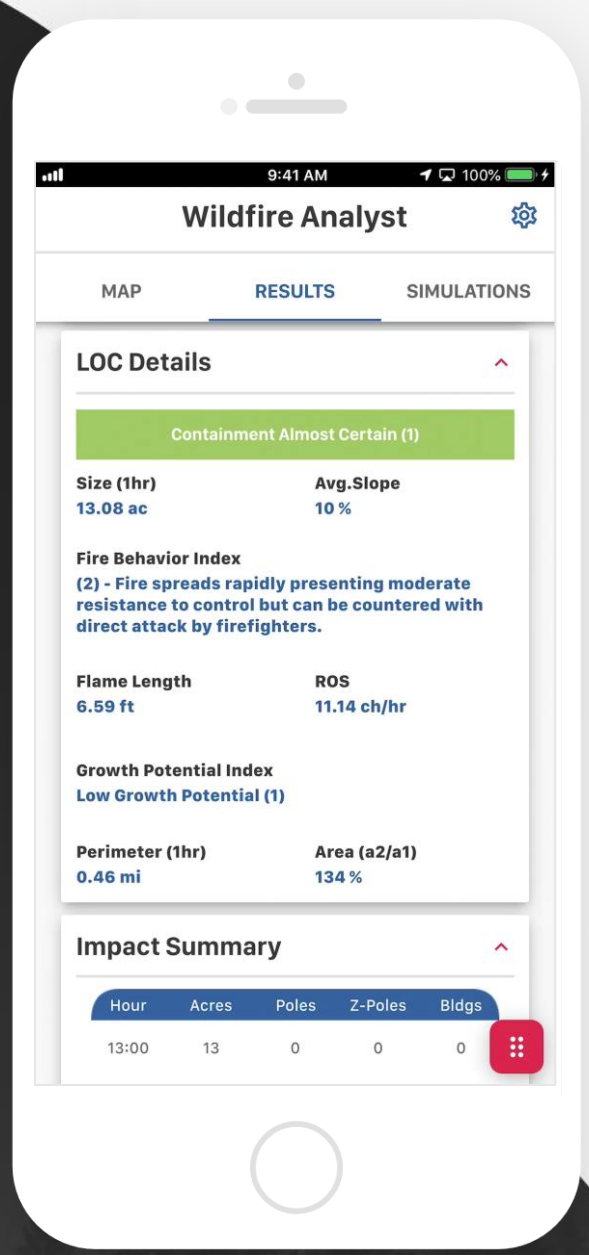
The impact analysis results and other information about the simulation are readily available on the Results tab. This information is derived automatically with each simulation.



ON-DEMAND FIRE BEHAVIOR ANALYSIS

5. Likelihood of Containment

LOC uses the fire behavior characteristics of the fire to provide an initial assessment of potential for containment. This immediately provides some intelligence to the Fire Professional about concerns for this fire.



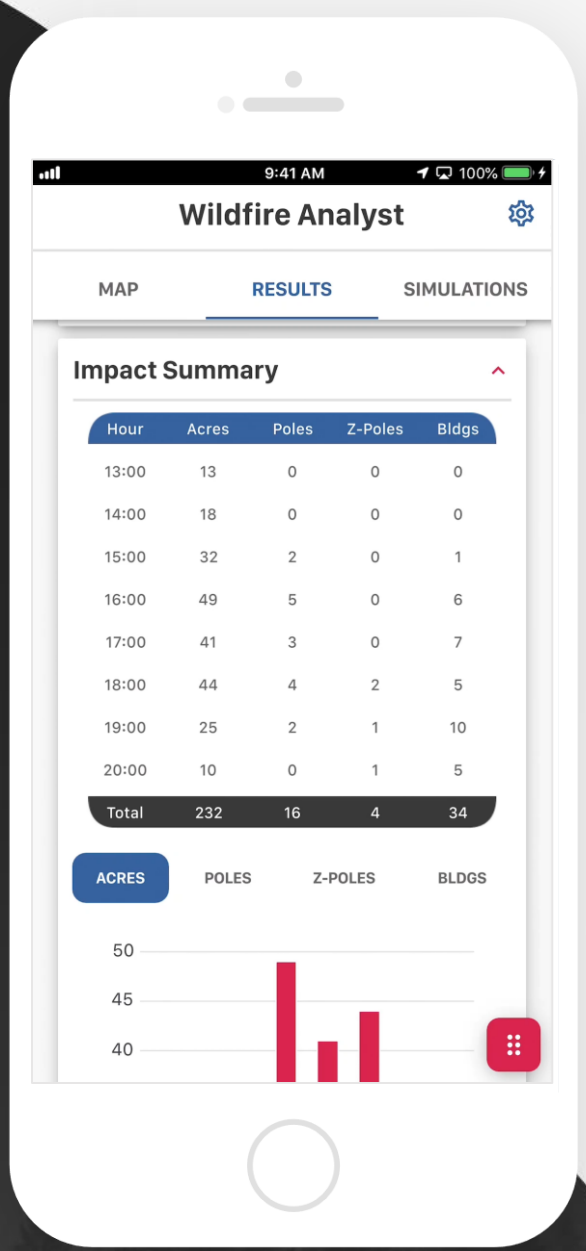
ON-DEMAND FIRE BEHAVIOR ANALYSIS

6. Impact Summary

A detailed hourly summary of potential impacts is provided that includes:

- Buildings
- Distribution poles
- Transmission poles
- Acres burned

Other custom values-at-risk can easily be included.



ON-DEMAND FIRE BEHAVIOR ANALYSIS

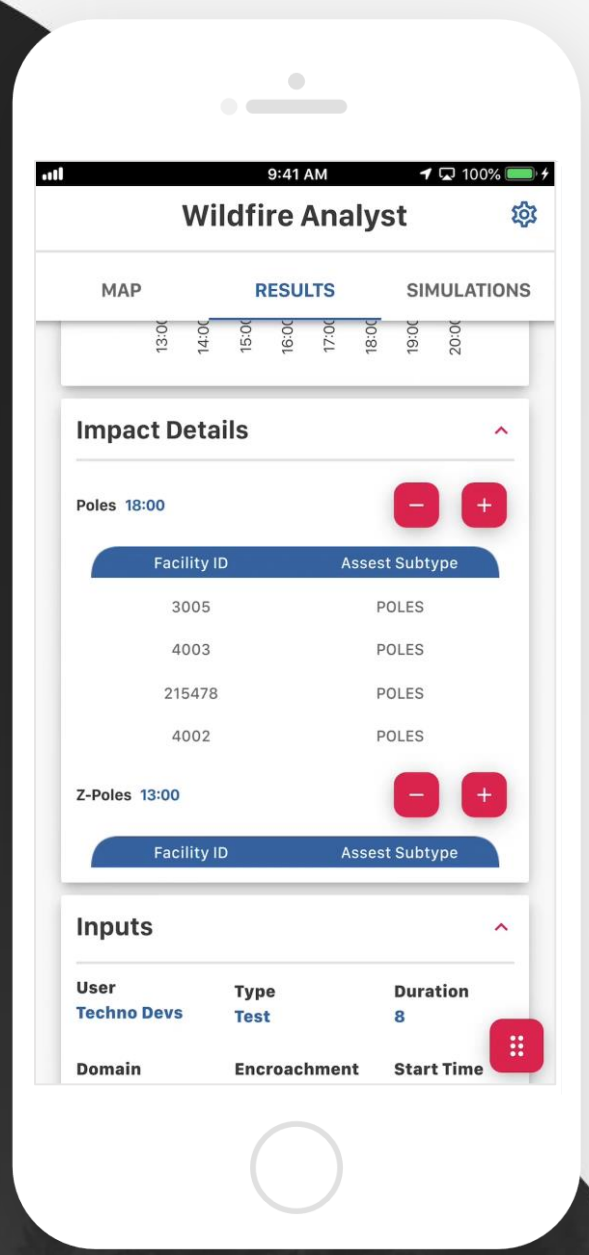
7. Impact Summary Charts

Charts are provided in addition to data tables to aid in quickly determining the consequence of the fire.

ON-DEMAND FIRE BEHAVIOR ANALYSIS

8. Impact Details

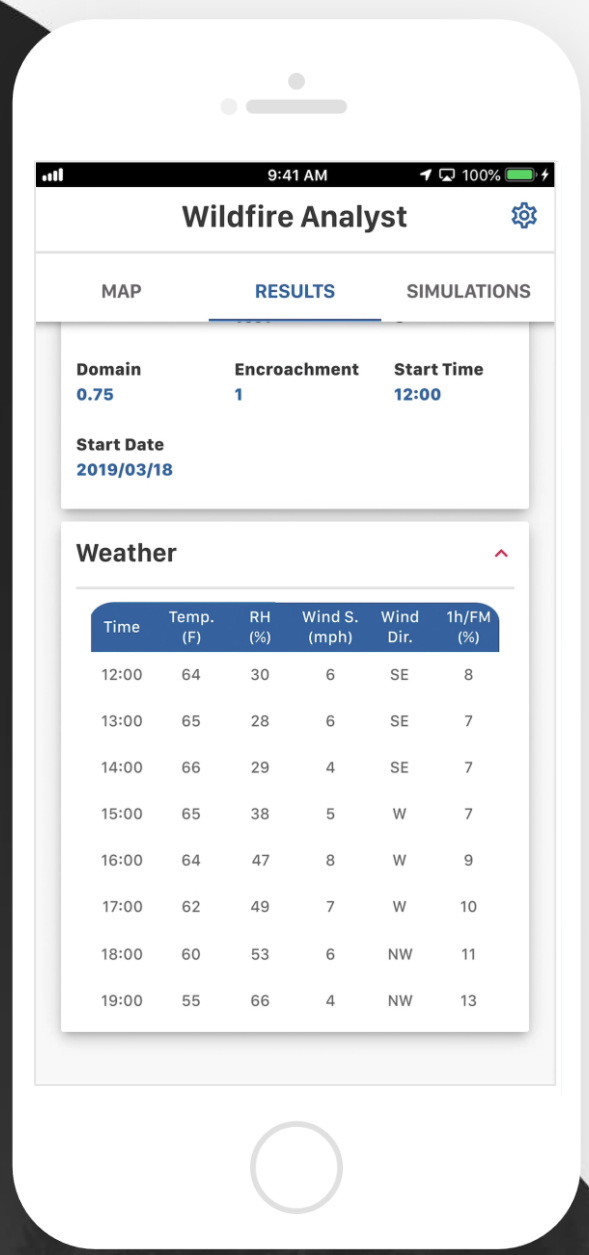
A detailed summary, by hour, is available for the electric utility assets, including the asset identifier and material type. The data to view is customizable.



ON-DEMAND FIRE BEHAVIOR ANALYSIS

9. Inputs & Weather

The primary input data is also summarized as reference, including the weather data for the ignition location.

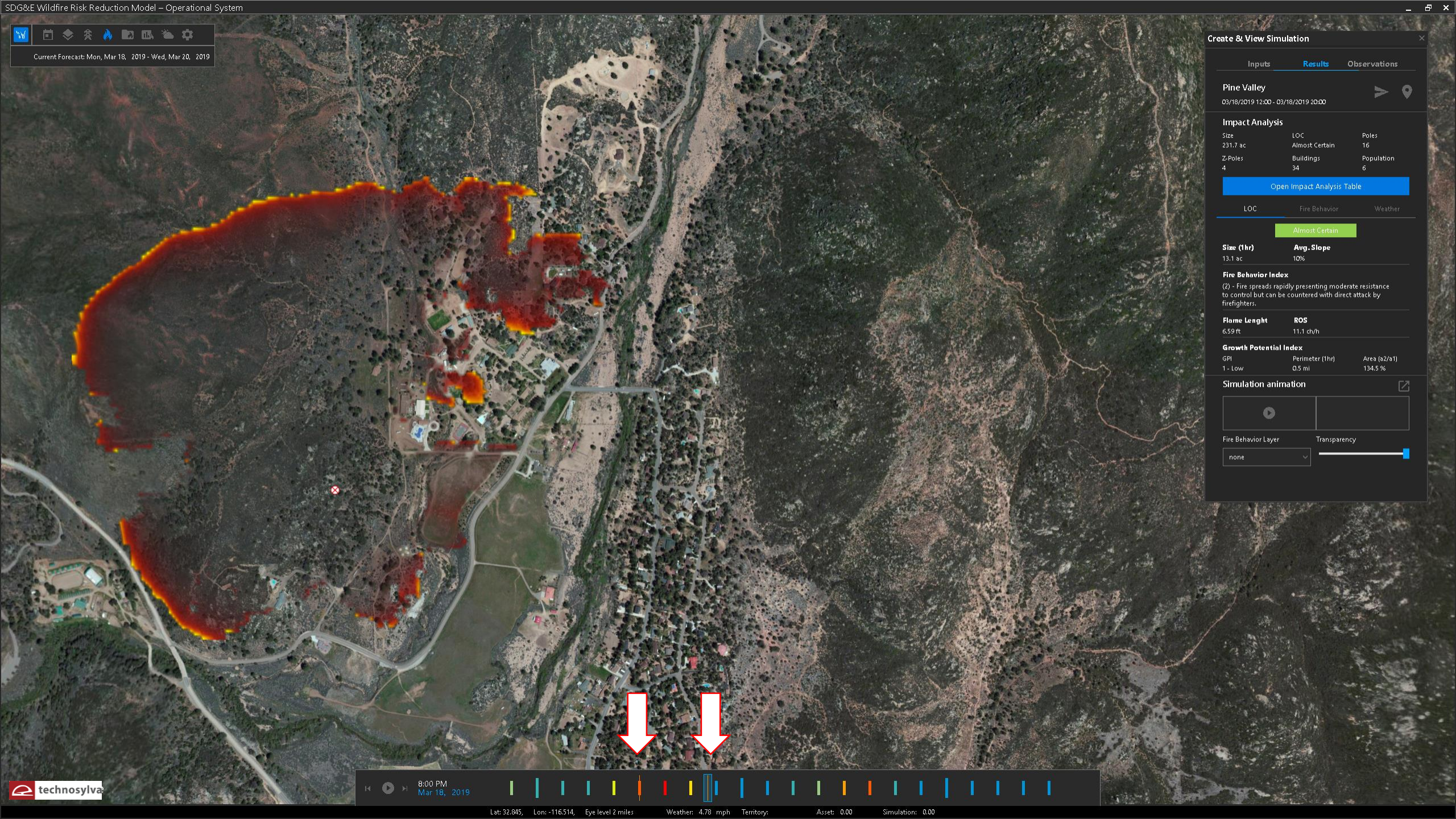


ON-DEMAND FIRE BEHAVIOR ANALYSIS

10. Reports & Sharing

Additional tools are provided to:

- Publish the simulation for viewing in a separate mobile app by Leadership
- Export the simulation information into a 2-page report to share with others via email, text, etc.
- Re-run the simulation using different input criteria, such as duration, or start time. This is a quick way to retain the simulation location.
- Export the simulation data to an external incident management or asset management system.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Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019
Create & View Simulation
Inputs
Results
Observations
Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00
Impact Analysis
Size
231.7 ac
LOC
Almost Certain
Poles
16
Z-Poles
4
Buildings
34
Population
6
Open Impact Analysis Table
LOC
Fire Behavior
Weather
Almost Certain
Size (1hr)
13.1 ac
Avg. Slope
10%
Fire Behavior Index
(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.
Flame Lenght
6.59 ft
ROS
11.1 ch/h
Growth Potential Index
GPI
1 - Low
Perimeter (1hr)
0.5 mi
Area (a2/a1)
134.5 %
Simulation animation
Fire Behavior Layer
none
Transparency
8:00 PM
Mar 18, 2019
technosylva
Lat: 32.845, Lon: -116.514, Eye level 2 miles
Weather: 4.78 mph
Territory:
Asset: 0.00
Simulation: 0.00

SDG&E Wildfire Risk Reduction Model – Operational System

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

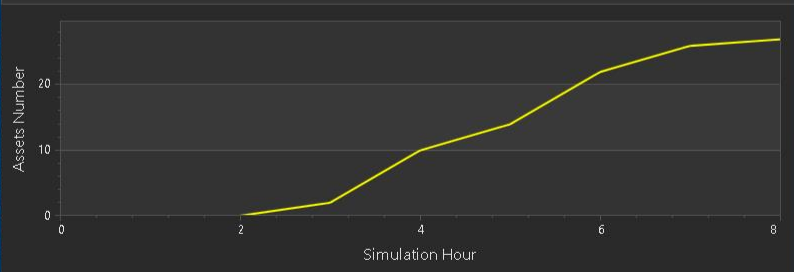
Assets | Places | Population | Buildings

Quick filter: Domain / Simulation

Type

Name	Distance (mi)	Direction	Time To Impact	Impact Datetime
Type: POLES				
P199370	0.1	SSW	2h 30m	21:30
P137144	0.1	SSW	2h 42m	21:42
P137145	0.08	SSW	3h 17m	22:17
P137146	0.03	WNW	3h 17m	22:17
P135059	0.04	SW	3h 33m	22:33
P104895	0.29	SSW	3h 42m	22:42
P104894	0.29	SSW	3h 56m	22:56
P175863	0.29	SSW	4h 27m	23:27
P104846	0.3	SSW	4h 4m	23:04
P175864	0.25	S	4h 55m	23:55
P970275	0.12	SE	5h 17m	00:17
P874107	0.21	NNE	5h 2m	00:02
P874108	0.22	N	5h 31m	00:31
P178015	0.22	NE	5h 45m	00:45
P178014	0.17	NE	6h 37m	01:37
P137142	0.11	SE	6h 50m	01:50
Type: TRANSFORMERS				
Type: ZPOLES				

Not Is null or empty([Time To Impact])



Create & View Simulation

Inputs | Results | Observations

Pine Valley

03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac

Avg. Slope 10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft

ROS 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

8:00 PM
Mar 18, 2019

technosylva

Lat: 32.849, Lon: -116.525, Eye level 2 miles Weather: 4.78 mph Territory: Asset: 0.00 Simulation: 0.00

SDG&E Wildfire Risk Reduction Model – Operational System

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

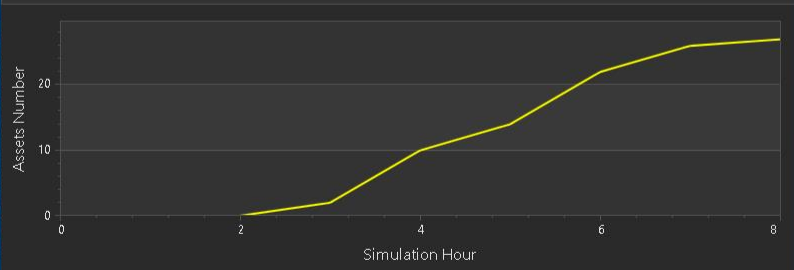
Assets | Places | Population | Buildings

Quick filter: Domain / Simulation

Type

Name	Distance (mi)	Direction	Time To Impact	Impact Datetime
Type: POLES				
P199370	0.1	SSW	2h 30m	21:30
P137144	0.1	SSW	2h 42m	21:42
P137145	0.08	SSW	3h 17m	22:17
P137146	0.03	WNW	3h 17m	22:17
P135059	0.04	SW	3h 33m	22:33
P104895	0.29	SSW	3h 42m	22:42
P104894	0.29	SSW	3h 56m	22:56
P175863	0.29	SSW	4h 27m	23:27
P104846	0.3	SSW	4h 4m	23:04
P175864	0.25	S	4h 55m	23:55
P970275	0.12	SE	5h 17m	00:17
P874107	0.21	NNE	5h 2m	00:02
P874108	0.22	N	5h 31m	00:31
P178015	0.22	NE	5h 45m	00:45
P178014	0.17	NE	6h 37m	01:37
P137142	0.11	SE	6h 50m	01:50
Type: TRANSFORMERS				
P137146	0.03	WNW	3h 17m	22:17
P135059	0.04	SW	3h 33m	22:33
P104895	0.29	SSW	3h 42m	22:42
P104846	0.3	SSW	4h 4m	23:04
P874108	0.22	N	5h 31m	00:31
P178015	0.22	NE	5h 45m	00:45
P178014	0.17	NE	6h 37m	01:37
Type: ZPOLES				
Z173128	0.43	SW	5h 42m	00:42
Z173127	0.42	WSW	5h 58m	00:58
Z173129	0.43	SW	6h 28m	01:28
Z173130	0.45	SW	7h 17m	02:17

Not Is null or empty([Time To Impact])



Create & View Simulation

Inputs | Results | Observations

Pine Valley

03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac — **Avg. Slope** 10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft — **ROS** 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

8:00 PM
Mar 18, 2019

technosylva

Lat: 32.846, Lon: -116.525, Eye level 2 miles — Weather: 4.78 mph — Territory: — Asset: 0.00 — Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

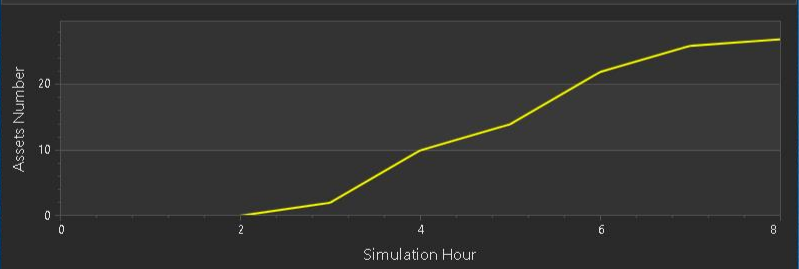
Impact Analysis

Assets | Places | Population | Buildings

Quick filter: Domain | Simulation

Type

Name	Distance (mi)	Direction	Time To Impact	Impact Datetime
Type: POLES				
P137143	0.1	S		
P873990	0.11	NE		
P175867	0.11	ESE		
P873989	0.12	ENE		
P178011	0.13	E		
P178012	0.13	E		
P178013	0.14	ENE		
P175868	0.15	E		
P175866	0.16	S		
P873991	0.16	NNE		
P970276	0.17	SE		
P170032	0.21	ESE		
P170089	0.21	ESE		
P970277	0.22	ESE		
P178016	0.25	NE		
P875901	0.29	ENE		
P178017	0.31	NE		
P972616	0.32	ENE		
P870700	0.33	NE		
P178018	0.33	NE		
P237868	0.34	SSE		
P175862	0.34	SSW		
P163514	0.35	ENE		
P163515	0.36	ENE		
P163510	0.36	ENE		
P163516	0.38	E		
P163513	0.38	ENE		
P163511	0.38	ENE		
P175861	0.38	SSW		
P178019	0.38	NE		
P163519	0.39	E		
P237867	0.4	SSE		
P163517	0.4	E		
P163512	0.41	ENE		



Create & View Simulation

Inputs | Results | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr)	Avg. Slope
13.1 ac	10%

Fire Behavior Index
(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght	ROS
6.59 ft	11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

8:00 PM
Mar 18, 2019

technosylva

Lat: 32.844, Lon: -116.525, Eye level 2 miles | Weather: 4.78 mph | Territory: | Asset: 0.00 | Simulation: 0.00

SDG&E Wildfire Risk Reduction Model – Operational System

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

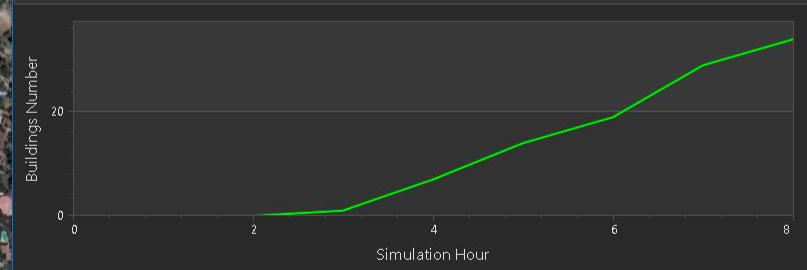
Assets | Places | Population | Buildings

Quick filter: Domain / Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.05	WSW	2h 59m	21:59
0.03	NW	3h 22m	22:22
0.02	NNW	3h 29m	22:29
0.11	N	3h 49m	22:49
0.07	N	3h 54m	22:54
0.07	NNW	3h 55m	22:55
0.04	W	3h 6m	22:06
0.11	N	4h 1m	23:01
0.08	N	4h 21m	23:21
0.2	NNE	4h 36m	23:36
0.04	S	4h 44m	23:44
0.04	N	4h 46m	23:46
0.21	NNE	4h 51m	23:51
0.07	N	4h 8m	23:08
0.08	NE	5h 20m	00:20
0.23	NNE	5h 35m	00:35
0.07	ENE	5h 38m	00:38
0.23	ENE	5h 47m	00:47
0.24	ENE	5h 54m	00:54
0.27	ENE	6h 15m	01:15
0.28	NE	6h 16m	01:16
0.28	NE	6h 16m	01:16
0.19	ENE	6h 24m	01:24
0.09	ENE	6h 25m	01:25
0.24	NE	6h 31m	01:31
0.29	ENE	6h 31m	01:31
0.3	ENE	6h 46m	01:46
0.15	SE	6h 47m	01:47
0.28	NE	6h 50m	01:50
0.1	ESE	7h 37m	02:37
0.11	ESE	7h 52m	02:52
0.09	E	7h 55m	02:55
0.17	ENE	7h 7m	02:07
0.17	ENE	7h 7m	02:07

Not Is null or empty([Time To Impact])



Create & View Simulation

Inputs | Results | Observations

Pine Valley

03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac — **Avg. Slope** 10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft — **ROS** 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

8:00 PM
Mar 18, 2019

technosylva

Lat: 32.837, Lon: -116.522, Eye level 2 miles — Weather: 4.78 mph — Territory: — Asset: 0.00 — Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

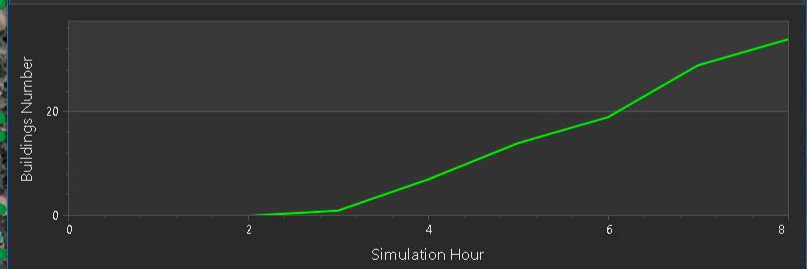
Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
0.07	N	4h 8m	23:08
0.07	NNW	3h 55m	22:55
0.07	N	3h 54m	22:54
0.07	SSE		
0.08	NE	5h 20m	00:20
0.08	N	4h 21m	23:21
0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
0.1	ESE	7h 37m	02:37
0.1	ESE		
0.11	ESE	7h 52m	02:52
0.11	N	4h 1m	23:01
0.11	N	3h 49m	22:49
0.11	E		
0.11	NE		
0.11	ENE		
0.11	E		
0.11	ESE		
0.12	NE		
0.12	ENE		
0.13	E		
0.13	ESE		
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac
Avg. Slope 10%

Fire Behavior Index
(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft
ROS 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none
Transparency

8:00 PM
Mar 18, 2019

Lat: 32.850, Lon: -116.529, Eye level 2 miles Weather: 4.78 mph Territory: Asset: 0.00 Simulation: 0.00

SDG&E Wildfire Risk Reduction Model – Operational System

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

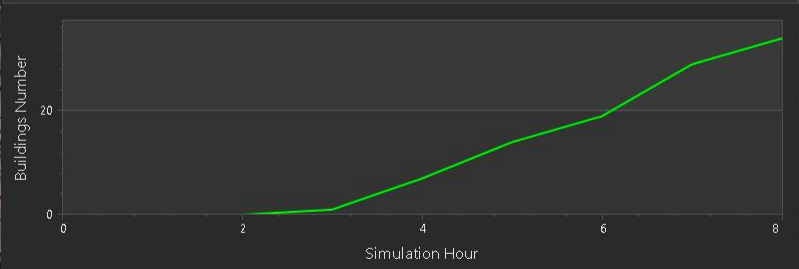
Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
0.07	N	4h 8m	23:08
0.07	NNW	3h 55m	22:55
0.07	N	3h 54m	22:54
0.07	SSE		
0.08	NE	5h 20m	00:20
0.08	N	4h 21m	23:21
0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
0.1	ESE	7h 37m	02:37
0.1	ESE		
0.11	ESE	7h 52m	02:52
0.11	N	4h 1m	23:01
0.11	N	3h 49m	22:49
0.11	E		
0.11	NE		
0.11	ENE		
0.11	E		
0.11	ESE		
0.12	NE		
0.12	ENE		
0.13	E		
0.13	ESE		
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley

03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr)	Avg. Slope
13.1 ac	10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght	ROS
6.59 ft	11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

1:00 PM
Mar 18, 2019

technosylva

Lat: 32.851, Lon: -116.528, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

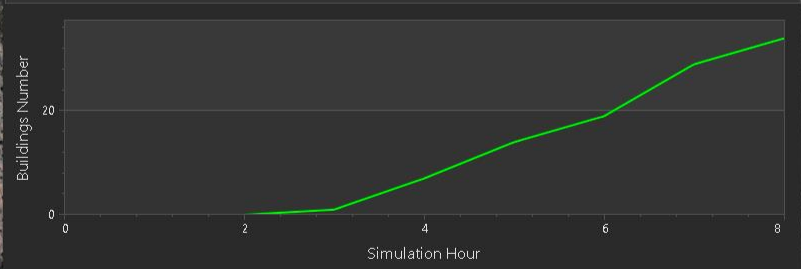
Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
0.07	N	4h 8m	23:08
0.07	NNW	3h 55m	22:55
0.07	N	3h 54m	22:54
0.07	SSE		
0.08	NE	5h 20m	00:20
0.08	N	4h 21m	23:21
0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
0.1	ESE	7h 37m	02:37
0.1	ESE		
0.11	ESE	7h 52m	02:52
0.11	N	4h 1m	23:01
0.11	N	3h 49m	22:49
0.11	E		
0.11	NE		
0.11	ENE		
0.11	E		
0.11	ESE		
0.12	NE		
0.12	ENE		
0.13	E		
0.13	ESE		
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac
Avg. Slope 10%

Fire Behavior Index
(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft
ROS 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none
Transparency

2:00 PM
Mar 18, 2019

technosylva

Lat: 32.836, Lon: -116.530, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

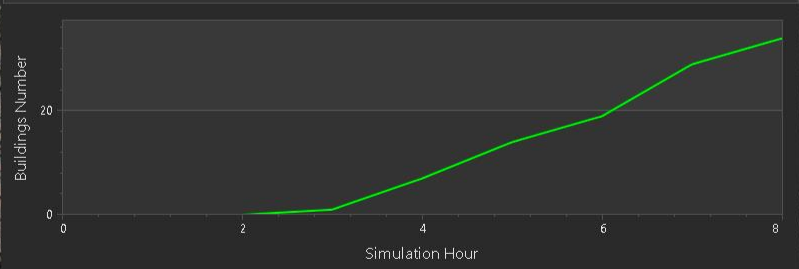
Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
0.07	N	4h 8m	23:08
0.07	NNW	3h 55m	22:55
0.07	N	3h 54m	22:54
0.07	SSE		
0.08	NE	5h 20m	00:20
0.08	N	4h 21m	23:21
0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
0.1	ESE	7h 37m	02:37
0.1	ESE		
0.11	ESE	7h 52m	02:52
0.11	N	4h 1m	23:01
0.11	N	3h 49m	22:49
0.11	E		
0.11	NE		
0.11	ENE		
0.11	E		
0.11	ESE		
0.12	NE		
0.12	ENE		
0.13	E		
0.13	ESE		
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr)	**Avg. Slope**
13.1 ac	10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght	**ROS**
6.59 ft	11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

3:00 PM
Mar 18, 2019

technosylva

Lat: 32.836, Lon: -116.531, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

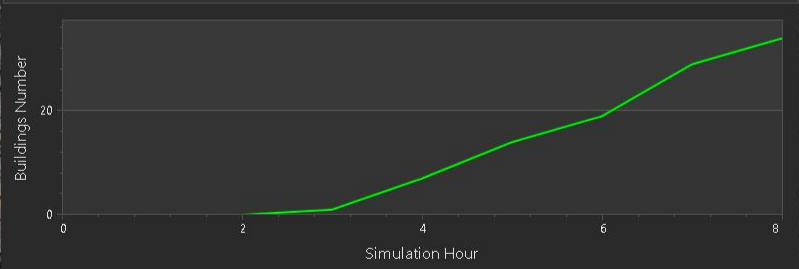
Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
0.07	N	4h 8m	23:08
0.07	NNW	3h 55m	22:55
0.07	N	3h 54m	22:54
0.07	SSE		
0.08	NE	5h 20m	00:20
0.08	N	4h 21m	23:21
0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
0.1	ESE	7h 37m	02:37
0.1	ESE		
0.11	ESE	7h 52m	02:52
0.11	N	4h 1m	23:01
0.11	N	3h 49m	22:49
0.11	E		
0.11	NE		
0.11	ENE		
0.11	E		
0.11	ESE		
0.12	NE		
0.12	ENE		
0.13	E		
0.13	ESE		
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr)	Avg. Slope
13.1 ac	10%

Fire Behavior Index

(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght	ROS
6.59 ft	11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

4:00 PM
Mar 18, 2019

technosylva

Lat: 32.836, Lon: -116.529, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
0.03	NW	3h 22m	22:22
0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
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0.09	E	7h 55m	02:55
0.09	ENE	6h 25m	01:25
0.09	NE		
0.09	E		
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0.11	N	4h 1m	23:01
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0.11	E		
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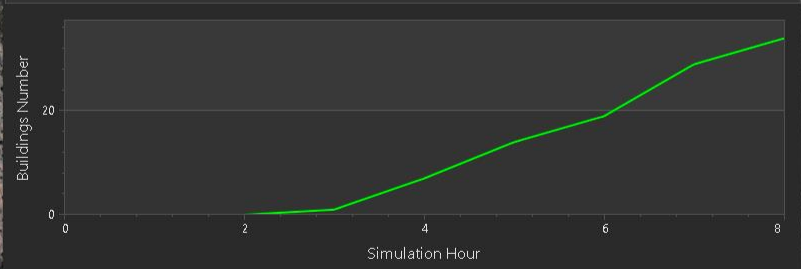
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

Pine Valley
03/18/2019 12:00 - 03/18/2019 20:00

Impact Analysis

Size	LOC	Poles
231.7 ac	Almost Certain	16
Z-Poles	**Buildings**	**Population**
4	34	6

Open Impact Analysis Table

LOC | Fire Behavior | Weather

Almost Certain

Size (1hr) 13.1 ac — **Avg. Slope** 10%

Fire Behavior Index
(2) - Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.

Flame Lenght 6.59 ft — **ROS** 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

5:00 PM
Mar 18, 2019

technosylva

Lat: 32.835, Lon: -116.533, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
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0.04	N	4h 46m	23:46
0.04	S	4h 44m	23:44
0.04	W	3h 6m	22:06
0.05	WSW	2h 59m	21:59
0.05	SSE		
0.06	ENE		
0.06	ENE		
0.07	ENE	5h 38m	00:38
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0.07	N	3h 54m	22:54
0.07	SSE		
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0.08	N	4h 21m	23:21
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0.09	NE		
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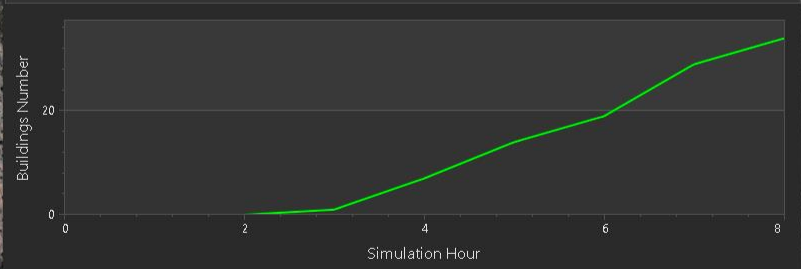
0.13	ESE		



Create & View Simulation

Inputs | **Results** | Observations

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Open Impact Analysis Table

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Avg. Slope 10%

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Flame Lenght 6.59 ft
ROS 11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none
Transparency

6:00 PM
Mar 18, 2019

technosylva

Lat: 32.836, Lon: -116.530, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

SDG&E Wildfire Risk Reduction Model – Operational System

Current Forecast: Mon, Mar 18, 2019 - Wed, Mar 20, 2019

Impact Analysis

Assets | Places | Population | **Buildings**

Quick filter: (•) Domain ( ) Simulation

Drag a column header here to group by that column

Distance (mi)	Direction	Time To Impact	Impact Datetime
0.02	NNW	3h 29m	22:29
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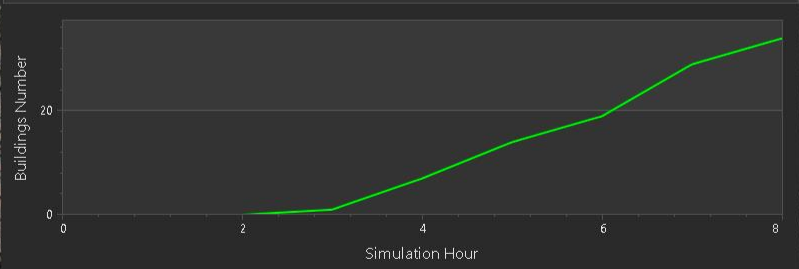
0.13	ESE		



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6.59 ft	11.1 ch/h

Growth Potential Index

GPI	Perimeter (1hr)	Area (a2/a1)
1 - Low	0.5 mi	134.5 %

Simulation animation

Fire Behavior Layer: none

Transparency

7:00 PM
Mar 18, 2019

technosylva

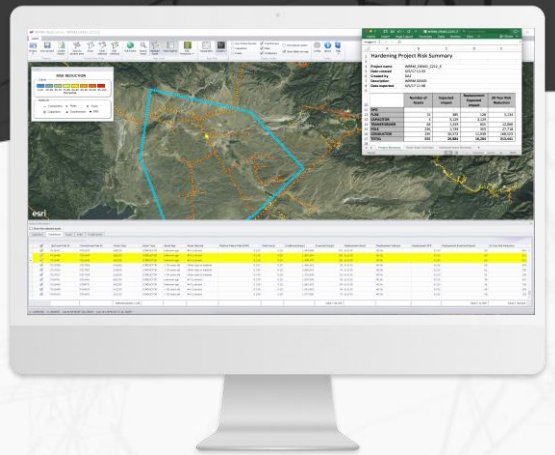
Lat: 32.835, Lon: -116.533, Eye level 2 miles | Weather: 0.00 | Territory: | Asset: 0.00 | Simulation: 0.00

Lessons Learned - Wildfire Risk Forecasting

1. The technology exists & it works.
2. “Big data” is not an issue.
3. Fire spread modeling can satisfy both risk forecasting & on-demand behavior analysis.
4. Continued enhancement of fire behavior models is necessary to address knowledge gaps
5. Historical calibration & comparison is key
6. Technology + SME
7. Good data is critical, especially landscape fuels, LFM and weather data

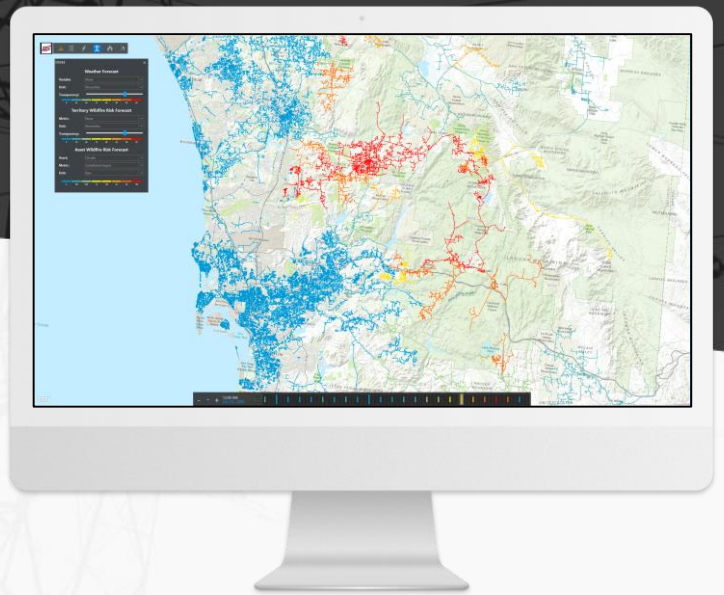
WILDFIRE ANALYST™ ENTERPRISE

Electric Utility Solutions



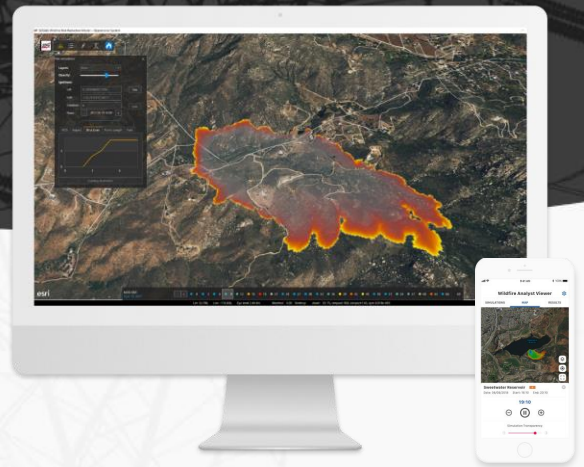
Wildfire Risk Reduction For Asset Hardening

WRRM



Wildfire Risk Forecasting & Monitoring

FireCast



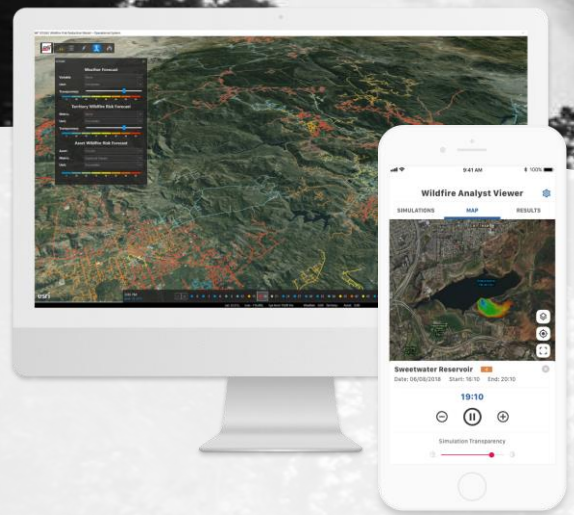
Wildfire Simulation For Real-Time Analysis

FireSim

technosylva

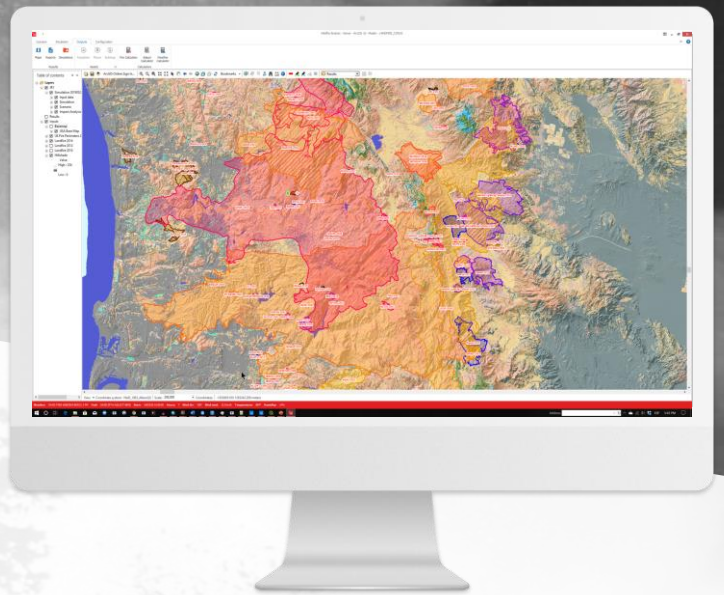
WILDFIRE ANALYST™ ENTERPRISE

Wildfire Agencies Solutions



Wildfire Modeling in the fireline

Wildfire Analyst Mobile



FBAN level Operational Wildfire modeling

Wildfire Analyst Desktop

Wildfire Calculations in the field

Wildfire Analyst Pocket

SEMINARIO INTERNACIONAL
PLANIFICACIÓN Y PREVENCIÓN DE INCENDIOS DE PAISAJE Y EL ROL DE LA RESTAURACIÓN POST INCENDIOS

Santiago, Chile, 20 y 21 de junio 2019

Gracias | Thank You

Enabling Wildfire Risk Forecasting

Requirements, Challenges, Achievements & Lessons Learned

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Technosylva San Diego, US
Tecnosylva, Leon, Spain