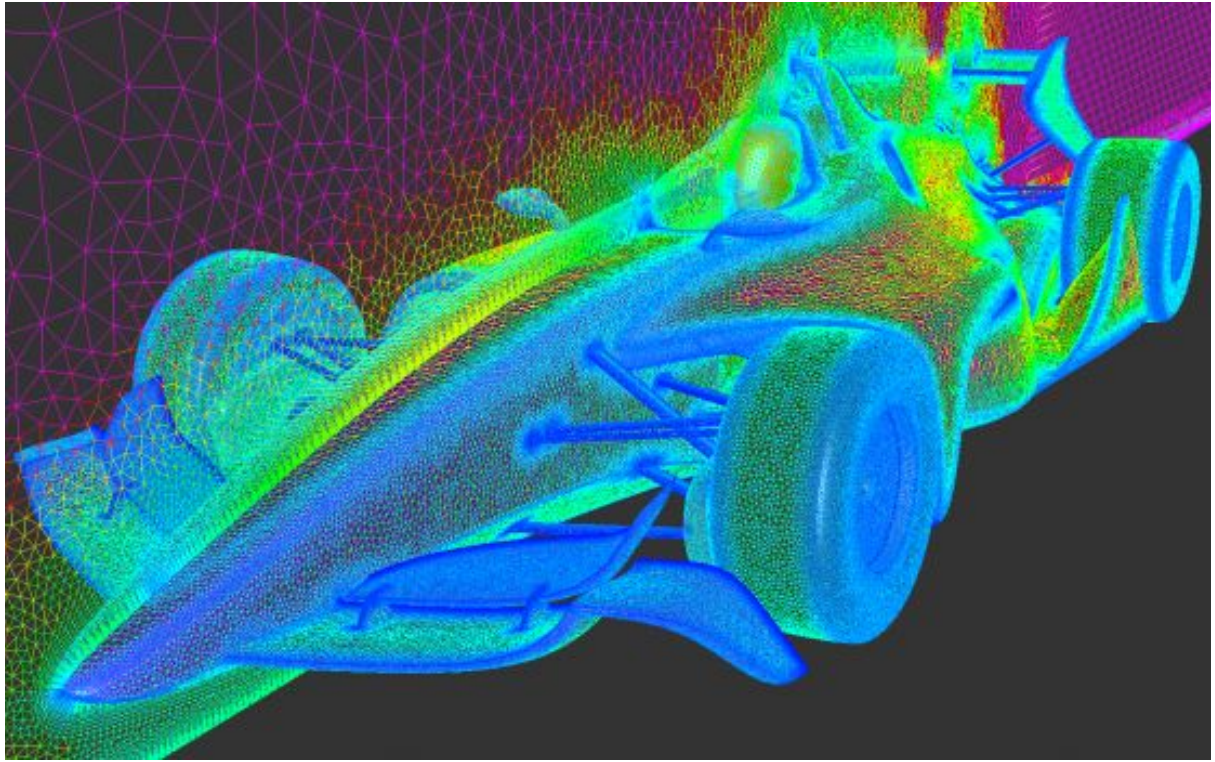
FireMind

Michael Burnam-Fink

Metis Final Project

FIRETEC: Computational Fluid Dynamics



FIRETEC is Limited

"FIRETEC takes the huge computational resources at the Los Alamos National Laboratory to run, so it is currently a research tool only."

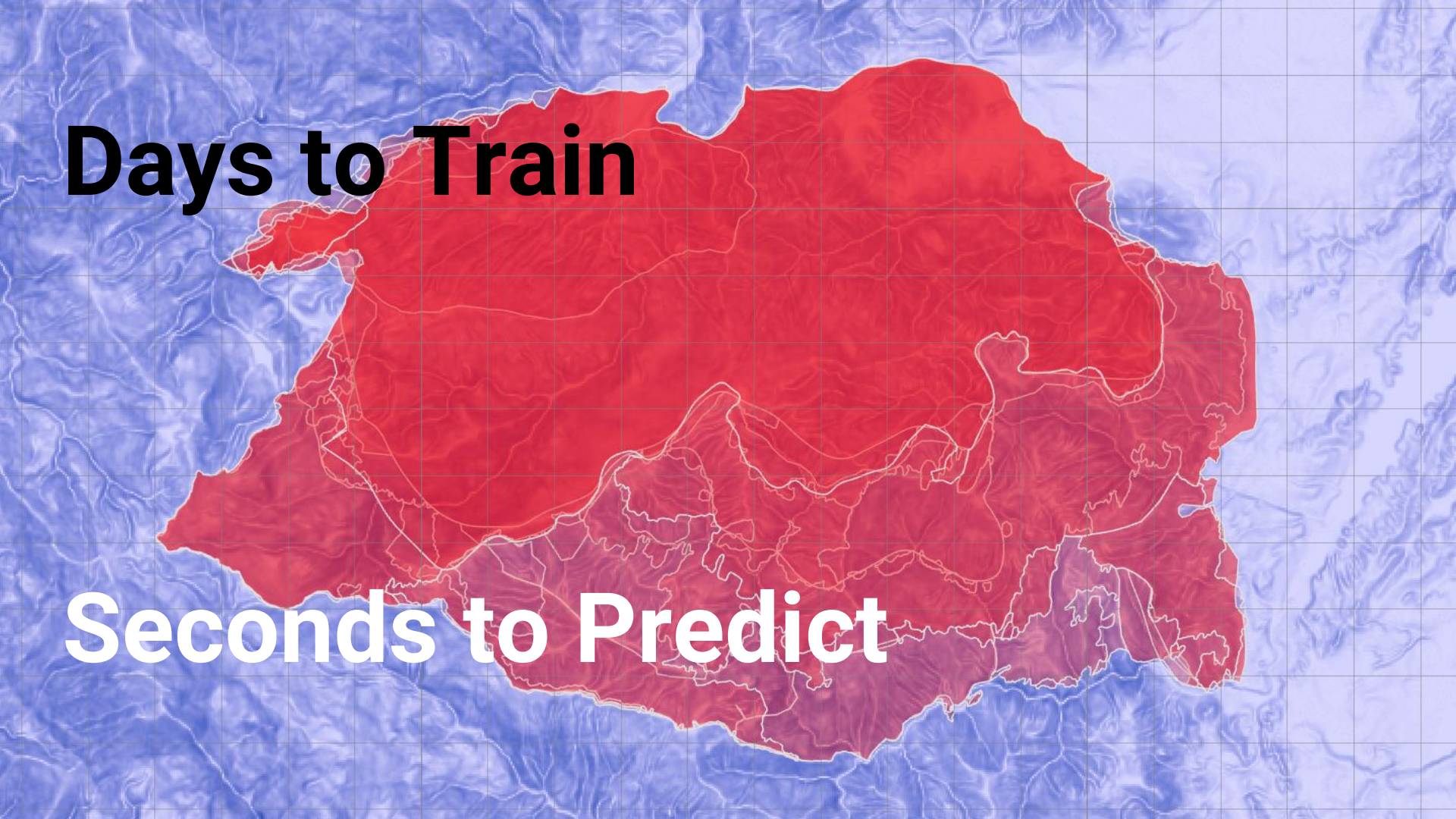
-FIRETEC website

"FIRETEC's simulations run more slowly than real fires burn, making it useless for real-time forecasting."

-The Economist

METIS

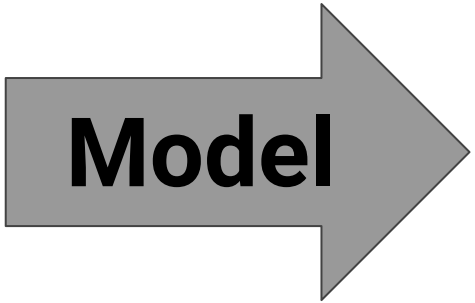
Wildfire Demonstrates Emergent Behavior


Days to Train
Seconds to Predict

Data Science Research Design

$Fire_{TODAY}$

[[0, 0, 0, 0, 0, 0],
[0, 0, 0, 0, 0, 0],
[0, 0, 1, 1, 1, 0],
[0, 1, 1, 1, 0, 0],
[0, 1, 1, 0, 0, 0],
[0, 0, 0, 0, 0, 0]]



$Fire_{TOMORROW}$

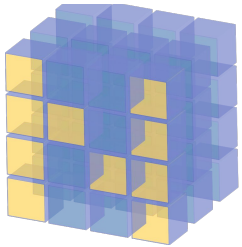
[[0, 0, 0, 0, 0, 0],
[0, 0, 1, 1, 1, 0],
[0, 0, 1, 1, 1, 0],
[0, 1, 1, 1, 0, 0],
[0, 1, 1, 0, 0, 0],
[0, 0, 0, 0, 0, 0]]

METIS

Tools

ArcGIS

GeoPandas

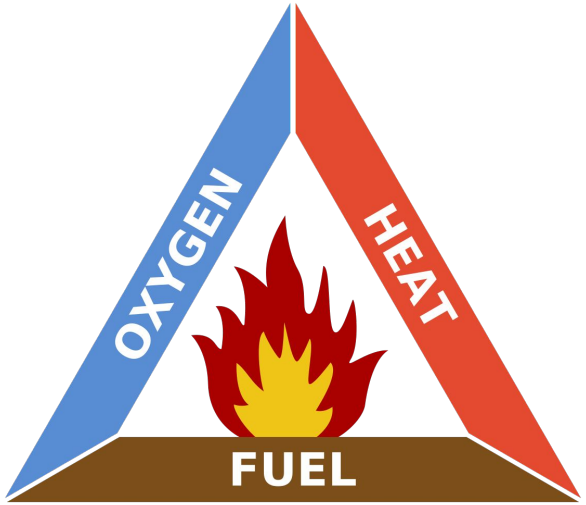


NumPy

mongoDB

METIS

Data Sources



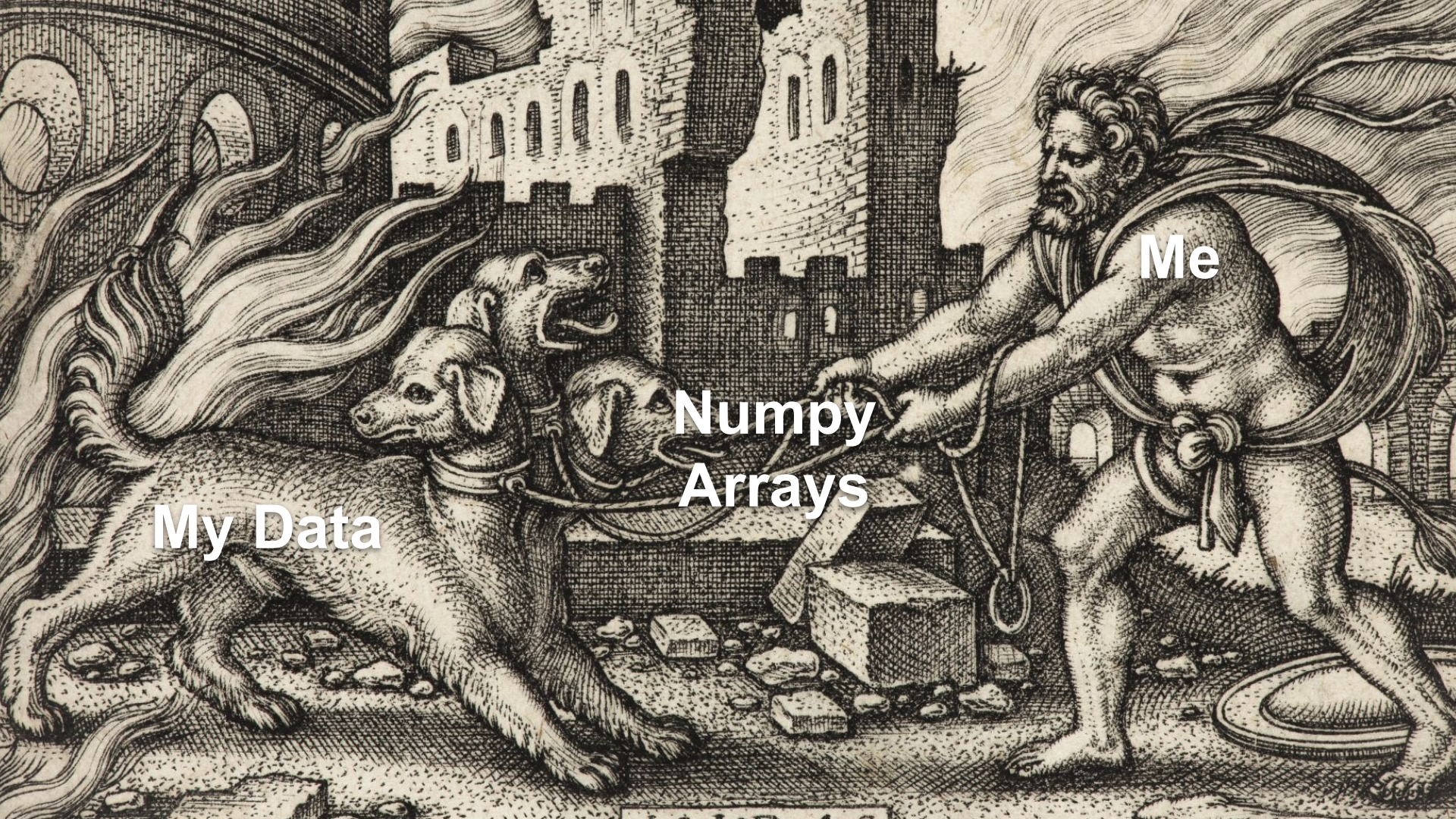
Landfire	Geomac	NREL WIND
LANDFIRE™	GeoMAC Wildland Fire Support	NREL Transforming ENERGY
FUEL	HEAT	OXYGEN

METIS

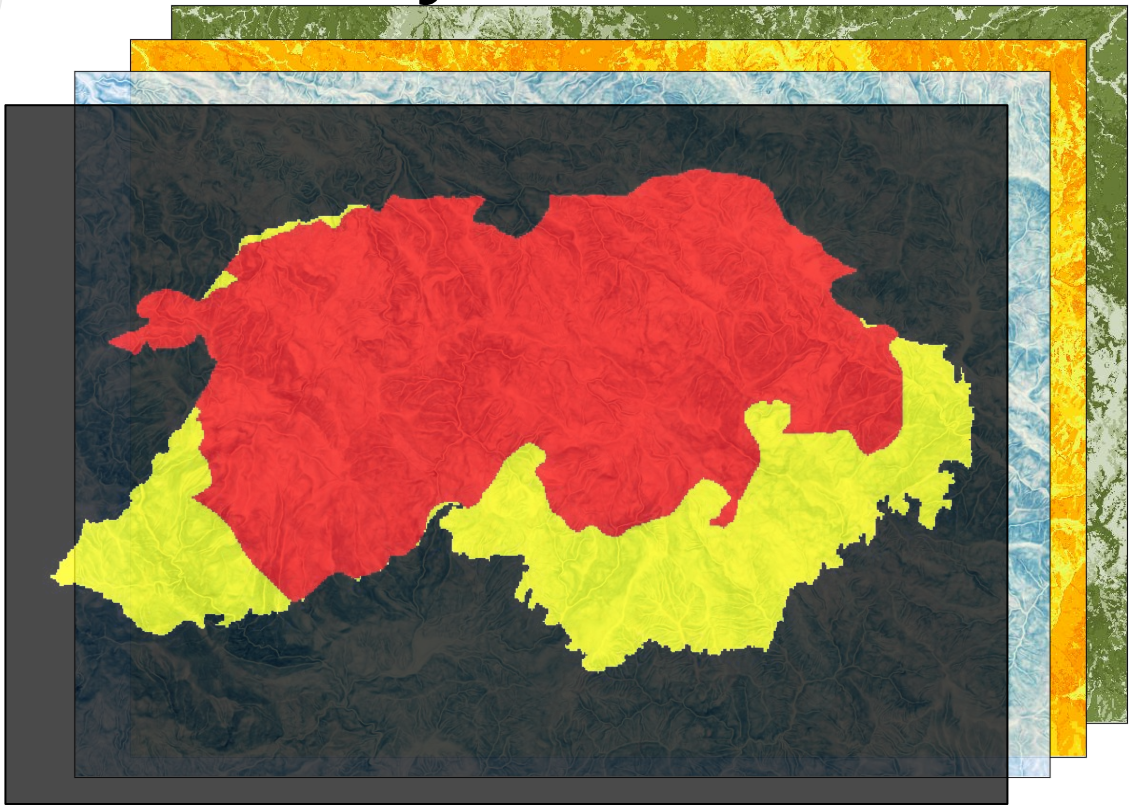
Data Sources

	Landfire	Geomac	NREL WIND
			
	Fuel & Topography	Fire Perimeters	Atmospheric
Spatial:	30 m x 30 m Raster	Lat-Lon Polygon	1 km x 1 km Grid
Temporal:	2 Years	1 Day	1 Hour
CRS:	EPSG: 5070	EPSG: 4269	???
Data Format:	ArcGIS	GeoPandas	HDF5 API

METIS


Me
Numpy
Arrays
My Data

Stacked Data Layers



METIS

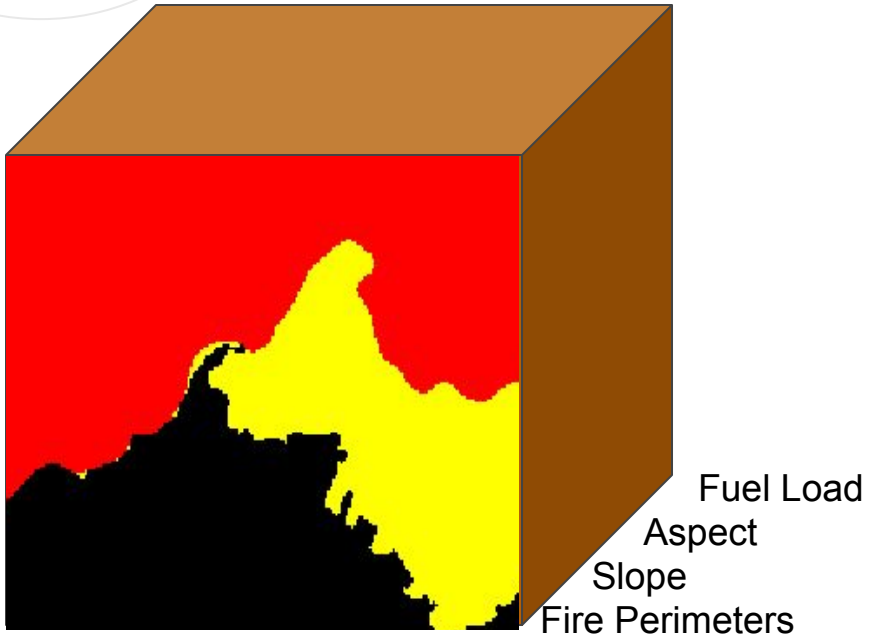
Convolute to Fire Progress Tensors

METIS

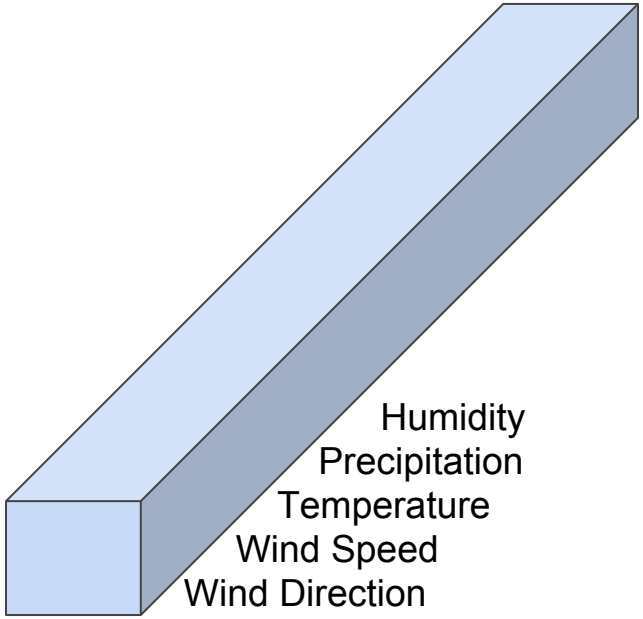
Fire Progress Tensors

71,000 Observations

6 *factors* * 256x * 256y

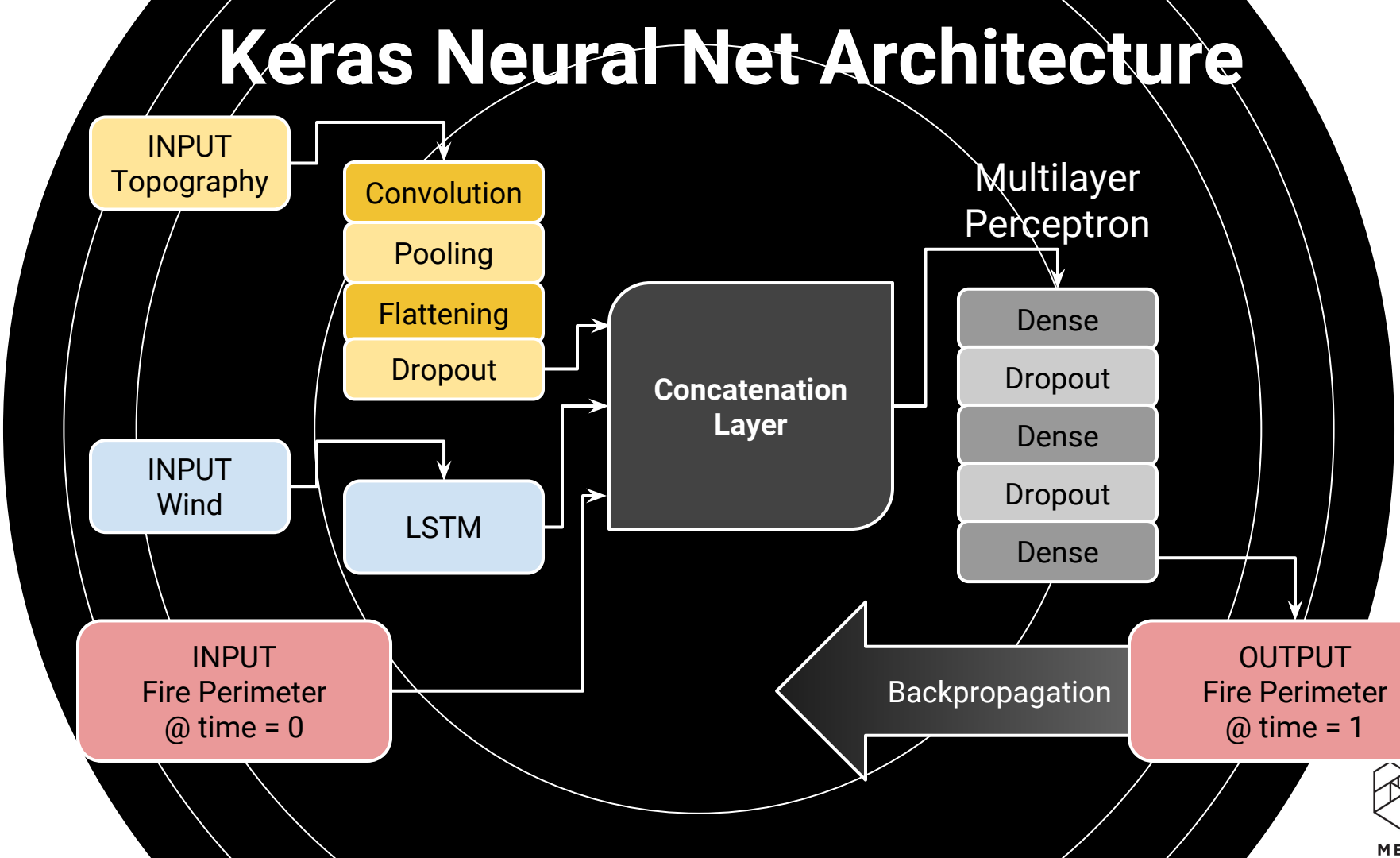


6 *factors* * 24 hrs



METIS

Keras Neural Net Architecture

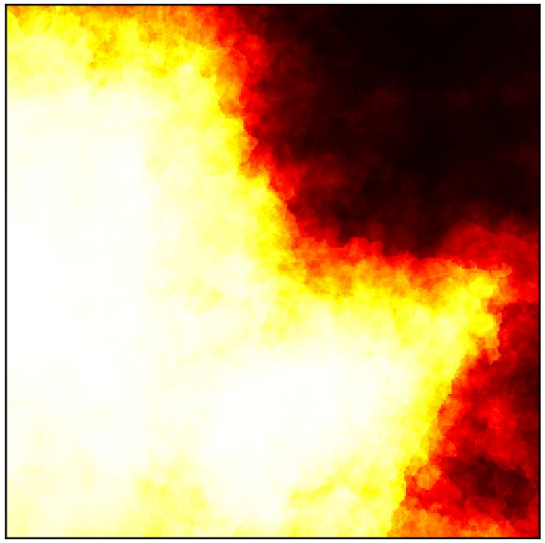


METIS

Results: 0.85 Mean Test F1 Score

Today

Prediction



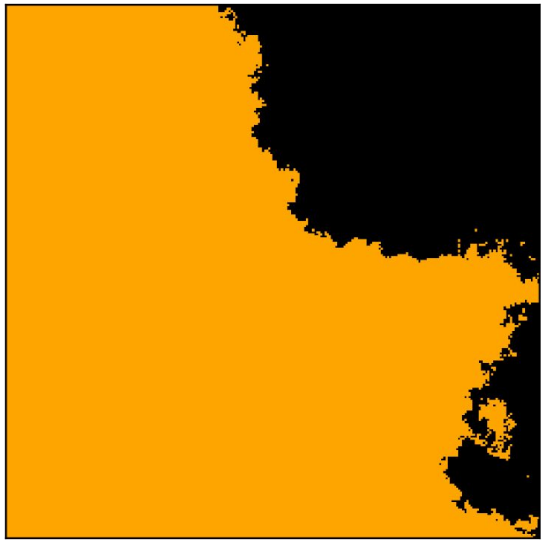
Tomorrow

METIS

Results: 0.85 Mean Test F1 Score

Today

Prediction

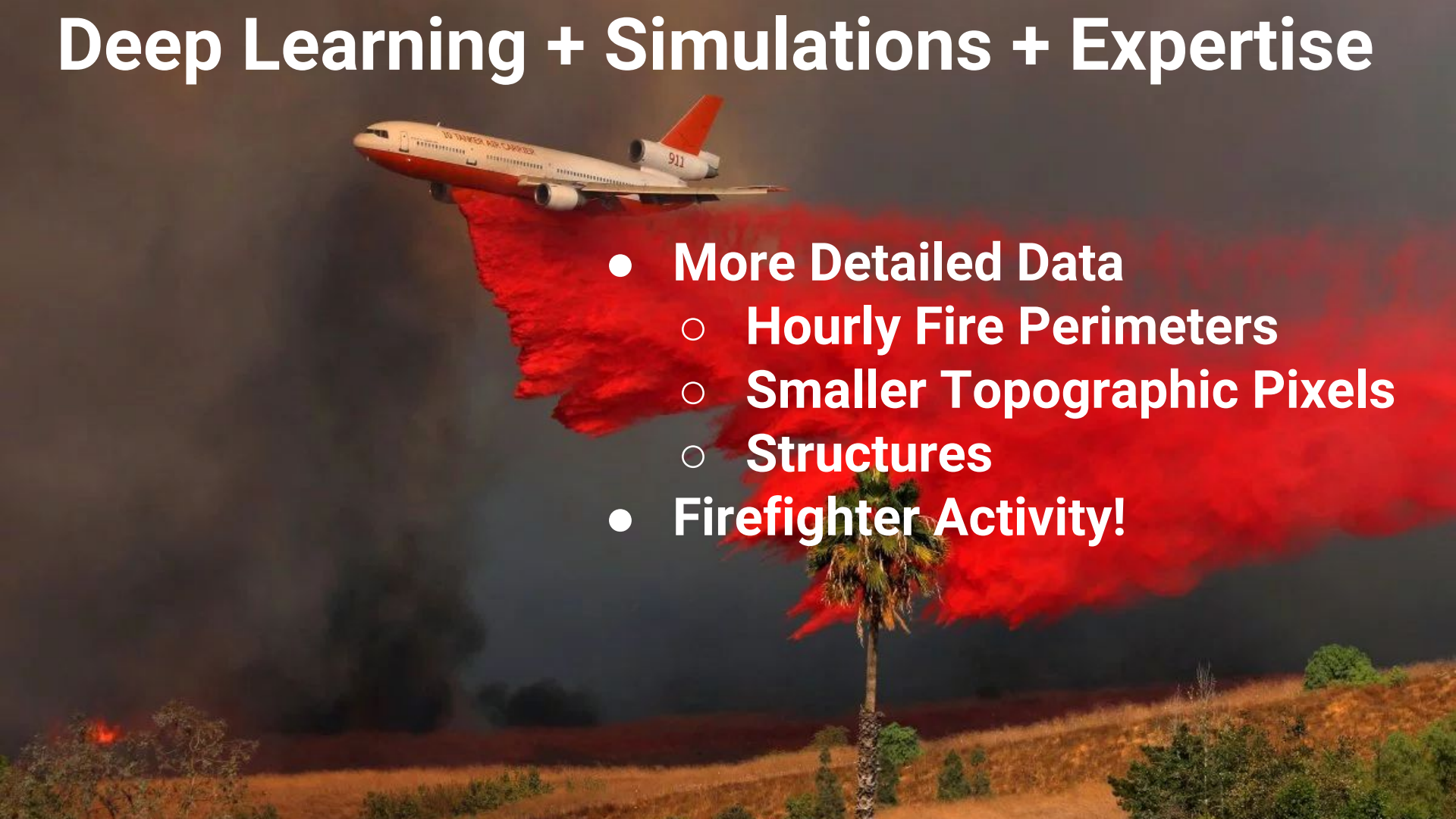


Tomorrow

METIS


“Pretty Good” Data Science
is not
Good Enough on the Ground

Deep Learning + Simulations + Expertise



- More Detailed Data
  - Hourly Fire Perimeters
  - Smaller Topographic Pixels
  - Structures
- Firefighter Activity!

Thank You!

[mburnamfink]

- LinkedIn
- Medium
- Github
- Gmail

METIS