CURRENT DEVELOPMENTS FOR MAPPING LIFE FUEL MOISTURE CONTENT

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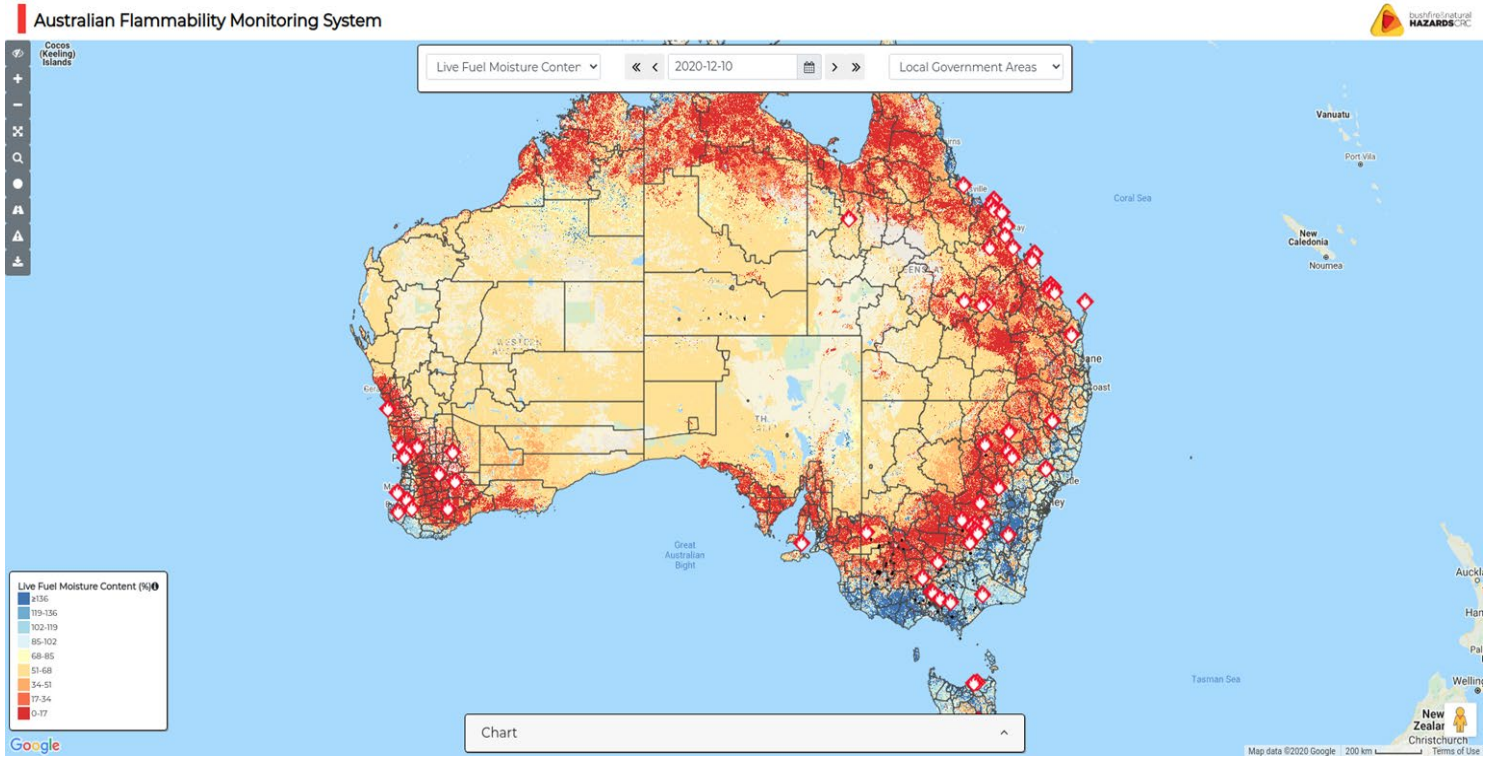
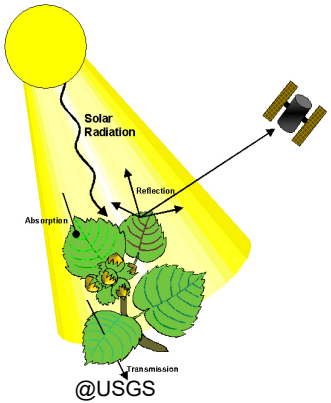
After the Orroral Valley Fire @ Marta Yebra

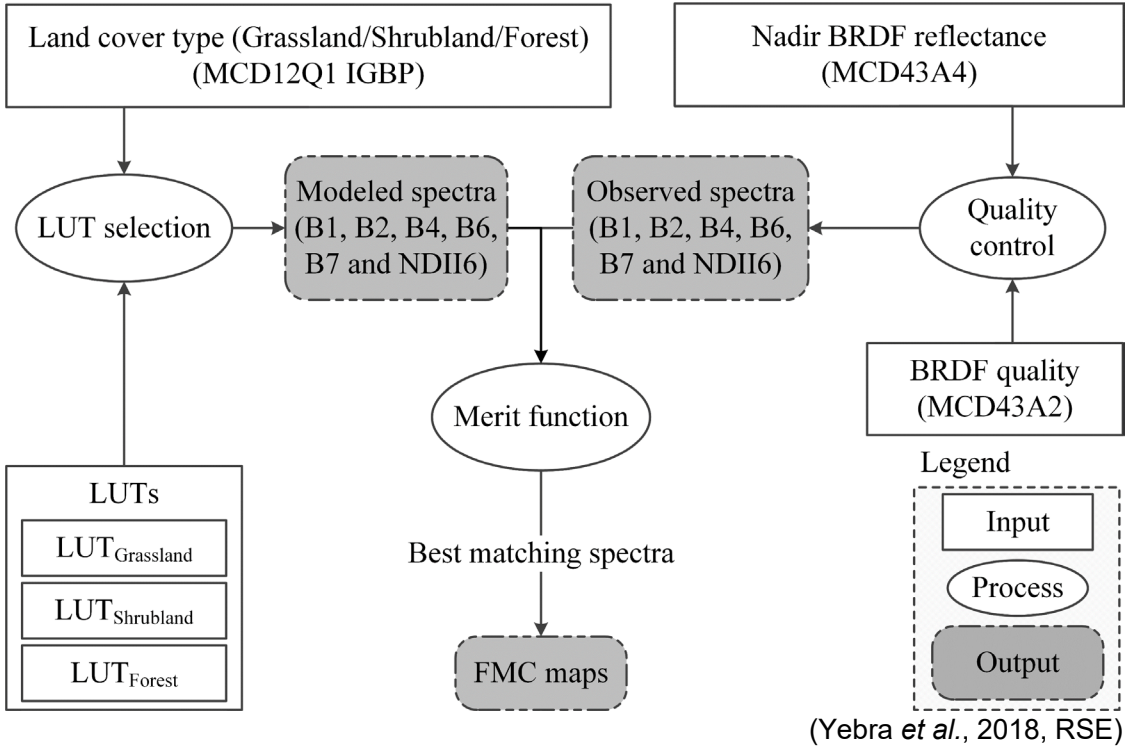
The Australia Flammability Monitoring System



Physic based Fuel moisture content algorithm

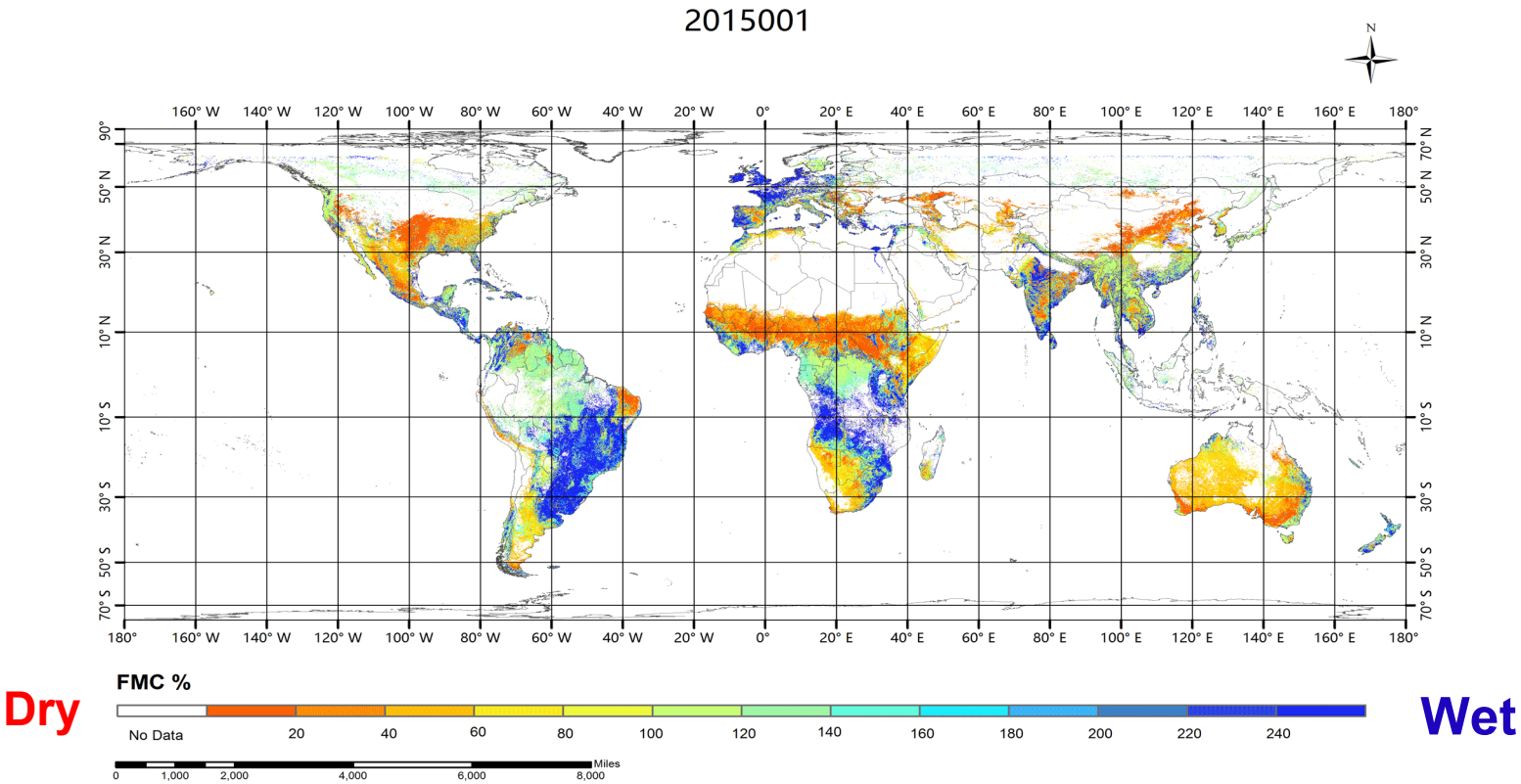


@USGS



(Yebra *et al.*, 2018, RSE)

Fuel Moisture Content at global scale

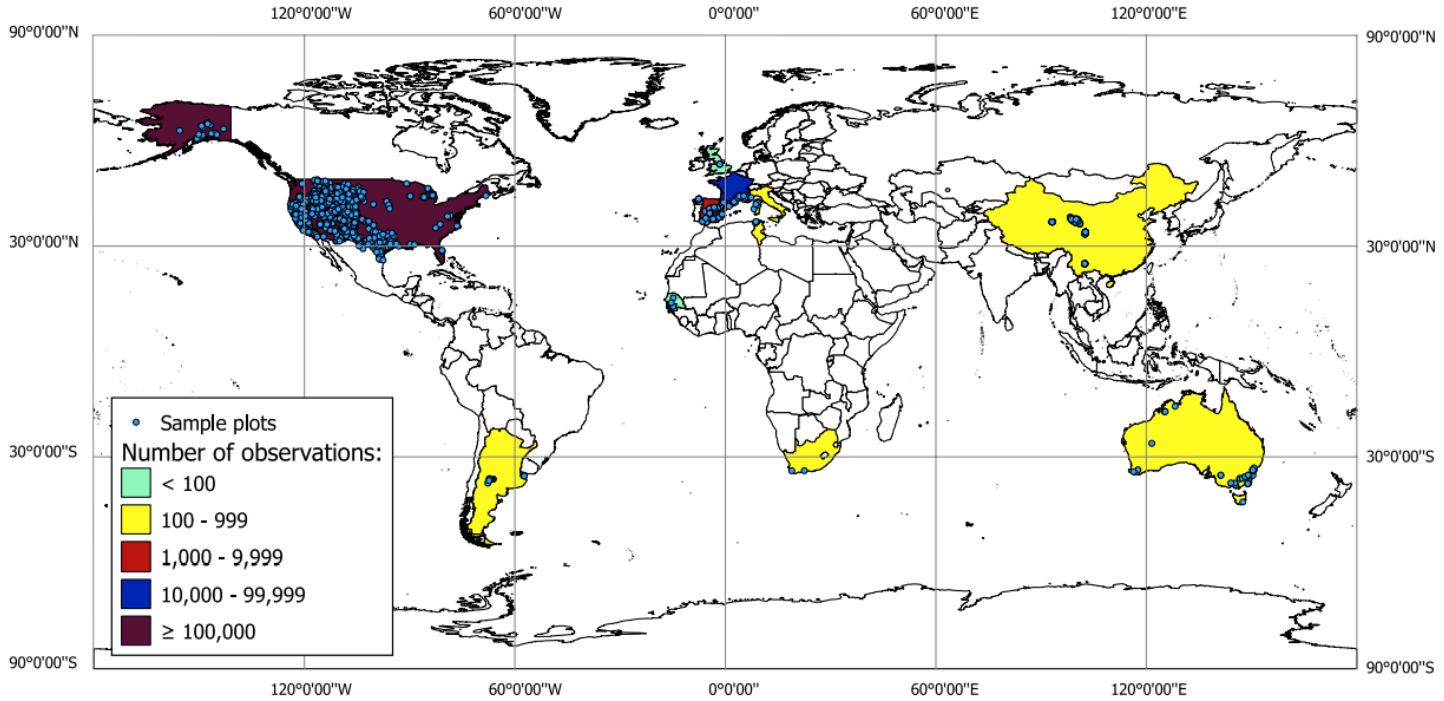


(Quan et al. 2021; ISPRS)

Globe-LFMC

WE ARE UPDATING! GET IN TOUCH IF YOU HAVE DATA!!

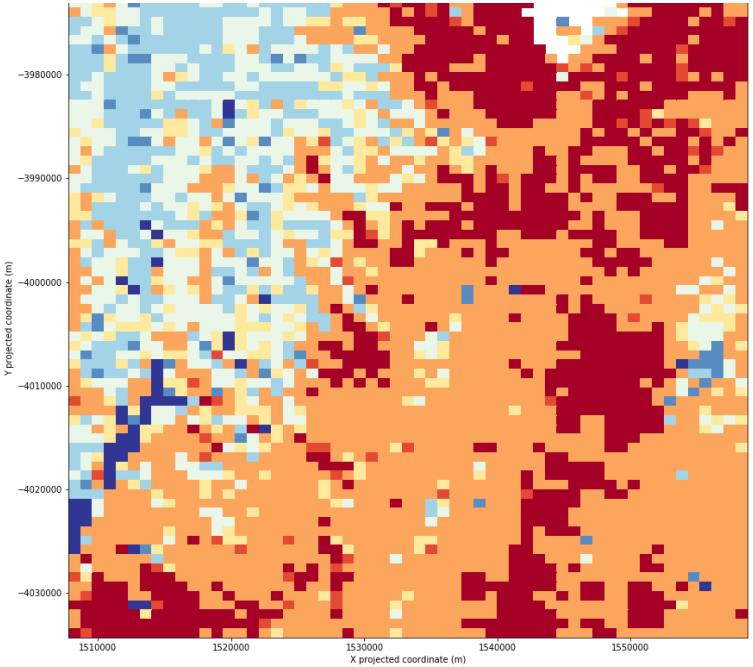
An extensive global database of live fuel moisture content (LFMC) measured from 1,383 sampling sites in 11 countries



Yebra et al. 2019, Scientific Data - Nature

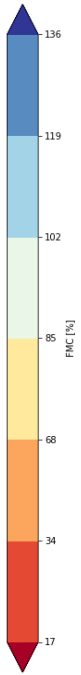
The need of higher resolution

MODIS (500m)



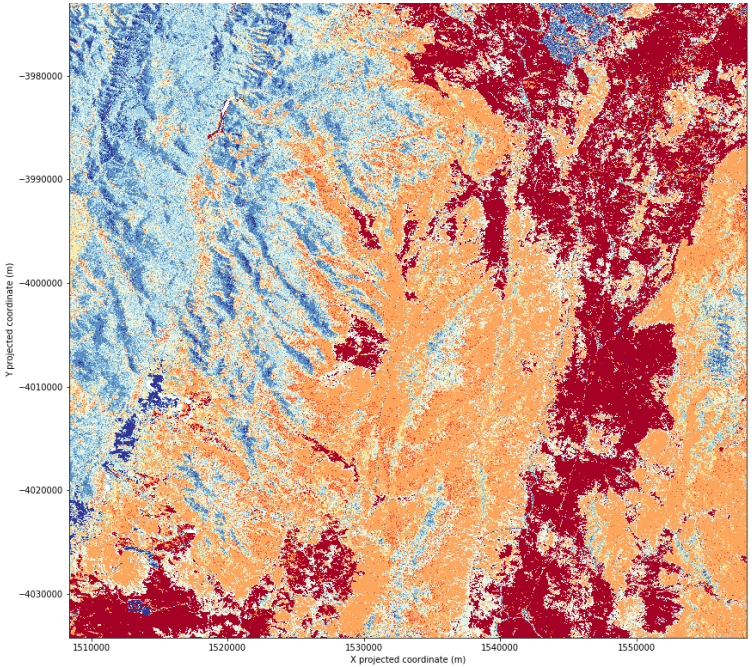
10 hours of compute time across Australia

WET



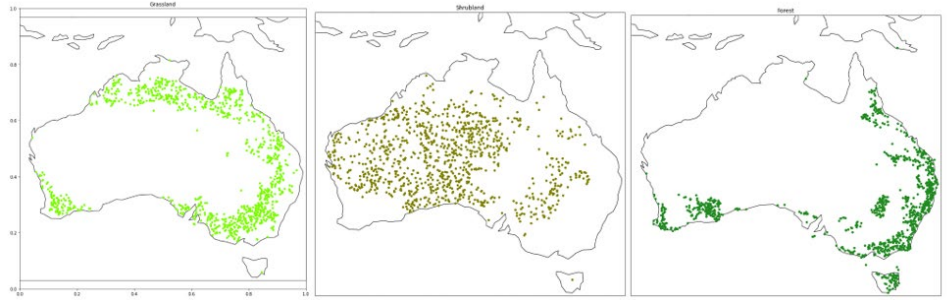
DRY

Sentinel-2 (20m)

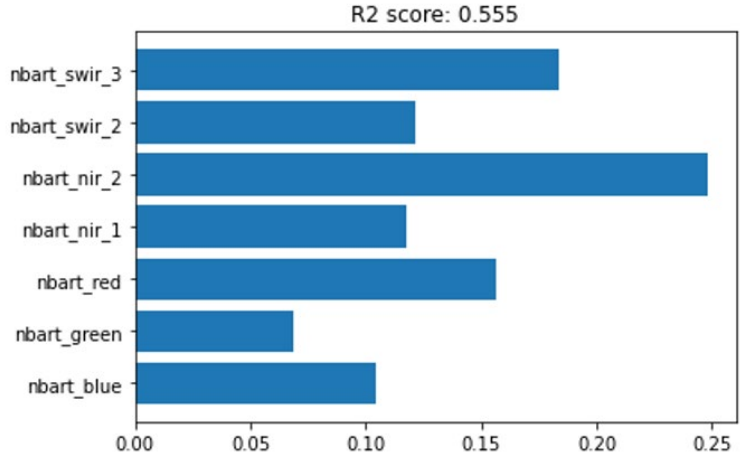


Weeks of compute time across Australia

MODIS-Sentinel 2 Emulator



Dataset containing the Sentinel-2 reflectances and corresponding MODIS-derived FMC values for 3000 selected samples to train a machine learning algorthm



Yebra et al., in preparation

Ozfuel

A microsatellite remote sensing mission to monitor fuel flammability and predict bushfire-prone areas from Low Earth Orbit.

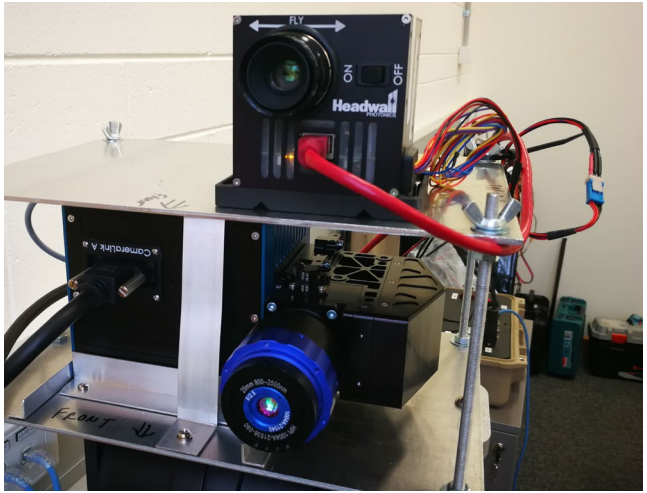
- OzFuel roadmap to $1.2B Australian Space Agency's National Space Mission for Earth Observation

https://inspace.anu.edu.au/activity/missions/ozfuel

Spectral response of eucalypt flammability traits

Elevated Work Platform (6-11m)

Visible - Near-Infrared imaging spectrometer (400-1000 nm)

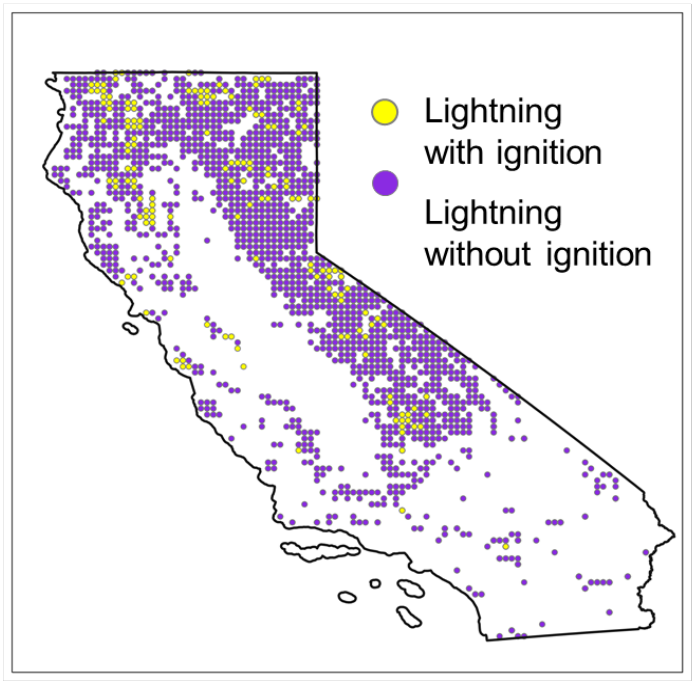


Short-Wave Infrared imaging spectrometer (900-2500 nm)

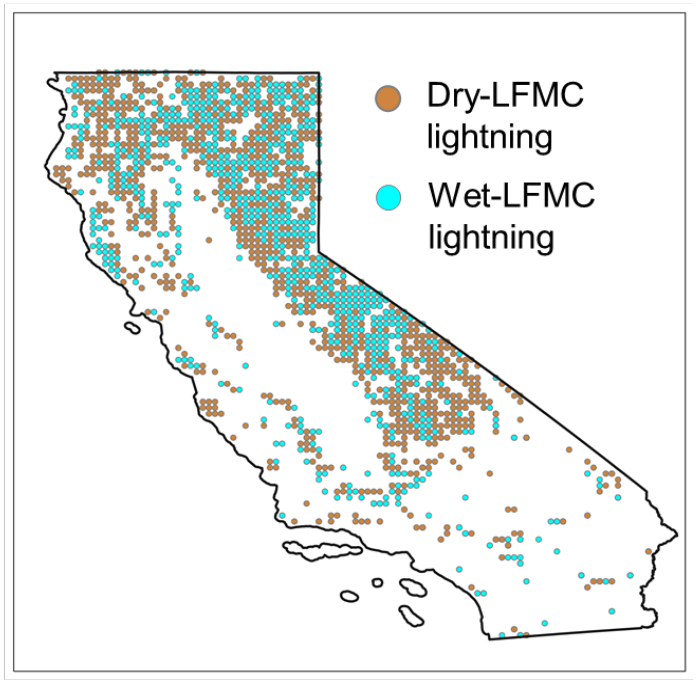
9

Effect of live fuel moisture content on wildfire occurrence

Lightning occurrence and fire outcomes



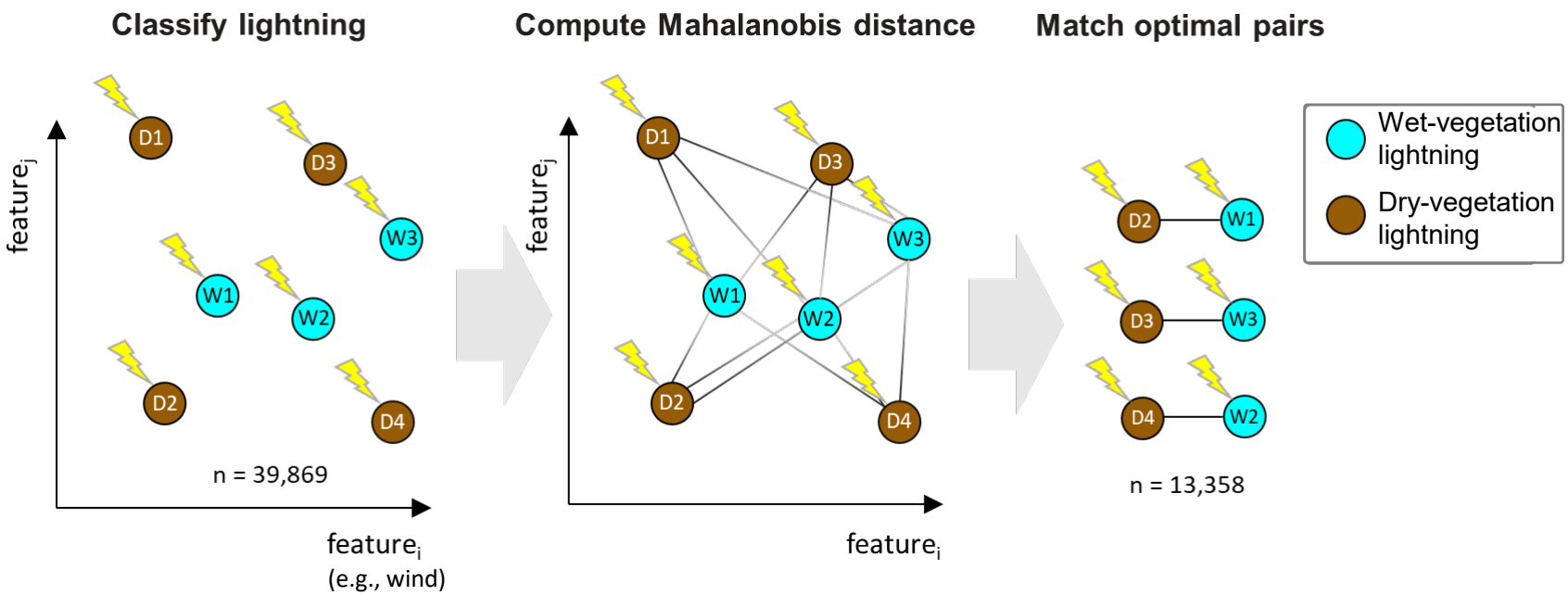
LFMC at time of lightning



Rao et. al., submitted to GRL

10

Effect of live fuel moisture content on wildfire occurrence

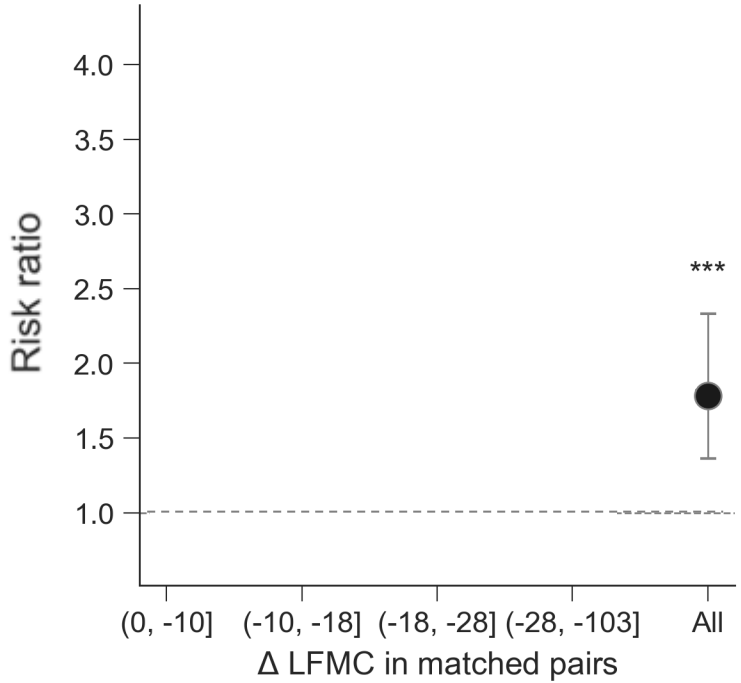


Where i is fuel availability, precipitation, VPD, winds, and other location-specific differences

Rao et. al., submitted to GRL

11

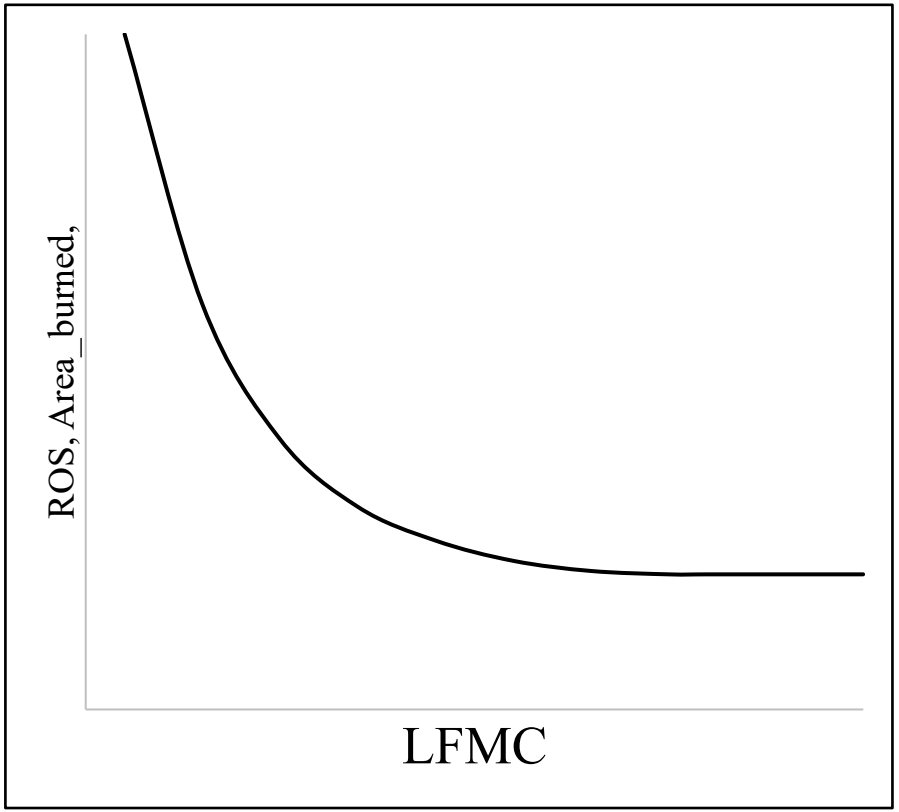
Live Fuel Moisture Content increases the likelihood of a lightning-caused wildfire



* p < 0.05
** p < 0.01
*** p < 0.001

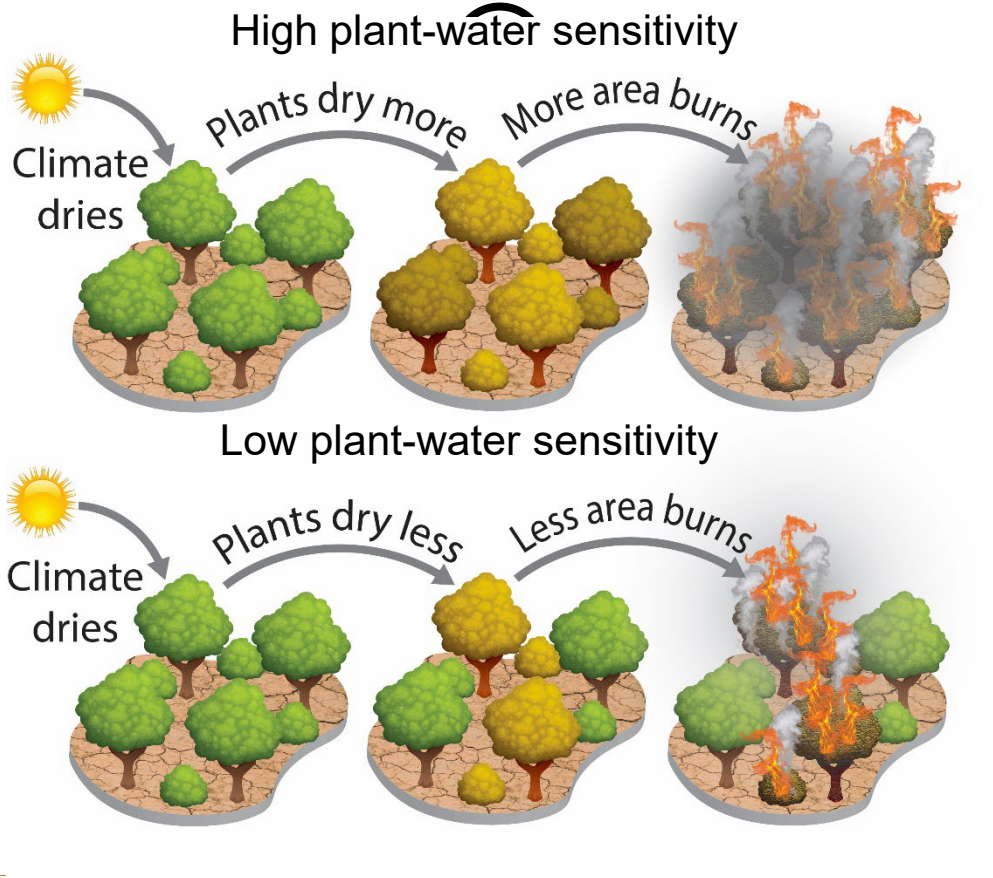
12

Effect of Live fuel moisture content on wildfire rate of spread and burned area

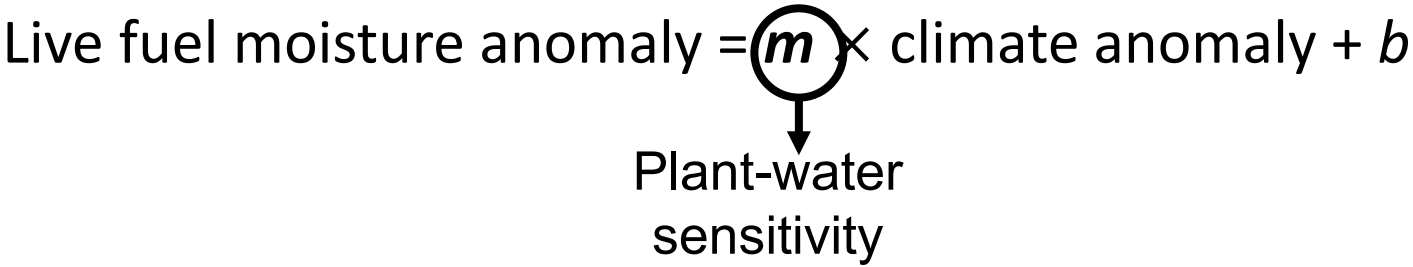


Dennison & Mortiz 2009,
Pimont et al. 2019a,b,
Martin-StPaul et al. 2018,
Chuvieco et al 2009,
Rossa et al 2016,
and many others…

Does plant-water sensitivity regulate wildfire vulnerability?

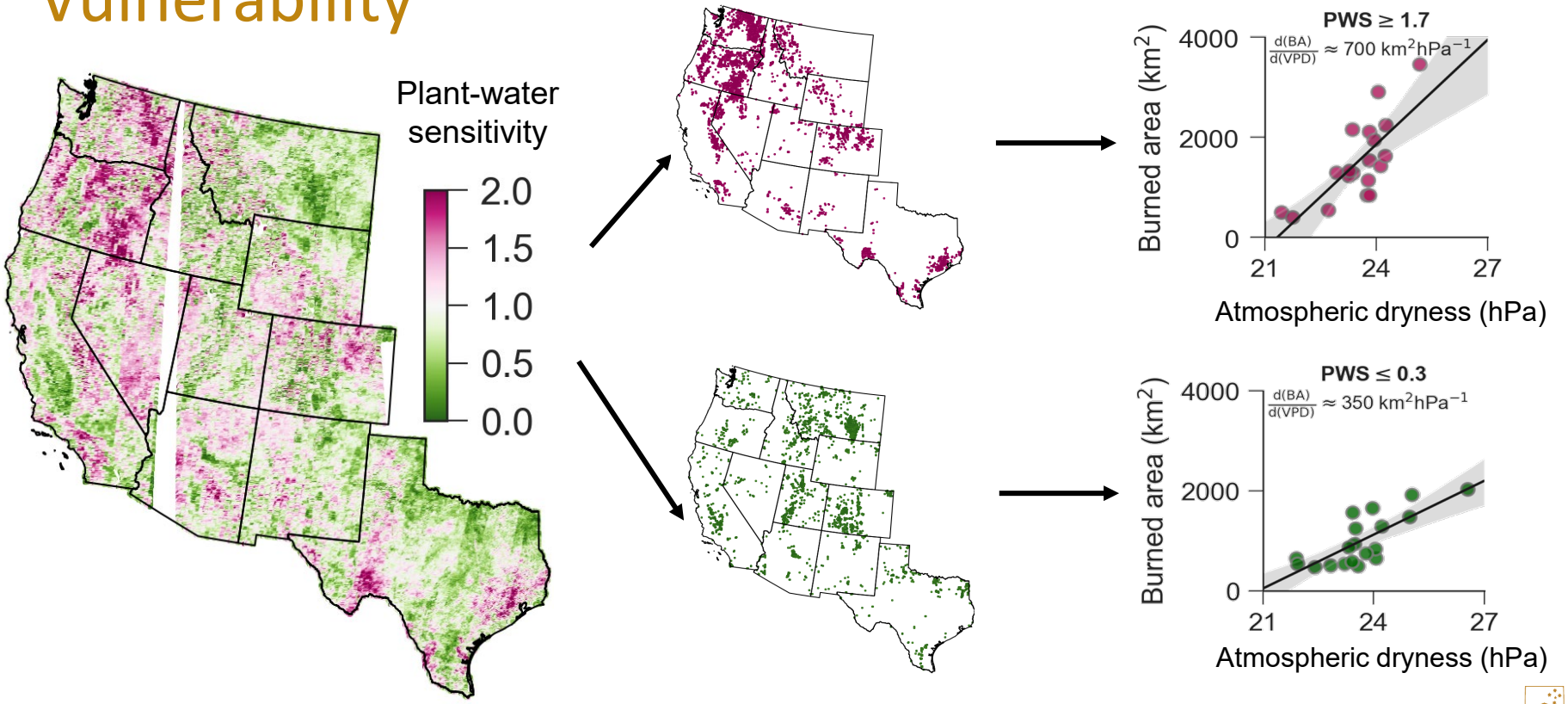


Estimating plant-water's sensitivity to climate



Rao et. al., Nat. Eco. Evo., 2022

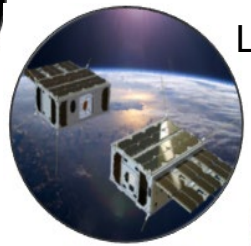
Plant-Water Sensitivity Regulates Wildfire Vulnerability



(Rao *et al.*, 2022; Nature Ecology & Evolution)

A layered approach to Ignition detection

Geostationary Satellite



Low Earth Orbit CubeSats

High Altitude Platforms

Drones

Cameras on towers

On Ground Sensors

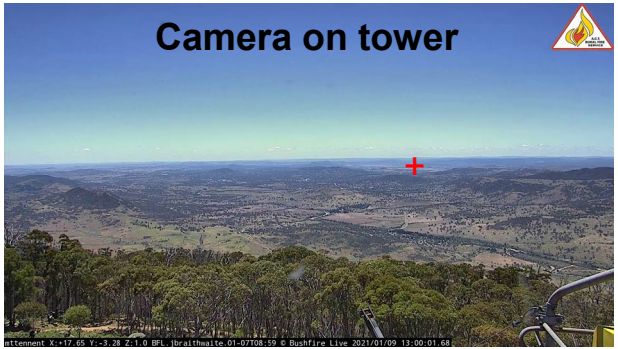
Trial in the
Australian Capital Territory

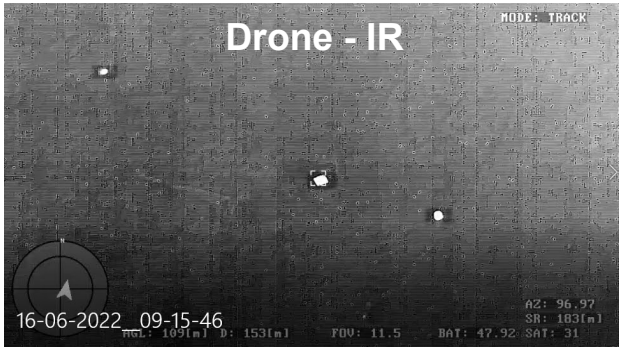
Yebra et al. 2021 AJEM

Experimental design

Stratify ignitions by the factor that influence detections

1. Topography, vegetation structure, weather, time of day
2. Proximity to detection sources
3. Fuel, climate and weather, season





Take home message

Very low live FMC contributes to higher ignitability as well as increases fuel continuity and burned area

Affects of climate change on burned area will not be uniformly experienced everywhere as it depends on plant-water sensitivity

We need to facilitate access to LFMC-relate products via GWIS to be used in Fire Danger estimations

We are testing a system to enable early fire detect in the Australian Capital Territory → cal/val sites for your active fire detection algorithms?

THANKS

Contact Us

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After the Orroral Valley Fire @ Marta Yebra

Australian National University
NSSN NSW Smart Sensing Network
FIRE NEURAL NETWORK
Australian Government Bureau of Meteorology
Australian Research Council
Stanford University
WESTERN SYDNEY UNIVERSITY
OPTUS
bushfire&natural HAZARDSCRC

Live Fuel Moisture Content increases the likelihood of a lightning-caused wildfire

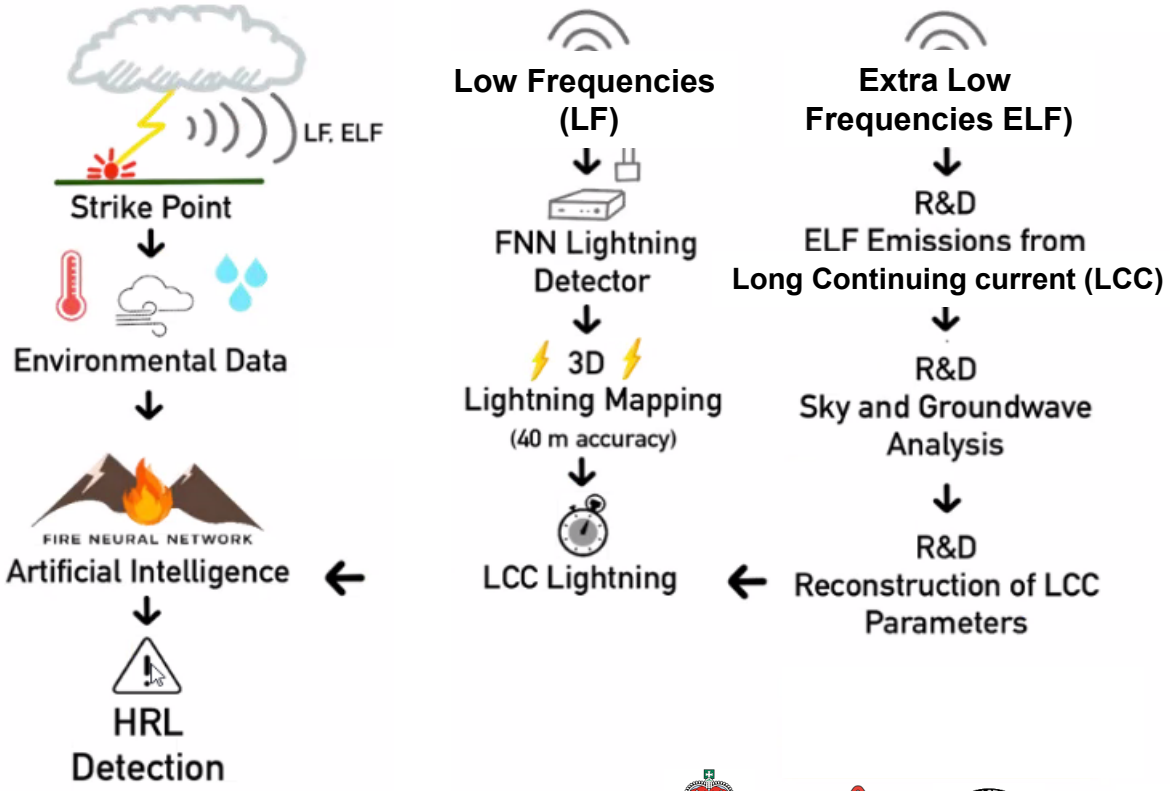
$$\text{Risk ratio} = \frac{\text{True positives}}{\text{Predicted positives}} \times \frac{\text{Predicted negatives}}{\text{False negatives}}$$

$$= \frac{\text{Dry}-\text{LFMC lightning with ignition}}{\text{Dry}-\text{LFMC lightning strikes}} \times \frac{\text{Wet}-\text{LFMC lightning strikes}}{\text{Wet}-\text{LFMC lightning with ignition}}$$

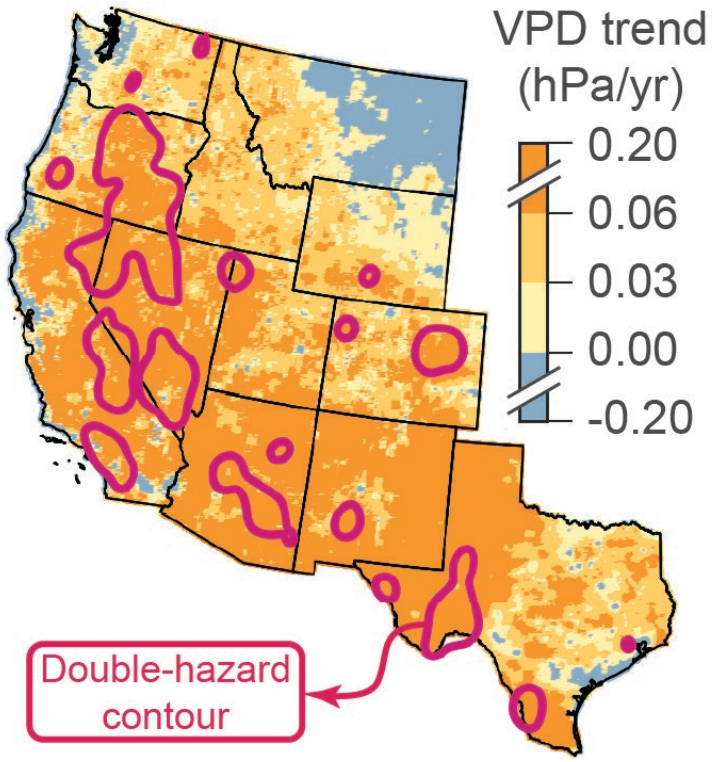
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

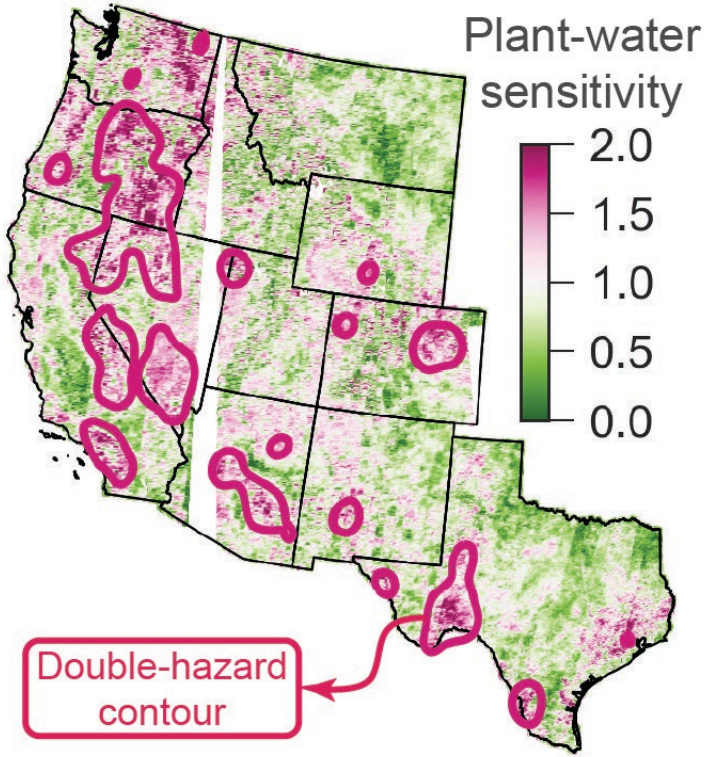
21

Rapid identification of High Risk Lightning (HRL)



Double-Hazards zones





(Rao *et al.*, 2022; Nature Ecology & Evolution)