

DECISION SUPPORT FOR POST-FIRE FOREST RESTORATION

Solomon Dobrowski - University of Montana

Zack Holden – USFS RMRS

Marco Maneta – University of Montana

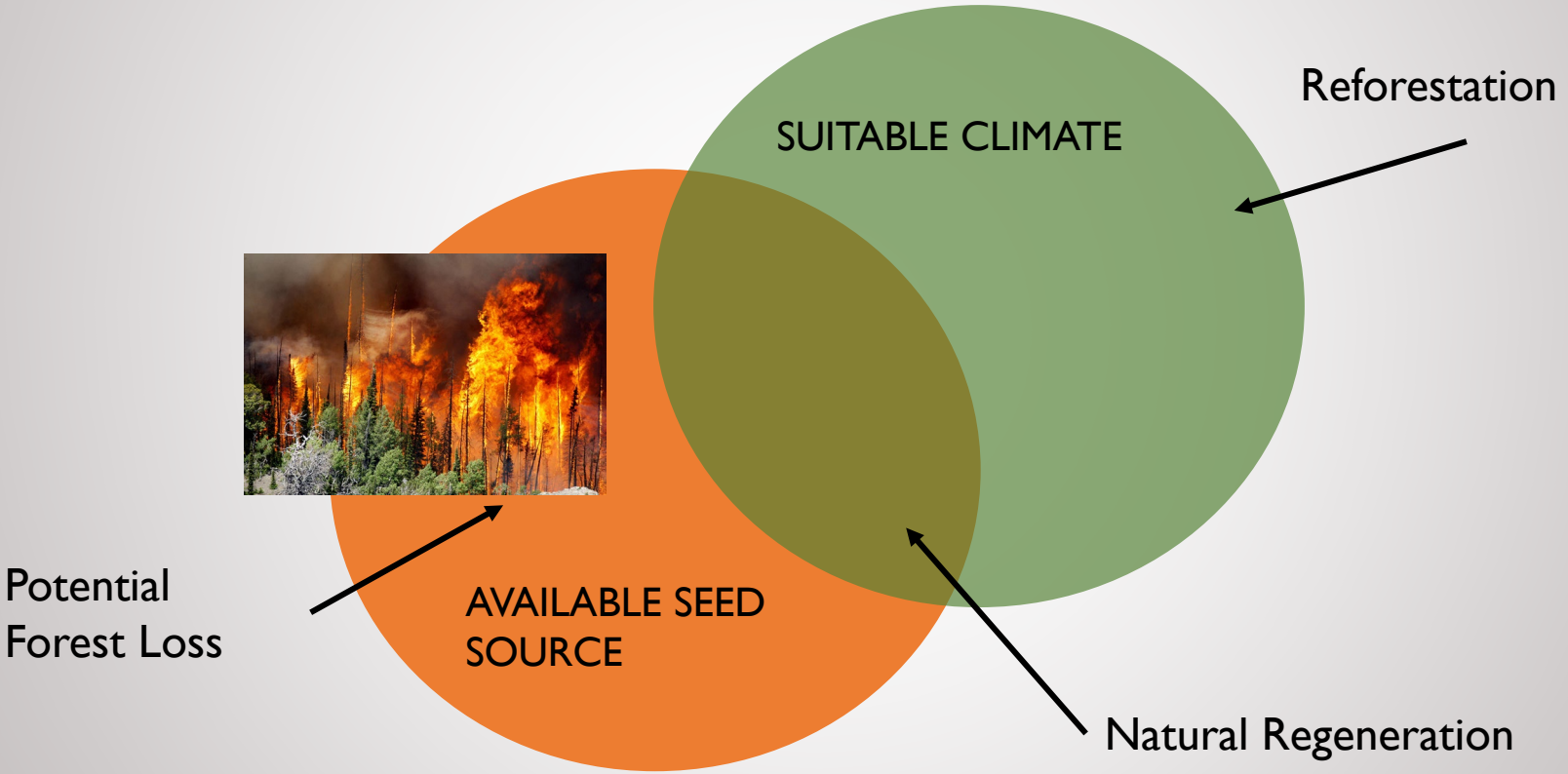


National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE



W.A. FRANKE
COLLEGE OF FORESTRY
AND CONSERVATION

REGENERATION



THE NEED



OPEN ACCESS

EDITED BY

Jose G. Borges,
University of Lisbon, Portugal

REVIEWED BY

Pete Bettinger,
University of Georgia, United States
David Ellison,
University of Bern, Switzerland

*CORRESPONDENCE

Solomon Z. Dobrowski
✉ solomon.dobrowski@umontana.edu

[†]These authors have contributed equally to this work and share first authorship

[‡]These authors share secondary authorship

[§]These authors share last authorship

RECEIVED 16 March 2024

ACCEPTED 02 May 2024

PUBLISHED 29 May 2024

CITATION

'Mind the Gap'—reforestation needs vs. reforestation capacity in the western United States

Solomon Z. Dobrowski^{1*†}, Matthew M. Aghai^{2†},
Ariella Chichilnisky du Lac^{3,4†}, Rebecca Downer^{2†},
Joseph Fargione^{5†}, Diane L. Haase^{6†}, Tyler Hoecker^{7,1†},
Olga A. Kildisheva^{5†}, Alix Murdoch^{5†}, Shaw Newman^{2†},
Malcolm North^{8†}, Phil Saksa^{4†}, Matt Sjöholm^{4†}, Tom Baribault^{2§},
Michele S. Buonanduci^{9,5§}, Marin E. Chambers^{10§},
Lisa Gonzales-Kramer^{2§}, Brian J. Harvey^{9§},
Matthew D. Hurteau^{11§}, Jonathan Loevner^{2§}, Hugh D. Safford^{12,7§}
and Joshua Sloan^{13§}

¹Department of Forest Management, University of Montana, Missoula, MT, United States, ²Mast Reforestation, Seattle, WA, United States, ³Doerr School of Sustainability, Stanford University, Stanford, CA, United States, ⁴Blue Forest, CA, United States, ⁵The Nature Conservancy, Arlington, VA, United States, ⁶United States Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ⁷USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ⁸USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ⁹USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ¹⁰USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ¹¹USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ¹²USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States, ¹³USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA, United States

THE TASK

Develop a suite of geo-spatial products to inform reforestation efforts

Leverage these products to develop a decision support tool for reforestation decision making

WHAT LIMITS REGENERATION?

Available Seeds
Heat/Drought Stress

LETHAL SURFACE TEMPERATURES

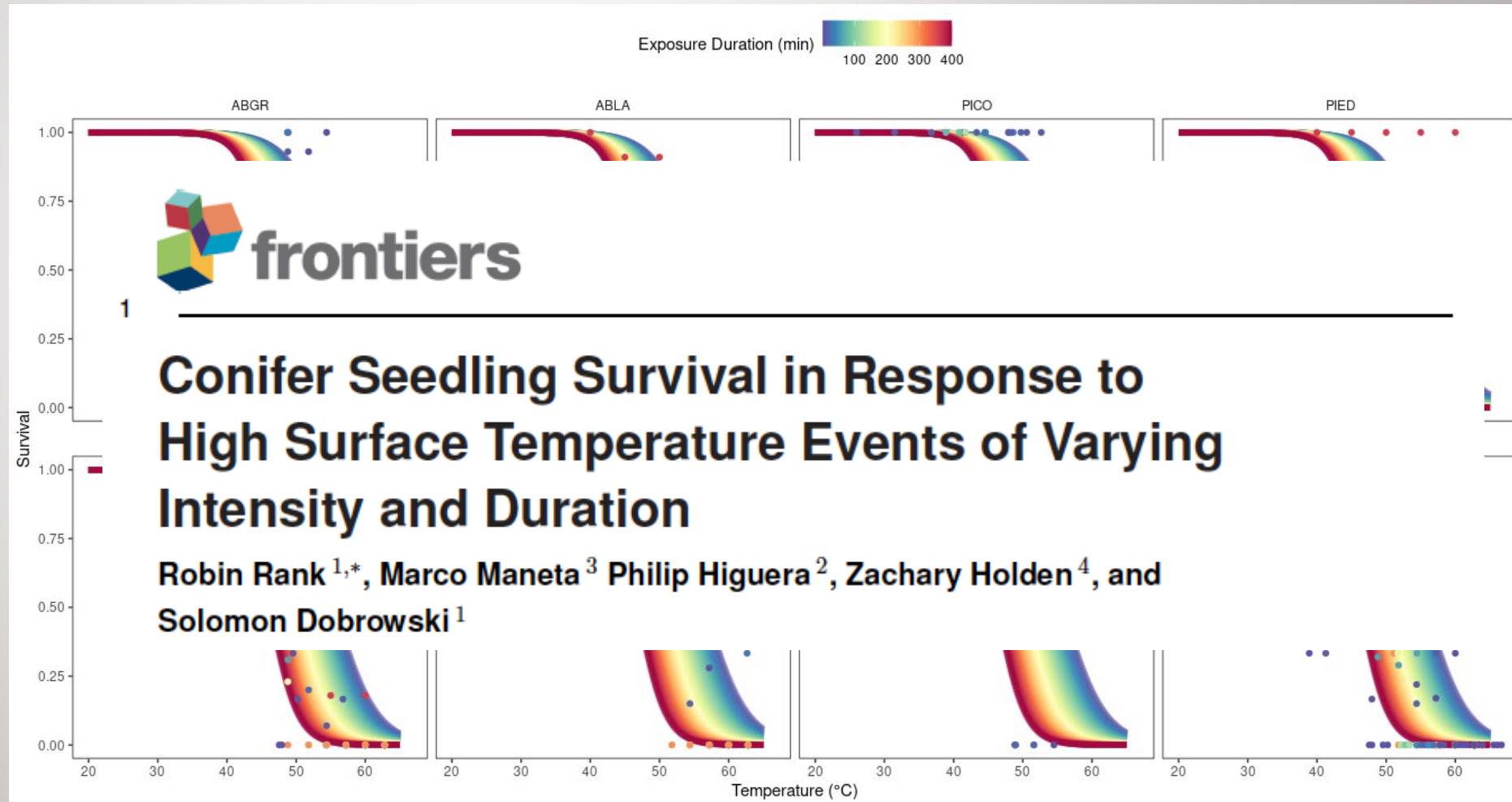
- Very brief exposure to high surface temperature can kill conifer seedlings
- Cambial damage and girdling;



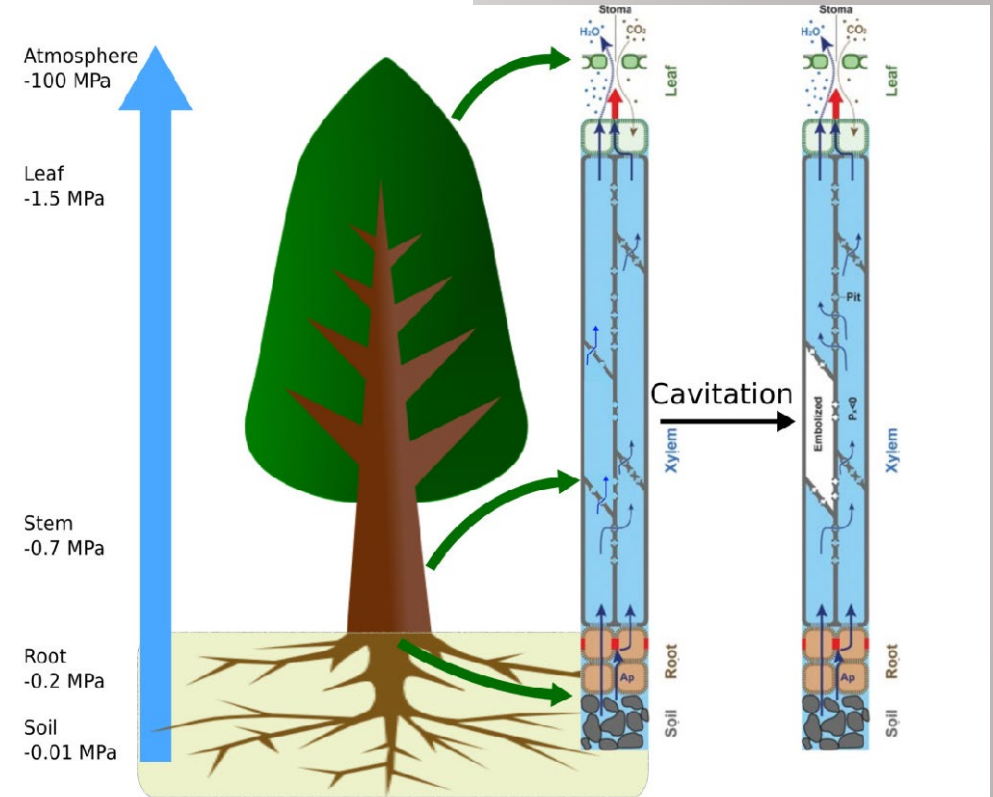
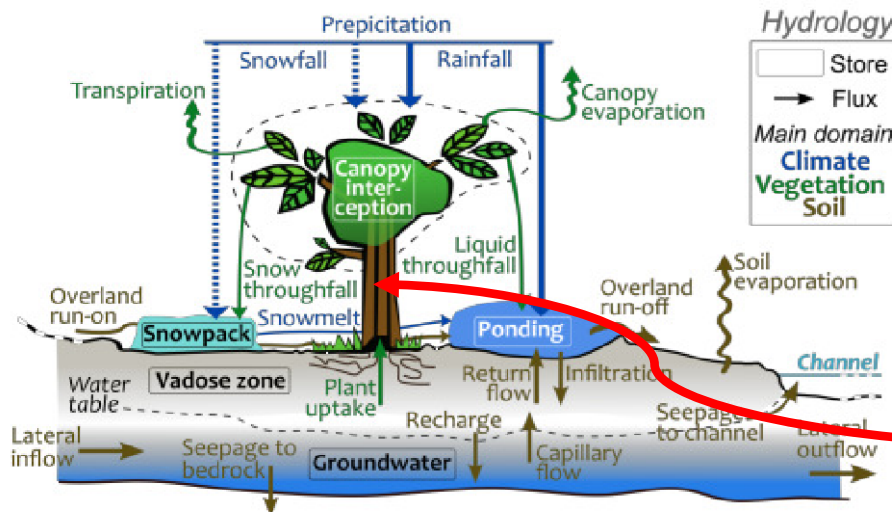
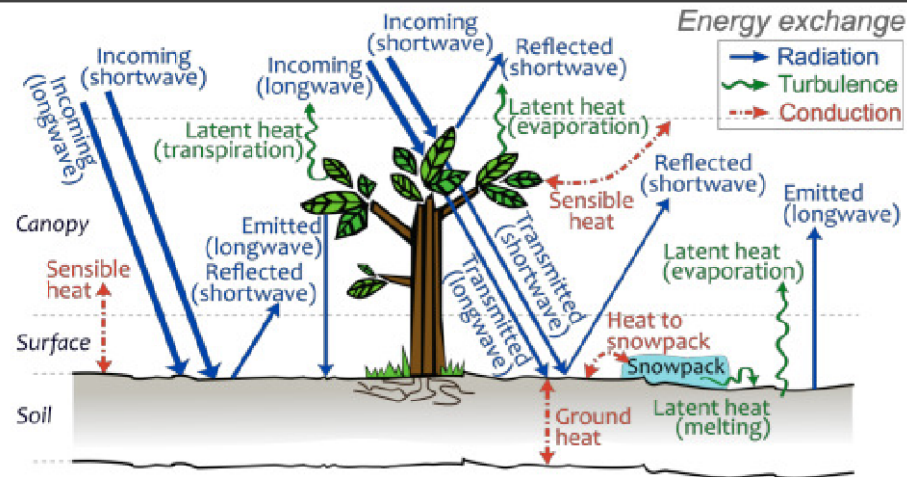
SOIL SURFACE TEMPERATURE (SST)

Time-dose response model of seedling survival

- Data derived from historical experiments
- Seedlings exposed to varying temperatures, durations
- Bayesian survival model fit using these data



ECOHYDROLOGICAL MODELING (ECH₂O)



Modified from Taiz 2nd edition and Venturas et al. 2017

(Maneta and Silverman 2013, figure from Kuppel et al., 2018)

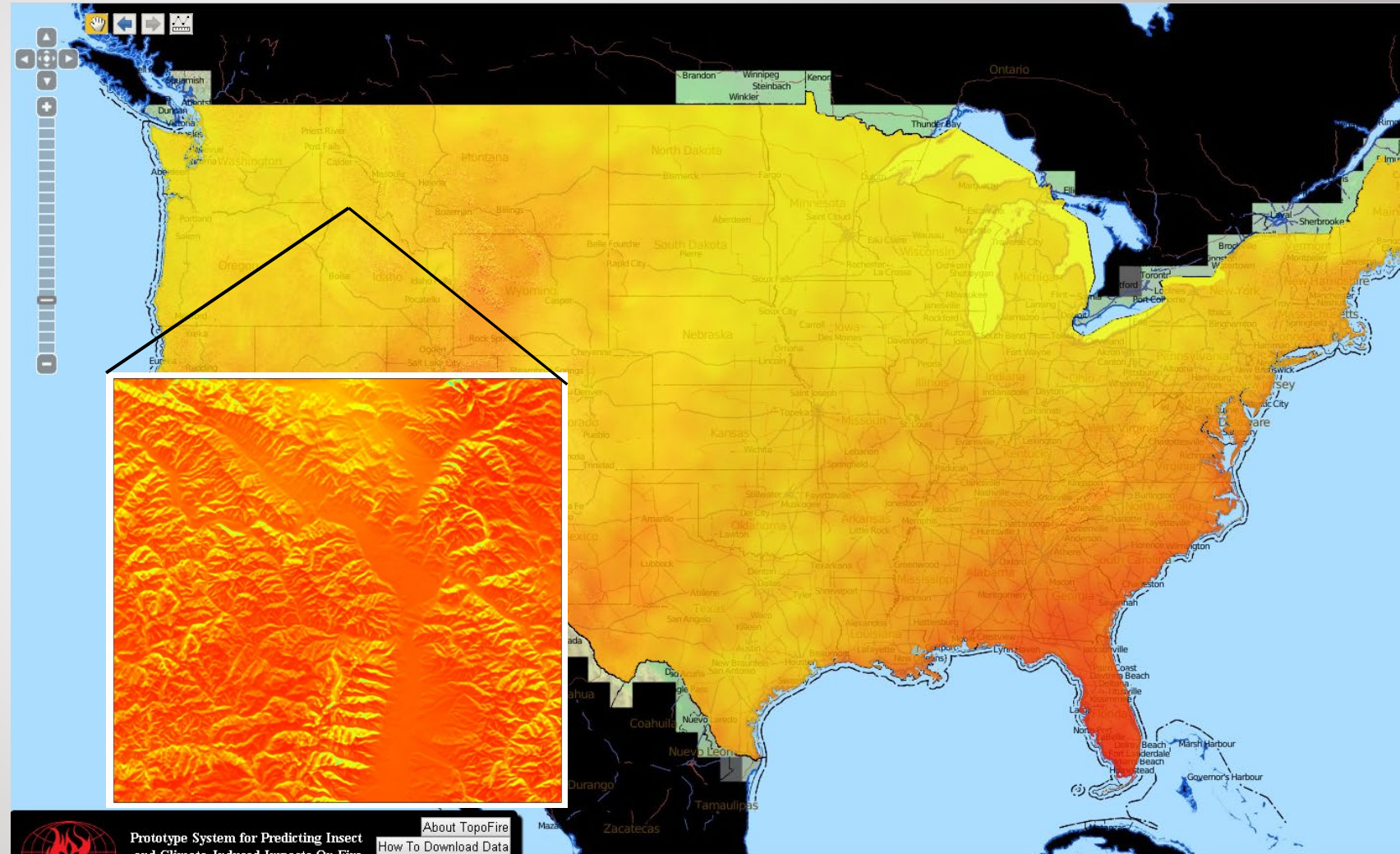
HIGH RESOLUTION WEATHER GRIDS ENABLE ASPECT-RESOLVING HYDROLOGIC MODELING

NASA A.35 WILDFIRE APPLICATIONS FUNDING (P.I. Z. HOLDEN)

Historical daily (1979-present)

250 meter resolution grids

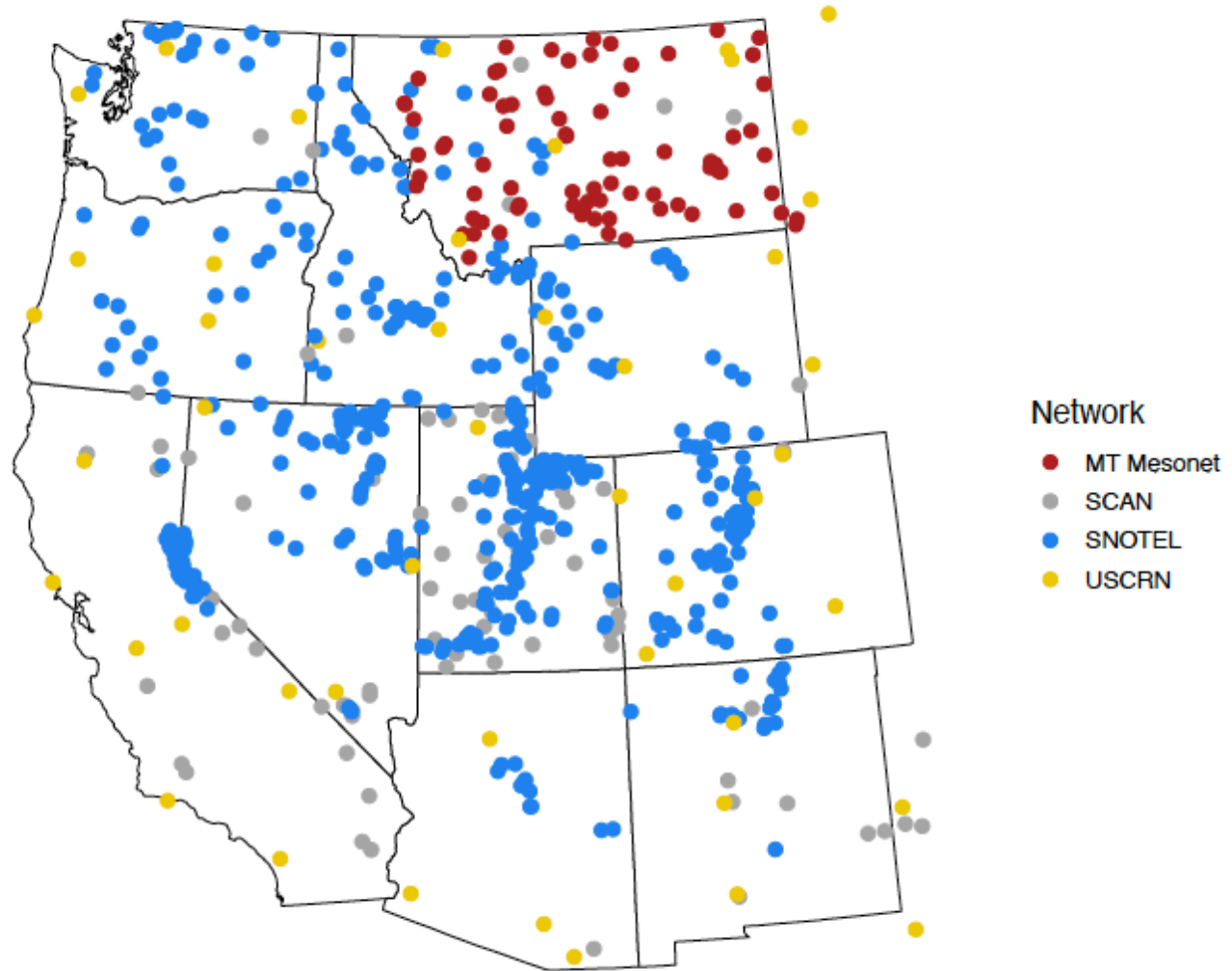
- Minimum temperature
- Maximum temperature
- Dewpoint temperature
- Minimum relative humidity
- Maximum relative humidity
- Shortwave radiation



 Prototype System for Predicting Insect and Climate-Induced Impacts On Fire Hazard in Complex Terrain

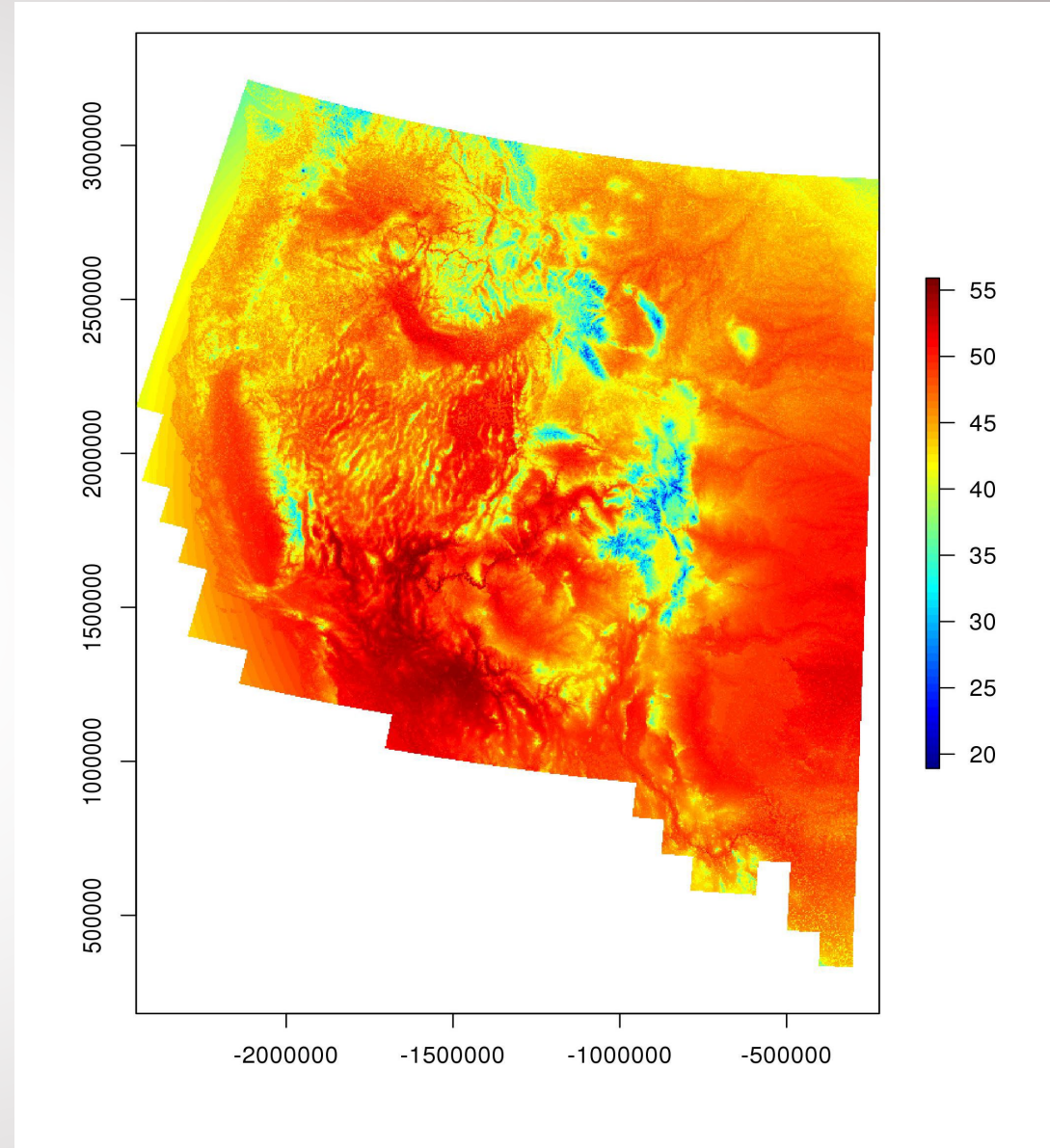
[About TopoFire](#)
[How To Download Data](#)
[Publications](#)

ECOHYDROLOGICAL MODELING

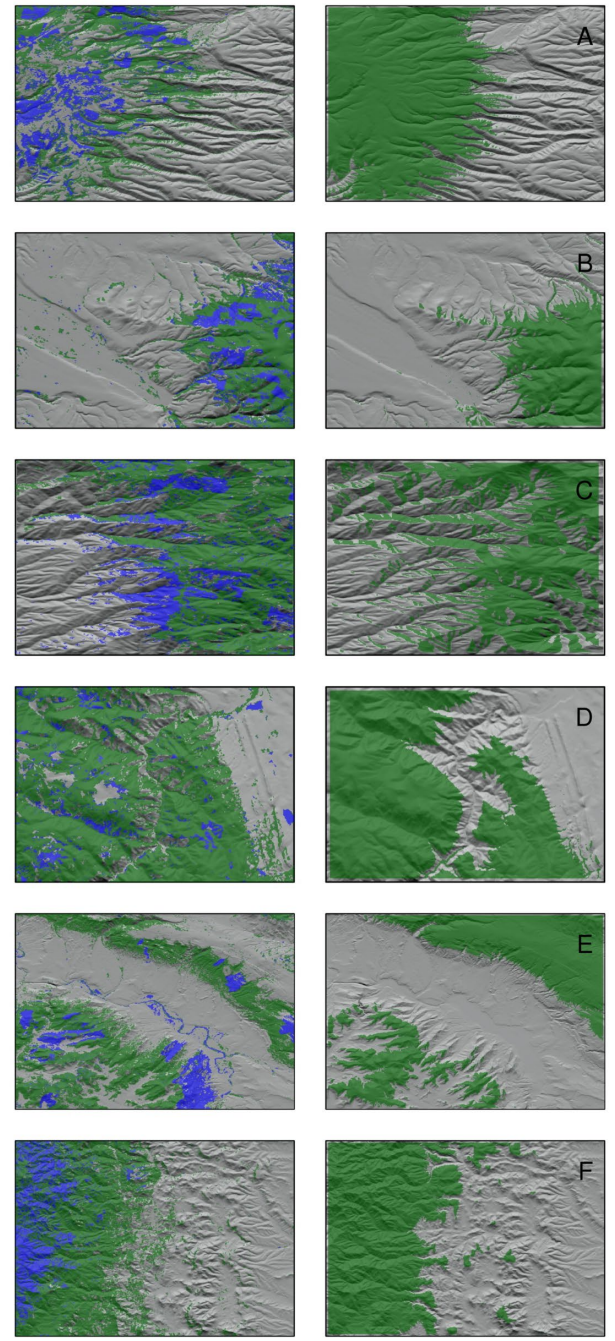
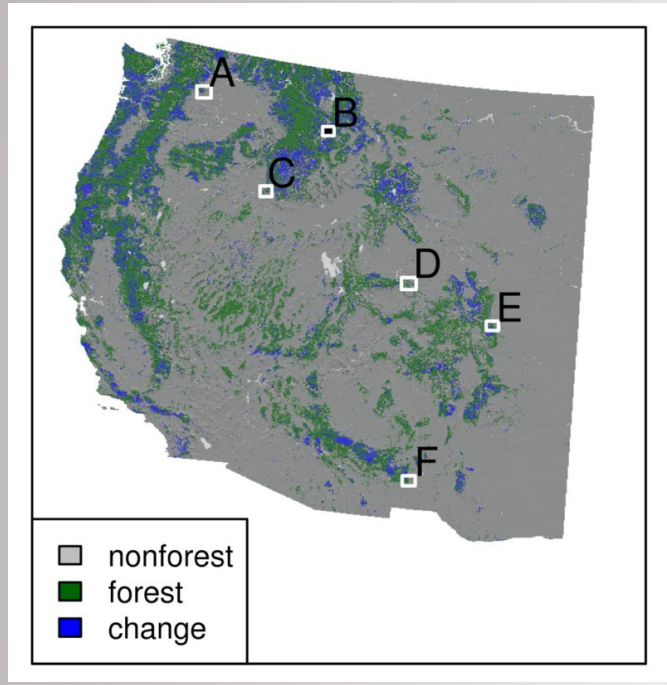


POTENTIAL SOIL SURFACE TEMPERATURE (P-SST)

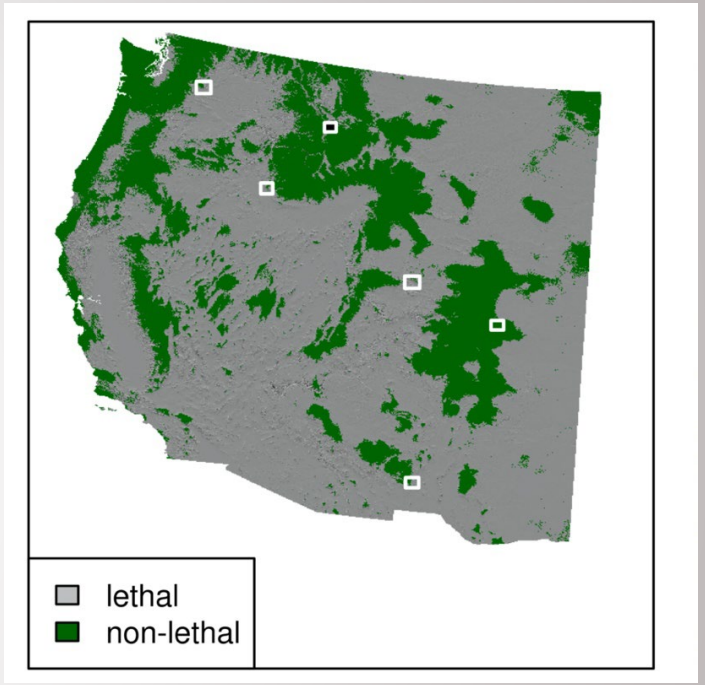
- Maximum SST in absence of overstory
- Simulated 3 hourly timestep between 1980-2017 for a bed of 2 inch ponderosa pine seedlings
- Future (2050) simulations for 5 GCMs



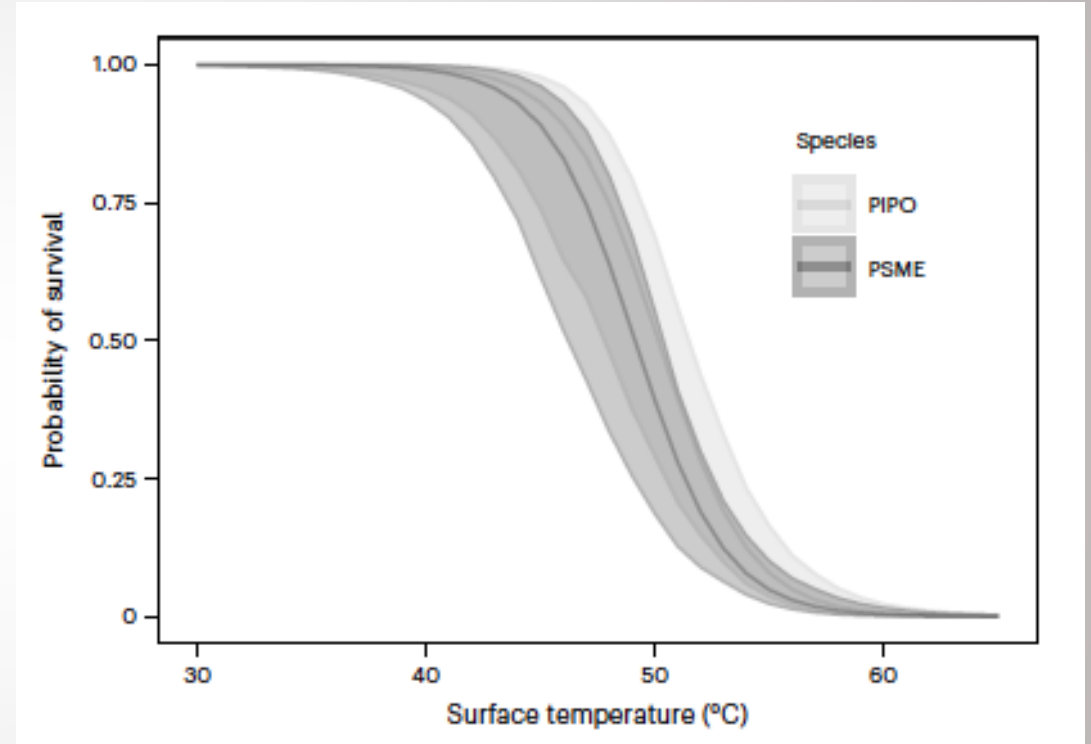
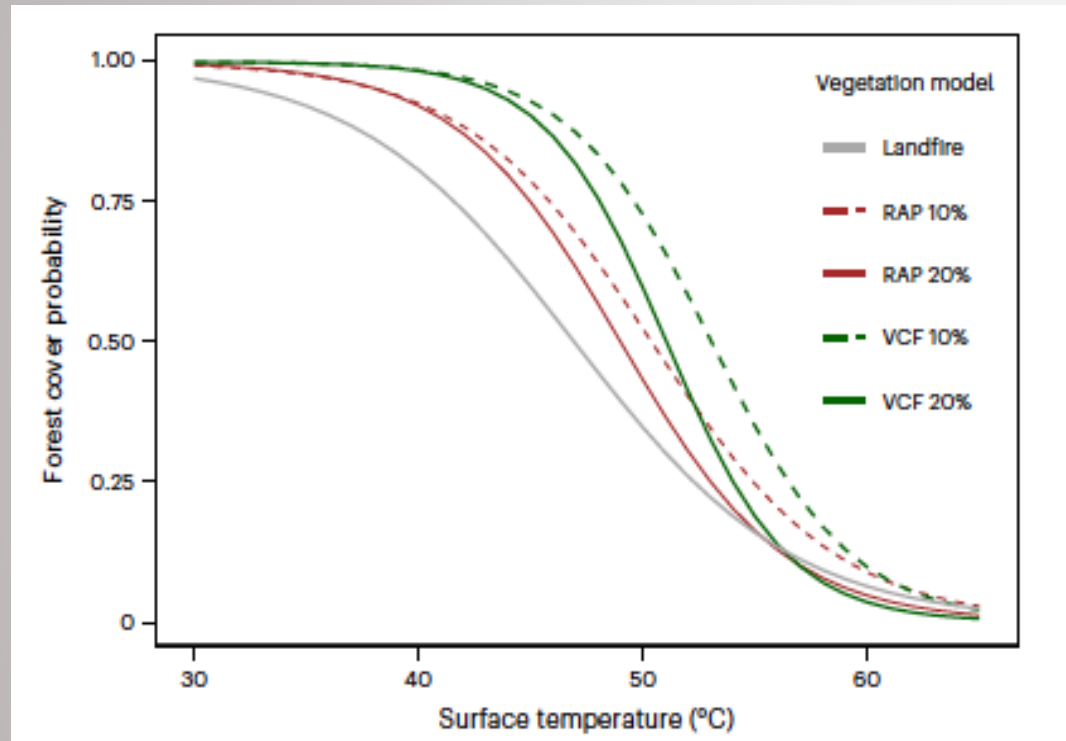
Observed



Predicted



SOIL SURFACE TEMPERATURE (SST)




Low-elevation forest extent in the western United States constrained by soil surface temperatures

Received: 17 December 2023

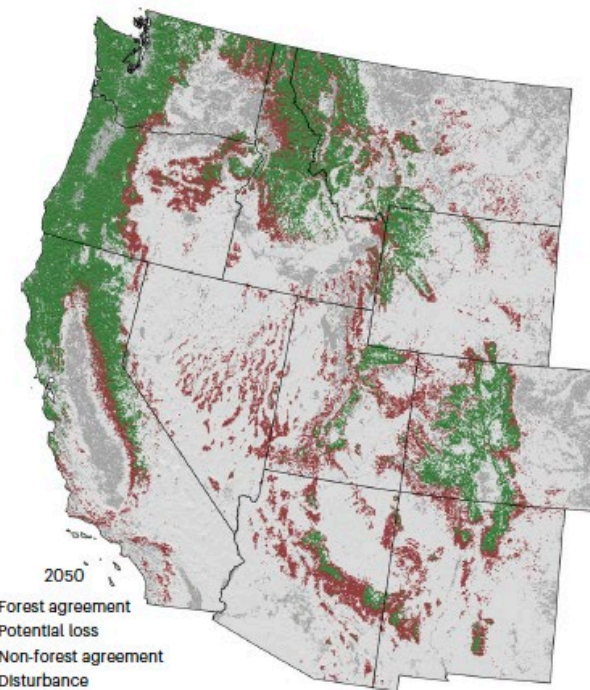
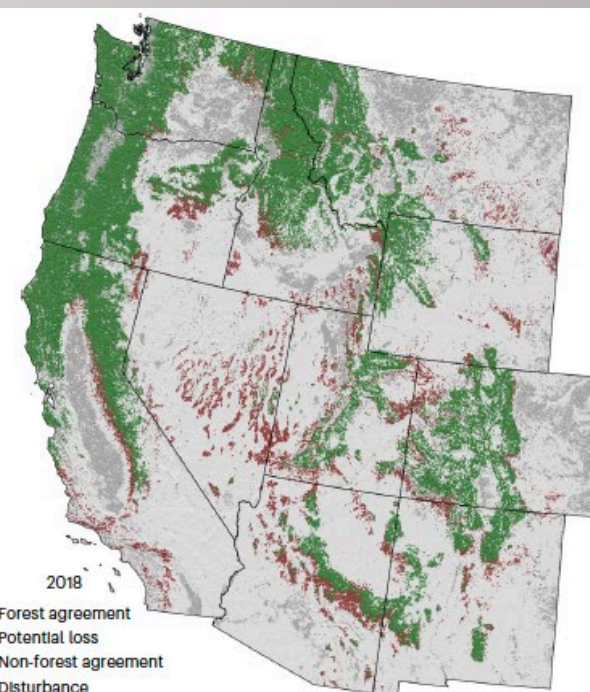
Accepted: 29 September 2024

Published online: 19 November 2024

 Check for updates

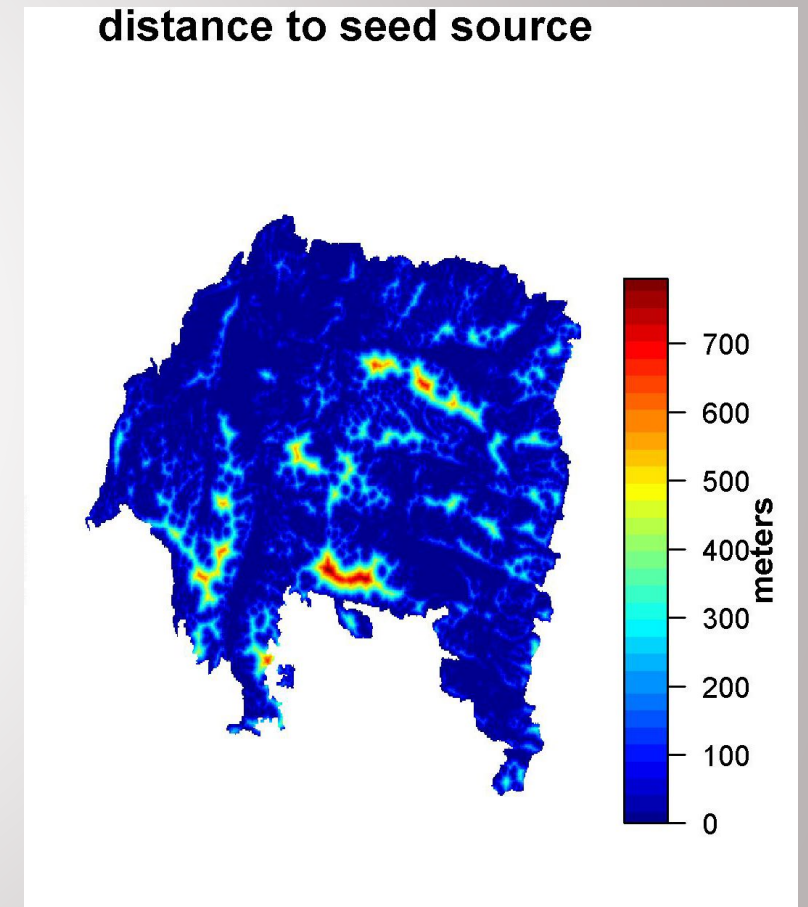
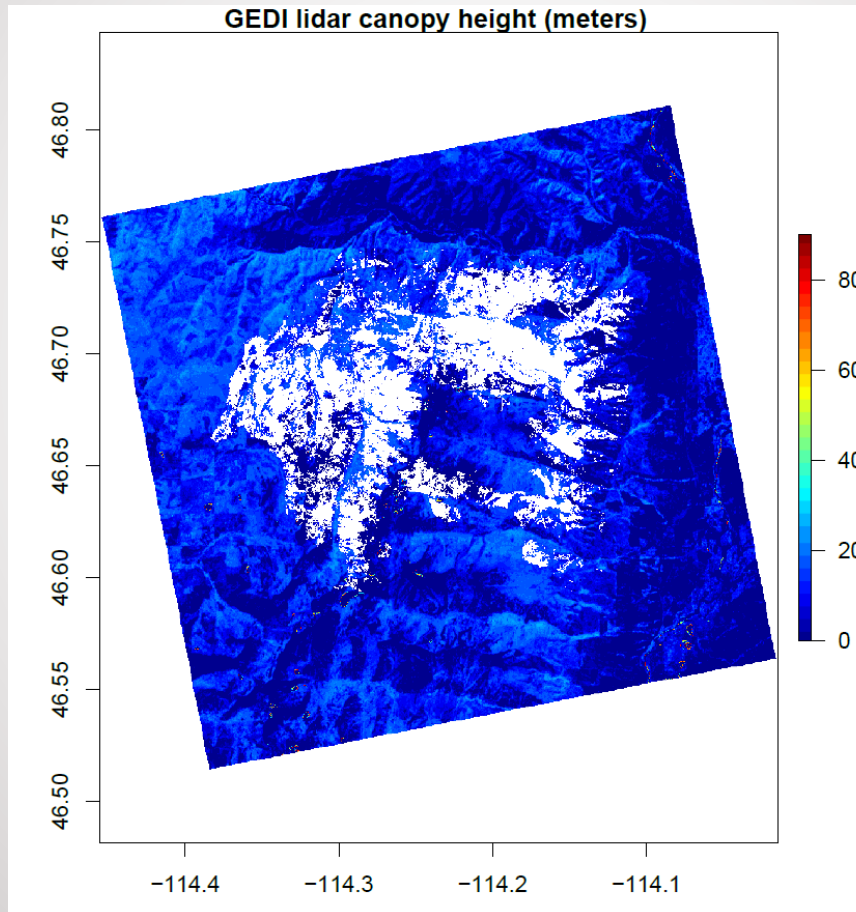
Zachary A. Holden¹✉, Solomon Z. Dobrowski², Alan Swanson³,
Zachary Hoylman^{2,4}, Drew Lyons⁵, Allen Warren³ & Marco Maneta⁶

Climate change and disturbance threaten forested ecosystems across the globe. Our ability to predict the future distribution of forests requires understanding the limiting factors for regeneration. Forest canopies buffer against near-surface air temperature and vapour pressure deficit extremes,



SEED SOURCES

- Combine 30m GEDI lidar height data with 30m RAP forest cover

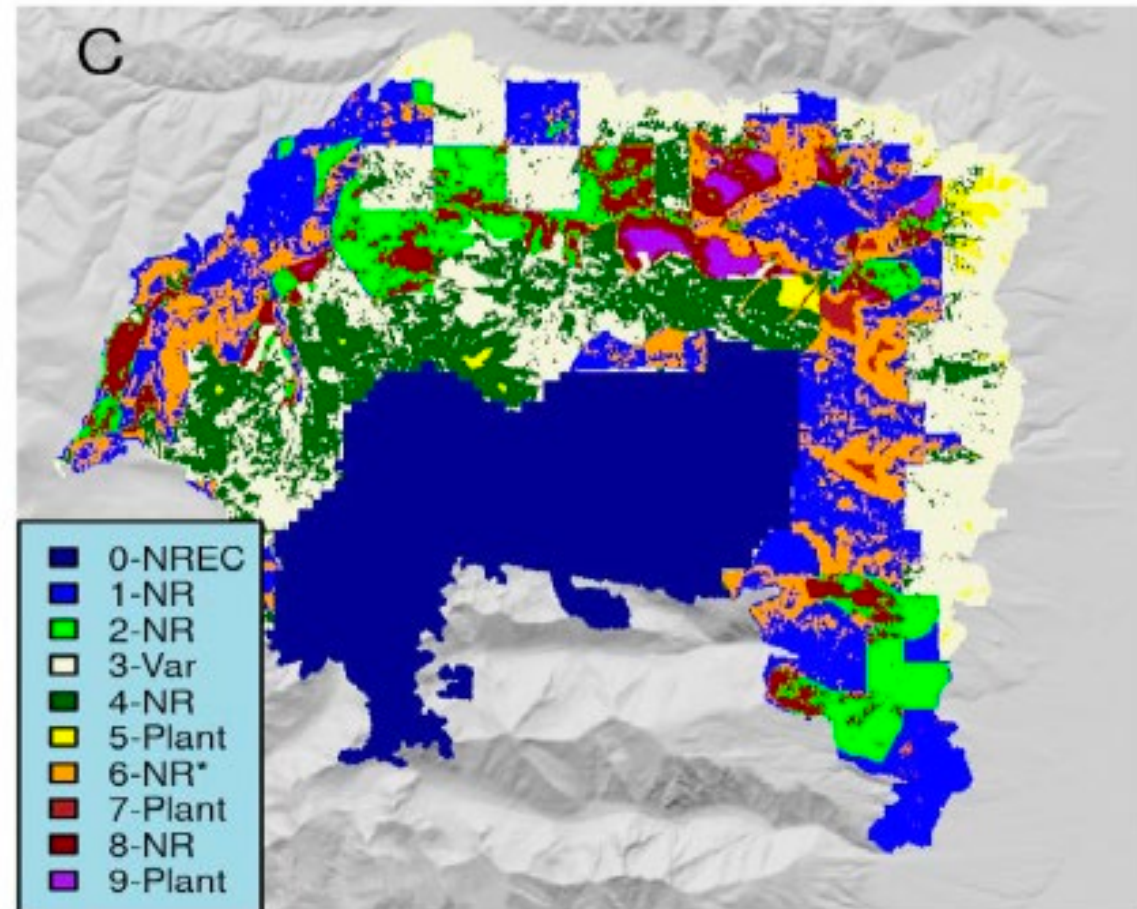


WHAT LIMITS REFORESTATION?

Administrative constraints
Resources (cost vs benefit)

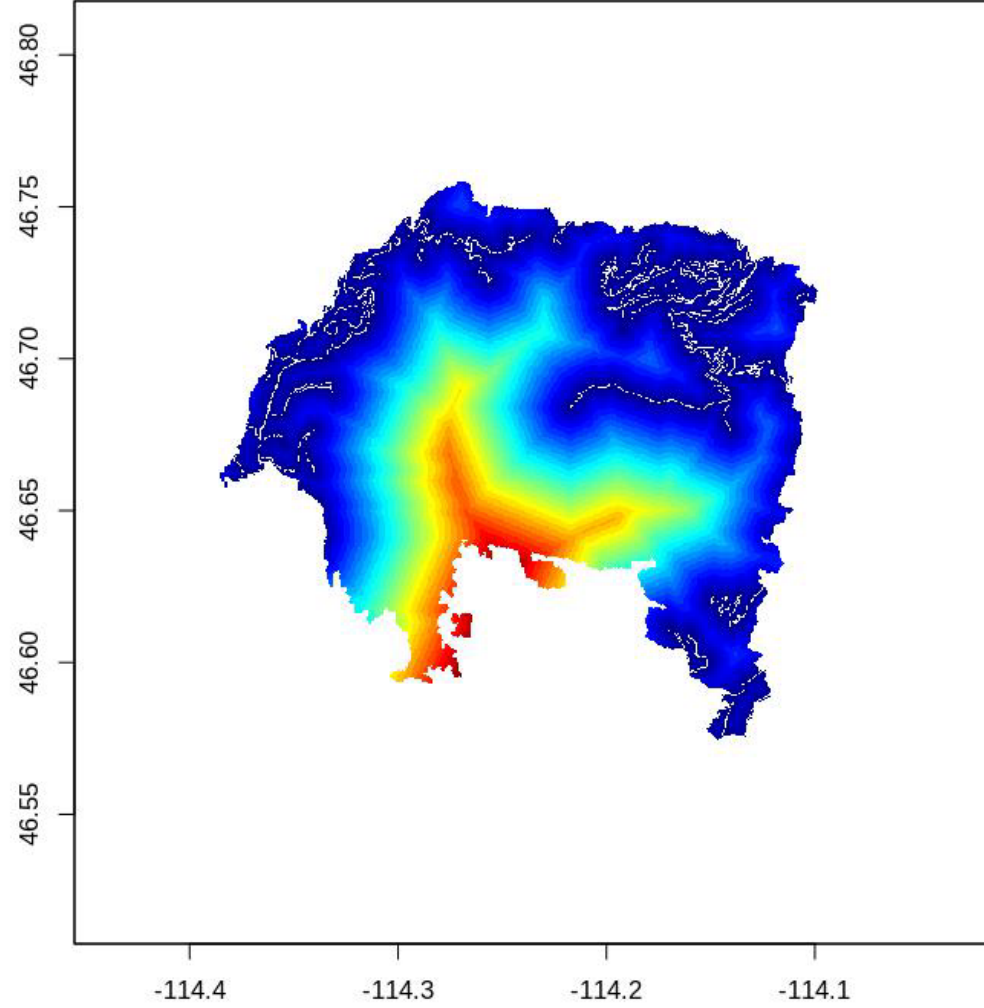
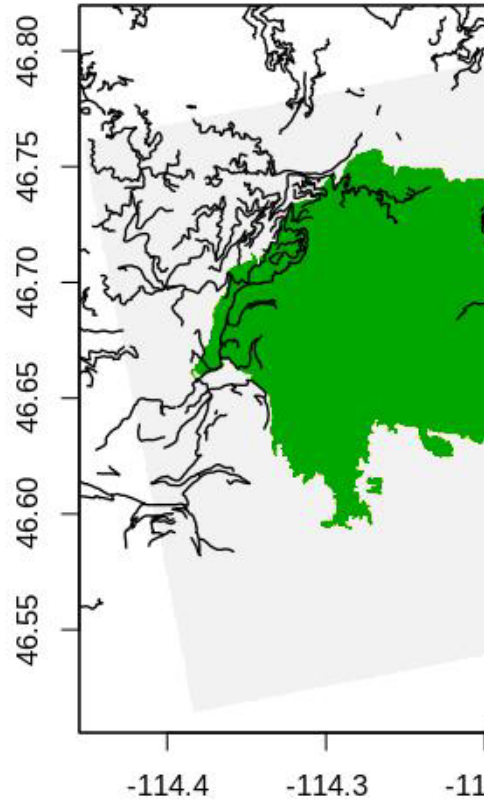
USFS ADMINISTRATIVE PRIORITIES

- FACTS database: Forest Activity Tracking System
- Tabular and spatial tracking of all activities on USFS lands

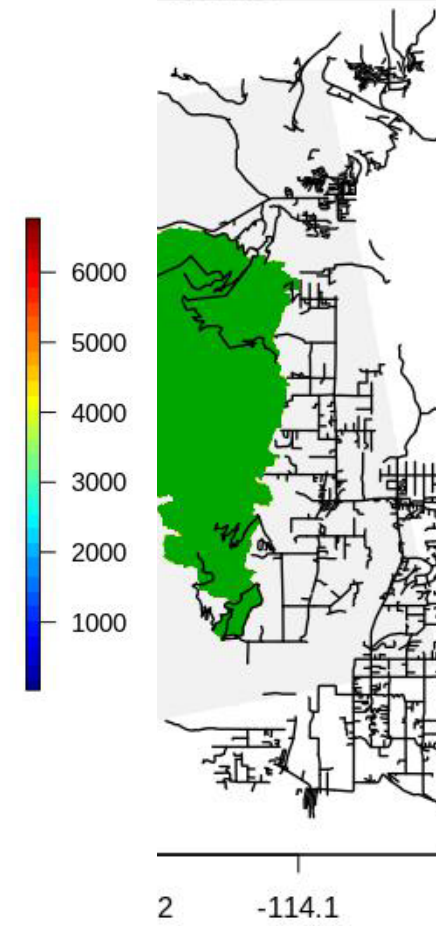


COSTS

USFS Road



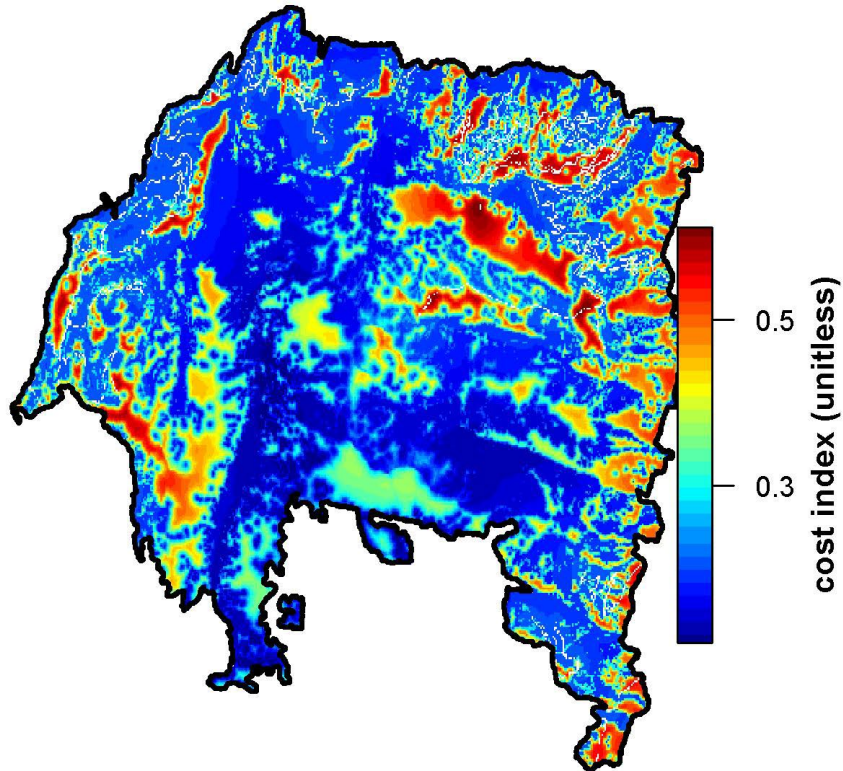
Roads



COST/BENEFIT

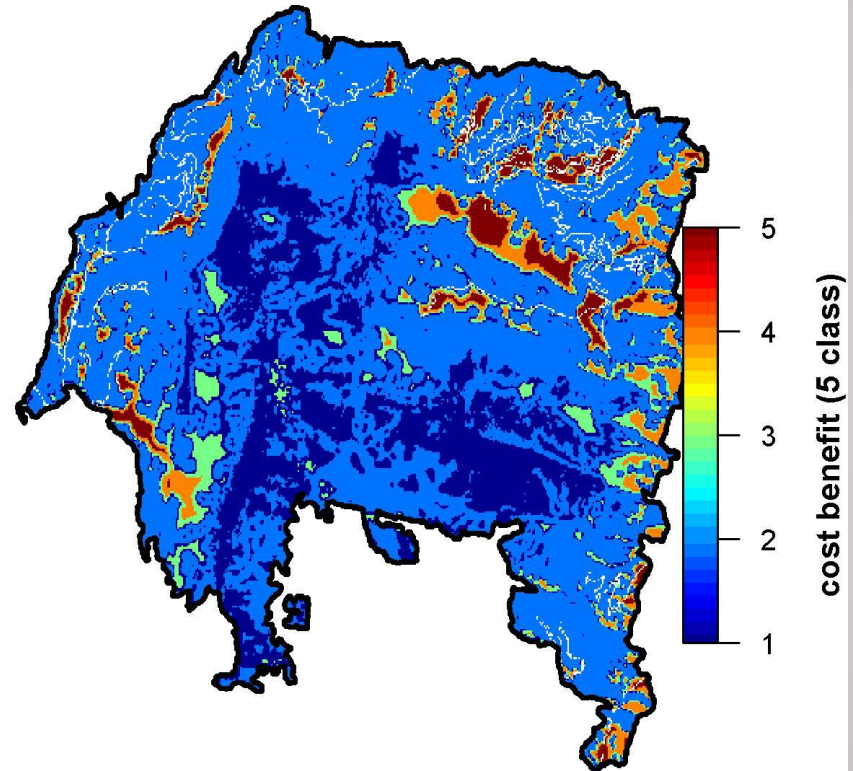
cost-benefit index

cost_index.tif



cost-benefit clusters

cost_cluster_5class.tif



HTTPS://ORTHANC.DBS.UMT.EDU/REGENMAPPER

alpheus.dbs.umt.edu

Google Docs

Topofire -- Regeneration Mapper

Montana Upload File

Show 50 entries Search: LOL

| gid | fire_id | fire_name | year | start_month |
|-------|-----------------------|------------|------------|-------------|
| 2365 | MT4675911417619880825 | LOLO CREEK | 1988-08-25 | 8 |
| 26268 | MT4667411426820170715 | LOLO PEAK | 2017-07-15 | 7 |

Showing 1 to 2 of 2 entries (filtered from 28,819 total entries) Previous 1 Next

Blue Mountain

Lolo Peak

St. Joseph Peak

St. Mary Peak

Ranger Peak

Stevensville

Lee Metcalf National Wildlife Refuge

McClain

Carlton

Florence

McClain

Miller Creek

Southgate Triangle

Lee Metcalf National Wildlife Refuge

Stevensville

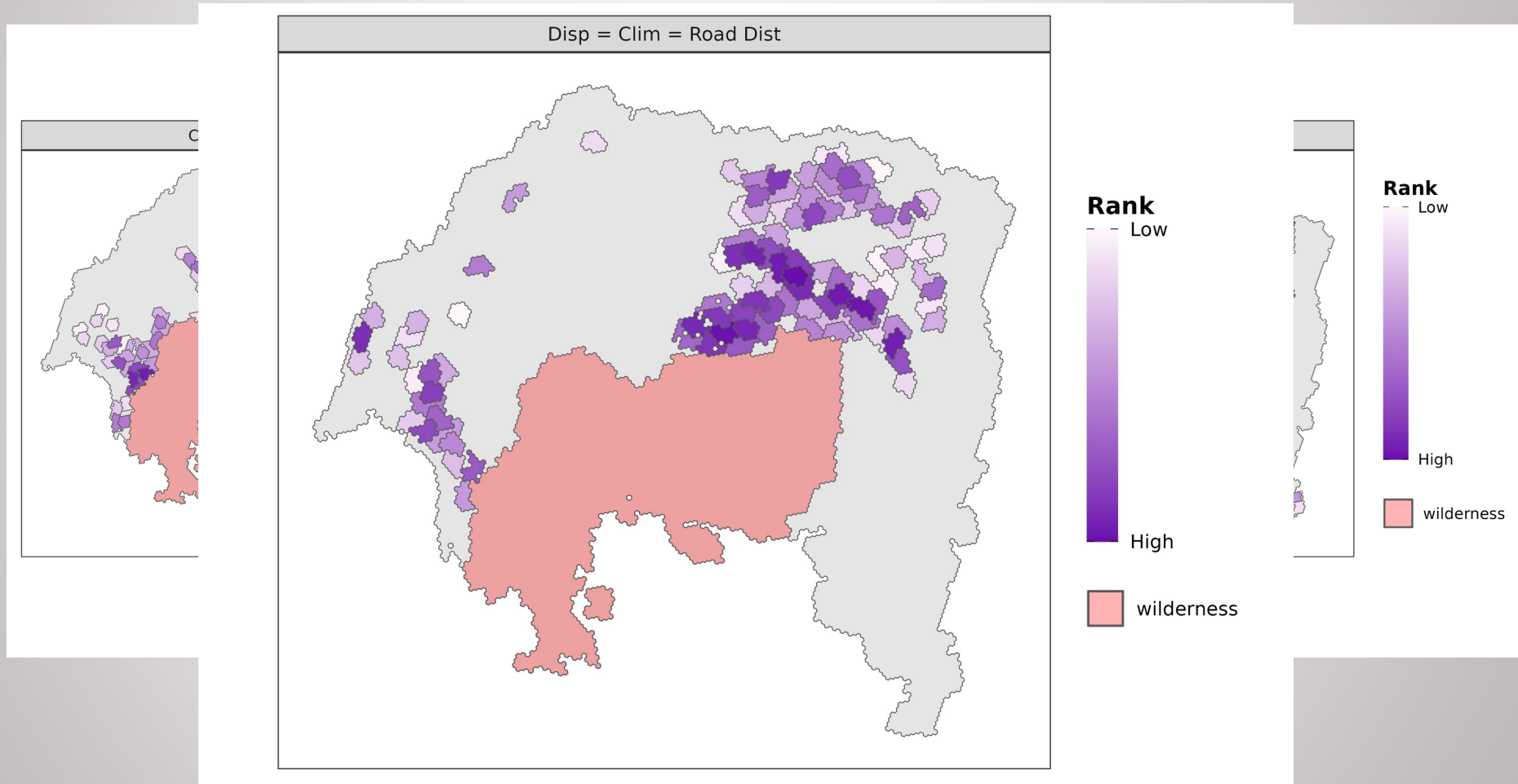
St. Mary Peak

Ranger Peak

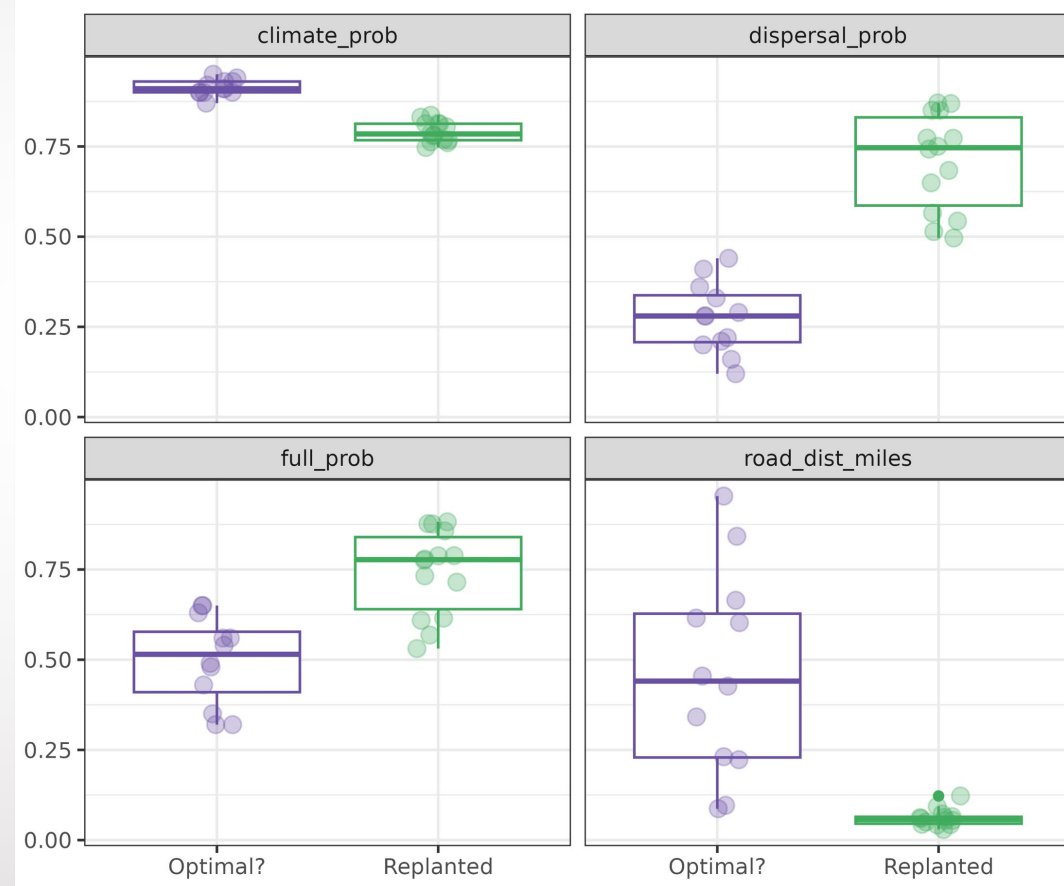
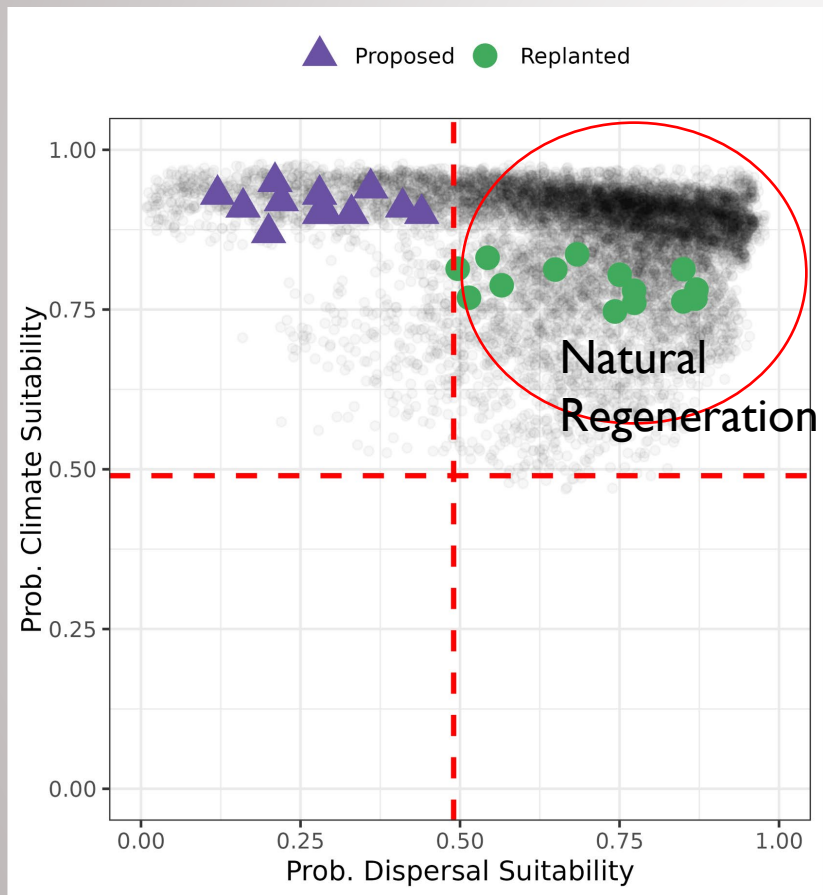
IDAHO MONTANA

IDAHO

SPATIAL OPTIMIZATION (IN THE WORKS)



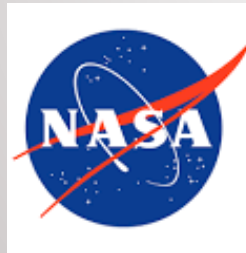
OPTIMAL PLANTING?



THANK YOU

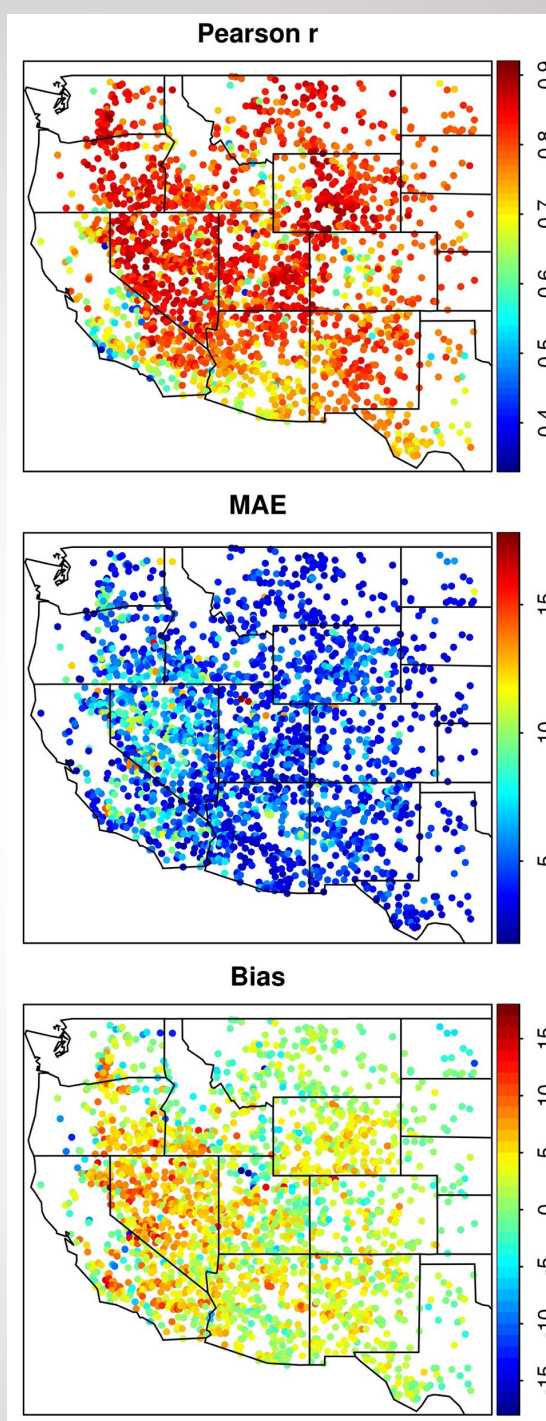


National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE



POTENTIAL SOIL SURFACE TEMPERATURE (P-SST)

Comparisons against
MODIS LST and MODIS
VCF data



REGENMAPPER WORKFLOW OVERVIEW

