Fire Behavior

Prescribed Fire in Wisconsin

Photo Credit: Zach Pacana

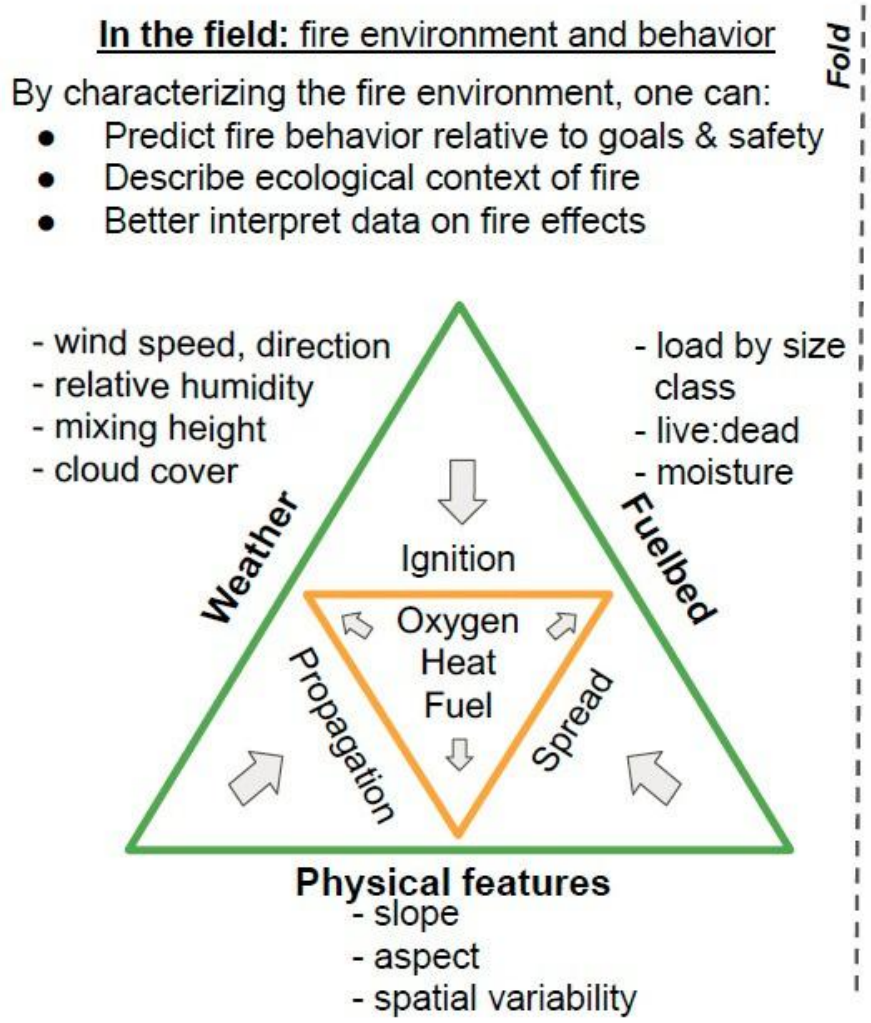
Objectives

- Fire Triangle
- Elements of Fire Behavior
- Predicting Fire Behavior
- Fire Behavior Scenarios

What is Fire Behavior?

How a fire interacts and responds to the environment

- Direction
- Rate of Spread (ROS)
- Intensity



What is Fire Behavior?

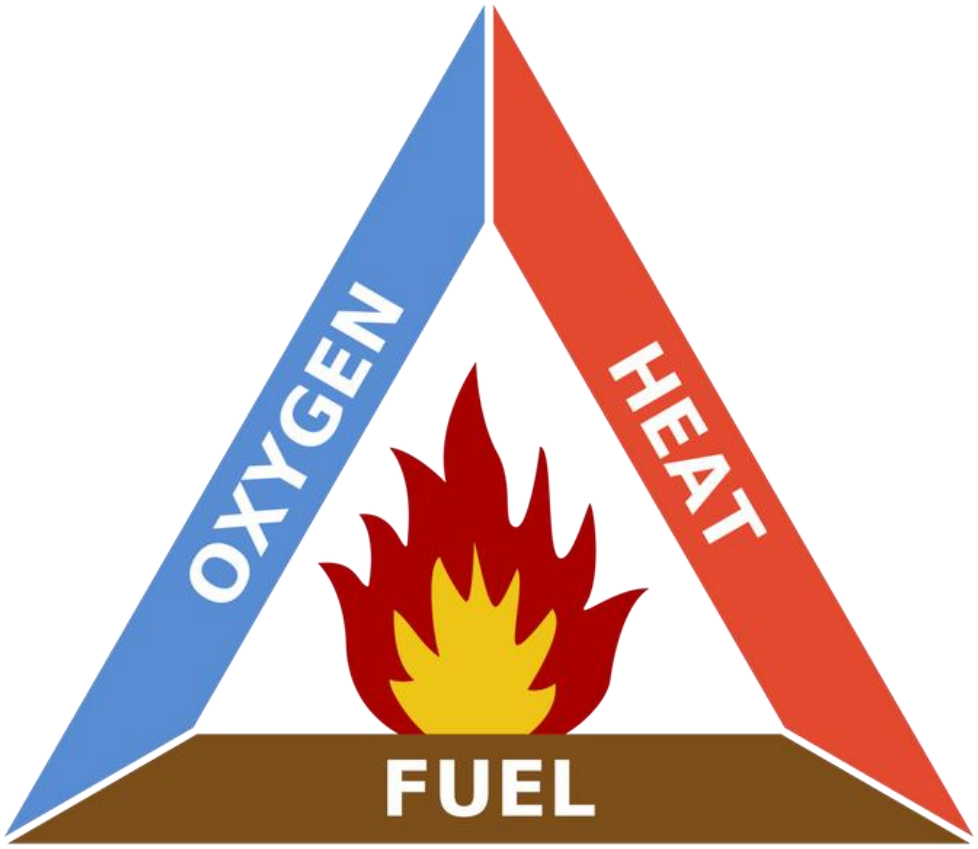
Fire behavior is a conditional measure

- We encourage certain fire behavior for ecological benefits
- We discourage certain fire behavior for safety considerations

Sometimes we encourage and discourage certain fire behavior on the same fire

Fire Triangle

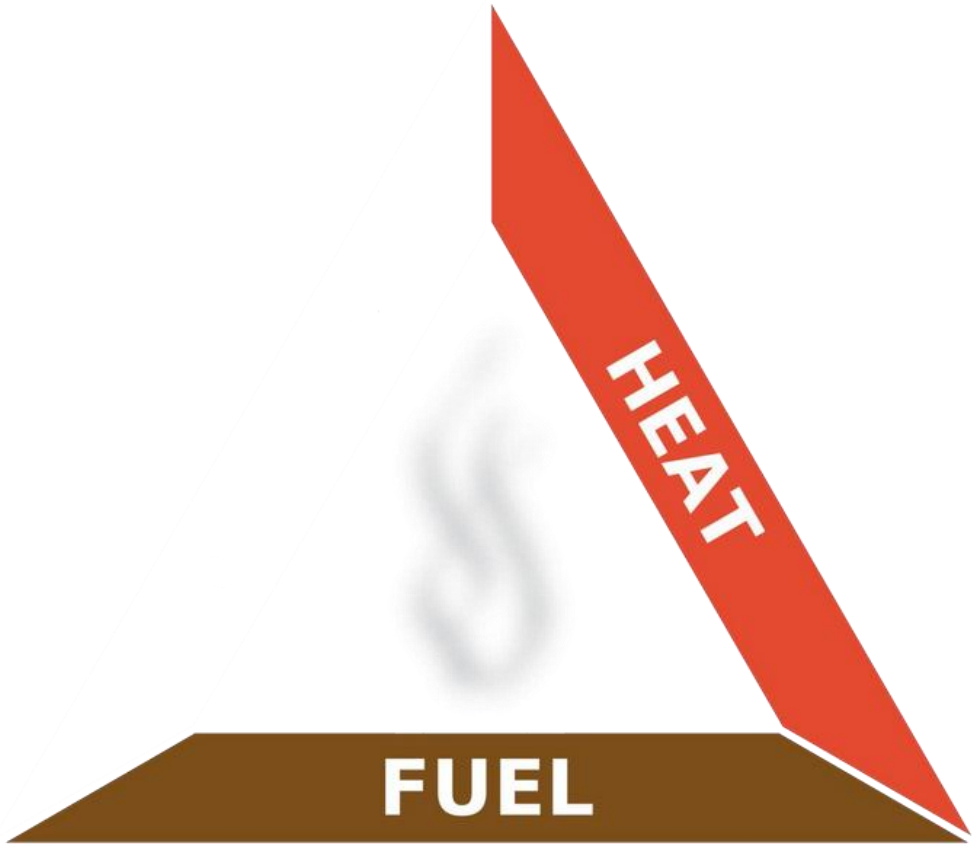
3 elements must be present and interact for fire to start and continue



Fire Triangle

3 elements must be present and interact for fire to start and continue

The removal of any one of these elements inhibits combustion



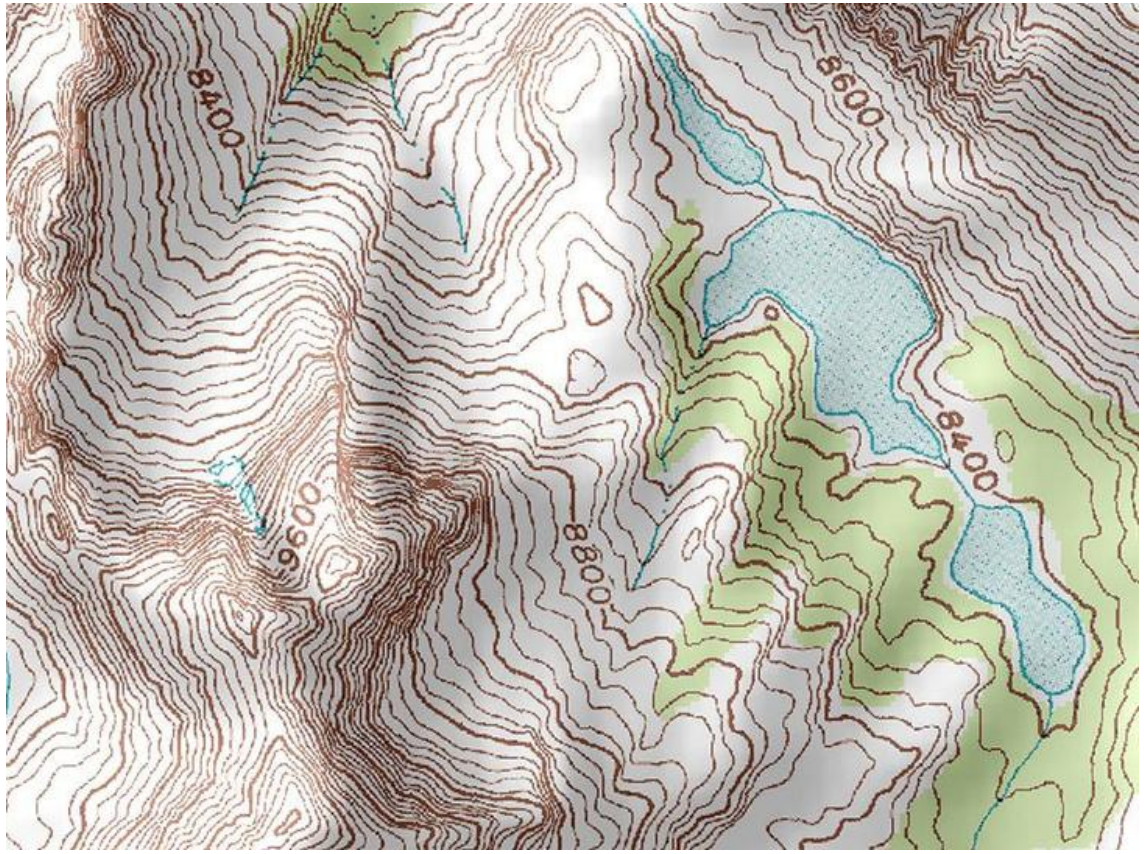
Environmental Factors

- Topography
- Fuels
- Weather

Environmental Factors

Topography

- Lay of the land is the easiest and most stable factor
- Used to predict fire behavior



Elements of Topography

Slope

- Steepness/inclination of the terrain

Aspect

- Direction a slope is facing (North, South, East, West)

Steep Slopes

- Spreads quickly
- Increased intensity can ignite larger fuels
- At top edge and within slope is poor break location

Gentle Slopes

- Fire behavior dictated more by fuels and weather
- Good location for control lines

Aspect

South and Southwest

- High sun exposure
- Lighter and sparser fuels
- Higher temperatures
- Lower humidity
- Lower fuel moistures

North

- Low sun exposure
- Heavier fuels
- Lower temperatures
- Higher humidity
- Higher fuel moistures

Fuel Characteristics

These variables indicate potential fire behavior:

- Fuel loading – How much fuel is present
- Size and shape – Grass vs leaf litter. Shrubs vs trees/big logs
- Compactness – Old brush pile vs new brush pile
- Horizontal continuity – Are fuels touching/stacked or scattered
- Vertical arrangement – Ladder fuels
- Moisture content – How wet is the fuel

Fuel Characteristics

These variables indicate potential fuel behavior:

- Fuel loading
- Size and shape
- Compactness
- Horizontal continuity
- Vertical arrangement
- Chemical content

Physical and chemical characteristics remain constant during a fire

- Moisture content

Moisture content changes continually

Primary Fuel Groups of Southwest WI

- Cool Season Grasses
  - Smooth Brome
  - Kentucky bluegrass
  - Fescue
- Warm Season Grasses
  - Big bluestem
  - Indiangrass
  - Switchgrass
  - Little bluestem
- Forbs
  - Goldenrods
  - Asters
  - Coreopsis
  - Etc.
- Leaf Litter
  - Oaks
  - Hickories
  - Maples/Cherries
- Pine Litter
  - Pine needles
- Timber
  - Oaks/Hickories
  - Maples/Cherries
  - Red/White/Jack Pine
- Shrubs
  - Willows
  - Dogwoods
  - Sumac
  - Etc.

The Absence of Fuel

Reducing available fuels from the triangle can decrease fire spread and intensity.

- Bare soil
- Mowed line
- Live grass
- Water
- Dirt
- Gravel or Paved Roads

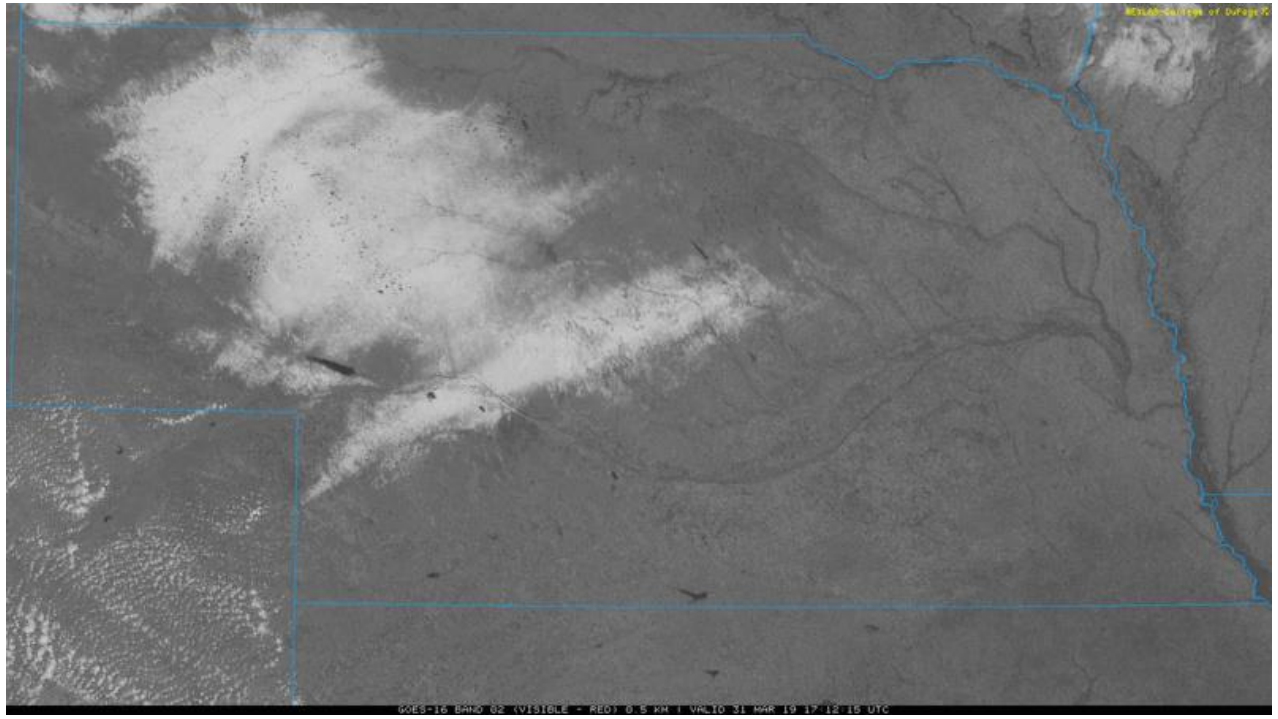
Weather

Weather is the short-term variation of the atmosphere

Weather

Weather variables related to fire:

- Temperature
- Relative Humidity
- Wind
- Precipitation
- Atmospheric Stability



Temperature

Degree of hotness or coldness of the air

Hot temperatures

- Accelerate evaporation
- Reduce energy needed to ignite fuels

Relative Humidity

- Amount of moisture in the air
  - As the air becomes dry, more moisture is pulled from fuels

Primary weather element that affects fuel moisture

Temperature vs. Relative Humidity

Rule of Halves

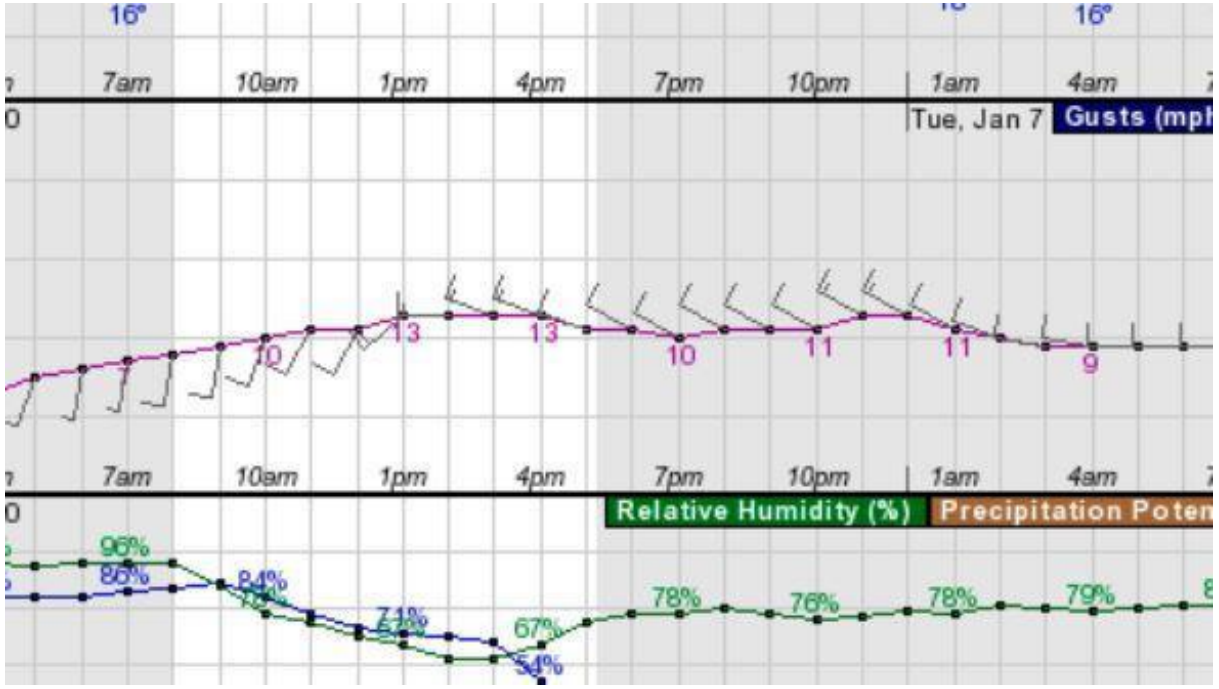
- When the air temperature increases by 20°F, the relative humidity will typically decrease by 50%.

Use this rule in the field to predict changes in RH and corresponding fire behavior

Wind

Horizontal movement of air

- Most difficult element to predict
- Most variable weather element

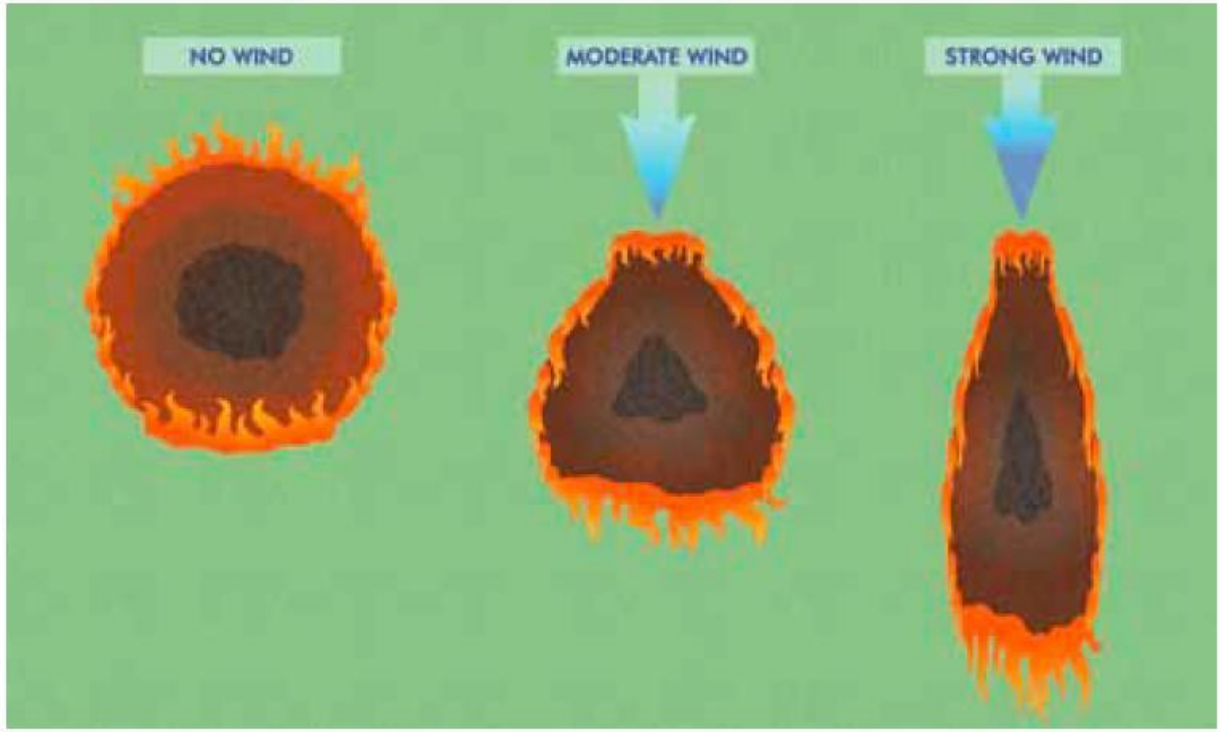


Most critical weather element affecting fire behavior

Wind

How does wind influence fire behavior?

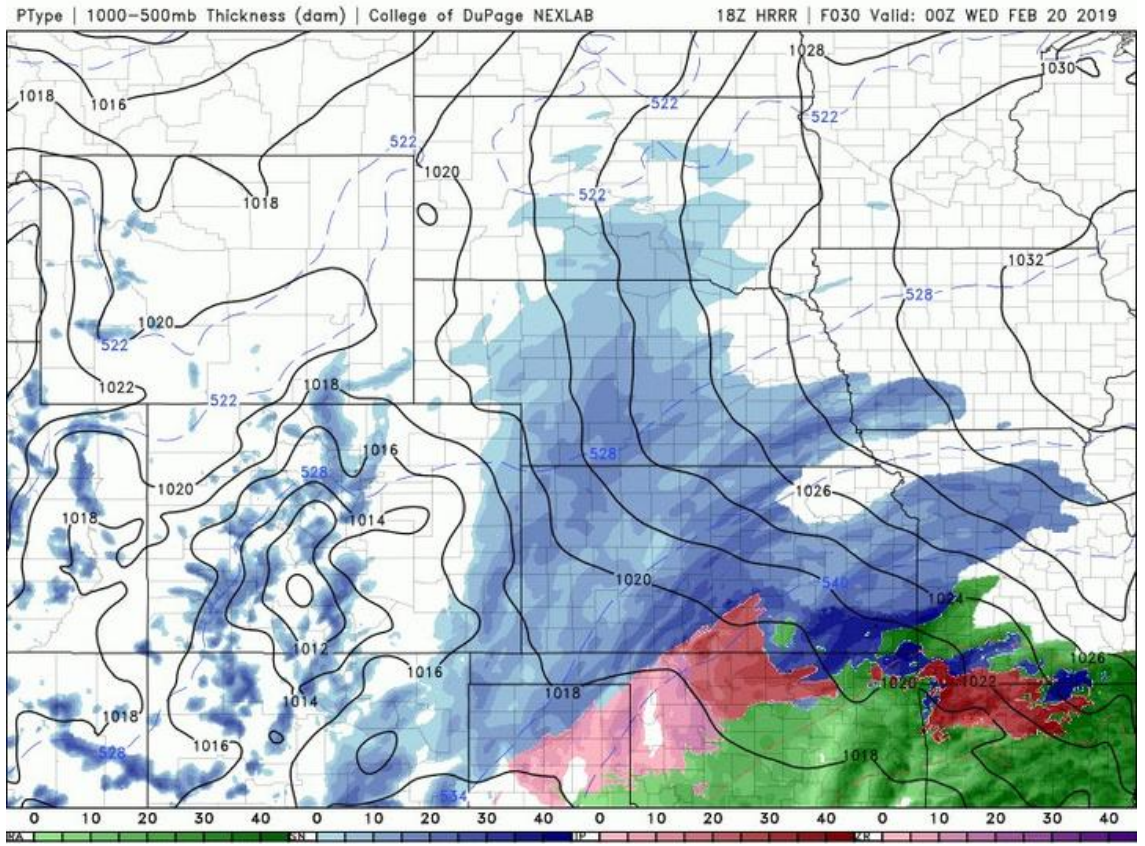
- Increases oxygen supply
- Determines direction of fire
- Influences speed of fire
- Increases fuel drying



Precipitation

Condensed moisture that falls to Earth's surface

- Quick absorption by light fuels
- Single events usually do not impact moisture levels in heavy fuels like trees
- Single precipitation events followed by heat could lead to emergence of green vegetation



Atmospheric Stability

Stable atmosphere

- Suppress or resist upward motion
- Limit drafts into fire
- Indicators:
  - Stratus Clouds
  - Smoke column dissipates
  - Poor Visibility
  - Steady Winds

Unstable atmosphere

- Encourages upward motion
- Updrafts could cause spot fires
- Indicators:
  - Cumulus Clouds
  - Good visibility
  - Gusty winds
  - Fire whirls

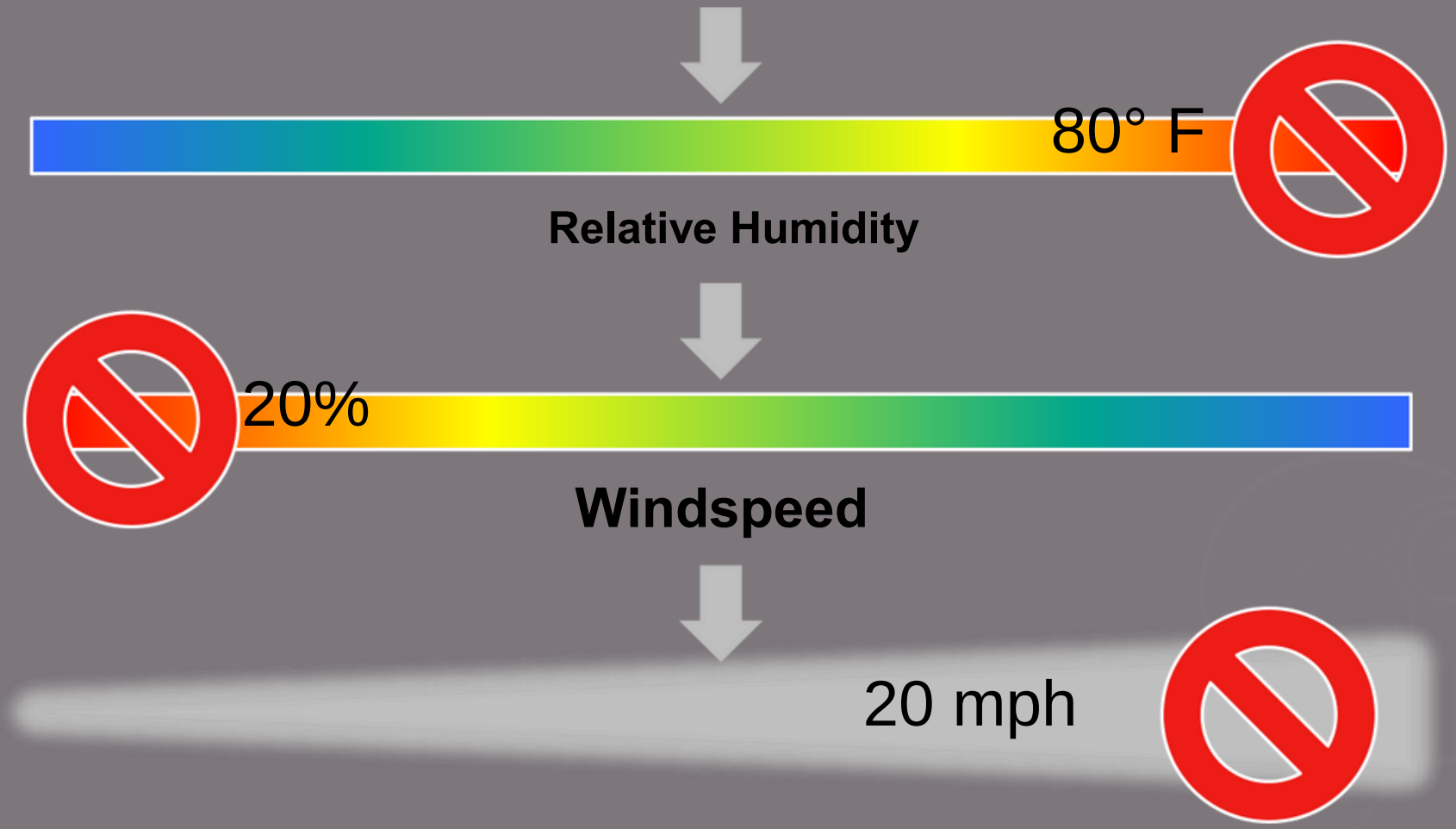
Critical Fire Weather Conditions

- Strong and shifting wind
- Low relative humidity
- High temperature
- Unstable atmosphere

Watch out if you see these conditions!

80-20-20 Rule

A fire weather “rule of thumb” “Dormant Grass Fuels” Temperature



Extreme Fire Behavior

Characteristics

- Crowning
- Prolific spotting
- Large firewhirls
- Convective column
- Aggressive rate of spread

Contributing Factors

- Excessive fuels
- Low fuel moistures
- Low relative humidity
- High probability of shifting wind
- High temperature
- Unstable atmosphere

Extreme Fire Behavior

We can reduce the risk of extreme fire behavior by planning and following our fire prescription.

Keep heavy fuels away from burn unit boundaries

Preventing Extreme Fire Behavior (If desired)

- Develop a conservative burn plan (Temp-Humidity-Wind)
- Follow the burn plan
- Monitor weather throughout fire
- Maintain communication with crew
- Call off burn if necessary


Questions?