Smoke Planner: A Planning and Decision Support System for Prescribed Burning

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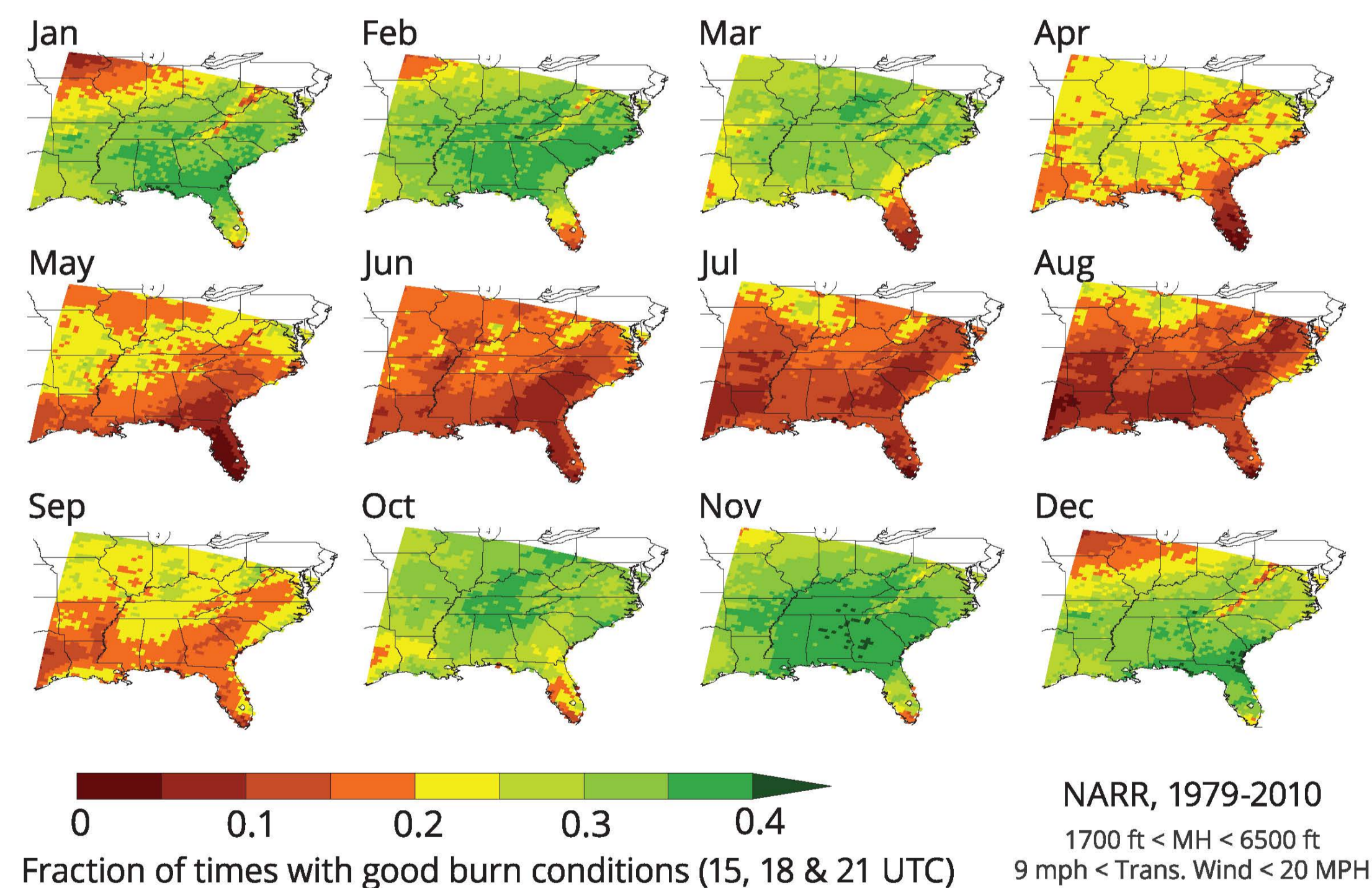Brian Potter[3], Joel Dubowy[2]

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Background

Several agencies, including the USDA Forest Service, plan to increase the pace and scale of prescribed burning to mitigate the threats of extreme wildfire and smoke.

Finding enough days with the precise weather and fuel conditions for safe and effective burns is a hurdle to meeting objectives at the scales needed. Our previous proof-of-concept work in the Southeast, where most U.S. prescribed burning takes place, highlighted the benefits of building burn weather-window climatologies for identifying under-utilized burn periods, the most restrictive weather parameters and burn opportunities stemming from possible modifications to them. (Chiodi et al., 2018; 2019).

Prescribed burn-window climatology

Jan Feb Mar Apr
May Jun Jul Aug
Sep Oct Nov Dec

0   0.1   0.2   0.3   0.4
Fraction of times with good burn conditions (15, 18 & 21 UTC)

NARR, 1979-2010
1700 ft < MH < 6500 ft
9 mph < Trans. Wind < 20 MPH

For more information

Chiodi, A.M., B.E. Potter, and N.K. Larkin (2021): Multi-decadal change in western US nighttime vapor pressure deficit. Geophys. Res. Lett., 48(15), e2021GL092830, doi: 10.1029/2021GL092830

Chiodi, A.M., N.K. Larkin, J.M. Varner, and J.K. Hiers (2019): Sensitivity of prescribed burn weather windows to atmospheric dispersion parameters over southeastern USA. Int. J. Wildland Fire, 28(8), 589-600, doi: 10.1071/WF18209

Chiodi, A.M., N.S. Larkin, and J.M. Varner (2018): An analysis of southeastern U.S. prescribed burn weather windows: Seasonal variability and El Niño associations. Int. J. Wildland Fire, 27(3), doi: 10.1071/WF17132

Smoke Planner

Lessons learned from the Southeast study informed development of a **decision support tool** we call the **Smoke Planner**. It is designed to **lower hurdles to prescribed burning** by allowing managers to mine historical weather data to come up with burn-weather prescriptions that have the best chance of occurring, and **understand and track when burn windows are most likely to occur.**
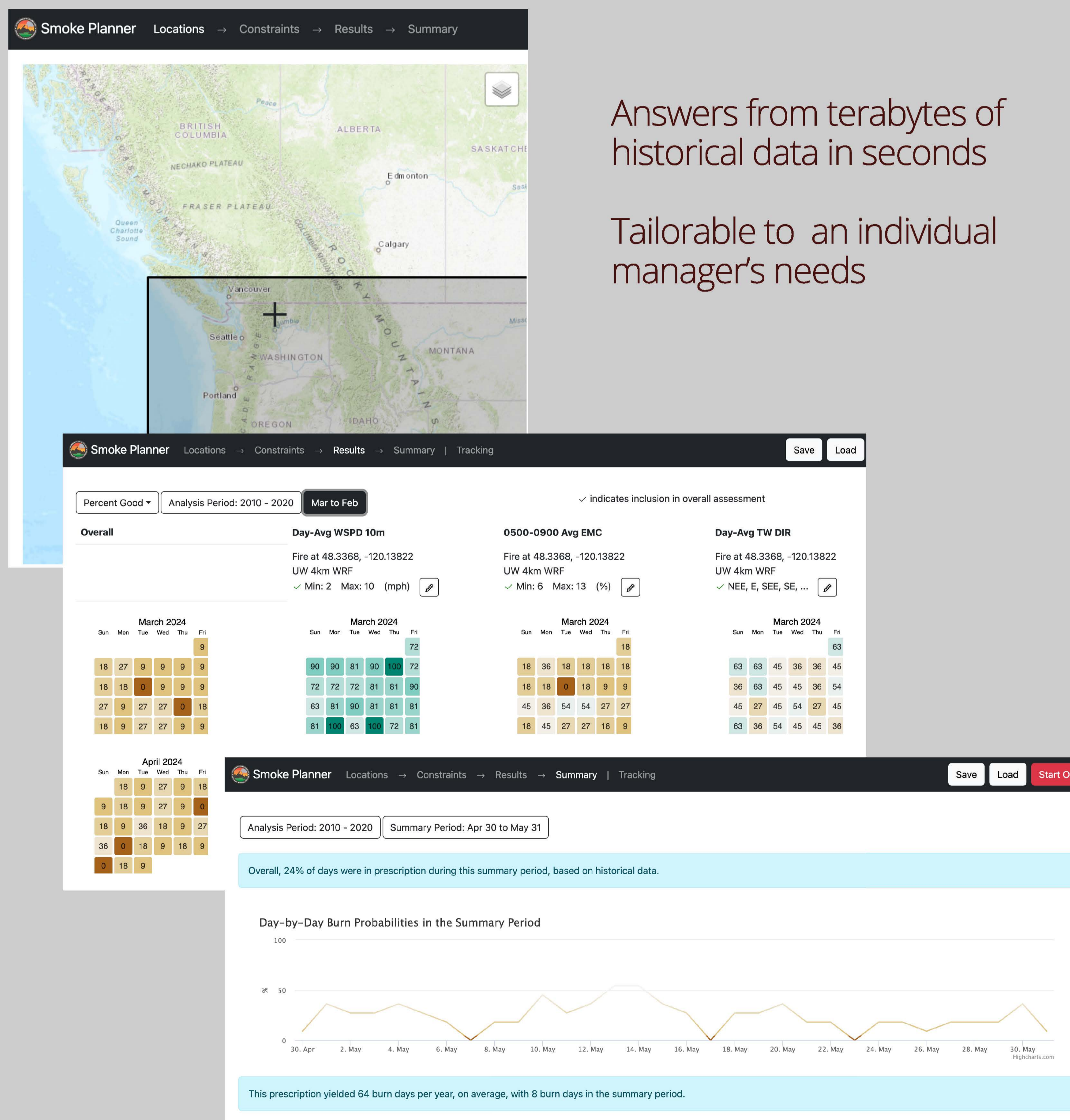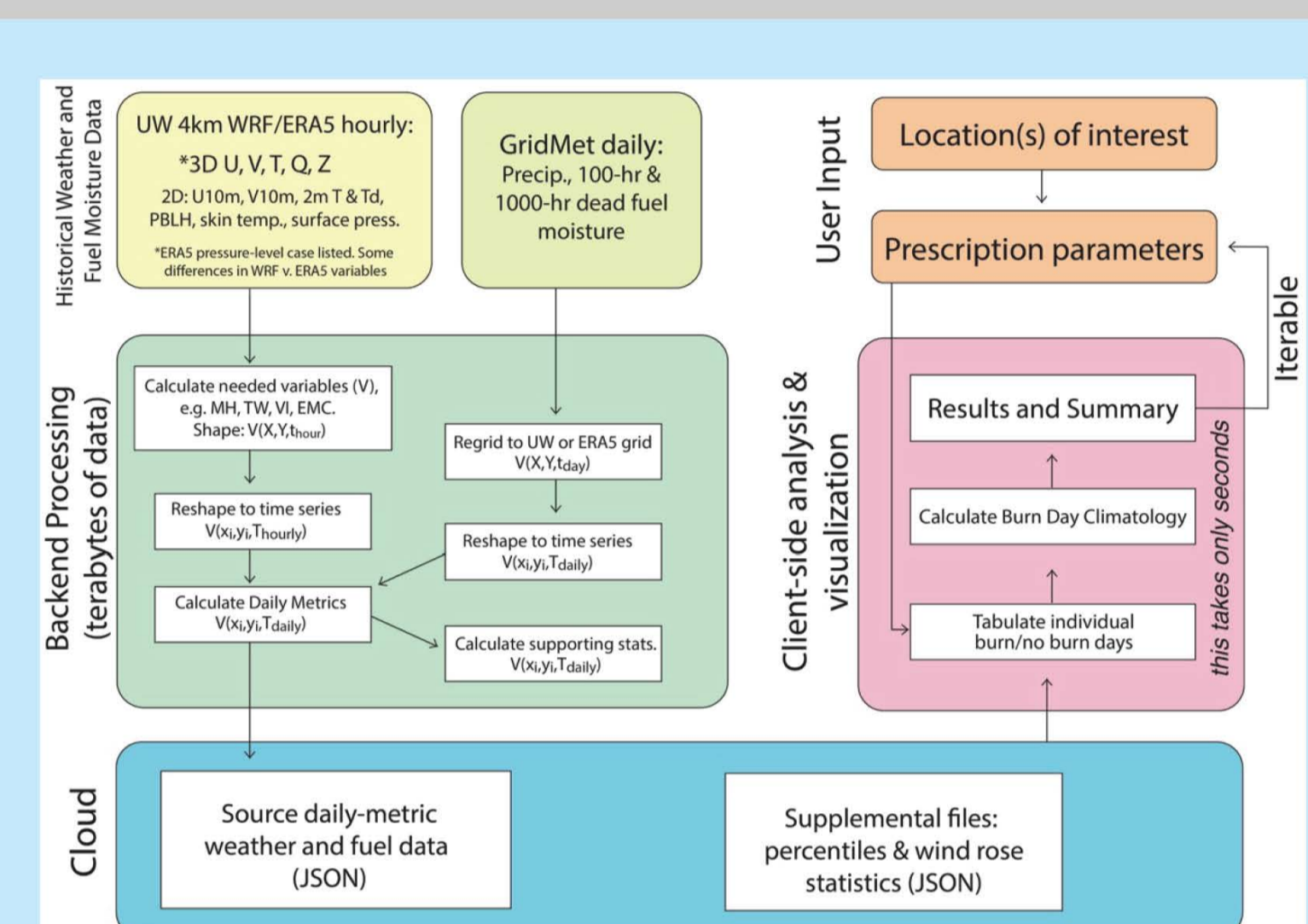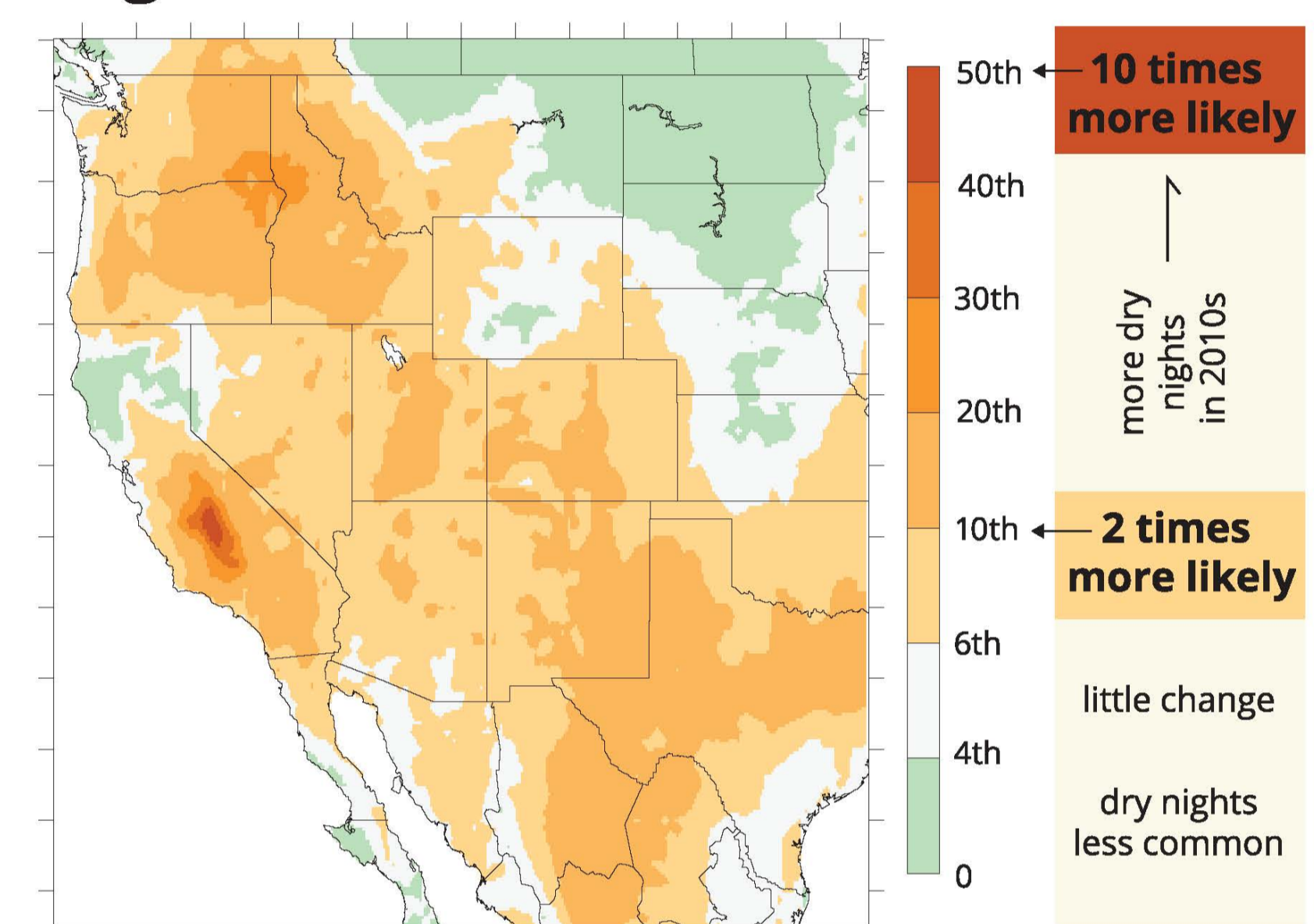

Answers from terabytes of historical data in seconds

Tailorable to an individual manager's needs

Equilibrium Moisture Content
then ('80s & '90s) v. now (2010s)

2010s percentile of a dry (5th percentile) night in the '80s & '90s

50th — 10 times more likely
40th
30th — more dry nights in 2010s
20th
10th — 2 times more likely
6th — little change
4th — dry nights less common
0

Present efforts to do more prescribed burning are taking place amid large, multi-decadal, trends in western U.S. fire weather that we and others are at work characterizing (e.g., Chiodi et al., 2021)

Nighttime Jul-Aug-Sep Vapor Pressure Deficit
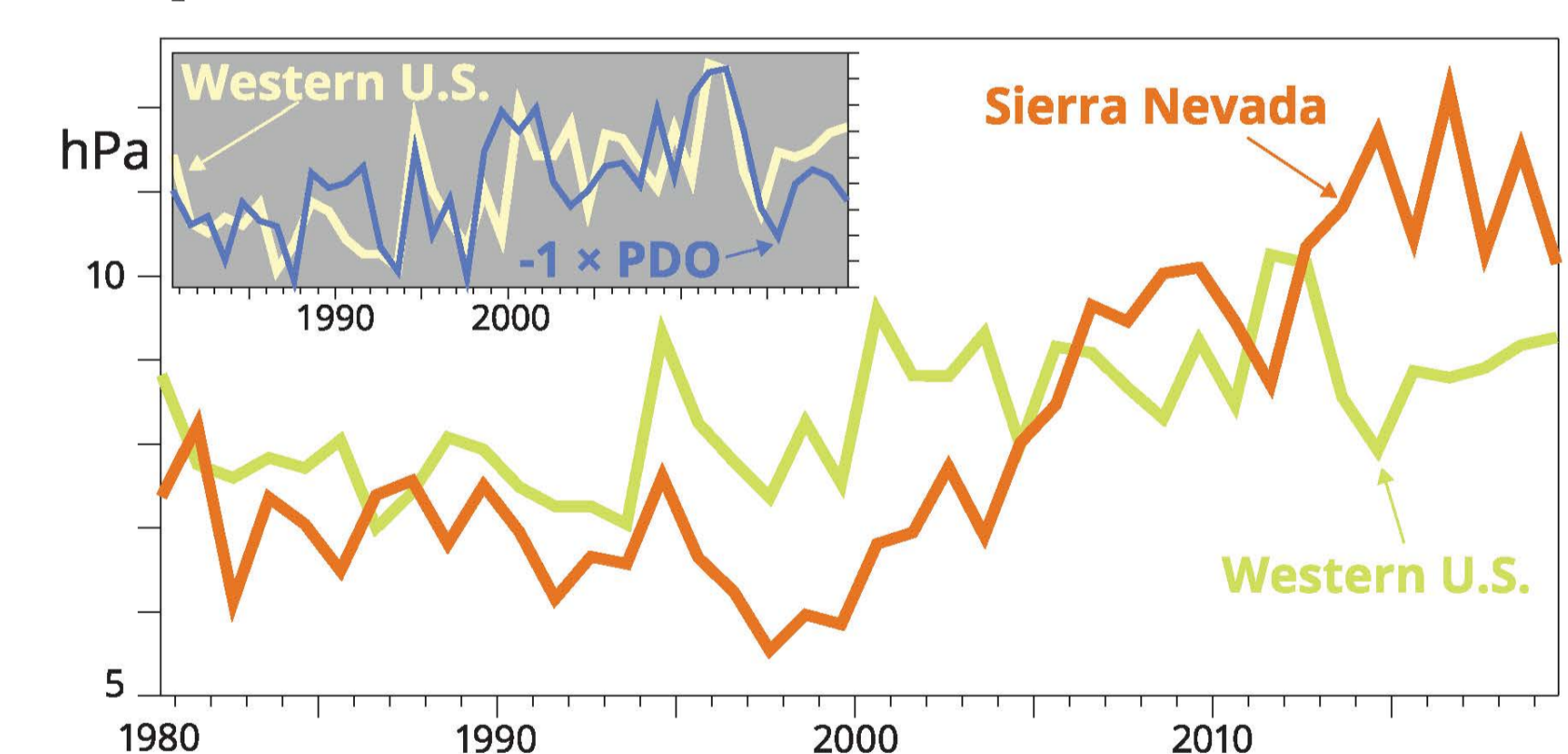
We have found that the variability of summertime western U.S. atmospheric dryness (VPD) has a statistical link (r=0.6) to Pacific air sea interaction patterns (Pacific Decadal Oscillation; PDO), but more work is needed to understand the processes responsible.

One concern is that nighttime fire activity has increased, making firefighters' jobs harder. Increasing atmospheric dryness (vapor pressure deficit; VPD) is suspected to have played a role. We are evaluating this hypothesis and investigating the variability and trends in other nocturnal meteorological factors (wind, stability) that might have played a role in causing the perceived change in nocturnal fire behavior.

We are also building tools that allow managers to quantify the impact of these trends in meteorological conditions on their prescribed burn windows.