



Statewide, tree-scale mortality monitoring for improved forest management

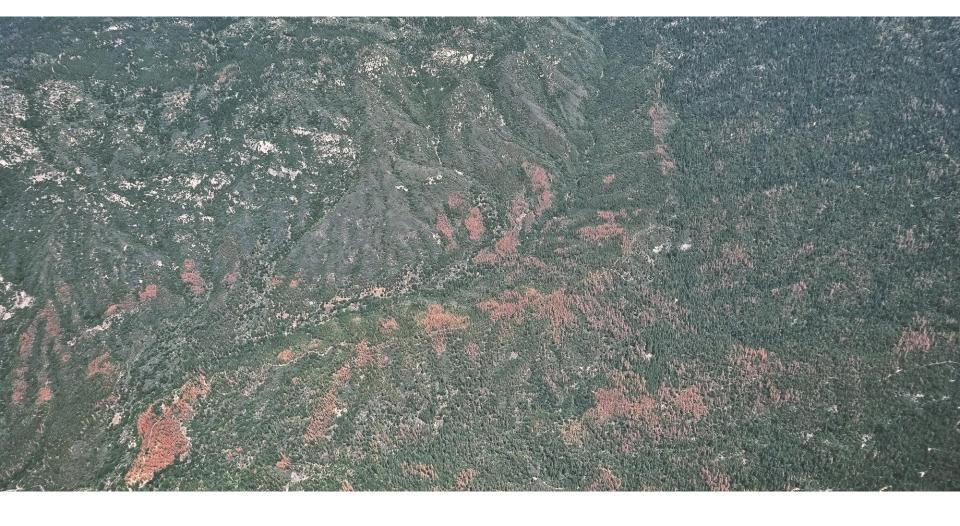
David Marvin & Christopher Anderson



United States Department of Agriculture National Institute of Food and Agriculture



Thank you!

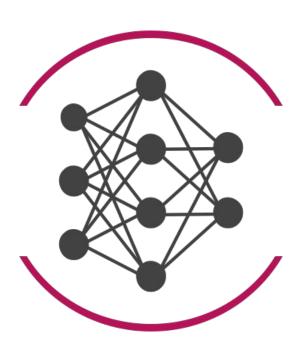








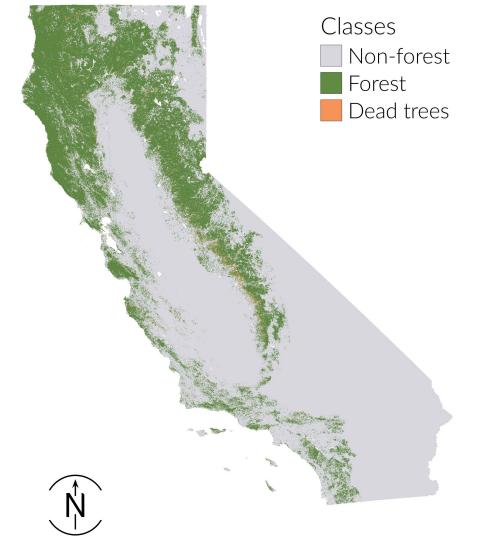




# What we did

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Created statewide maps of tree mortality from high resolution satellite imagery for **2016** 



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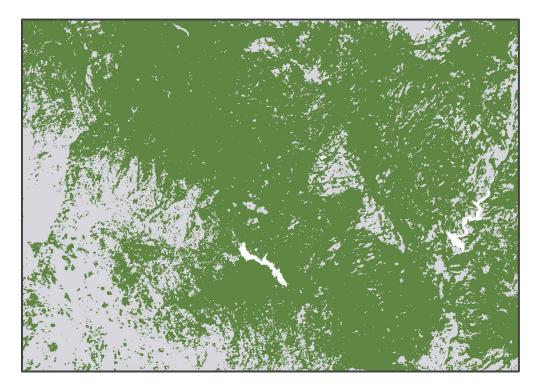
## How we did it

- 1. Semi-supervised object-based image analysis
- 2. Deep-learning classification
- 3. Deep-learning regression





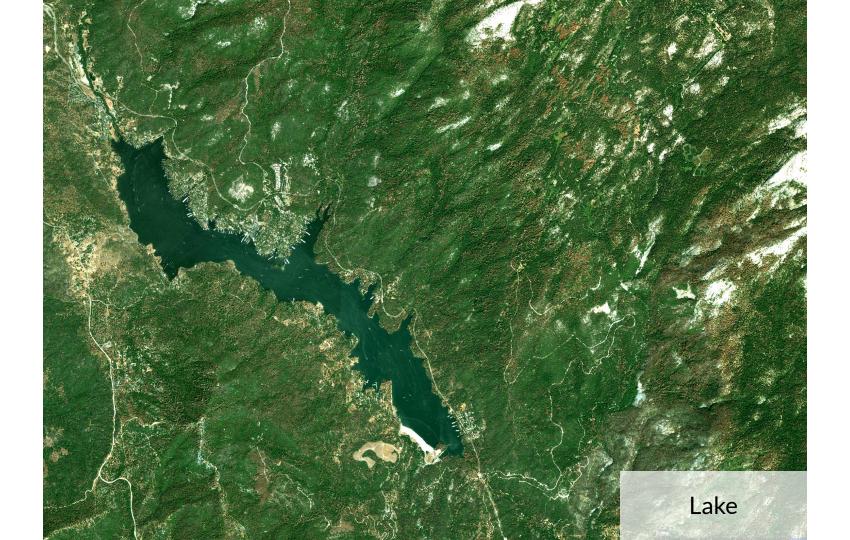


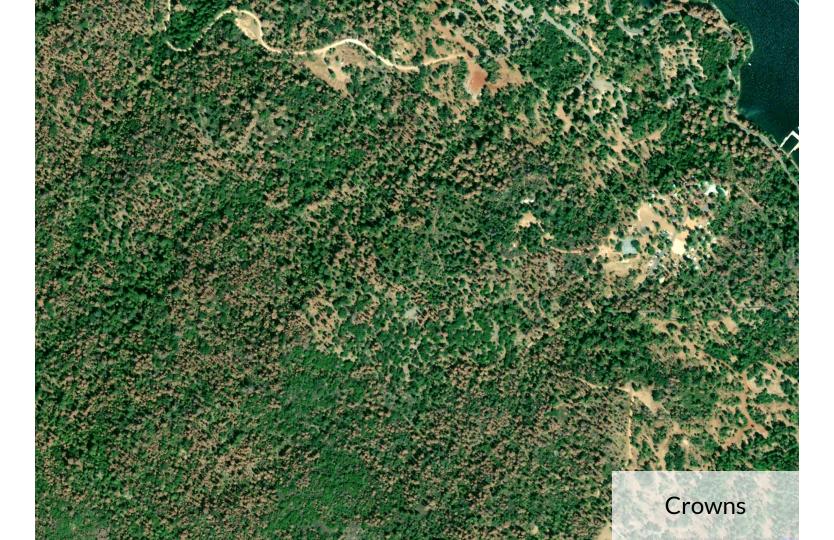


Bass lake & Sierra National Forest













# Our goal

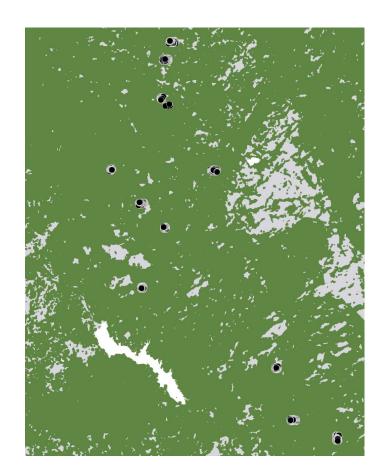
Create statewide maps of tree mortality from high resolution satellite imagery

## Our methods

- 1. Semi-supervised object-based image analysis
- 2. Deep-learning classification
- 3. Deep-learning regression

# Field data evaluation

Dead tree crowns	4,820
Area covered	70 ha
Elevation range	1346 - 2371 m
Year collected	Sept 2018



#### 1. Semi-supervised object-based image analysis

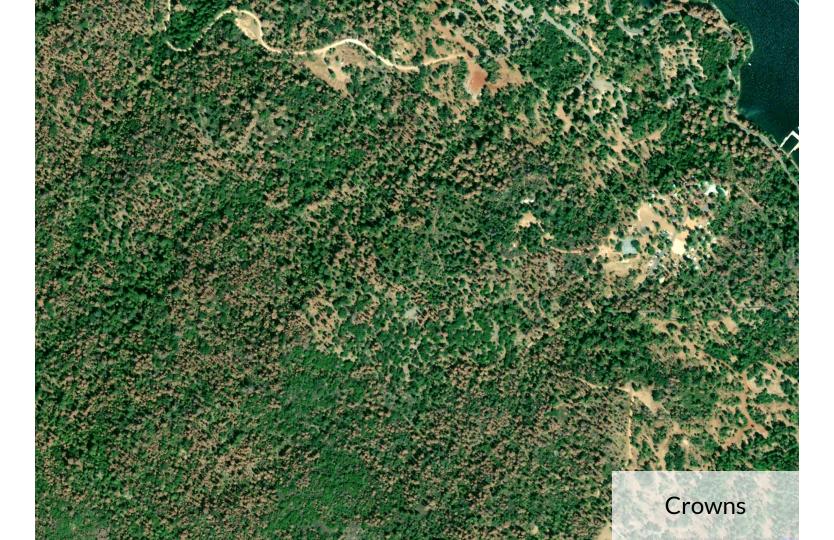
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- Resolution: 1 m<sup>2</sup>
- o Output: [ground, live tree, dead tree] classes

#### 2. Deep-learning classification

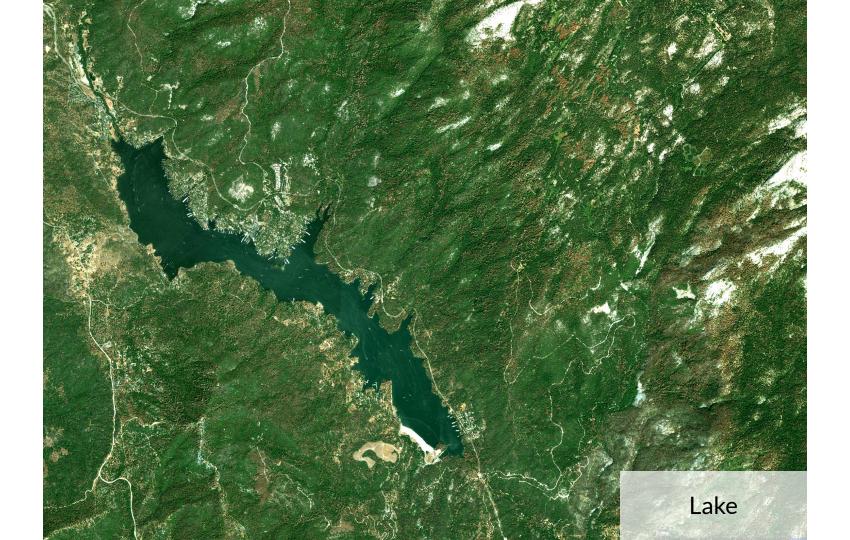
- o Input data: Planet
- o Resolution: 9 m<sup>2</sup>
- Output: [ground, live tree, dead tree] classes

#### 3. Deep-learning regression

- o Input data: Sentinel-1, Sentinel-2
- o Resolution: 100 m2
- o Output: % mortality (0-100)









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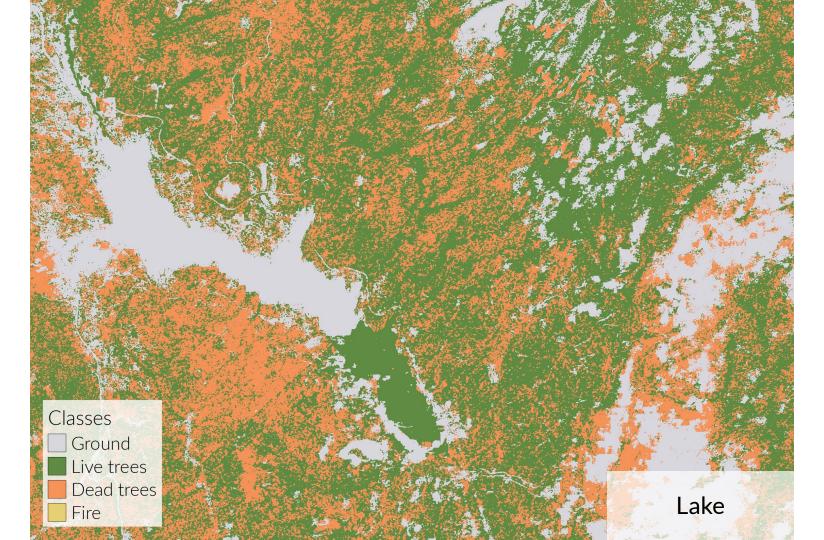
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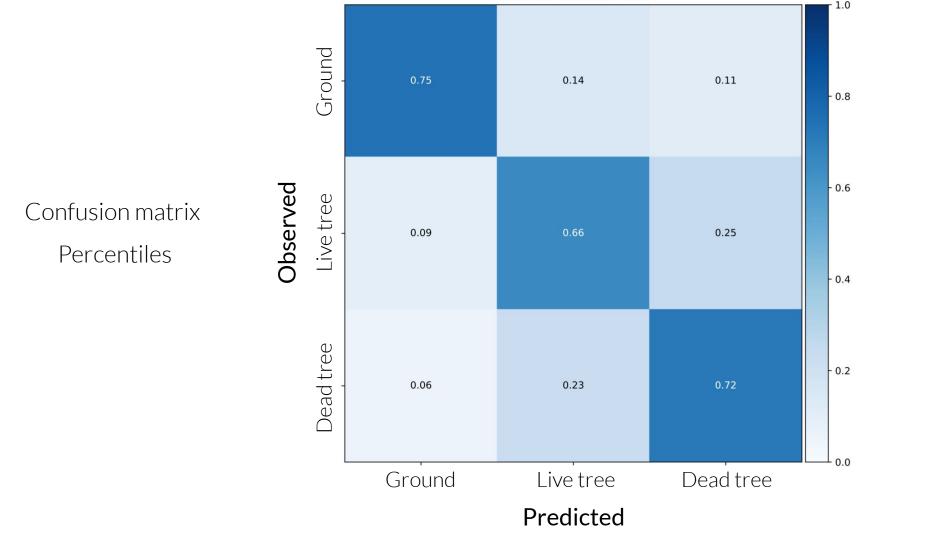
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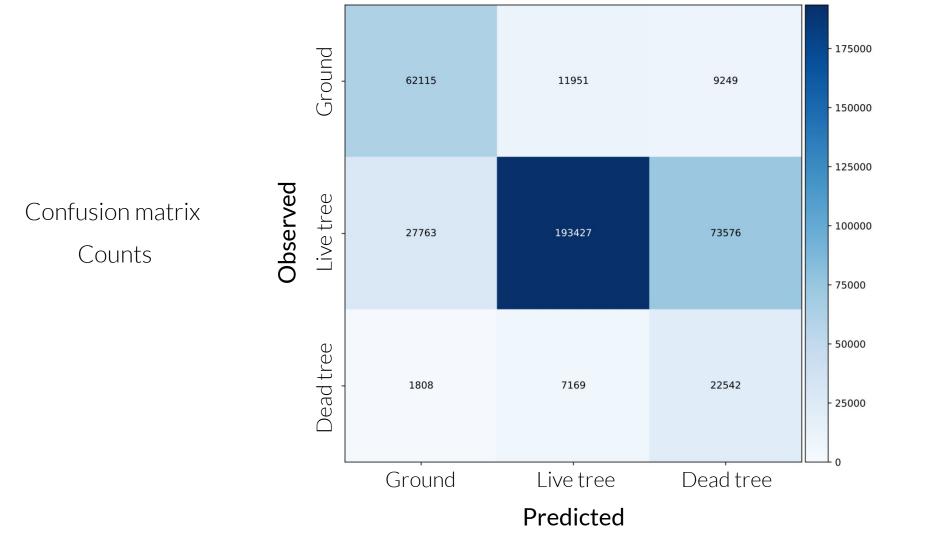
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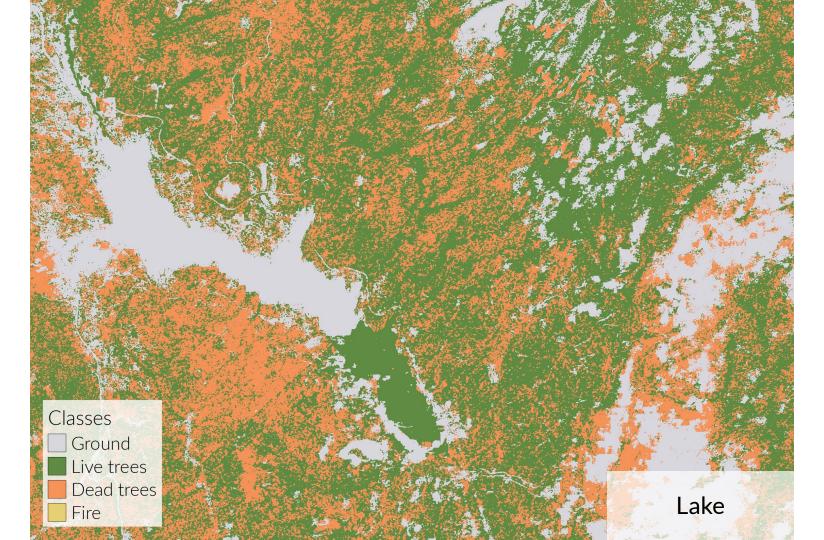


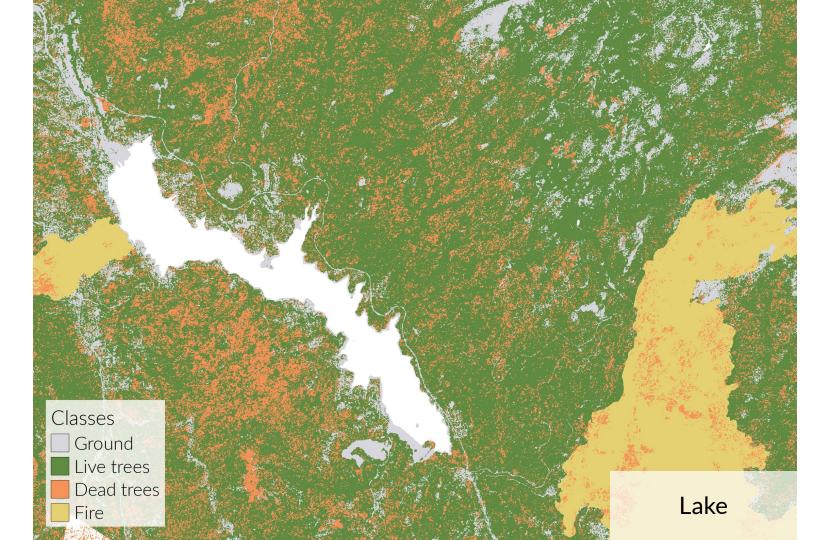












### Field data evaluation

#### from NAIP predictions

Accuracy score	0.619
AUC score	0.602
Precision	0.482
Recall	0.536

#### from Planet predictions

Accuracy score	0.687
AUC score	0.636
Precision	0.595
Recall	0.447









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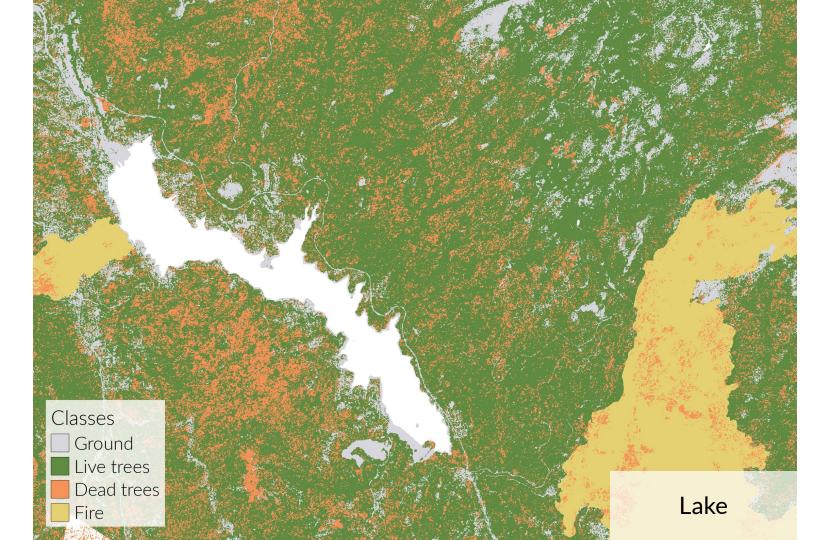
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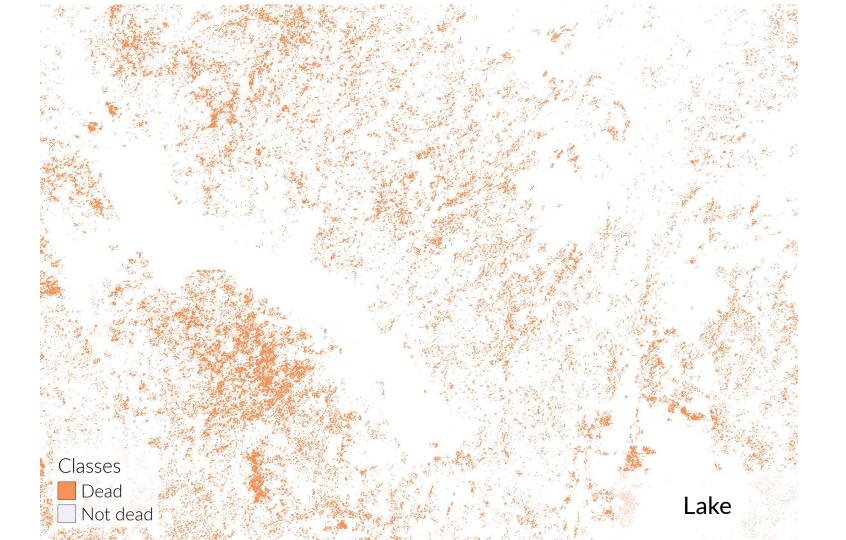
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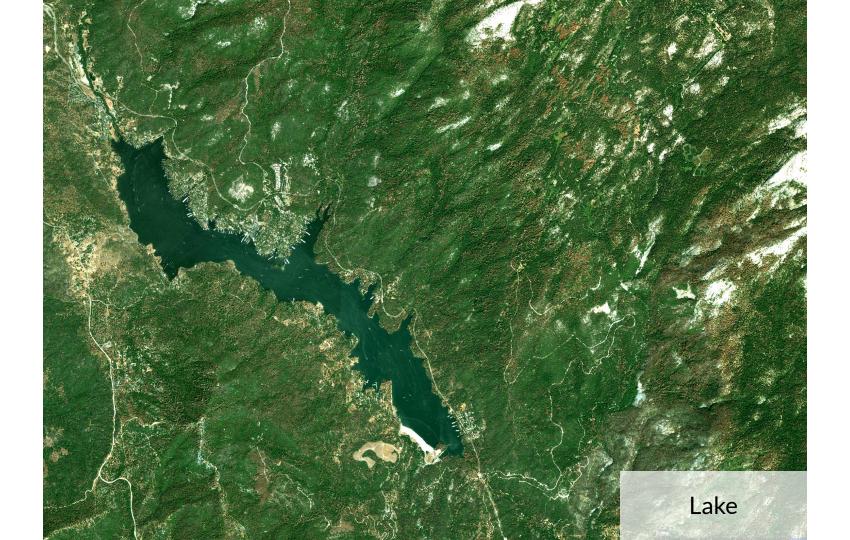
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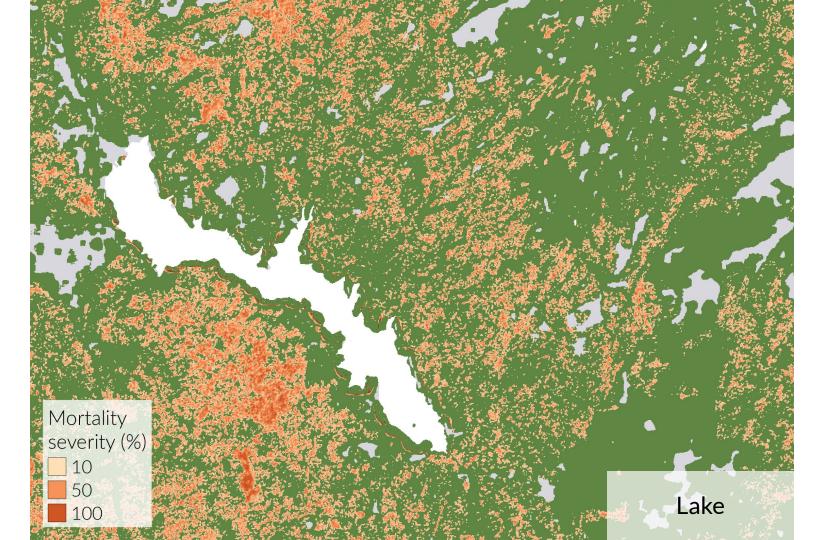
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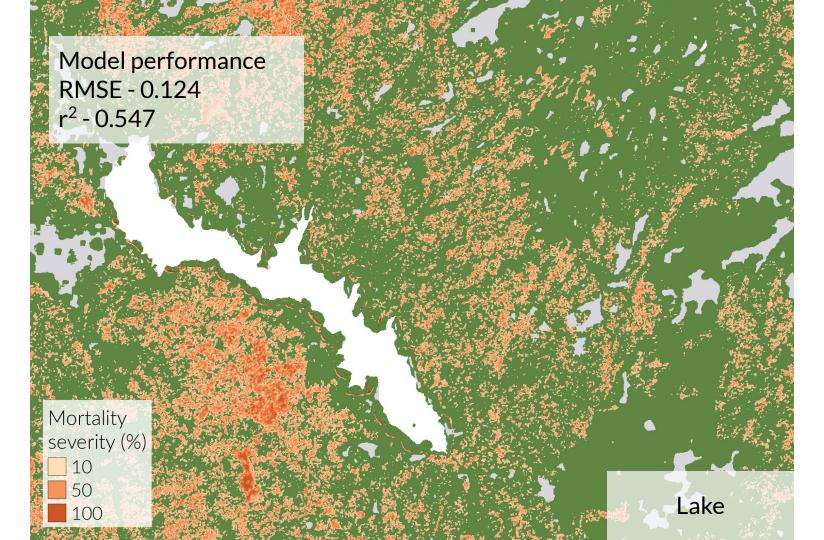
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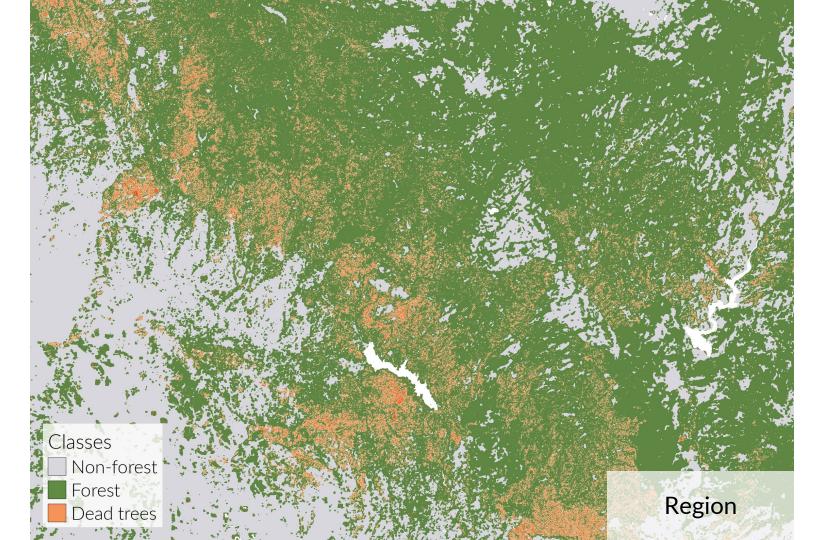




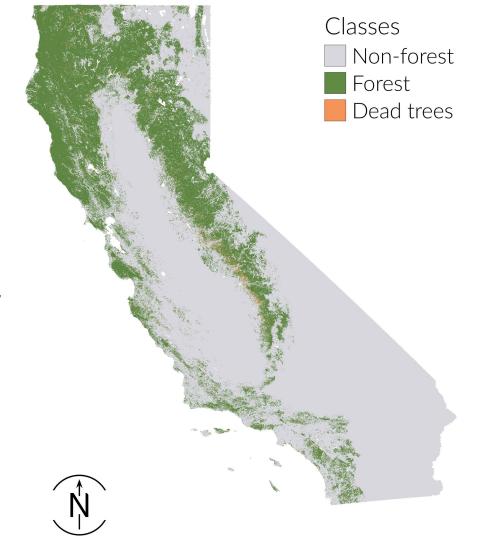








A statewide map of tree mortality from high resolution satellite imagery

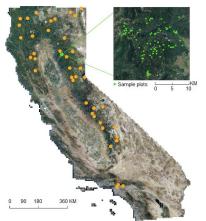


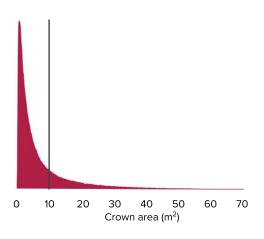
# But...

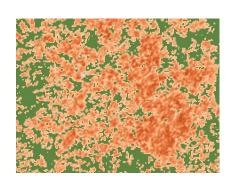
How many trees died?



Xu et al 2018, Remote Sensing of Environment







## Estimated Tree Mortality

USFS Salo

2015: 29 million

2016: 62 million

2015-2016: 70.5 million





## Thank you!

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