FireSRnet: Geoscience-driven super-resolution of future fire risk from climate change

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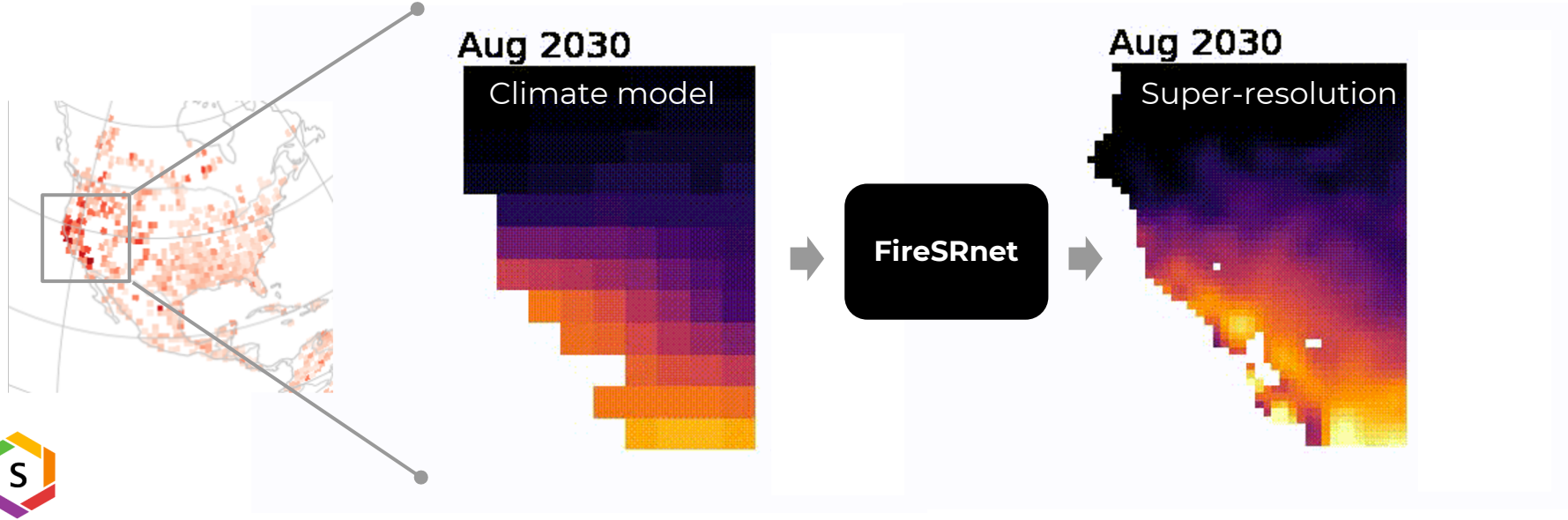
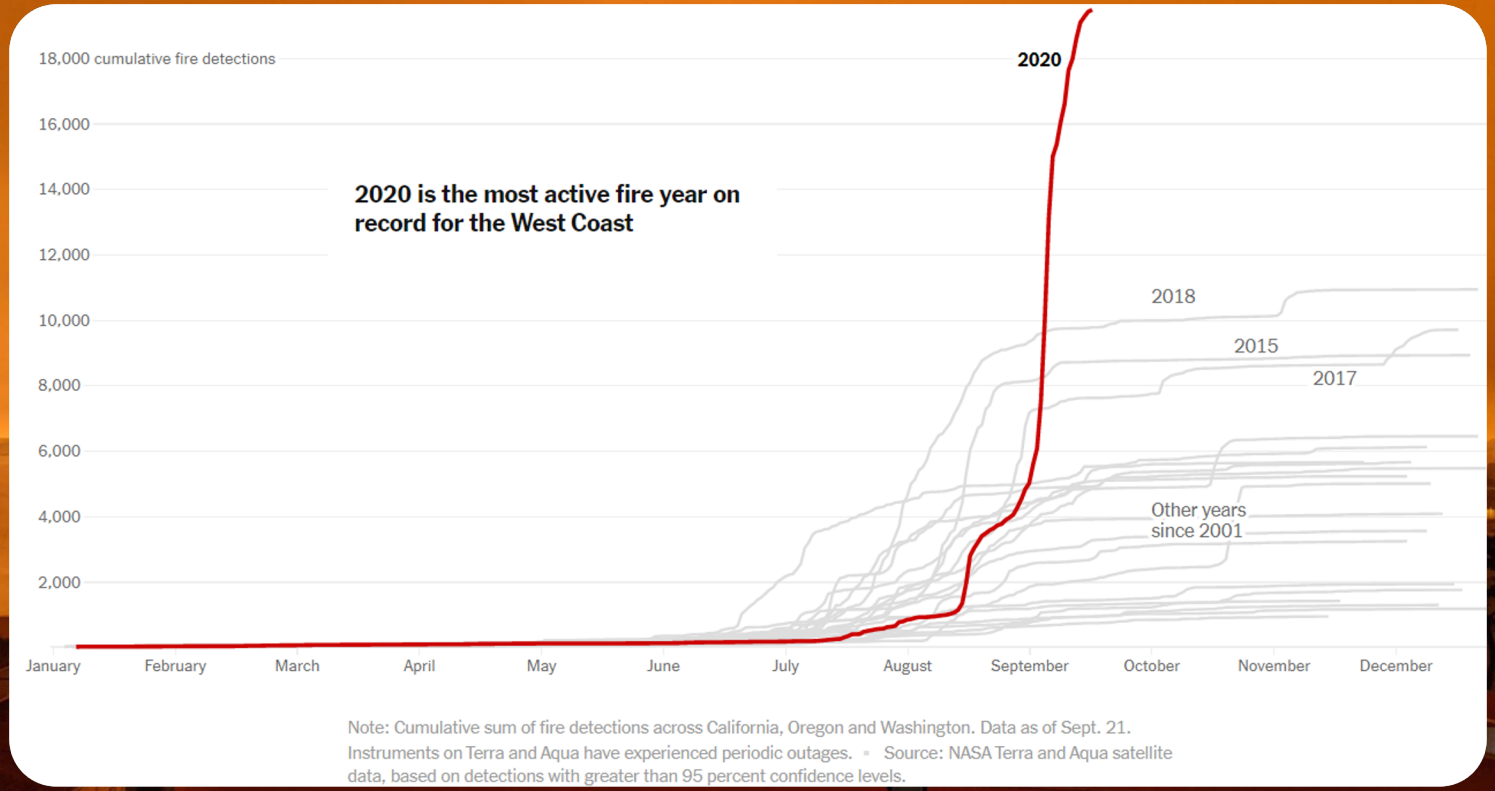
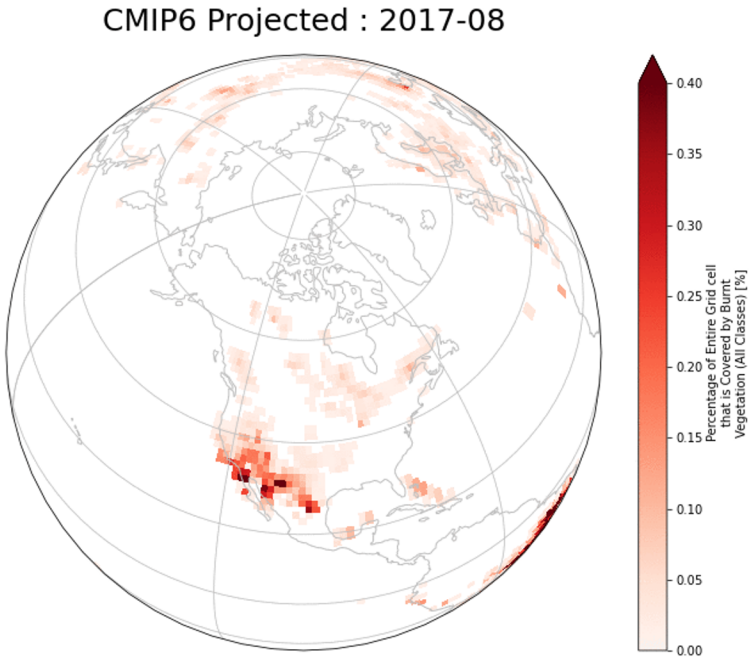



San Francisco, CA
09Sep2020

Wildfire exposure increasing in California and globally due to climate change



The Problem: Climate models simulate fire exposure at low resolution



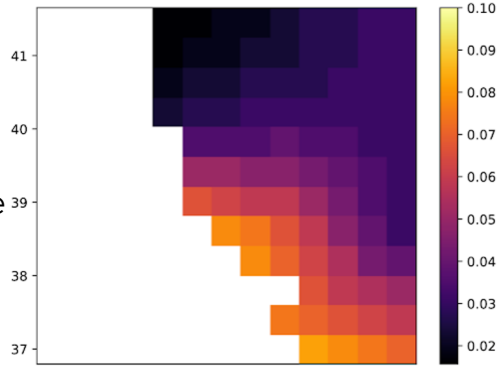
The Solution: Image super-resolution

What do we need super-resolution?

- Enhance spatial resolution of climate models
- Provide local, asset-level risk assessments
- Better quantify benefits of reducing carbon emissions

Aug 2040

Fire exposure CMIP6 climate model

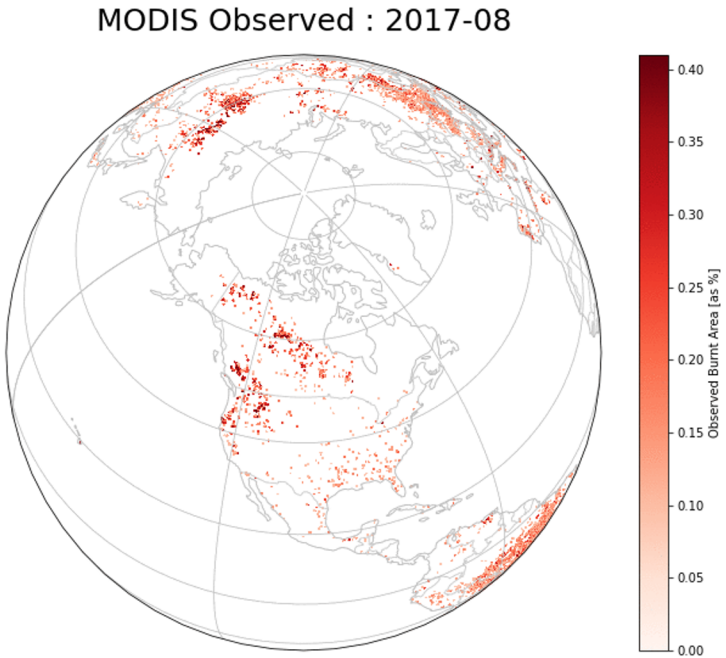


SR Model
0.4°→0.1°

Aug 2040

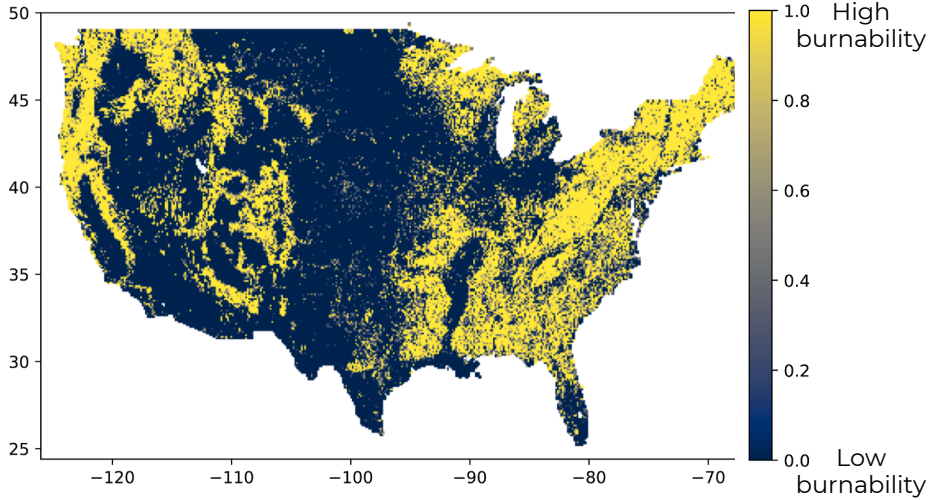
?

High-resolution satellite imagery enables super-resolution model development

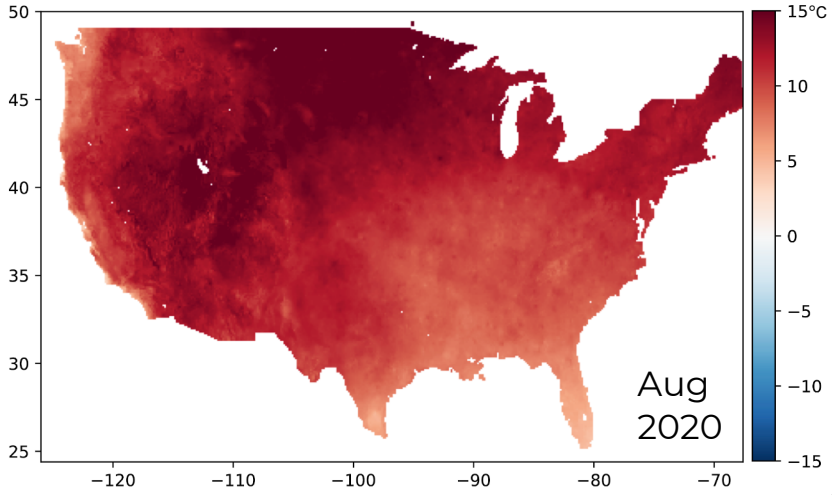


Geoscience-driven input channels provide local information on fire exposure

Burnable Land Index



Temperature Deviation

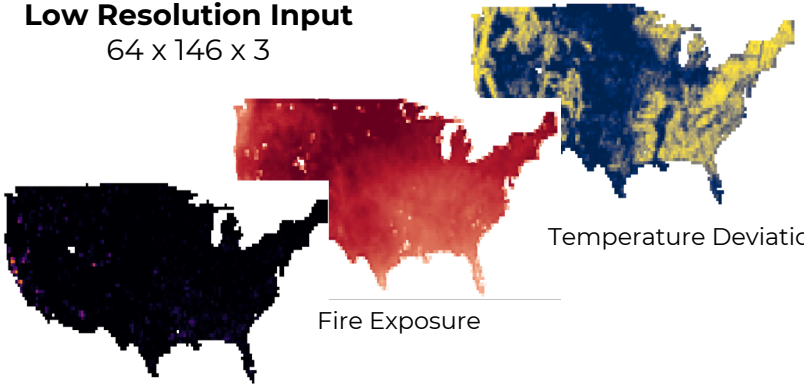


Design goals for SR model

- Efficient learning on small datasets
- Resolution scalability
- SpatioTemporal Generalization
- Extensible Geoscience inputs

Efficient network architecture

Low Resolution Input
64 x 146 x 3



Burnable Land Index

Temperature Deviation

Fire Exposure

FireSRnet 4x Output
Fire Exposure
256 x 584 x 1

2D Conv1
16 filters
9 x 9 filter size

2D Upsampling

2D Conv2
8 filters
5 x 5 filter size

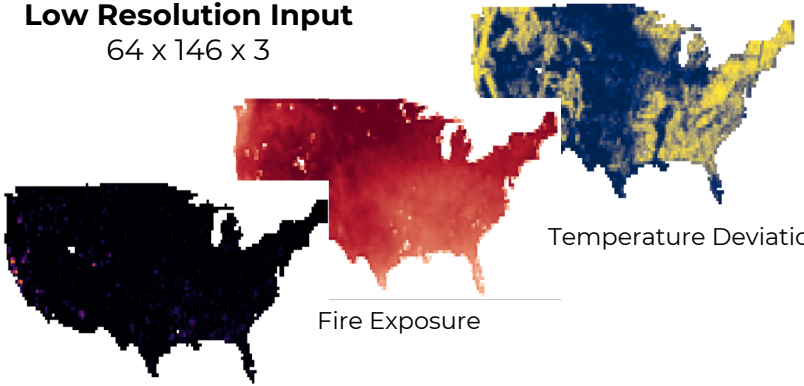
2D Conv3
8 filters
3 x 3 filter size

2D Upsampling

1D Conv4
1 filter 8:1 convolution

Flexible network architecture

Low Resolution Input
64 x 146 x 3



Burnable Land Index

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FireSRnet 4x Output
Fire Exposure
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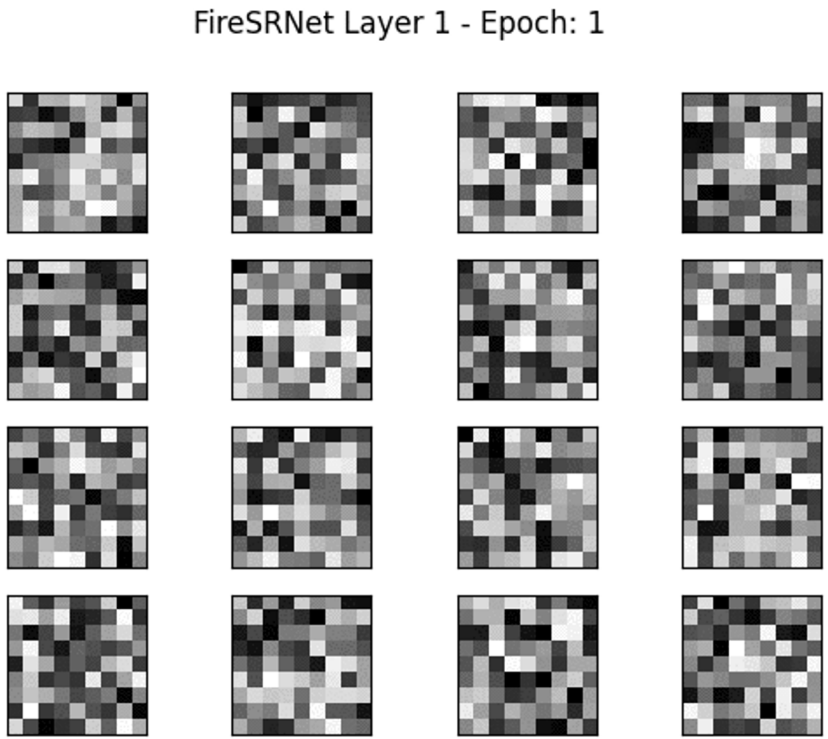
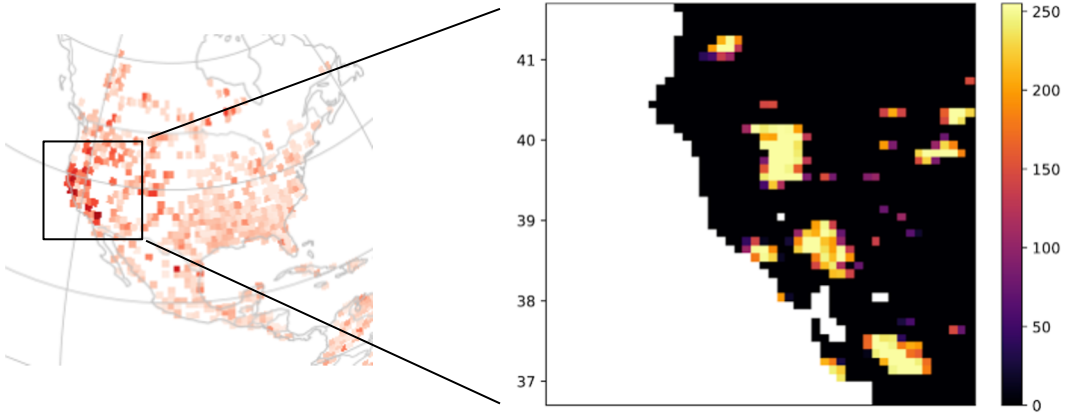
Discriminative features for fire detection



Quantitative model evaluation shows FireSRnet outperforms bicubic

	RMSE	R^2	Precision	F1	Threat Score
FireSRnet-4x	**0.0400**	**0.2434**	**0.9257**	**0.9479**	**0.9015**
Bicubic-4x	0.0433	0.1810	0.8747	0.9320	0.8735

Qualitative model evaluation: Case Study



Fire Original

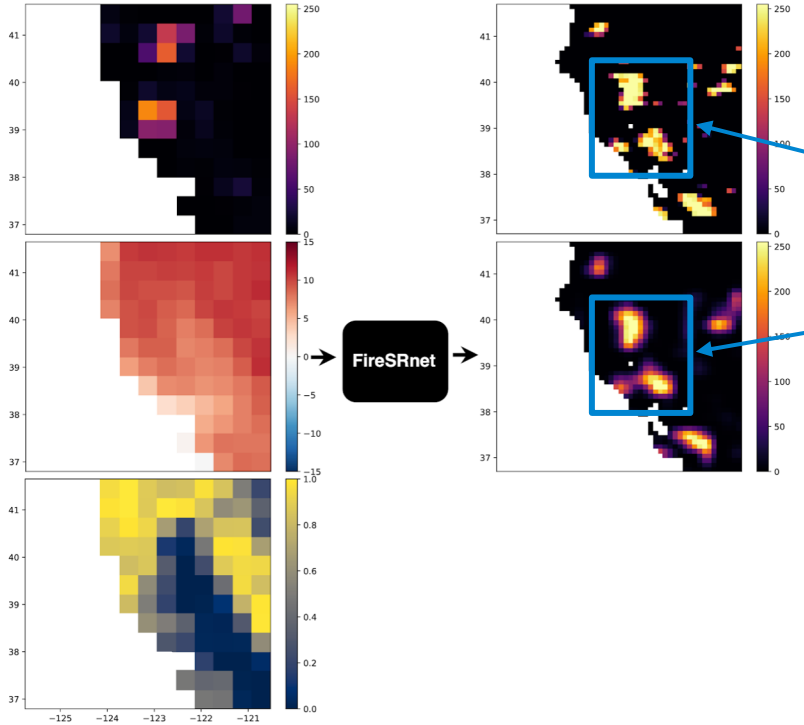
Northern California
Aug 2020

Qualitative model evaluation: Case Study

Fire 4x Upscaling

Temperature Deviation

Burnable Land Index



Fire Original

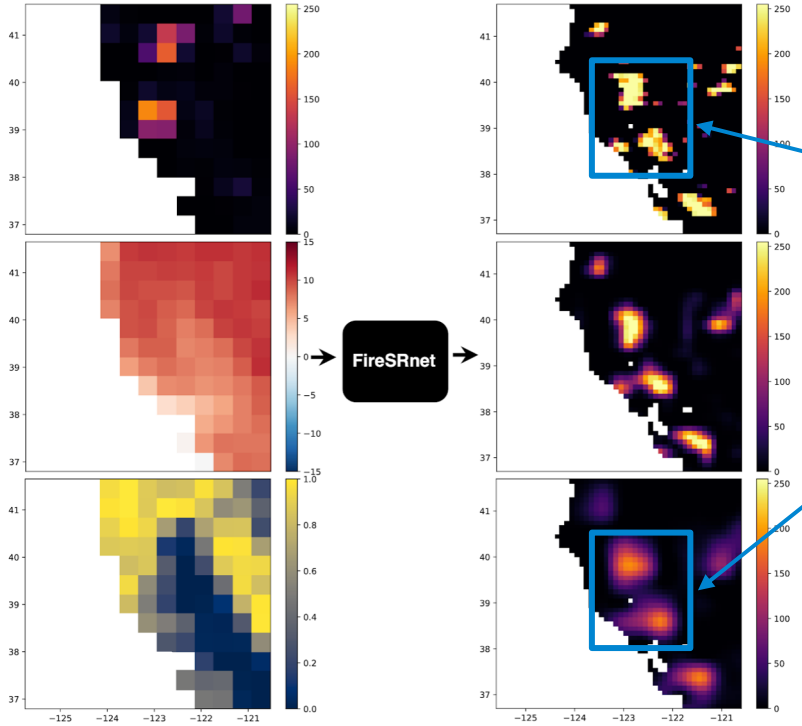
FireSRnet

Detection ✅

Magnitude ✅

Northern California
Aug 2020

Qualitative model evaluation shows FireSRnet outperforms bicubic at 4x SR

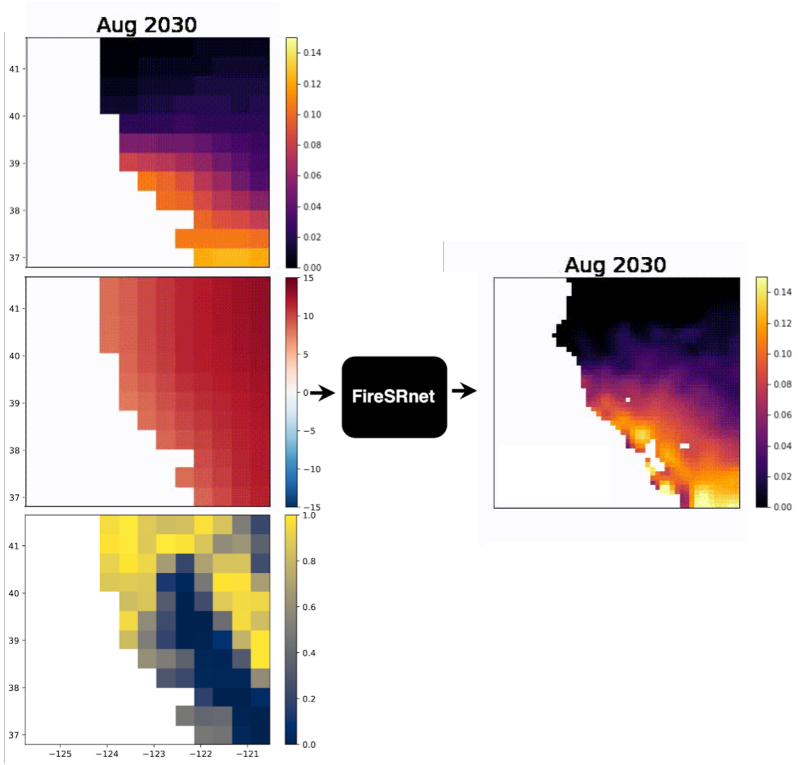


FireSRnet enhances resolution of future climate model simulations

CMIP6 Fire

CMIP6 Temperature Deviation

Burnable Land Index



FireSRnet

Northern California CMIP6

Contributions of FireSRnet

- **Novel:** Novel modeling approach for SR of fire exposure from climate models
- **Performant:** Strong performance at 4x and 8x resolution enhancement
- **Global:** Enables local, asset-level fire exposure assessments at global scale

If interested in research topic or discussing open roles, contact: ***gopal@sustglobal.com***