

Weather Forecasting Needs and Challenges for Prescribed Fire

Brian Potter, AirFire Team, USDA Forest Service
Workshop on Fire Weather and Forecasting
Norman, OK 13-15 February 2024

Context - Why Focus on Prescribed Fire?

2022 Hermits Peak escaped RxB

Forest Service review of RxB practices

Wildfire Crisis Strategy relies on RxB

Society and land management agencies are placing a great demand on fuel managers to accomplish prescribed burn acres, in order to protect communities and resources.

Burners need to know that
they can meet their
objectives without causing
smoke impacts

Common Objectives

Reduce post-logging fuels

Reduce fuels around a community

Maintain habitat for chosen species

Protect watersheds from catastrophic fire

Eliminate invasive species



Consumption
Rate of spread
Intensity
Residence time
Acreage burned

Translating Objectives to Weather

Consumption
Rate of spread
Intensity
Residence time
Acreage burned



- Heavy dead fuel moisture
- Fine fuel moisture
- Wind speed
- Mix of heavy and fine fuels
- Sustained wind, moisture conditions
- Break-down of snowpack

Translating Objectives to Weather

Fuel Moisture: days to weeks of **temperature** and **humidity, precipitation, snowpack**

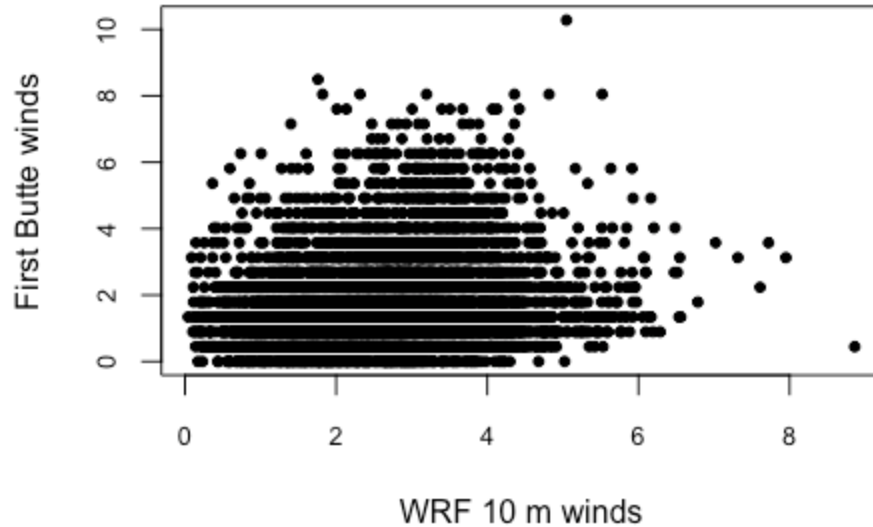
Mix of heavy and fine fuels: growing and curing degree days (**temperature, humidity**)

Sustained conditions: diurnal cycle of **wind, temperature, humidity**, possibly several days in a row

Breakdown of snowpack: **temperature, humidity, wind, sunlight, cloud cover** at night

Challenge: downscaling winds to the burn unit

WRF and RAWS winds, April-May 2016-2020



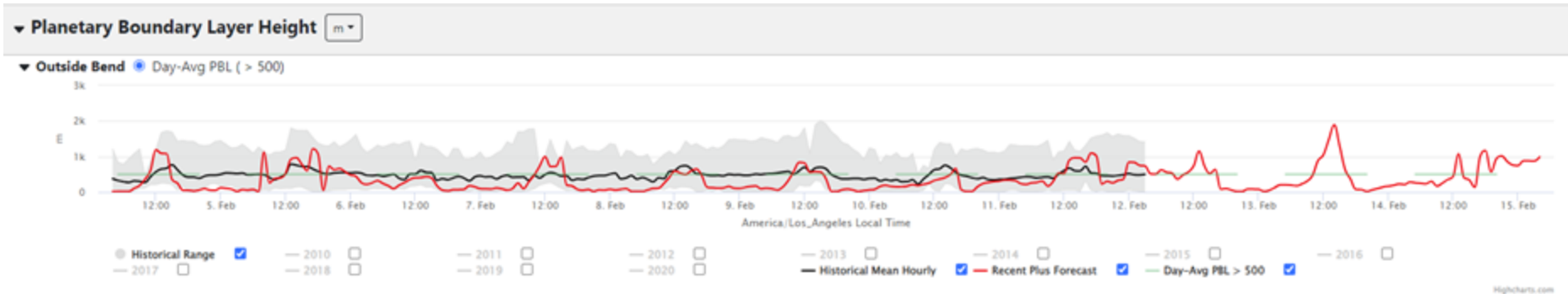
- “On-site wind is 3 m/s”
- Model for that time/point says 5 m/s
- Model says 3.5 m/s for tomorrow
- What is your forecast?

Challenge: diurnal cycle

“We need the longest PBL window possible for this burn, to take it slow but get it done. Which day is our best chance?”

Monday 2/12 is best in this forecast period, with more hours above the (user-specified) green line

But the three days are all very different, and different from the previous week



Smoke Impacts

Clean Air Act requires protocols to minimize smoke from prescribed fire

Administration can be EPA, state, tribal, municipal

Each agency gets to set their own process with EPA approval

Legal thresholds vs. citizen complaints

Smoke Lingers

Heavy fuels can smolder for days or weeks

Air quality agency protocol may or may not consider that in approval

The land manager needs to know, if possible where smoke will go as far into the future as possible

Worst impacts at night due to stability, and drainage flows

Weather Measures for Smoke Approval

Mixing height

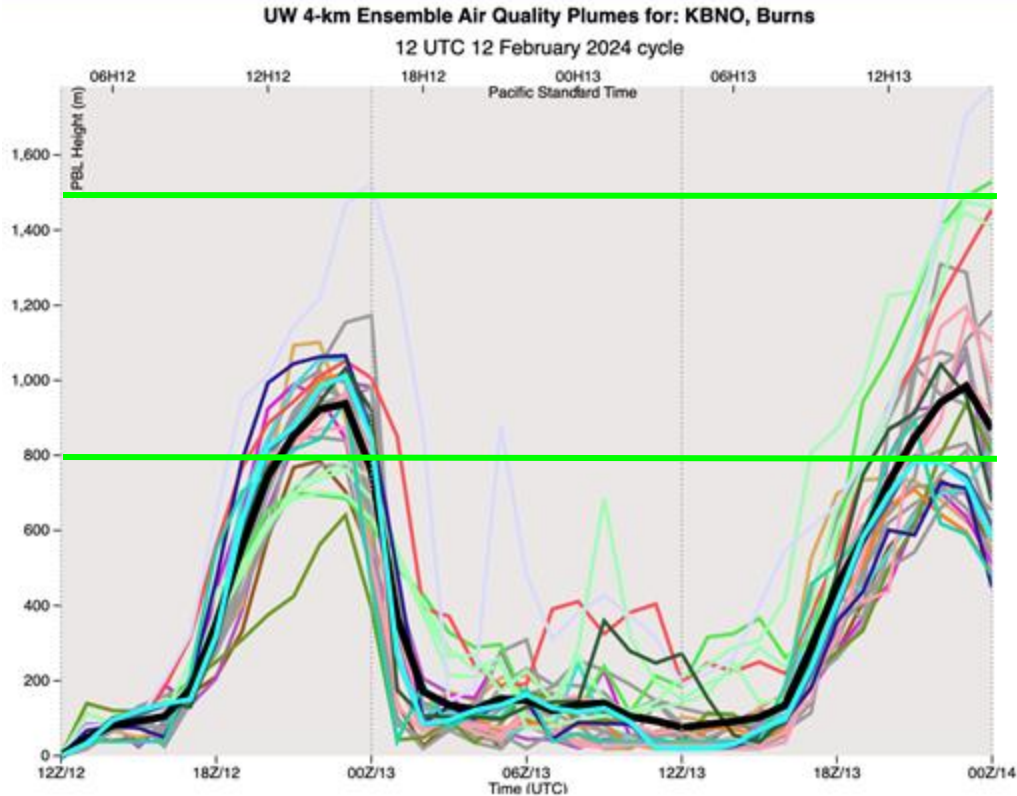
Transport wind

Stability classes

Model simulations

From what source? Air quality agency gets to decide their model, method, or tool of choice. May or may not be NWS.

Challenge: mixing height



“I can burn twice as many tons if it’s over 1500 m, as I can if it’s under 800 m.”

What value do you use?

How do you communicate the variability/range?

MH/PBL methods among most variable in forecasting

Challenge: nighttime smoke

Following the process doesn't guarantee there won't be consequences or impacts.

What kind of information or tool will help reduce the chance of those impacts?



Key take-aways

- Success in planning and execution depends on good weather forecast information weeks ahead, days ahead, and down to hourly information for the day of the burn
- Communicating uncertainty or confidence, range of possible conditions, can increase safety and “success around the edges”
- Smoke gets most of the attention because the process is more complex
- Research needs include methodology validation, tool development, and (re-)education