
Weather and Prescribed Burning
Weather Tutorial and Fire Weather Predictions

A basic knowledge and awareness of **weather** is **essential** for making critical fire management decisions.

Fire Weather Outline

- Intensity and Behavior.
- Fire Weather Forecast and Smoke Management.
- Critical Fire Weather Patterns and Weather Resources.

Risk, Threat, and Vulnerability

- Risk: The probability of the fire getting away and the landowner, burn boss, or crew member being sued.

- Threat: Refers to the source and means by which we could be sued.

- Vulnerability: Issues in our plan or unexpected issues that caused the plan to go awry.

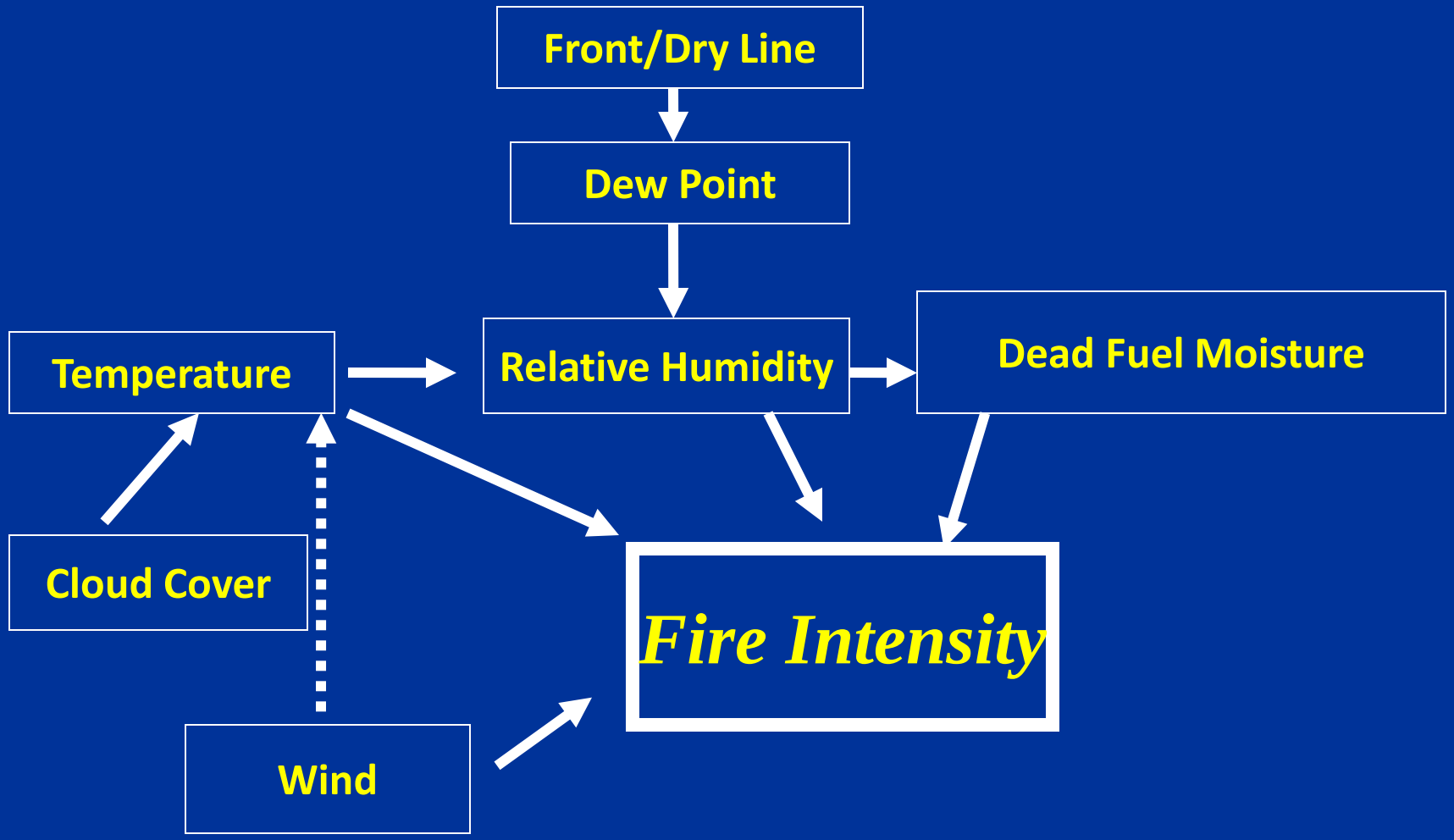
- Having failed, what decisions did we make that would allow the suit to be successful.

Weather

- Affects
  - -Fire Intensity.
  - -Fire Behavior.
  - -Effectiveness of controlling the target plans.
  - -Personnel comfort and safety.
  - -Keeping the fire in the planned area.

Weather Factors Affecting Fire Intensity

These factors are intergraded by the Burn Boss to determine the outcome of a fire.



Factors Affecting Fire Behavior and Fire Intensity

- Weather Factor
  - Extremely important for planning and conducting a prescribed burn
  - Fire Bosses need to be amateur weather geeks.
- Fuel Factors.
- Fire Behavior Factors

Using Weather Forecasts

- Understand weather vocabulary.
- Interpret weather maps.
- Understand fire weather forecasts.

Atmospheric Pressure

Low Pressure (L)

- Low pressure areas have less atmospheric mass above their location

High Pressure (H)

- High pressure areas have more atmospheric mass above their location.

Weather maps use the reporting stations to plot the pressure values much like a topography map to find areas of low and high pressure.

Atmospheric Pressure - *continue*

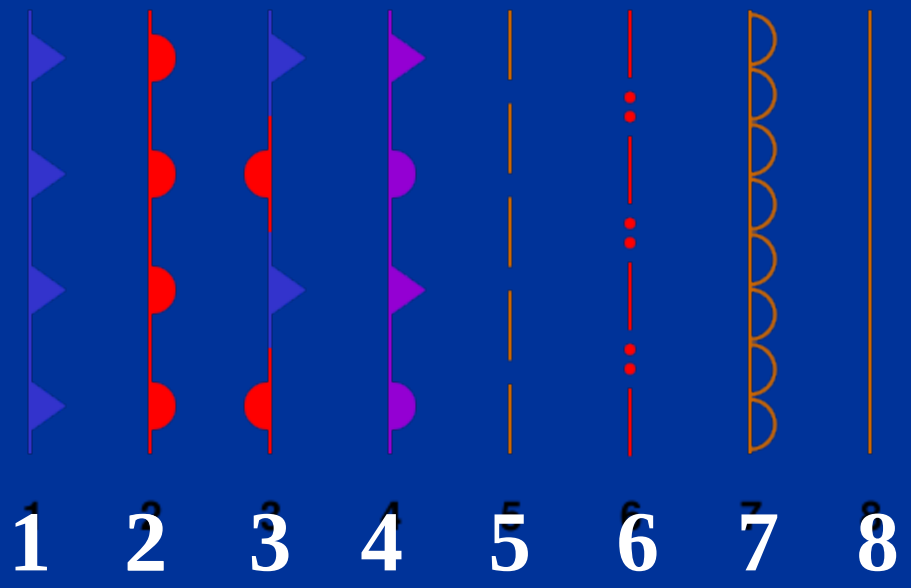
Low Pressure

- Associated with more violent weather fronts, troughs, and cyclones.
- Fall, Winter, and Spring have lower pressures and thus more weather variation.

High Pressure

- Associated with more stable air masses.
- Summer Highs can last some time creating less weather variation.

Fronts

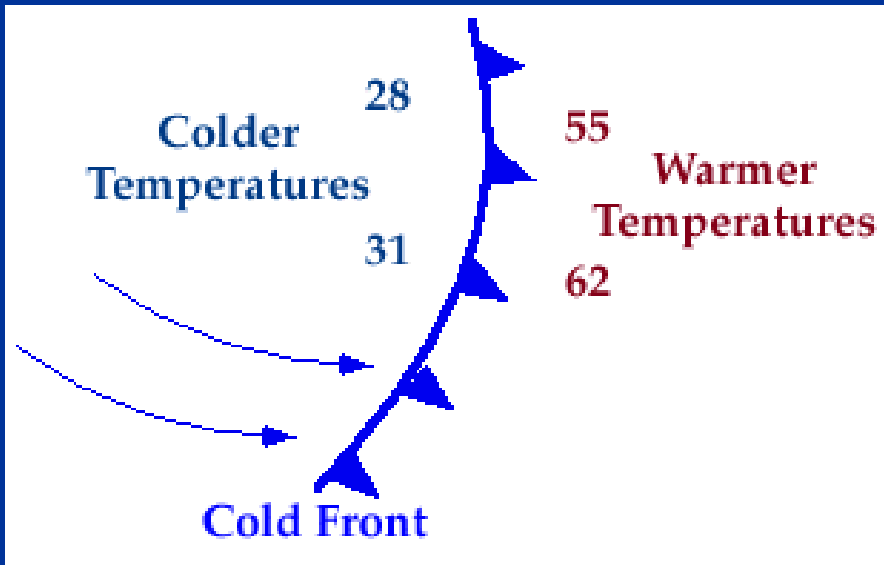


Weather Fronts

1. cold front
2. warm front
3. stationary front
4. occluded front
5. surface trough
6. squall line
7. dry line
8. tropical wave

Cold Front

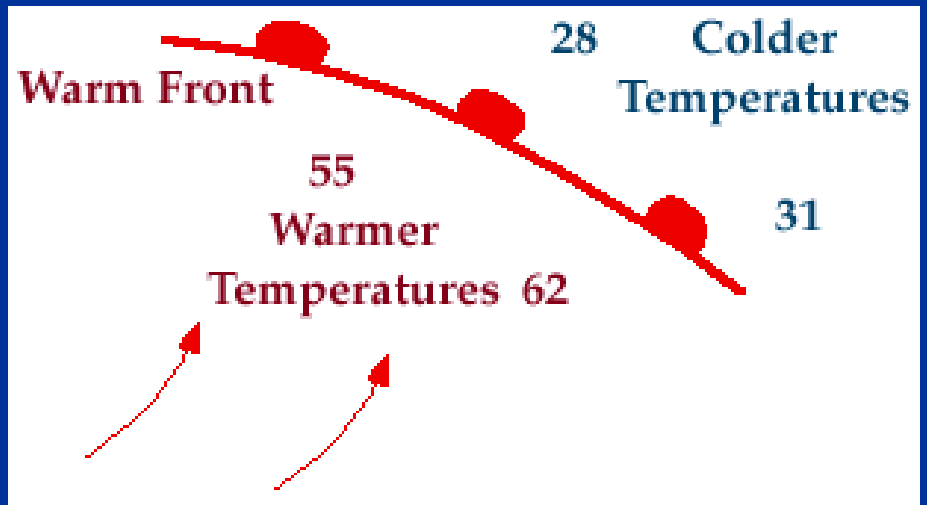
- The leading edge of a mass of air which is usually colder and drier than the air mass in front of it, outside of terrain effects.
- The colder air, being denser, wedges under the less dense warmer air, lifting it, causing the formation of mostly cumuliform (puffy, cotton-ball-like) clouds.
- The passage of a cold front usually results in velocity changes in winds and creates vertical movement of air (turbulence) and can set off atmospheric disturbances such as rain showers, thunderstorms , squall lines, tornadoes, and snowstorms ahead of and immediately behind the moving cold front.



Warm Front

Transition zone from cold air to warm air

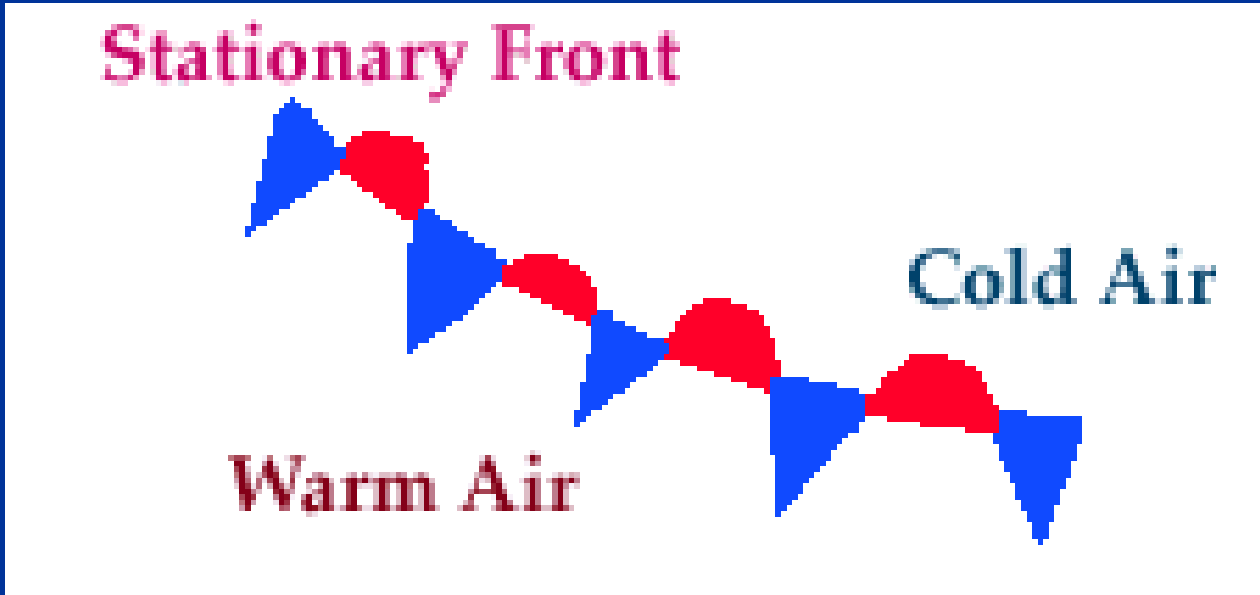
- A warm front is defined as the transition zone where a warm air mass is replacing a cold air mass.
- Warm fronts generally move from southwest to northeast and the air behind a warm front is warmer and more moist than the air ahead of it.
- When a warm front passes through, the air becomes noticeably warmer and more humid than it was before.



Stationary Front

A front that is not moving

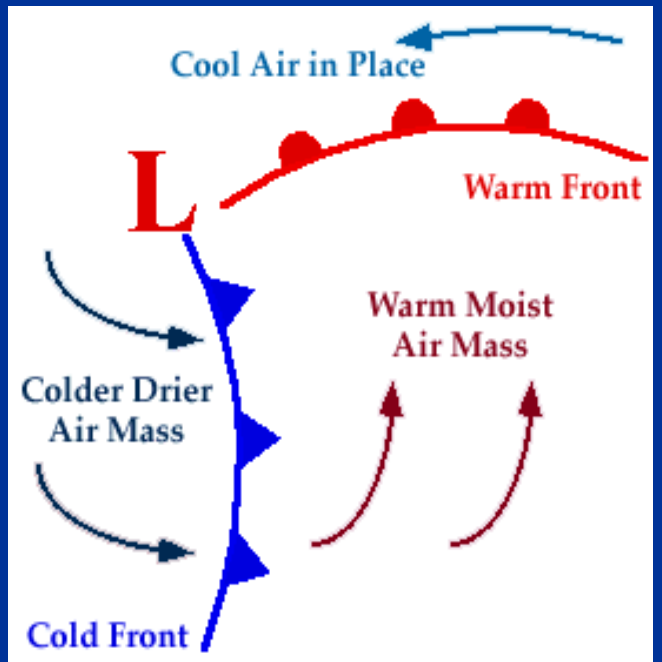
- When a warm or cold front stops moving, it becomes a stationary front. Once this boundary resumes its forward motion, it once again becomes a warm front or cold front.
- A stationary front is represented by alternating blue and red lines with blue triangles pointing towards the warmer air and red semicircles pointing towards the colder air.



Occluded Front

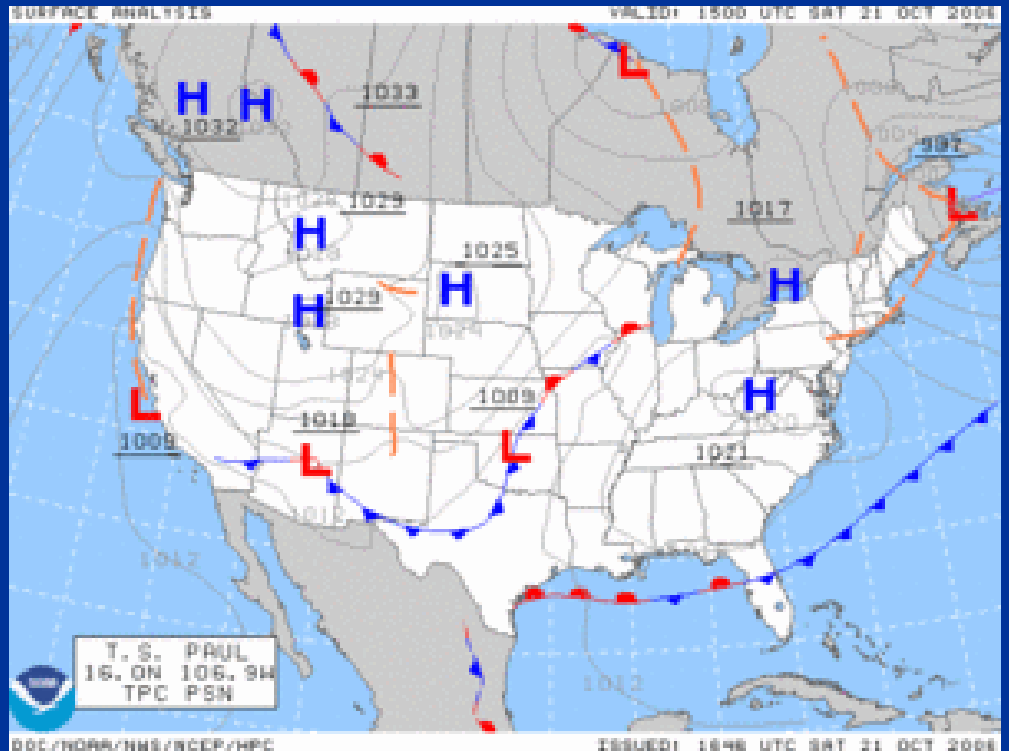
When a cold front overtakes a warm front

- A developing cyclone typically has a preceding warm front (the leading edge of a warm moist air mass) and a faster moving cold front (the leading edge of a colder drier air mass wrapping around the storm).
- North of the warm front is a mass of cooler air that was in place before the storm even entered the region.



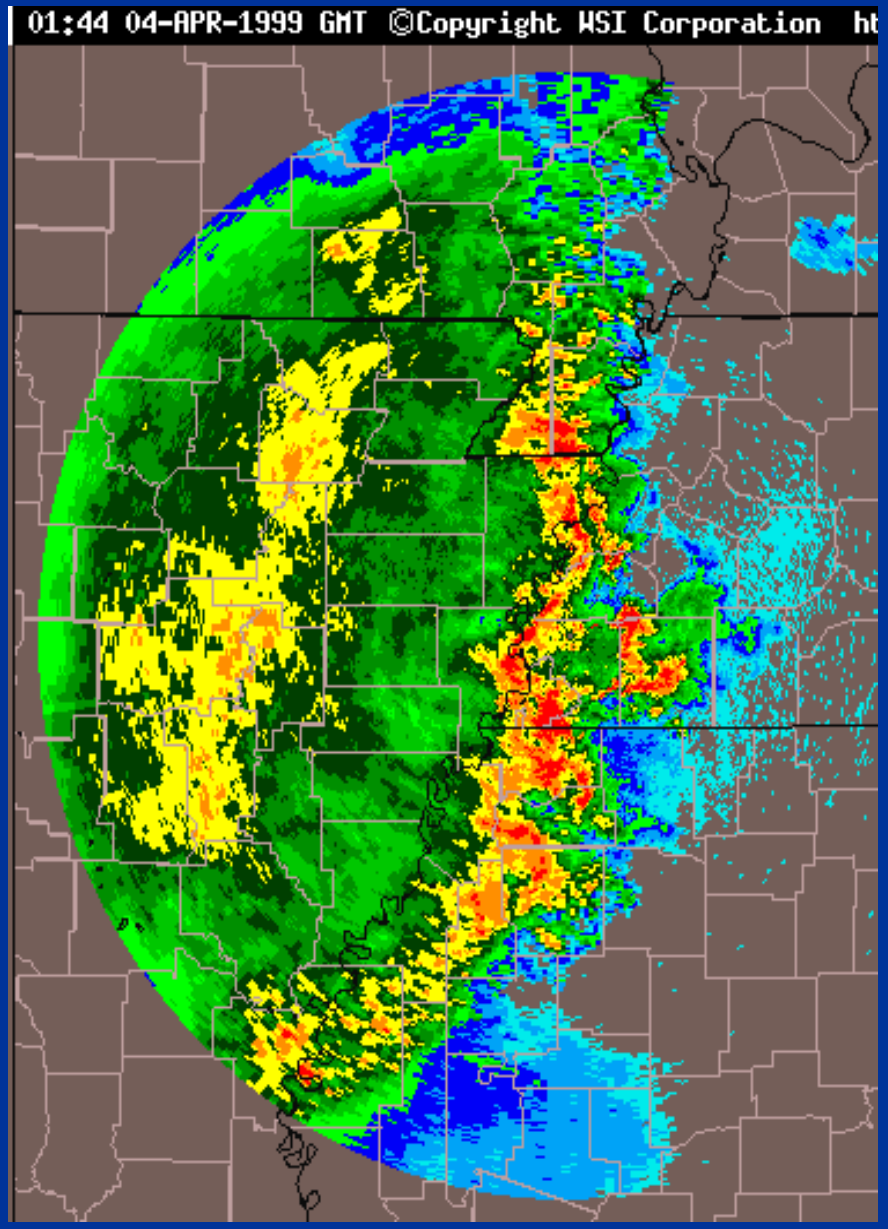
Surface Trough

- A trough of low pressure that contains significant weather phenomena (such as precipitation and distinct wind shifts) may be identified on the map by a thick brown dashed line running along the axis of the trough.
- On some maps this trough line may have the abbreviation, "TROF".



Squall Line

- A squall line is a line of thunderstorms will develop out ahead of and parallel to a cold front or dry line boundary.
- The storms first develop where there is the best combination of moisture, instability and lift.
- The storms will continue to evolve and new cells will develop (commonly toward the south and east).



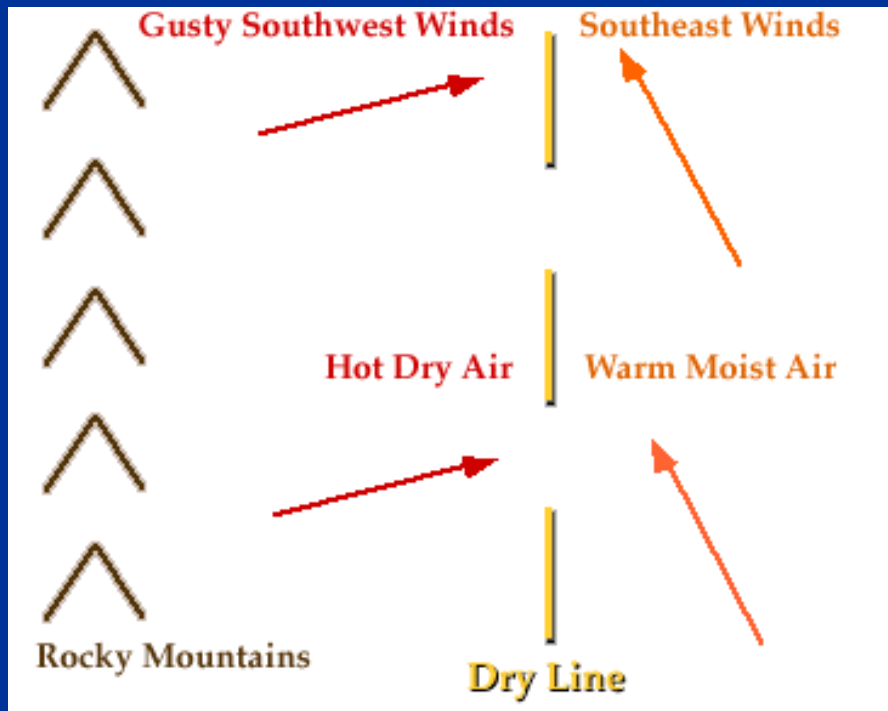
Dry Line

A moisture boundary

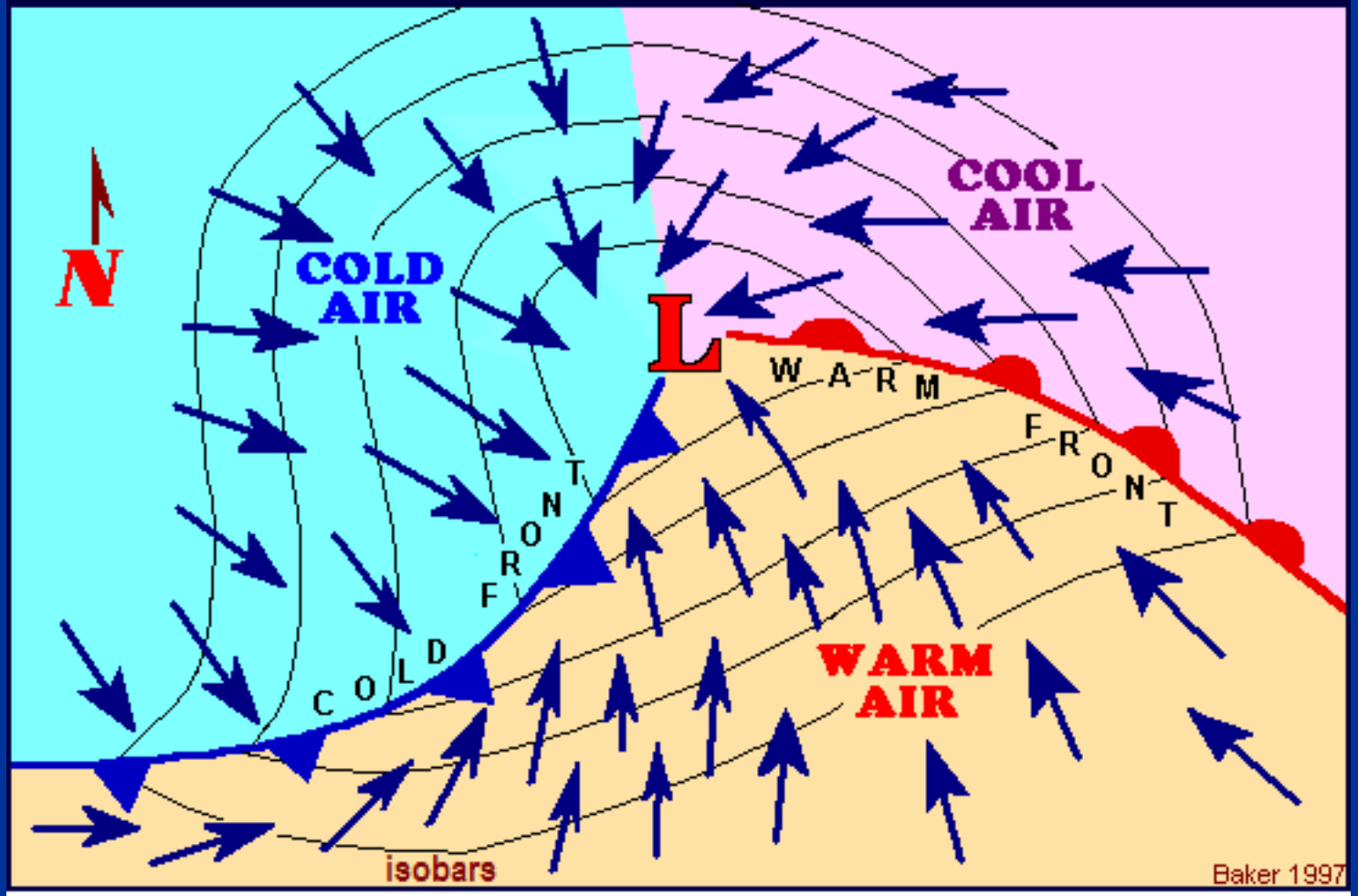
- A dry line is a boundary that separates a moist air mass from a dry air mass. Also called a "Dew Point Front", sharp changes in dew point temperature can be observed across a dry line.

- Dry lines are most commonly found just east of the Rocky Mountains, separating a warm moist air mass to the east from a hot dry air mass to the west.

- Drier air behind dry lines lifts the moist air ahead of it, triggering the development of thunderstorms along and ahead of the dry line (similar to cold fronts). It is not uncommon for tornadic supercells to develop along a dry line.



Typical Surface Wind Direction with Cold and Warm Fronts



forecast.weather.gov/MapClick.php?w0=t&w1=td&w2=wc&w3=sfcwind&w3u=1&w4=sky&w5=pop&w6=rh&w7=thunder&

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Weather Elements

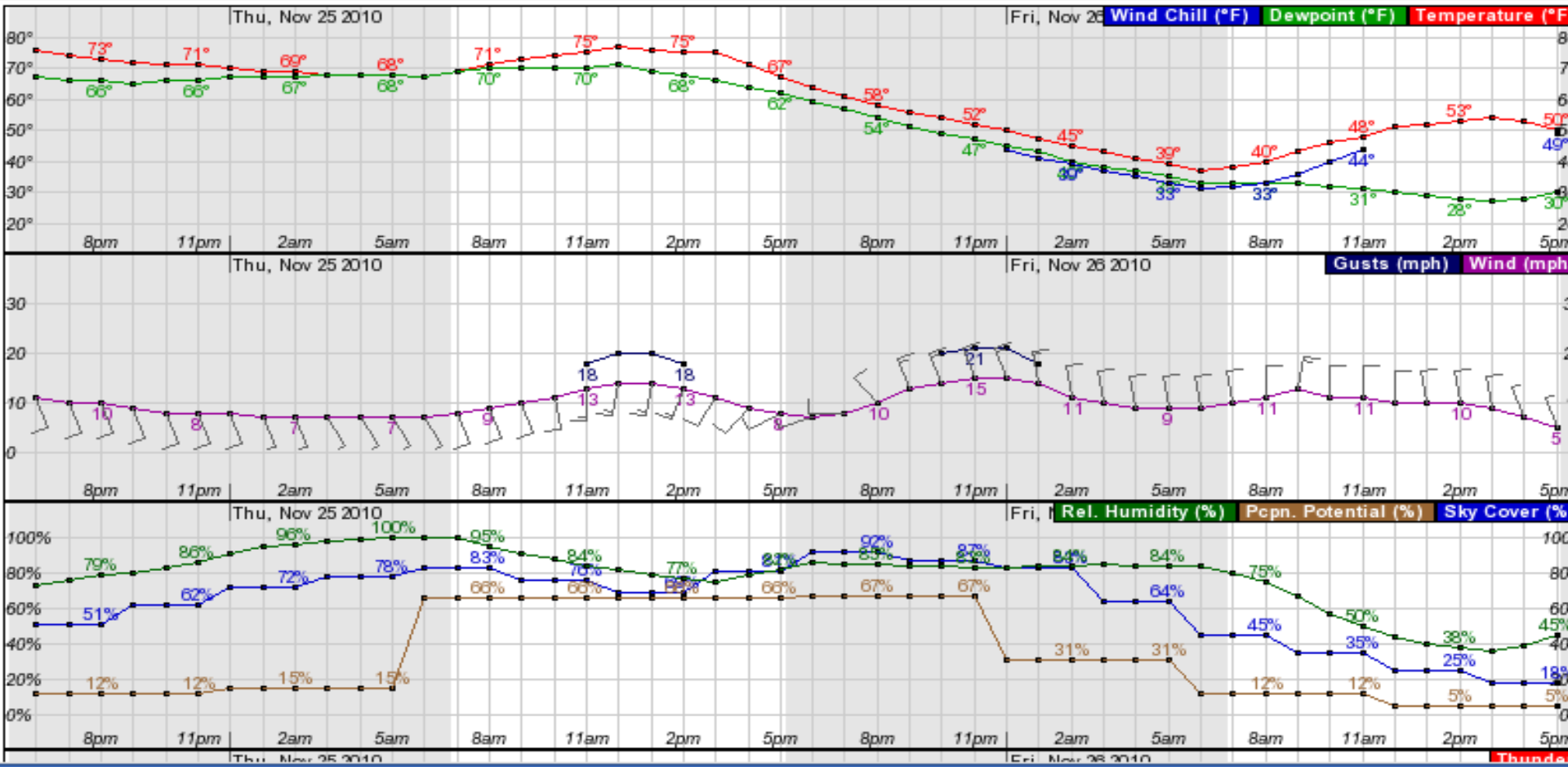
- [x] Temperature (°F)
- [x] Dewpoint (°F)
- [x] Wind Chill (°F)
- [x] Surface Wind mph
- [x] Sky Coverage
- [x] Precipitation Potential
- [x] Relative Humidity

Weather/Precipitation

- [x] Thunder
- [x] Rain
- [x] Snow
- [x] Freezing Rain
- [x] Sleet

48-Hour Period Starting: 6pm Wed, Nov 24 2010 Submit

Back 2 Days | Forward 2 Days



Warning!

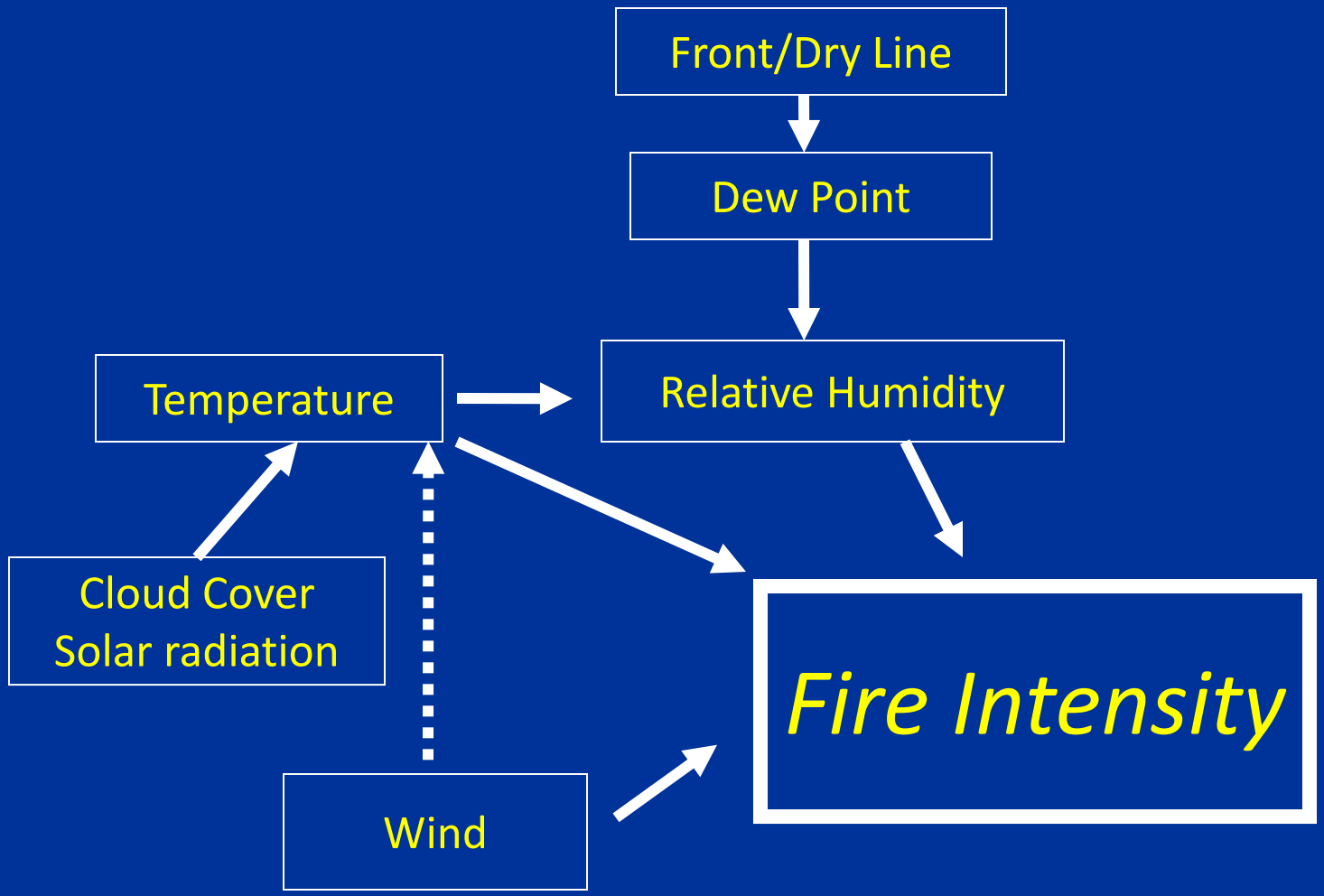
- **Do not plan a burn if a frontal boundary is expected to cross within a bare minimum of 48 hours prior to the burn.**
- **Problems**
  - **Shifting winds**
  - **Strong winds**
  - **DewPoint shifts**

Why do we need to know this?

Predict Fire Behavior and Fire Intensity

Weather Factors Affecting Fire Intensity

These factors are intergraded by the Burn Boss to determine the outcome of a fire.



Dew Point Facts

- The dew points is one of the most reliable measures of atmospheric moisture

Dew Point

- The temperature to which air must be cooled to reach saturation.
- An indicator of the moisture content on the air. The higher the dew point temperature, the higher the moisture content of the air.

Dew Point and Moisture

Rising Dew Point → Increasing Moisture

Lowering Dew Point → Decreasing Moisture

Solar Radiation
Cloud Cover

- Cloud cover can lower the temperature.
- Lower temperature raises humidity.

Temperature

- Temperature is a measure of the average energy of the particles (atoms or molecules) of a substance, or a measure of how **hot** or **cold** something is.
- The warmer the temperature, the quicker the fuel will ignite.

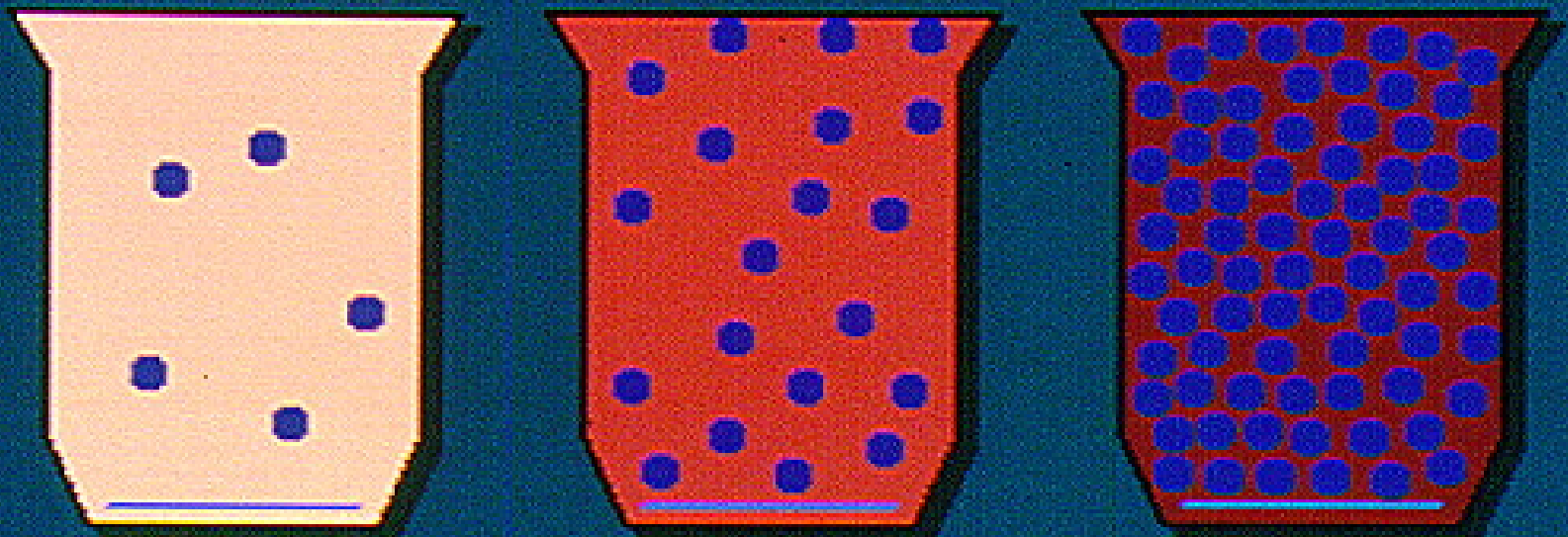
Relative Humidity

- Relative humidity is defined as the ratio of the partial pressure of water vapor in a gaseous mixture of air and water to the saturated vapor pressure of water at a given temperature.

Relative Humidity - *continue*

- What does it mean for prescribed burning?
  - The amount of water in the dead fuel.
  - More water in the dead fuel, the less it will burn.
  - Dead fuel responds over time to relative humidity.
    - Some fuel responds quickly (grass).
    - Other fuel may take a long time to respond (logs or slash).
- Relative humidity and temperature have an inverse relationship.

Temperature vs Water Vapor



Warm Medium High

The warmer the air, the more water vapor it can hold.

Wind

- Wind combined with higher temperatures can increase drying of vegetation.
- Wind speed and direction has a direct influence on Fire Intensity.
  - Adds oxygen to increase fire temperature.
  - Dries vegetation ahead of the fire front.
- Learn your prevailing wind direction.

Wind-driven Fire

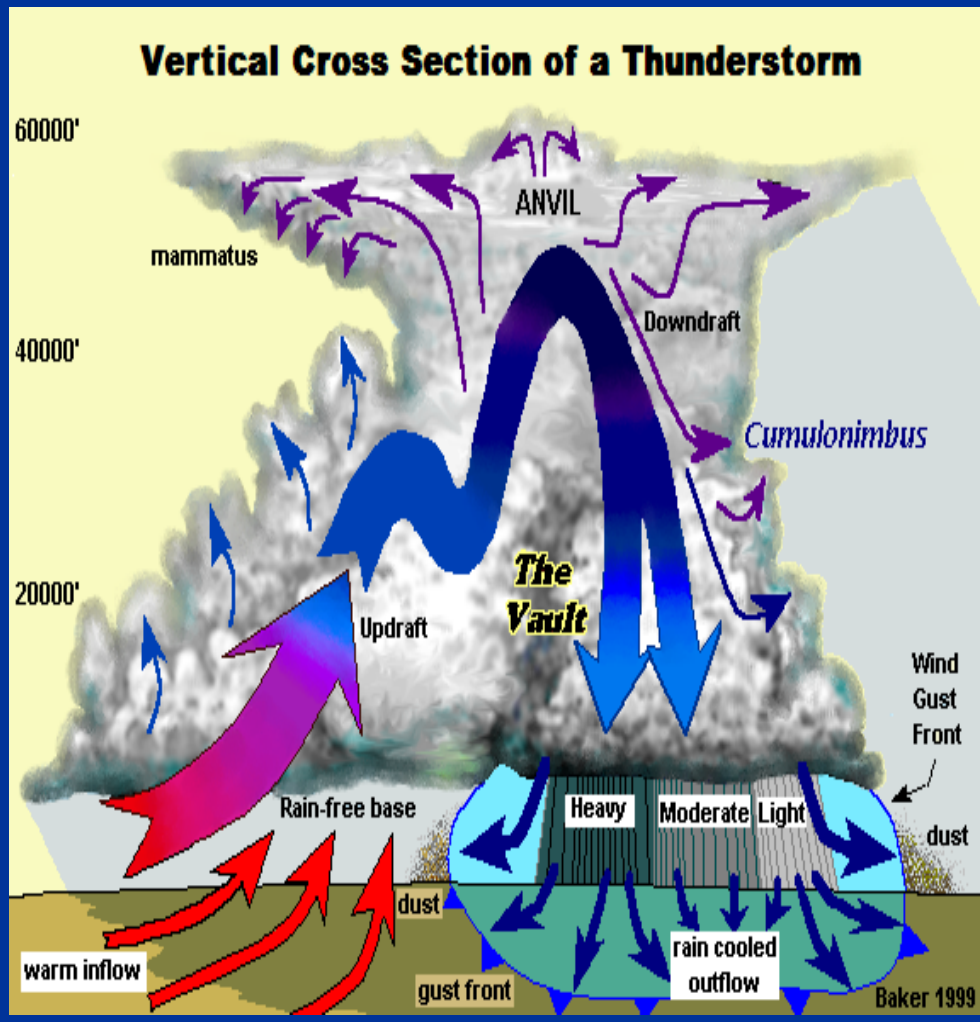
Wind-Driven Fires

- Often those that escape initial attack and become the largest.
- Easier to predict direction of spread.
- Wind shift poses a problem.
- Smoke column bend over by wind.
- Spotting downwind.
- Flanks and heel generally safe.

Critical Winds

Thunderstorm Winds

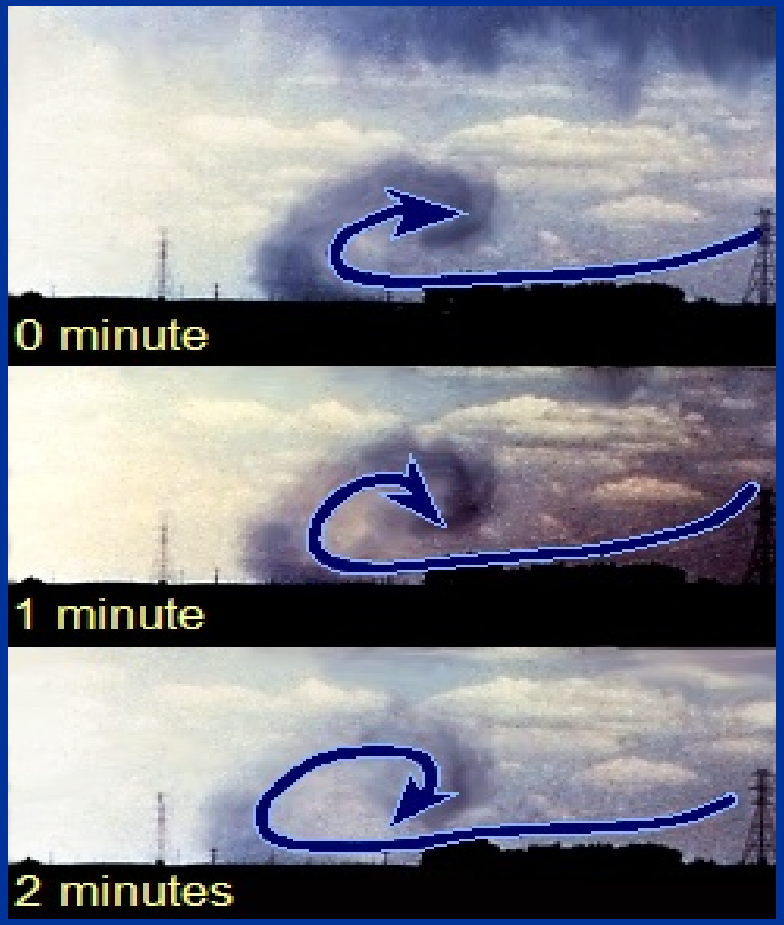
- **Thunderstorm Winds**
  - Indrafts and downdrafts can change both direction and speed suddenly.
  - Result in sudden changes in rate and direction of fire as well as intensity.
  - Indraft speeds range from 10 to 20 mph and gusty.
  - Downdrafts speeds range from 25 to 35 mph with gusts over 60 mph.



Critical Winds - *continue*

Thunderstorm Winds

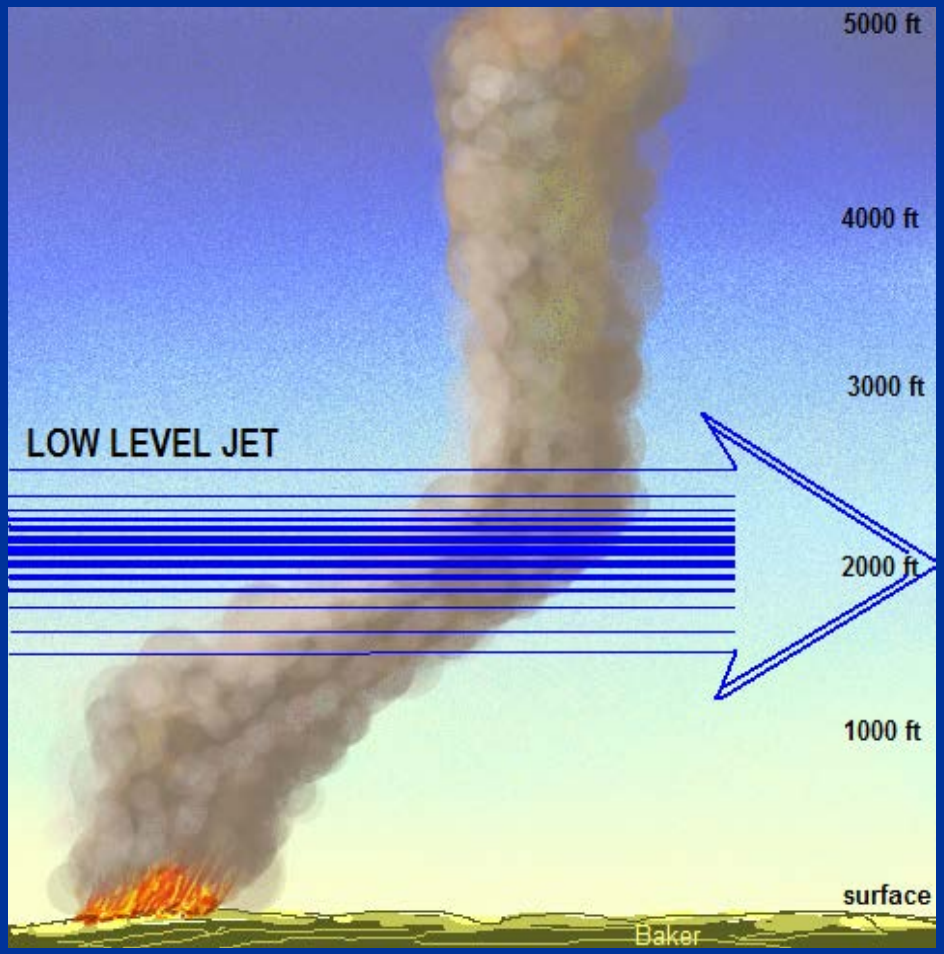
- **Gust Front**
  - Leading edge of the downdraft.
  - Boundary between two dissimilar air massess, similar to a cold front.
  - Most of the time, marked by a wind shift, decrease in temperature and increase in RH.

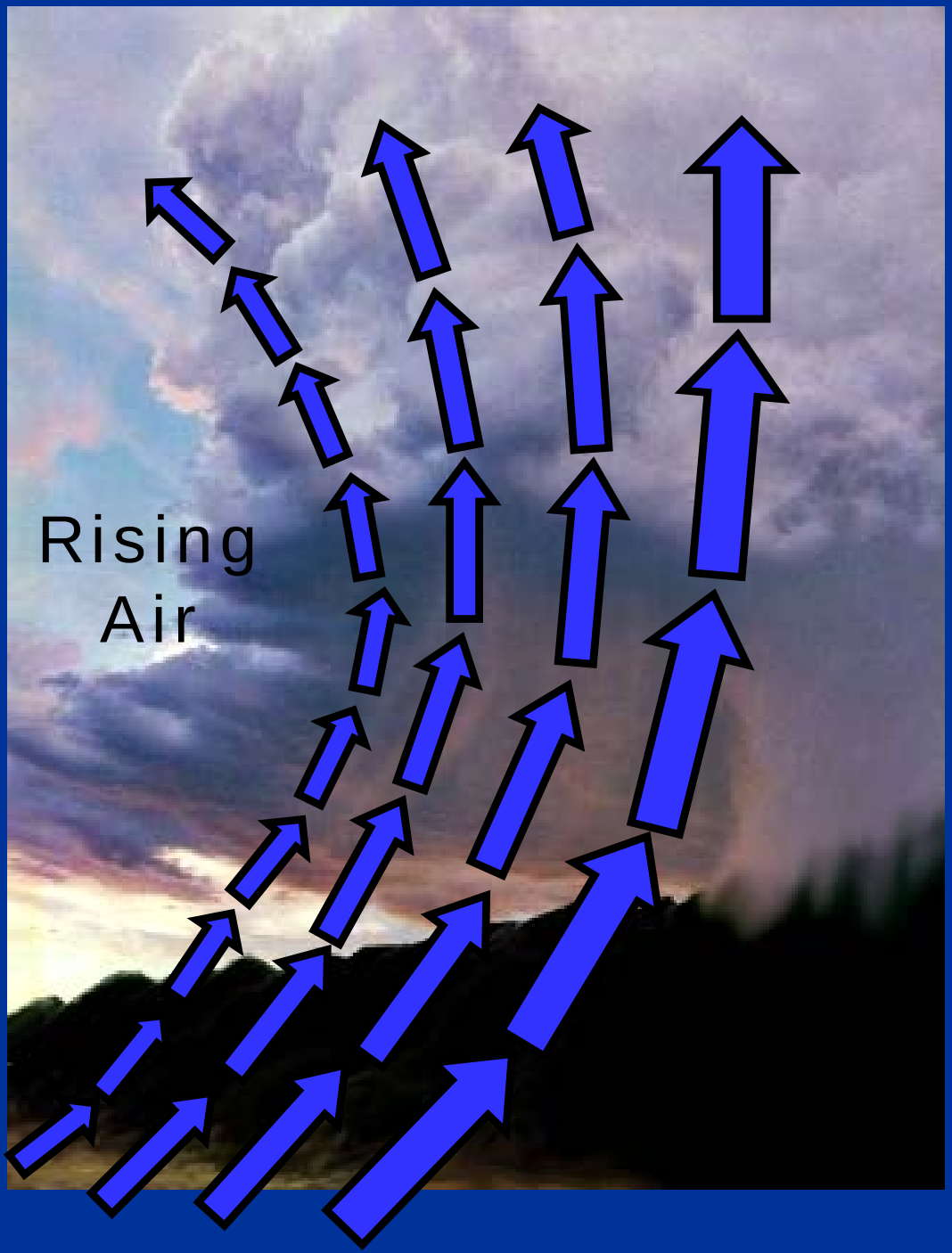


Critical Winds - *continued*

Low-Level Jets

- **Spotting downwind**
  - A jet stream 100 feet to several thousand feet above ground.
  - Develop ahead of cold fronts or troughs.
  - Wind speeds of 25 to 35 mph.
  - Can significantly increase rates of spread.





Unstable atmosphere

- Promotes the formation and growth of vertically developed clouds, thunderstorms and tall smoke columns.

An unstable atmosphere is most often associated with a critical or extreme wildland fire behavior

Atmosphere Stability

- Very unstable air can cause extreme fire behavior and can be a very dangerous time to implement a prescribed burn.
- A prescribed burn **NEEDS** some instability. The prescription should be designed to account for any problems caused by the instability.

Predict Weather and Fire Intensity

Prediction 1

- Overcast
- 45 F
- RH = 45%
- 5 mph wind

Predict Weather and Fire Intensity

Prediction 2

- Clear sky
- 101 F
- RH = 20%
- 15 mph wind

Weather can be Friend or Foe

The more you understand, the better your success with prescribed burning

Fire Weather Forecast is Critical for Prescribed Burning

Purpose of Fire Weather Forecast

- Predicts fire behavior for the safety of firefighter/prescribed burn managers and other people that may be threatened by wildfires.
- Allows a burn manager to predict the success of the burn to meet their objectives.

Fire Weather Forecast

- Need an understanding of the important weather elements that are available.
- Know where to find a forecast.
  - Long-term general forecast prior to burn date.
  - Fire weather and point forecast one to two days prior to burn date.
  - Fire weather forecast on burn date.
  - Spot forecast for the burn location.

Types of Fire Weather Forecasts

- General Forecast
  - Temperature, rainfall, weather map.
- Point forecast – general forecast for a smaller area (within 3 miles of a selected point.
- Fire Weather Forecast – Watches/Red Flag warnings.
- Spot Forecasts – Telephone call to National Weather Service or web submitted for your exact location.

General Forecast

- Daily and weekly forecast
- www.weather.com
- Local TV news/weather
- Local radio weather
- Many different web based weather sites.

Why General Forecasts May Not Fit Your Site

- They tend to average conditions over a large area.
- Area issued for a predetermined time period.
- May not stress important elements.
- May not fit local topography.

Point Forecast

- Applicable to your location (within a 3 mile area).
- Daily and weekly forecast.
- Temperature, rainfall probabilities, wind, speed and direction.
- Other weather conditions at nearest reporting station.
- www.srh.noaa.gov

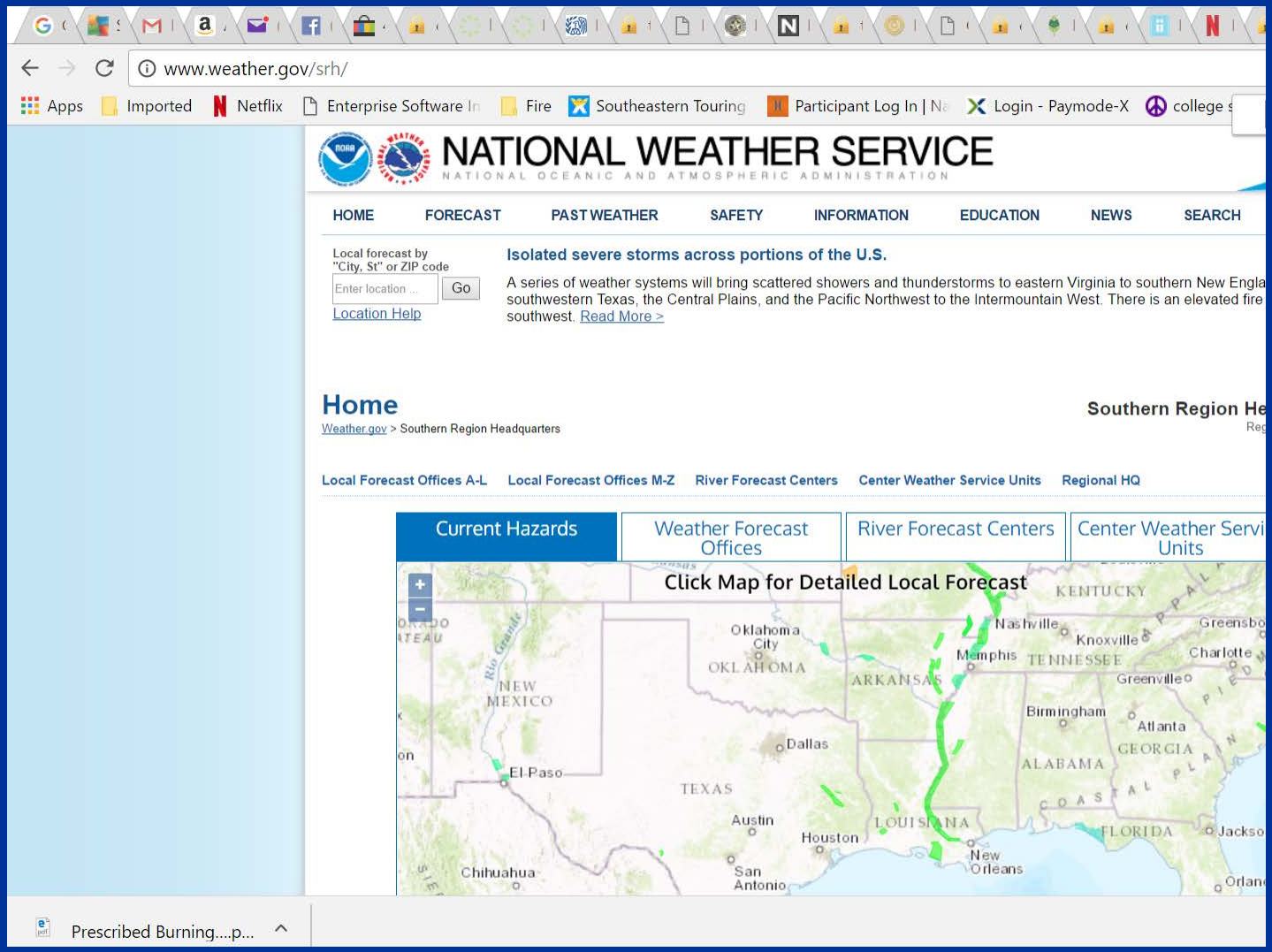
Weather Forecast Sites

- There are many weather forecast sites on the internet.
- For prescribed burning, a site with access to a point forecast, a spot forecast, and a fire weather forecast is idea.

Weather Forecast Site

- www.srh.noaa.gov (one stop shop).
  - General weather forecast
  - Point weather forecast
  - Spot forecast
  - Fire weather forecast
  - Weather map
  - Radar map
  - Hourly weather forecasts
  - And lots of other weather information

Click on Your Area



7-Day Forecast for Latitude 30.33N and Longitude -100.53W (Elev. 2198 ft) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://www.srh.noaa.gov/forecast/MapClick.php?site=sjt&map.x=169&map.y=266 Go Links

Google wind temperature effects Go Bookmarks PageRank 17 blocked Check Look for Map AutoFill Settings

NWS San Angelo, TX
Point Forecast: 17 Miles SSE Sonora TX
30.33N -100.53W (Elev. 2198 ft)

Cell Phone Weather Link: www.srh.noaa.gov/wml
En Español
Last Update: 10:33 pm CST Dec 14, 2006
Forecast Valid: 12am CST Dec 15, 2006-6pm CST Dec 21, 2006

Forecast at a Glance

Overnight	Friday	Friday Night	Saturday	Saturday Night	Sunday	Sunday Night	Monday	Monday Night
								
Mostly Clear Lo 40°F	Becoming Sunny Hi 74°F	Mostly Clear Lo 44°F	Becoming Sunny Hi 75°F	Increasing Clouds Lo 53°F	Decreasing Clouds Hi 74°F	Mostly Cloudy Lo 55°F	Slight Chc Tstms Hi 69°F	Partly Cloudy Lo 45°F

Detailed 7-day Forecast

Overnight: Mostly clear, with a low around 40. Calm wind.

Friday: Partly sunny, then gradually becoming sunny, with a high near 74. Calm wind becoming south southwest between 5 and 10 mph.

Friday Night: Mostly clear, with a low around 44. South wind around 5 mph becoming calm.

Saturday: Mostly cloudy through mid morning, then gradual clearing, with a high near 75. South wind between 5 and 15 mph.

Saturday Night: Increasing clouds, with a low around 53. South southeast wind between 5 and 10 mph.

Sunday: Cloudy, then gradually becoming partly sunny, with a high near 74. South southeast wind between 10 and 15 mph.

Current Conditions

[Move Down]

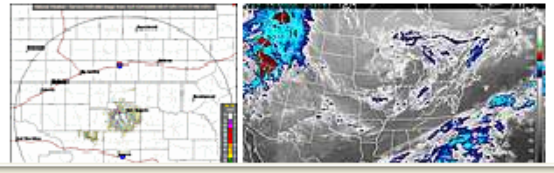
Sonora Municipal Airport
Last Update on Dec 14, 11:05 pm CST

Fair

37°F (3°C)

Humidity:	52 %
Wind Speed:	N 3 MPH
Barometer:	30.06"
Dewpoint:	21°F (-6°C)
Visibility:	10.00 mi.
More Local Wx:	**2 Day History**:

Radar and Satellite Images



National Weather Service • Since 187

Done Internet

start Gmail - Forest L... 7-Day Forecast ... JetStream MAX ... Butch burn talks Solitaire Microsoft Power... 11:32 PM

Purpose of Spot Forecasts

- Site specific forecasts that are issued to fit time, topography, and weather of a specific location.

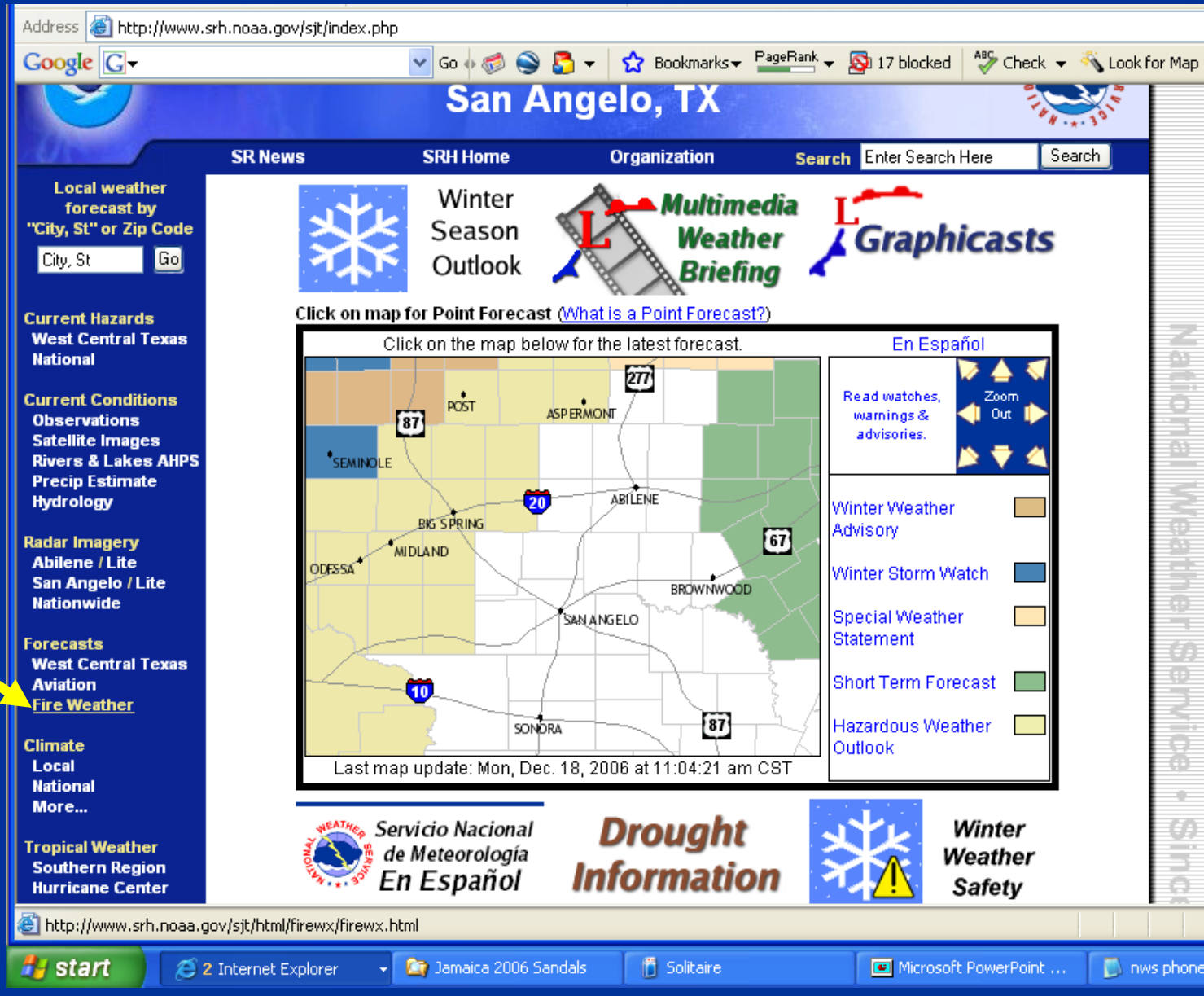
When to Request a Spot Forecast

- The general forecast does not fit your situation.
- Indicators suggest possible severe burning conditions.
- Control is not expected soon.
- Red flag warnings are posted for the fire area.
- There is or has been erratic fire behavior.
- The fire is moving into heavier fuels.

How to Obtain a Spot Forecast by Telephone

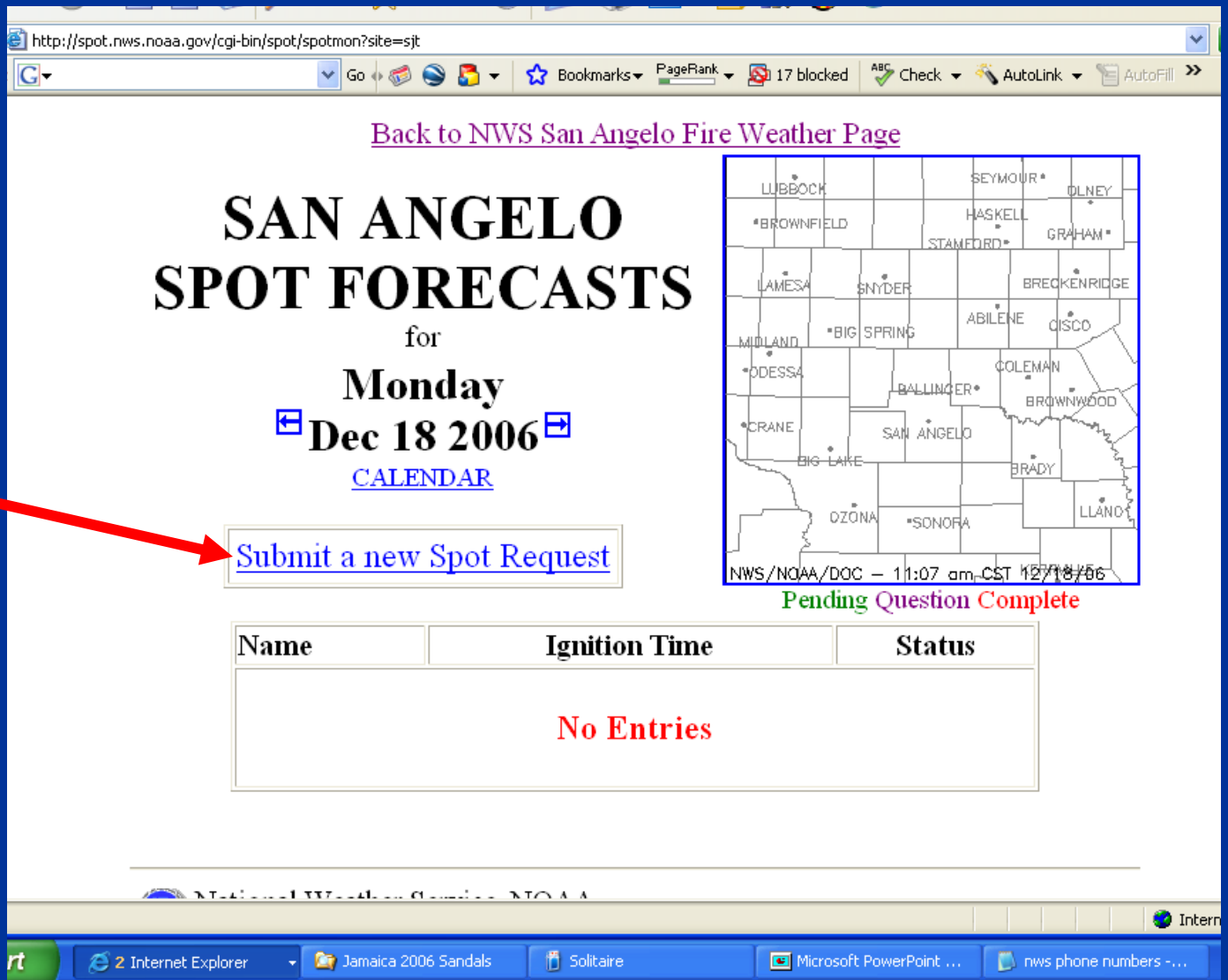
- Take a representative weather observation.
- Contact the nearest National Weather Service office.
- Ask to speak to a fire weather forecaster.
- Provide forecaster with your current weather conditions.
- Request specific information (wind speed, direction, possible shift, RH forecast, etc.).

ClickHere and then online spot request.



On-line Spot Forecast Request

Click



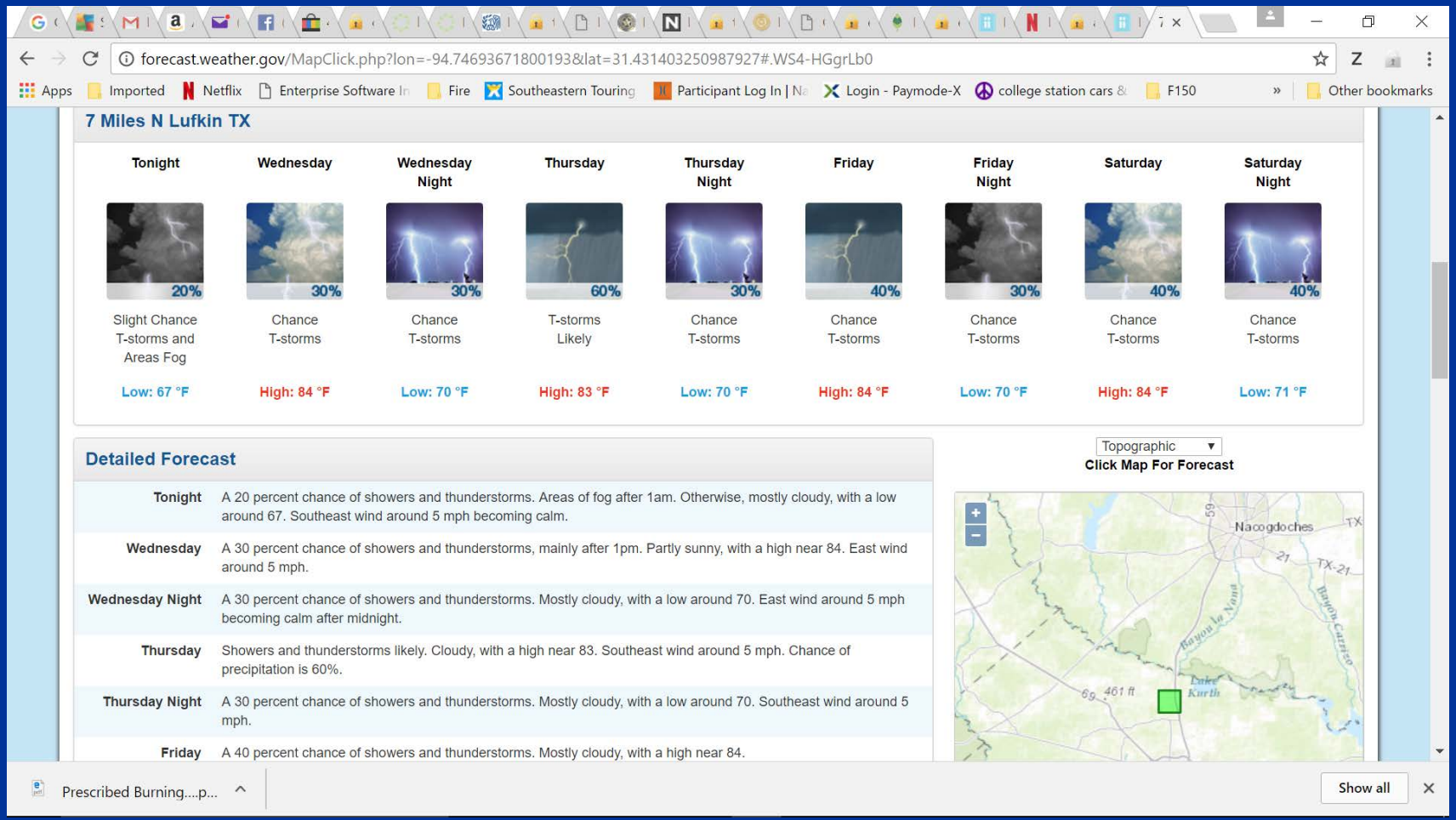
Include Current On-site Weather

So that the forecaster can adapt the broad scale forecast to the specific site.

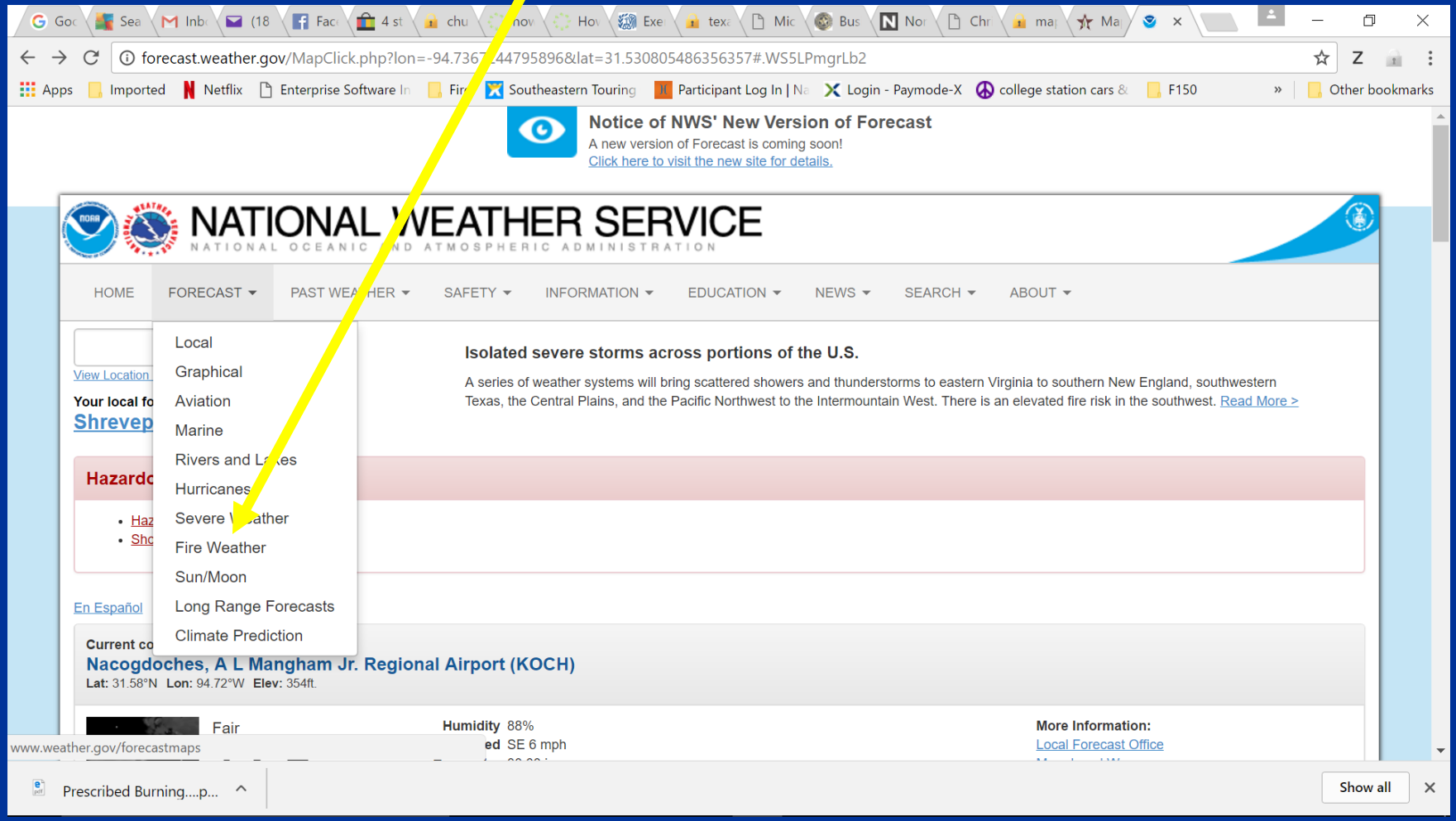
Fire Weather Forecast

- Weather variables that you need to predict fire and smoke behavior.
- Specific to your area, but not your exact location.

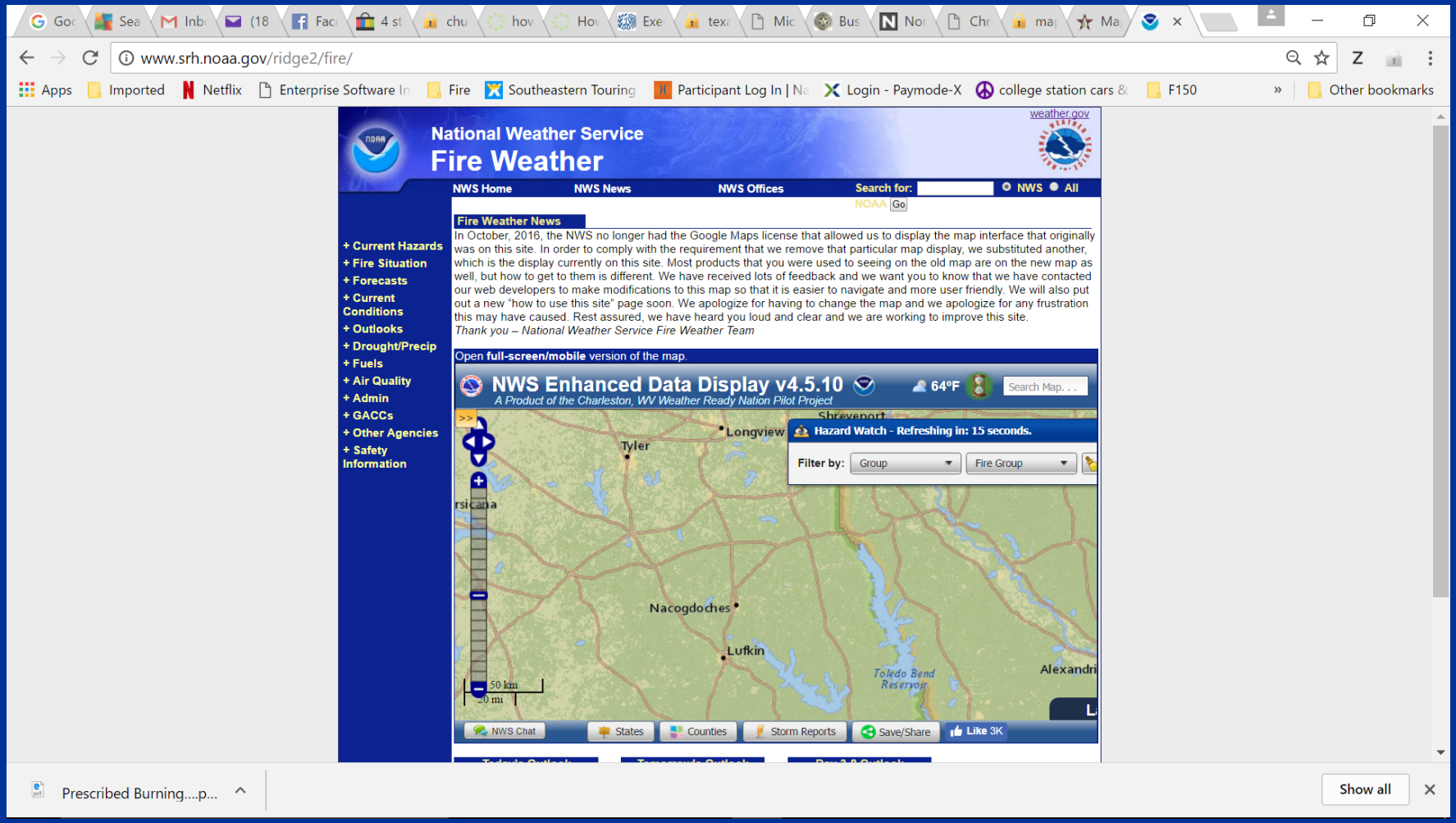
Click on Location of Your Ranch



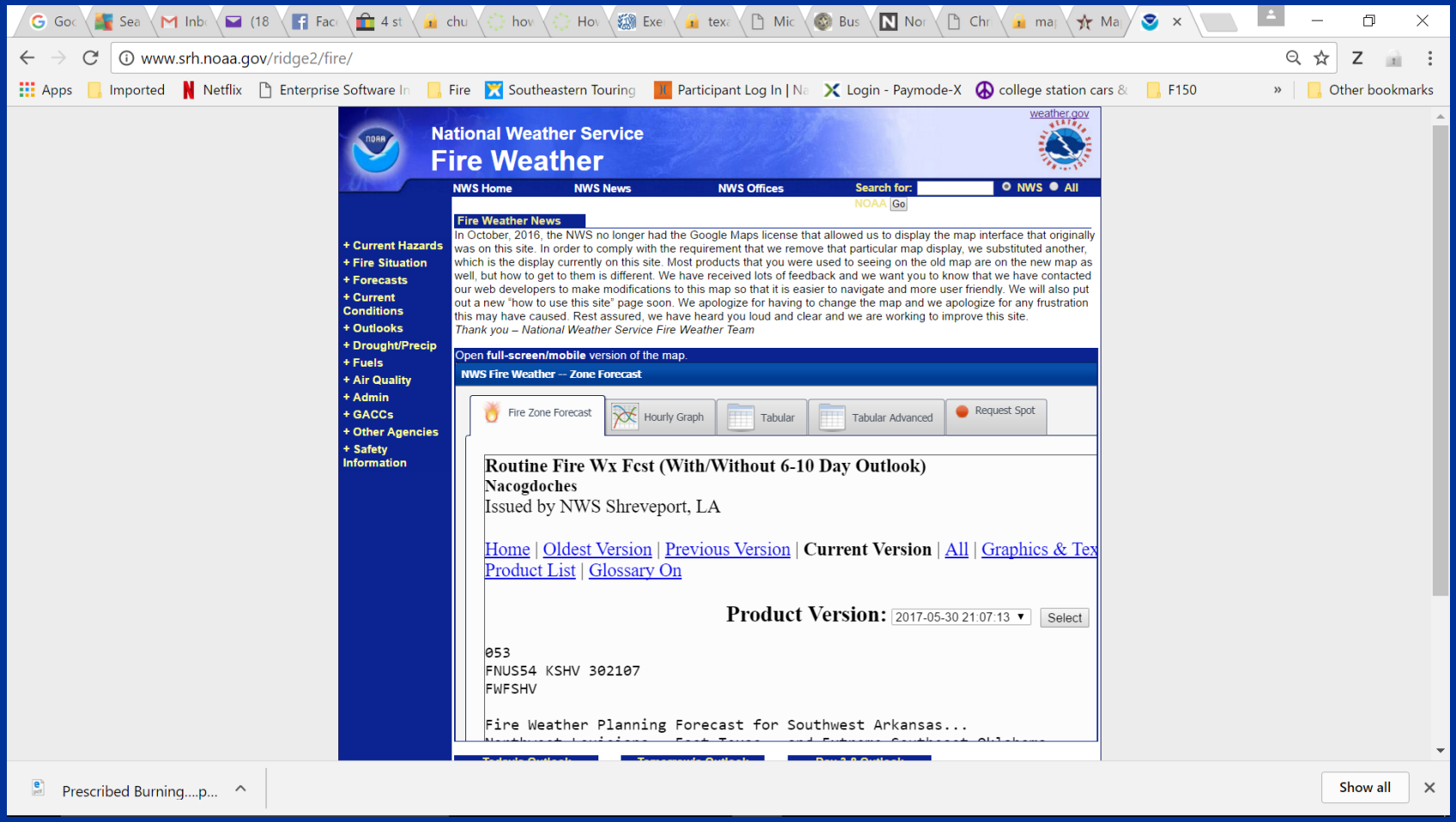
Click on Fire Weather



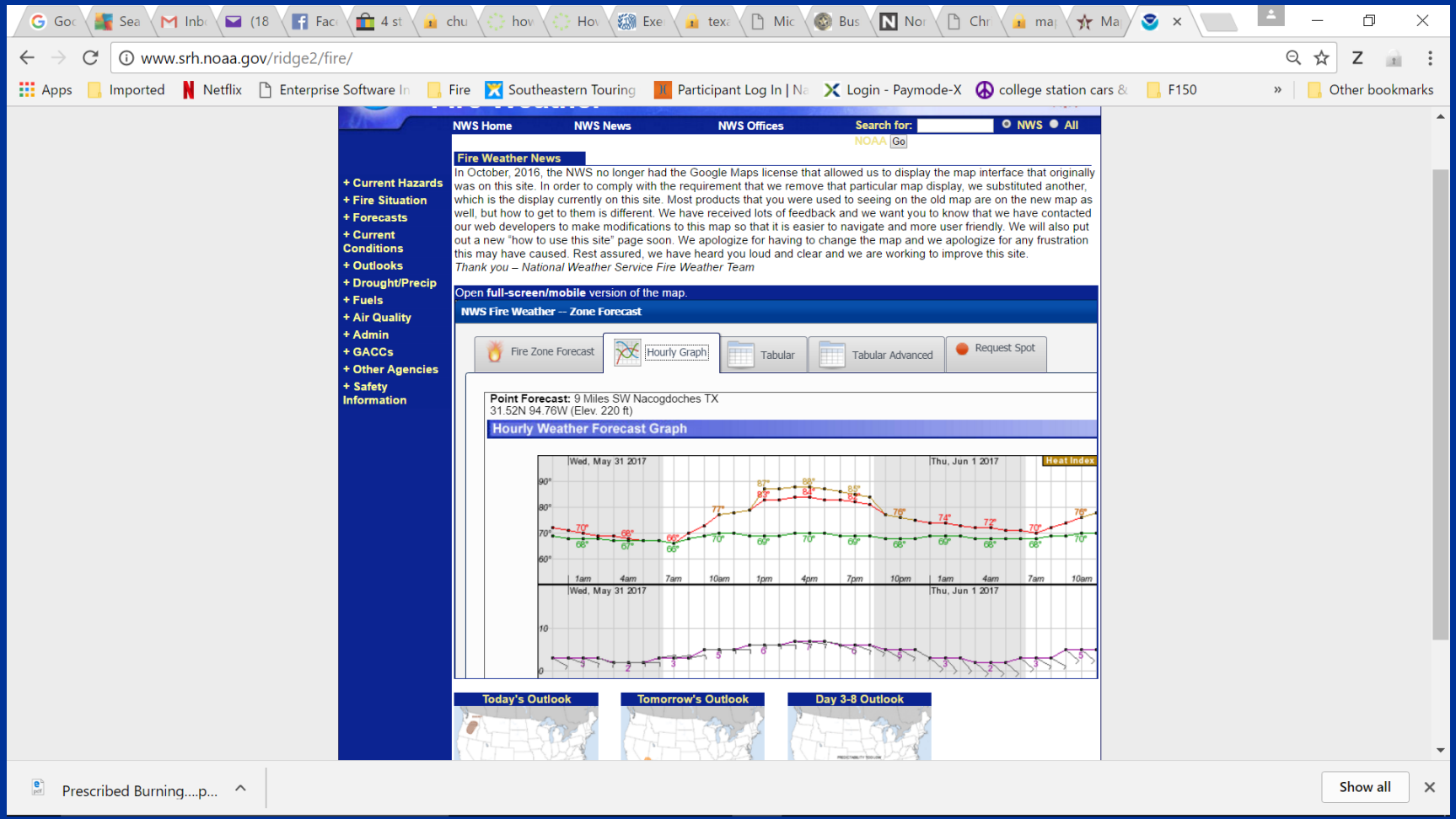
Click on your ranch



Fire weather narrative and predictions



Hourly predictions and other fire weather information

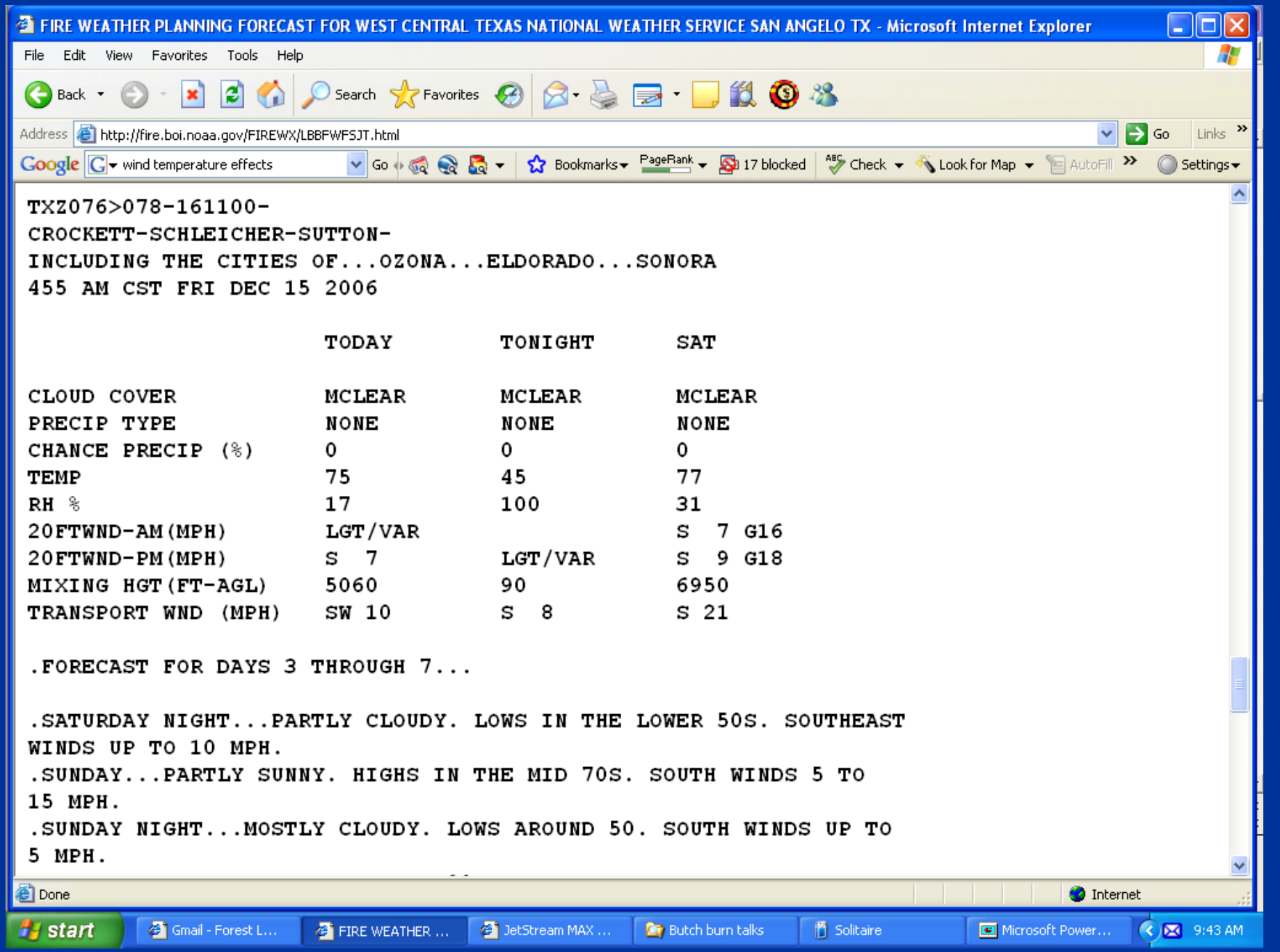


Fire Weather Forecast

- Assist the manager with the implementation of the burn.
- Provide data to cancel the burn if the weather is not within the burn prescription.
- Provide data to verify that the weather is within the burn prescription.

Forecasted Fire Weather Elements

- Temperature
- Relative Humidity
- Wind Speed
- Chance of Thunderstorms
- Red Flag Conditions
- Smoke Dispersion Elements
- Lightening Potential
- Drought indexes
- and other weather elements


FIRE WEATHER PLANNING FORECAST FOR WEST CENTRAL TEXAS NATIONAL WEATHER SERVICE SAN ANGELO TX - Microsoft Internet Explorer
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Address http://fire.boi.noaa.gov/FIREWX/LBBFWFSJT.html
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TXZ076>078-161100-
CROCKETT-SCHLEICHER-SUTTON-
INCLUDING THE CITIES OF...OZONA...ELDORADO...SONORA
455 AM CST FRI DEC 15 2006
TODAY TONIGHT SAT
CLOUD COVER MCLEAR MCLEAR MCLEAR
PRECIP TYPE NONE NONE NONE
CHANCE PRECIP (%) 0 0 0
TEMP 75 45 77
RH % 17 100 31
20FTWND-AM(MPH) LGT/VAR S 7 G16
20FTWND-PM(MPH) S 7 LGT/VAR S 9 G18
MIXING HGT(FT-AGL) 5060 90 6950
TRANSPORT WND (MPH) SW 10 S 8 S 21
.FORECAST FOR DAYS 3 THROUGH 7...
.SATURDAY NIGHT...PARTLY CLOUDY. LOWS IN THE LOWER 50S. SOUTHEAST
WINDS UP TO 10 MPH.
.SUNDAY...PARTLY SUNNY. HIGHS IN THE MID 70S. SOUTH WINDS 5 TO
15 MPH.
.SUNDAY NIGHT...MOSTLY CLOUDY. LOWS AROUND 50. SOUTH WINDS UP TO
5 MPH.
Done
Internet
start
Gmail - Forest L...
FIRE WEATHER ...
JetStream MAX ...
Butch burn talks
Solitaire
Microsoft Power...
9:43 AM

Purpose of the Red Flag Warning or Fire Weather Watch

- To alert fire managers of critical fire weather conditions that will increase fire danger in a significant way.

Red Flag Criteria

- Dry lightning.
- Unusually low relative humidity and unstable air.
- Strong and shifting winds with a dry cold front .
- The weather values that trigger a Red Flag event vary by regions across the state.

Keetch/Byram Drought Index

*Is a measure of the relative dryness of an area.

*It depicts the degree of drought on a scale that ranges from 0 to 800.

*It assumes vegetation on an area will be at its wilting point when the index is 800.

*When KBDI exceeds 400 consumption of the duff layer is likely.

*KBDI is a drought index – not necessarily a fire behavior index.

*Even when the KBDI is high, it is possible to conduct safe prescribed burns.

Palmer Drought Severity Index

*Uses temperature and rainfall information in a formula to determine dryness.

*Effective in determining long term drought (over several months) and is not as good with short-term forecasts (over several weeks).

*PDSI uses 0 value as normal, and a drought is shown in terms of minus numbers (I.e., -2 is moderate drought, -3 severe drought, and –4 is extreme drought).

*PDSI can also express rain using a corresponding level reflected by + values.

Haines Index

*The Haines Index reflects the atmospheric stability and dispersion. (For the technically minded, the index reflects the temperature difference between heights where the air pressure is 850 and 700 hectopascals; and also the dew point depression at the 850 hectopascal height. Each of these are scored from 1 to 3, and the two are added together, thus the range of 2 to 6 for the Haines Index).

*Values range from 2 to 6, which show the potential for large plume-driven fire growth.

*Index 2 or 3 – very low potential.

*Index 4 – low potential.

*Index 5 - moderate potential.

*Index 6 – high potential .

Lightning Activity Level=LAL

- Refers to the forecasted lightning activity level for a specific forecast.
- The values range from 1 to 6. 1 meaning no activity and 6 is a dry lightning outbreak.

Weather Forecast

- Print out every weather forecast that you get prior to a prescribed burn.
- If your local or regional NOAA weather station will provide you with a spot forecast, take advantage of their expertise.
- Don’t forget to take actual weather observations on-site.

Collecting Weather Data on Site

Problems With Weather Forecast

- Predicting future weather.
- Predicting from available resources.
  - Satellite
  - Weather Stations
- Predictions are rarely exact.
- We need to know what the weather conditions are on-site and at burn time.

Need for Weather Observation with Request

- Forecaster can adapt the broads scales forecast to the specific site.
  - Better data
  - More confidence

When/How Often to take Observations

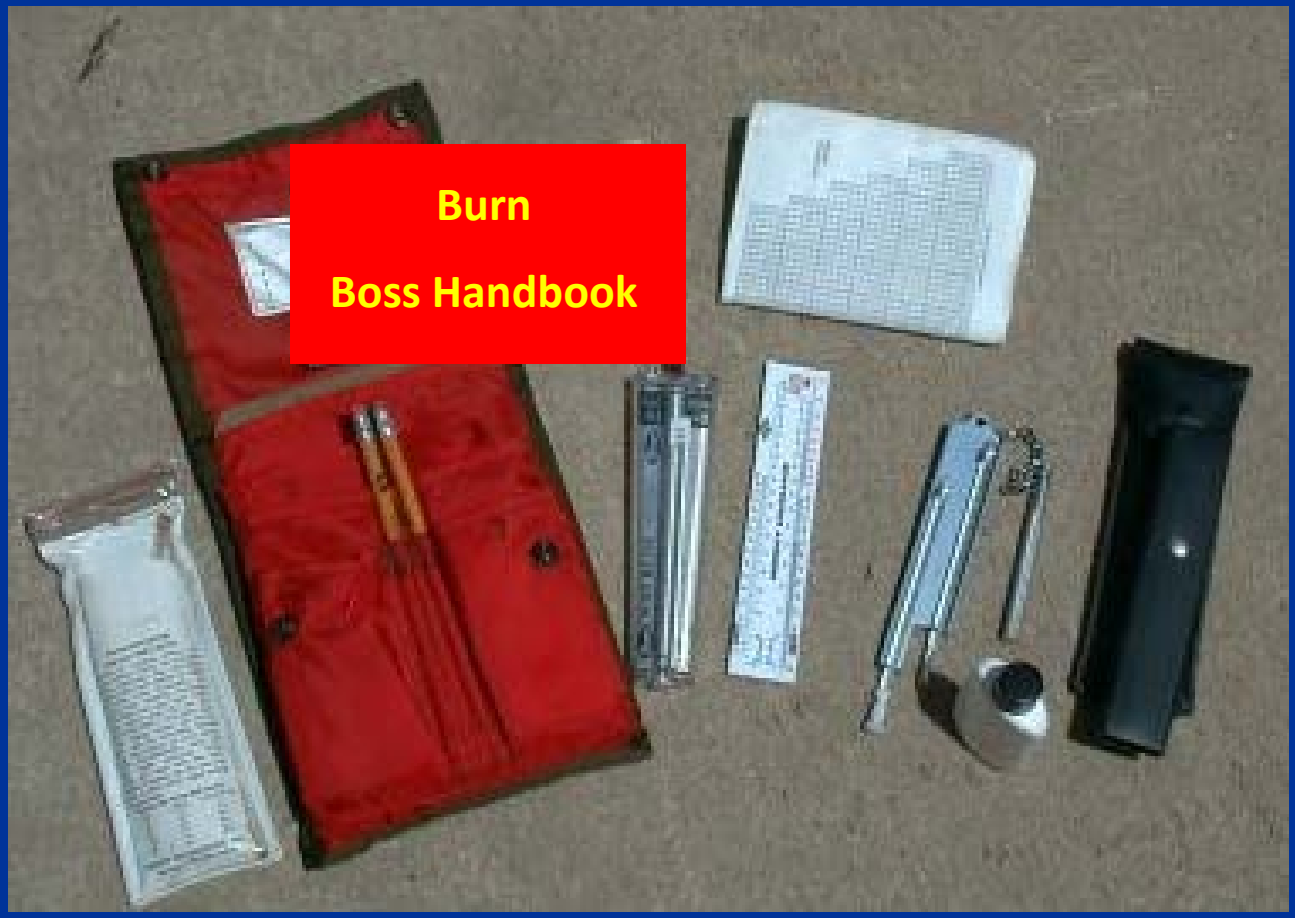
- Hottest/Driest and Coolest/Moistest Periods.
- Once every hour if weather changes are expected.

Where to Take Observations

- Small Fires – a representative location.
- Large Fires – problem areas.

Weather Observer Should Monitor

- Thunderstorms buildups.
- Approaching cold fronts.
- Inversions.
- Stability/instability.
- Wind shifts.
- Relative humidity.
- Cloud cover.



Belt Weather Kit

Fire Weather Equipment

- Sling Psychrometer
  - Wet bulb thermometer
  - Dry bulb thermometer
- Bottle of water
- Wind Speed Indicator
- Notebook
- Pencil
- Compass or GPS Unit
- Burn Boss Handbook & Journal

Weather Instrument

1. Temperature
2. Wind Chill
3. Relative Humidity
4. Dew Point
5. Heat Index
6. Wind Speed (current, max, avg.)

Weather

- A knowledge of weather and where to find forecasted weather information is critical information for a prescribed burn manager.
- Be sure and document all the weather information that you obtain.
- Don’t be afraid to call the weather forecasters in the NOAA office.