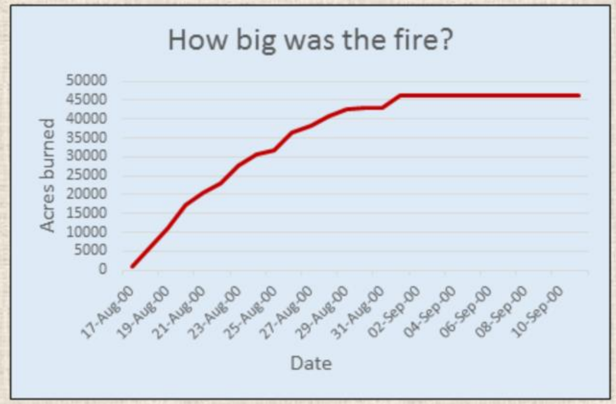
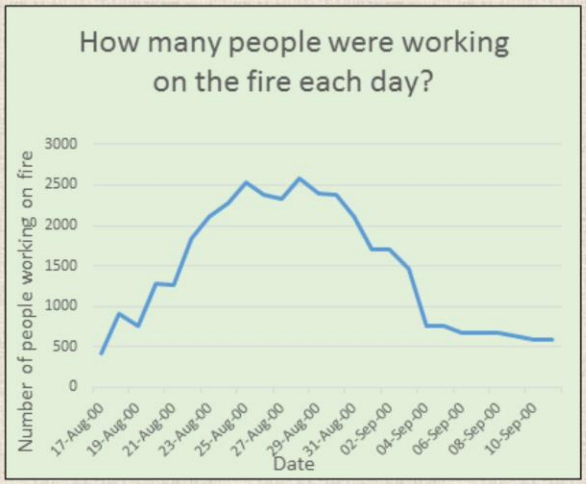
Fire Weather, Fire Climate, and the Storrie Fire

Part 1. Data from the Daily Situation Reports for the Storrie Fire

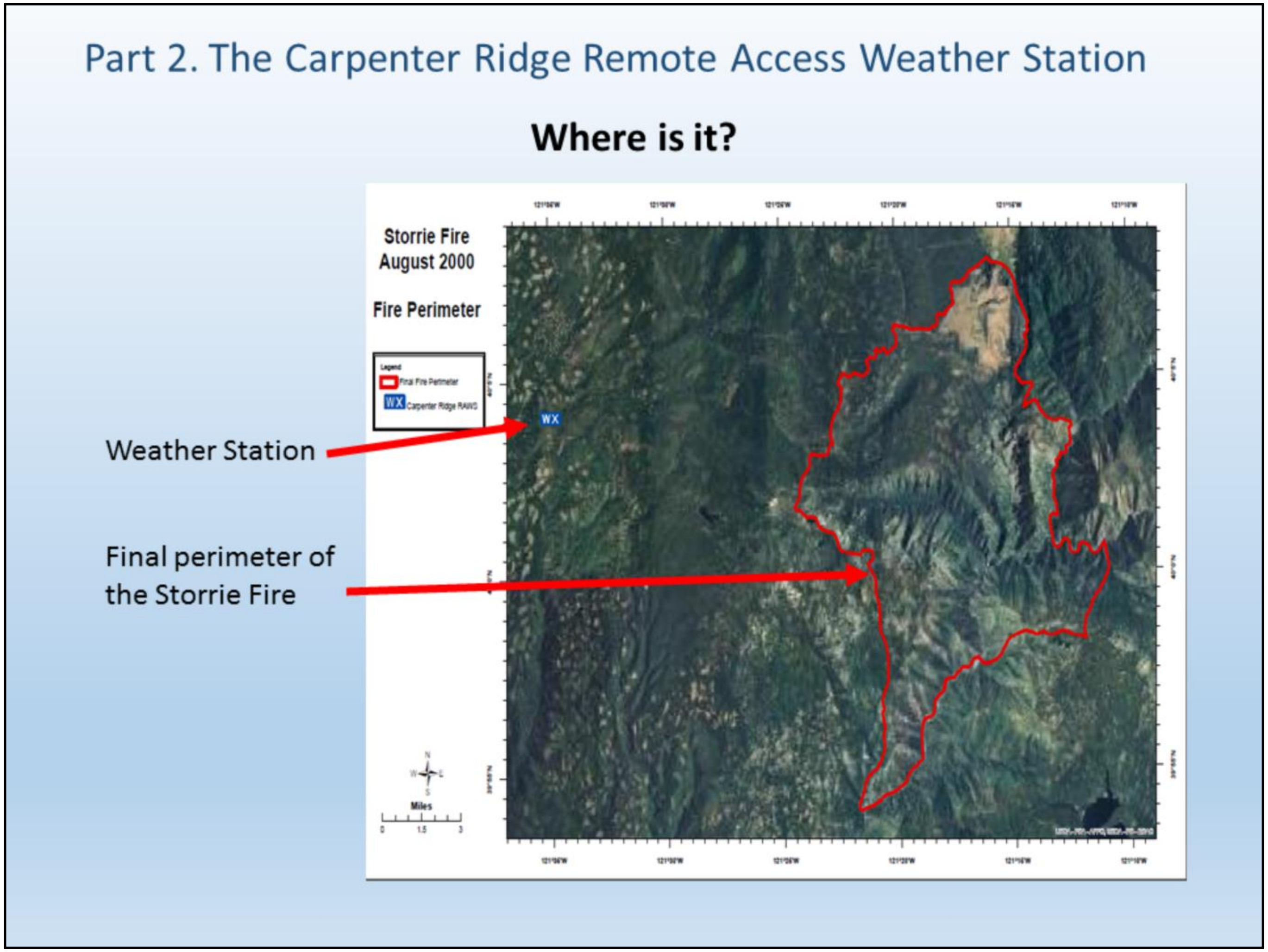
This kind of information is posted every day, for every current fire in the United States, on "Inciweb" (https://inciweb.nwcg.gov/). After each fire is out, the information is archived so you can find it years later.





Part 1 contains information about the Storrie Fire. Don't forget to consult the fire managers' journal entries in the journal entries in a separate document – *StorrieFireIncidentCommandTeamNarrative.docx.*

Here is information on the Storrie Fire's size each day, how many people were working on it, and how much it grew in the previous 24 hours. This information is taken from the Daily Situation Reports (journal entries). While the Situation Report showed the fire's size as about 45,000 acres, the fire was mapped carefully after it ended, and the results showed that it eventually burned 56,060 acres.



For your podcast, you will need information on weather conditions during the Storrie Fire. The next few slides show weather conditions during the time of the fire, but these records are not from the actual location of the fire; they are from a remote access weather station a few miles away. Remote Access Weather Station means that the station is operated electronically – not by people. Weather conditions are measured automatically at about 1 pm each day, and the data are transmitted by satellite to a recording center.

The Carpenter Ridge Remote Access Weather Station

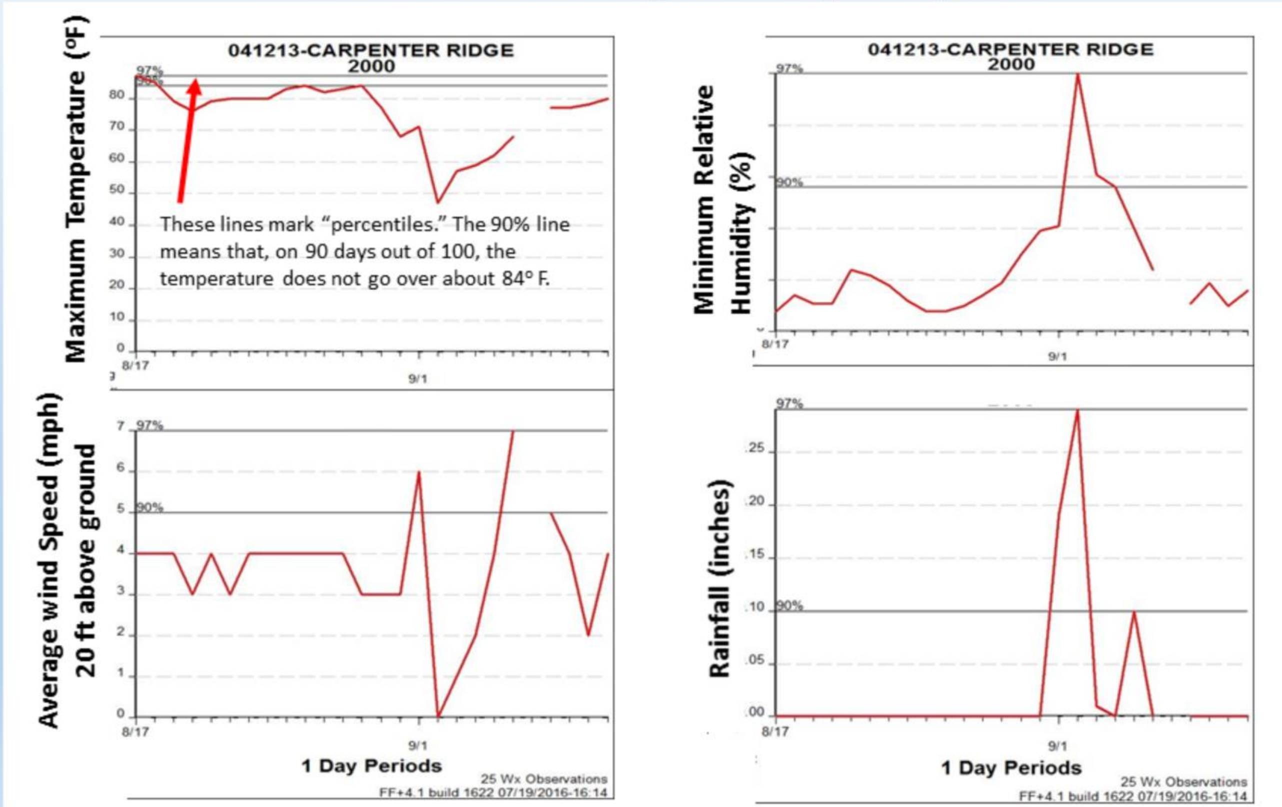
What does it look like?

See more photos and a video panorama at http://raws.dri.edu/cgi-bin/wea_info.pl?caCCRR.

Here are some photos of the weather station.

The Carpenter Ridge Remote Access Weather Station

Weather data for Aug. 17 – Sept. 11, 2000



Here are records of maximum temperature, minimum relative humidity, average wind speed, and rainfall for each day. The red arrow points to percentile lines; they are explained in the text connected to the arrow.

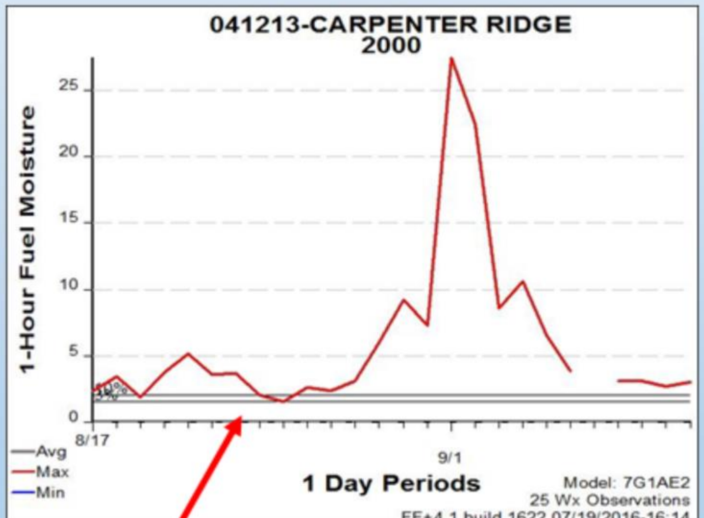
The wind speed in the lower left graph is not the average for ALL DAY; it is the average of the measurements taken in the 10 minutes before "transmit time" each day. That is the time when the previous 24 hours' weather is transmitted by satellite to the National Weather Service, around 1 pm.

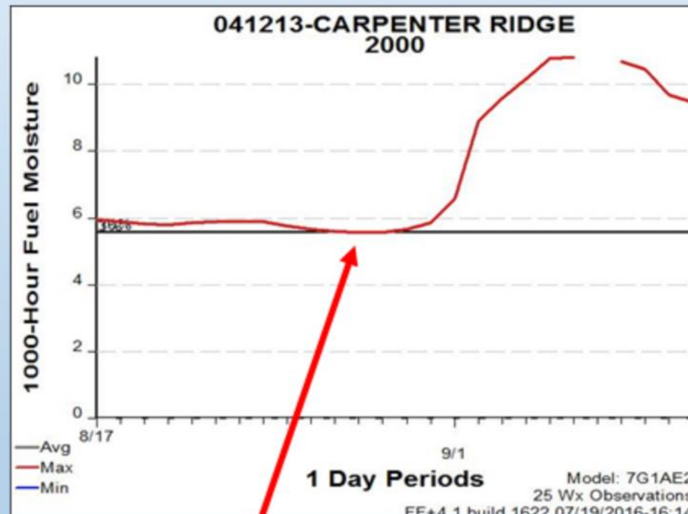
The Carpenter Ridge Remote Access Weather Station

Fuel Moisture data for Aug. 17 – Sept. 11, 2000

Percent moisture in "**1-hour" fuels**. These are fine fuels like grass and leaves. They respond very quickly to weather changes – within 1 hour.

Percent moisture in "**1000-hour fuels**". These are more than 3 inches in diameter. They include fallen logs and big tree branches. They take days, weeks, or even months to respond very much to weather changes.





The horizontal lines across the graphs show "percentiles." In this graph, they show that only 10% of days on record had a 1-hour fuel moisture less than about 2.5%, and only 3% of days had a 1-hour fuel moisture less than about 2%.

In this graph, the lines showing 10th percentile and 3rd percentile are stuck together. There may be no days on record when the 1000-hour fuel moisture dipped below this level, about 5.5%.

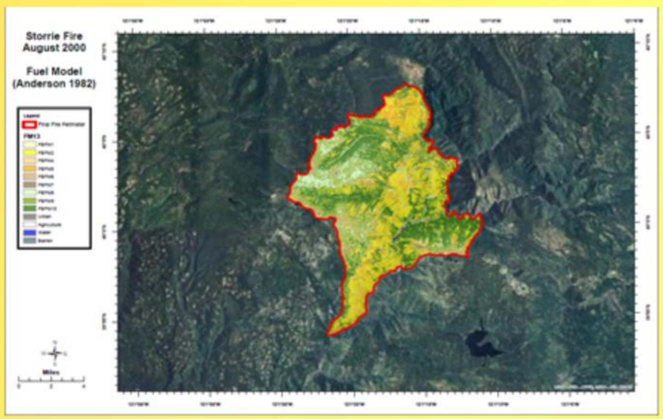
Here are records of fuel moistures during the time of the Storrie Fire. Again, the red arrows point to percentile lines, and these are explained below the graphs.

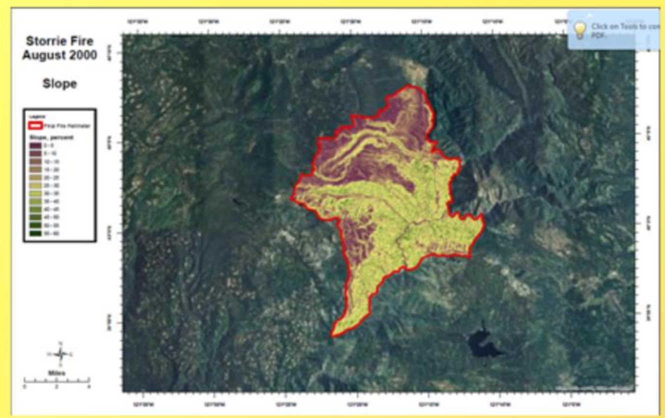
Part 3. Fire Spread Predictions from BEHAVE

The BEHAVE PLUS fire spread model (https://www.frames.gov/partner-sites/behaveplus/home/) currently forms the basis for all fire spread predictions in the United States. To get useful predictions from the model, one needs to provide good input data and meet many assumptions. These are the main assumptions used here:

- Fuel Model 1 (short grass) represent grassy openings and clearcuts. We assumed a 20% slope for these sites.
- Fuel Model 10 (mature/overmature timber and understory) represents the dense forest that covered most of the unlogged Storrie Fire area before the fire.

Here are maps of the actual fuel models and degrees of slope for the Storrie Fire area.





"Essentially, all models are wrong, but some are useful[1]."

[1]Box, G. E. P.; Draper, N. R. 1987. Empirical Model Building and Response Surfaces. New York: John Wiley & Sons: 424.

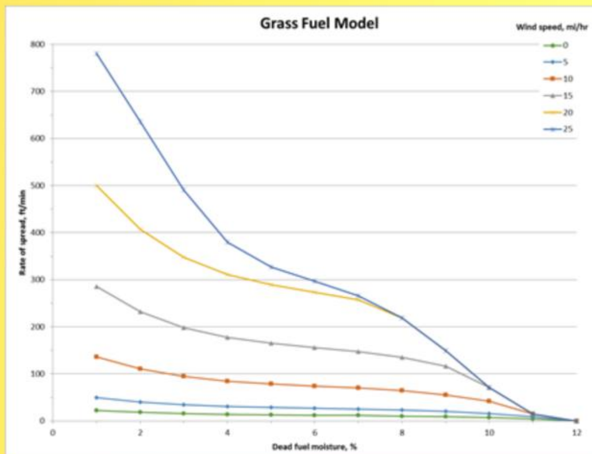
Part 3 shows some results from the fire spread model BEHAVE that could be use to predict fire spread rates and flame lengths from a variety of weather conditions on the Storrie Fire. BEHAVE is used by fire managers throughout the United States for managing wildland fires.

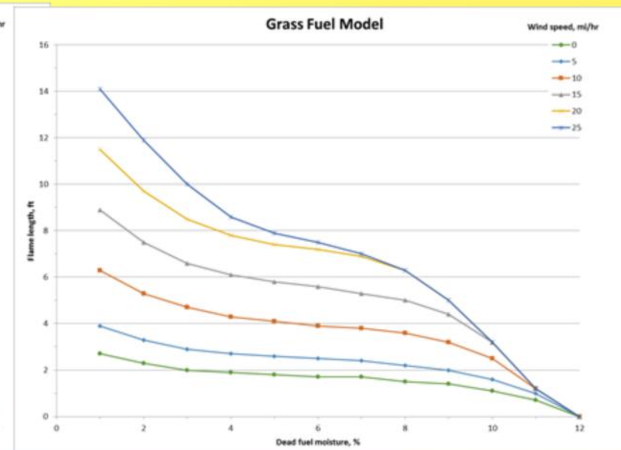
These maps show that there are a lot more than 2 fuel models in the Storrie Fire area. Models 1 and 10 were used here because they seemed to represent the majority of the area.

Fire Spread Predictions from BEHAVE:

How do dead fuel moisture and wind affect grassy fuels (Fuel Model 1)?

	Relative humidity (%)																				
Temp. (°F)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100
10-29	2	3	3	4	5	6	6	7	8	9	9	9	10	10	11	12	13	13	14	14	15
30-49	2	3	3	4	5	6	6	7	8	8	8	9	10	10	11	11	12	13	14	14	14
50-69	2	3	3	4	5	6	6	7	7	8	8	9	9	10	10	11	12	13	13	13	14
70-89	2	2	3	3	4	5	6	6	7	8	8	9	9	9	10	11	11	12	13	13	14
90-109	2	2	3	3	4	5	5	6	7	8	8	9	9	9	10	11	11	12	13	13	14
>109	2	2	3	3	4	5	5	6	7	8	8	9	9	9	10	11	11	12	13	13	13





Fuel moisture is the weight of a fuel particle's moisture expressed as percent of the particle's dry weight. Suppose you bring a stick in from the field and weigh it right away, and it weighs 25 grams. You then put it in the oven for a day, drying it until you can't get it any drier, and it weighs 20 grams. The moisture weighed 5 grams. Calculate the fuel moisture as 5 g/20 g = 0.25 or 25%. That is the particle's fuel moisture.

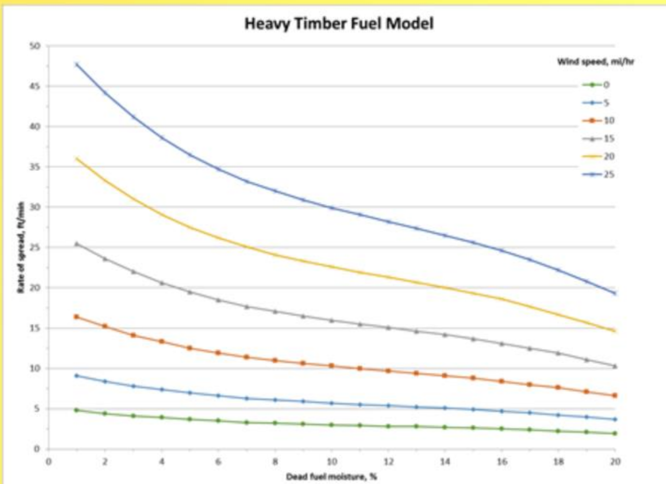
Use the table on top to estimate dead fuel moisture from temperature and relative humidity. Example: If temperature is 75 degrees F and humidity is 54%, dead fuel moisture in these grassy fuels will be 8%.

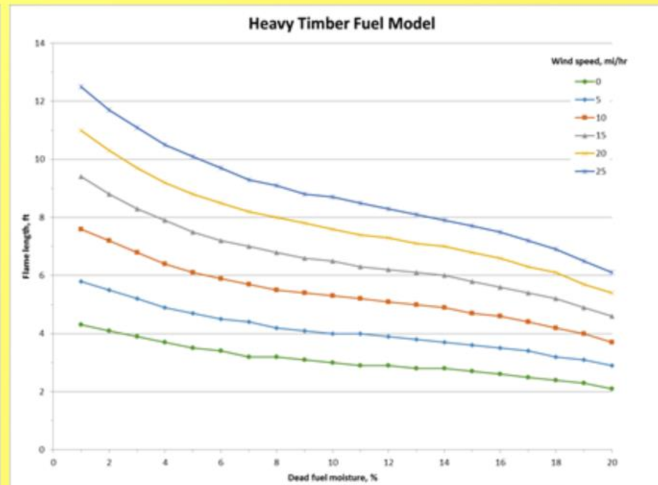
Use the graphs to answer "What if?" questions. Example: If dead fuel moisture is 8% and wind goes from 5 mph to 25 mph in these fine, grassy fuels, the fire's rate of spread is likely to go from 10 ft/minute to 220 feet/minute. If dead fuel moisture goes from 8% to 2% and wind stays at 5 mph, flame lengths are likely to go from 2 ft to 4 ft.

Fire Spread Predictions from BEHAVE:

How do dead fuel moisture and wind affect heavy timber fuels (Fuel Model 10)?

	Relative humidity (%)																				
Temp. (°F)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100
10-29	5	6	6	7	8	9	9	10	11	12	12	12	13	13	14	15	16	16	17	17	18
30-49	5	6	6	7	8	9	9	10	11	11	11	12	13	13	14	14	15	16	17	17	17
50-69	5	6	6	7	8	9	9	10	10	11	11	12	12	13	13	14	15	16	16	16	17
70-89	5	5	6	6	7	8	9	9	10	11	11	12	12	12	13	14	14	15	16	16	17
90-109	5	5	6	6	7	8	8	9	10	11	11	12	12	12	13	14	14	15	16	16	17
>109	5	5	6	6	7	8	8	9	10	11	11	12	12	12	13	14	14	15	16	16	16

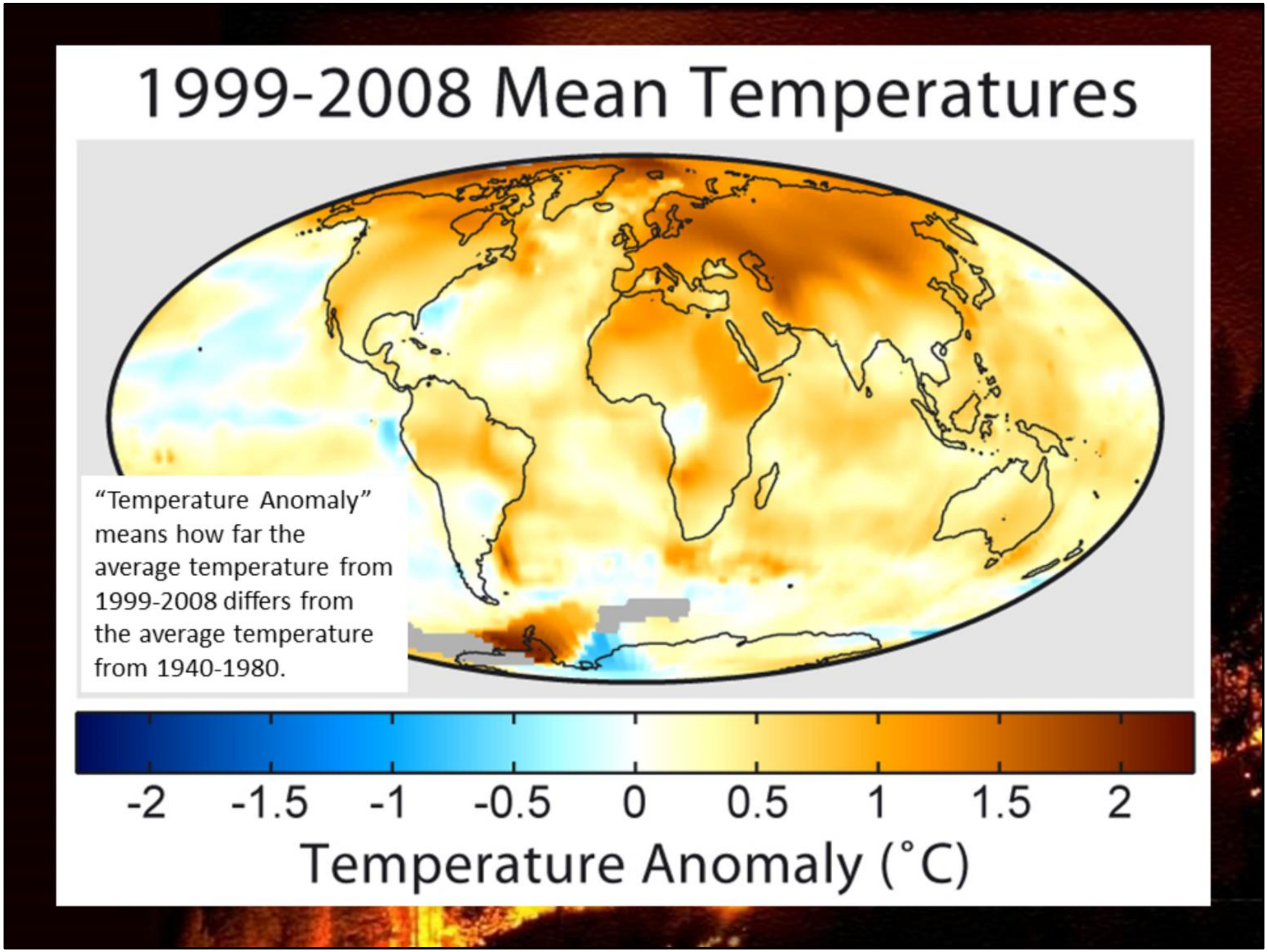




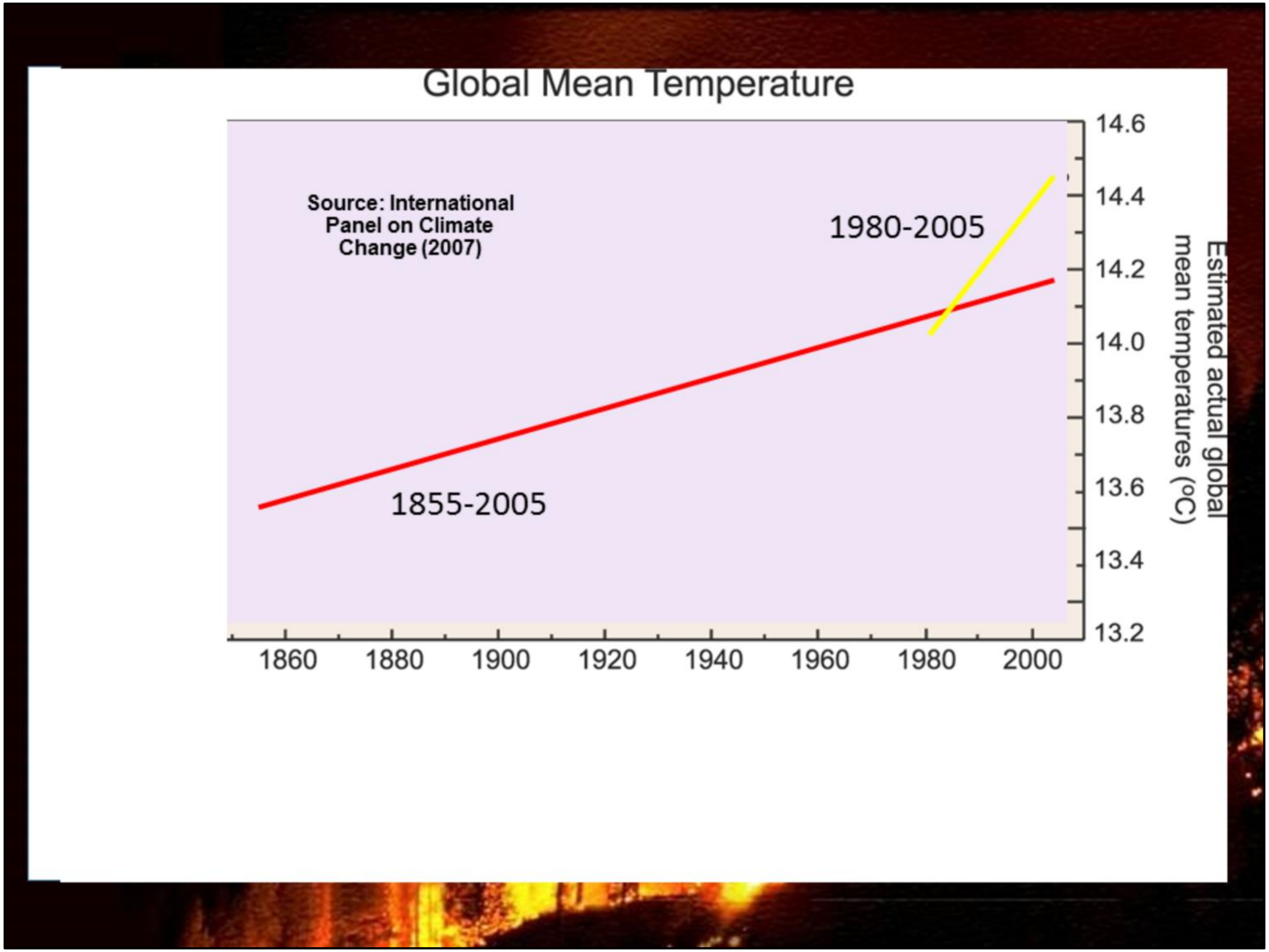
Use the table on top to estimate dead fuel moisture from temperature and relative humidity. Example: If temperature is 75 degrees F and humidity is 55%, dead fuel moisture in these closed <u>forests with heavy timber</u> will be 12%.

Use the graphs to answer "What if?" questions. Example: If dead fuel moisture is 8% and wind goes from 5 mph to 25 mph in these heavy fuels, the fire's rate of spread is likely to go from 6 ft/minute to 32 feet/minute. If dead fuel moisture goes from 8% to 2% and wind stays at 5 mph, flame lengths are likely to go from 4 ft to 5.5 ft.

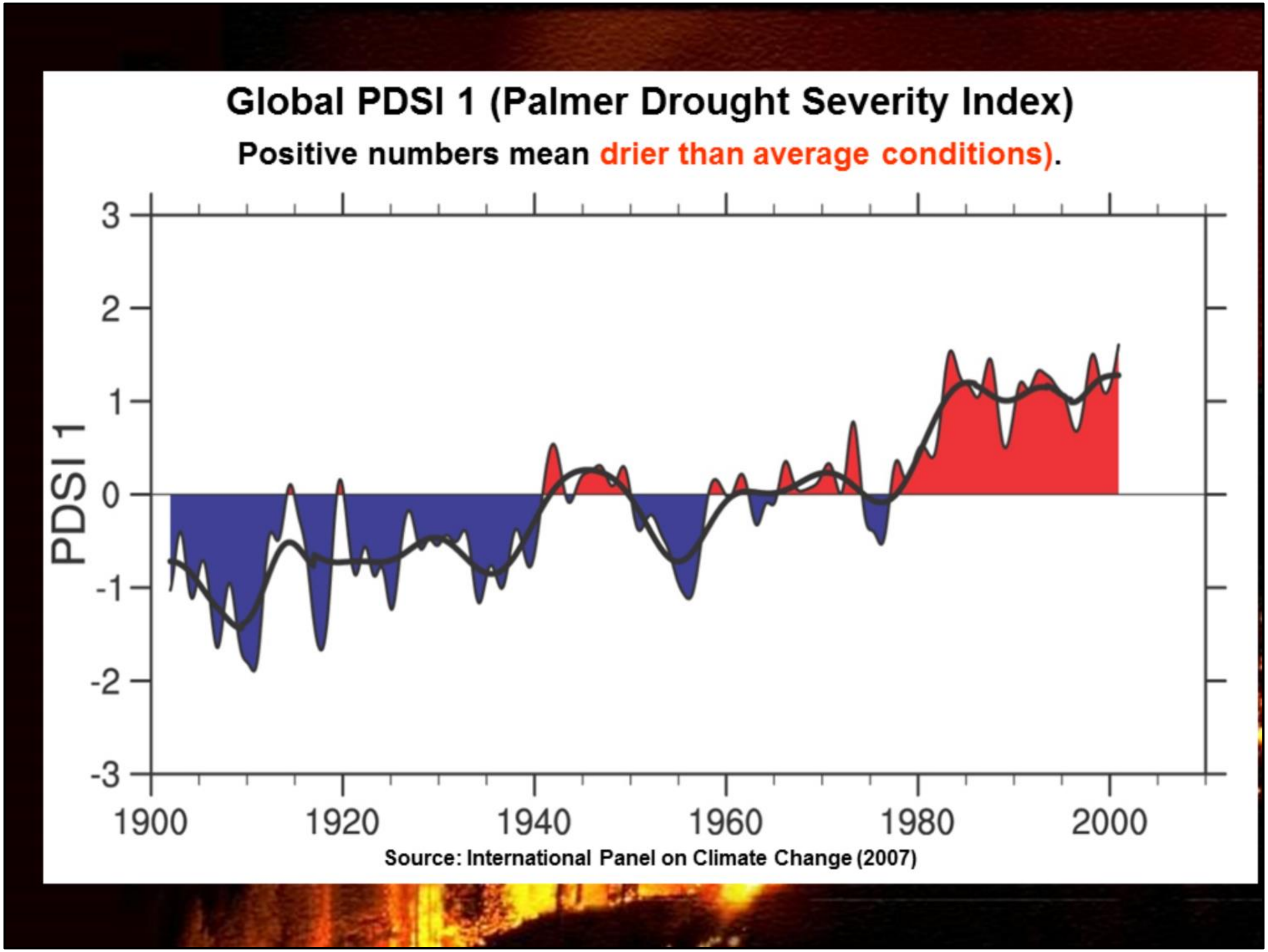
The slides in Part 4 have information about climate and how things have changed in the past century or two. You will need some of this information so your podcast can answer the question, "Is it possible that some places in the world, including the Sierra Nevada, might see more fires like the Storrie Fire because of global climate change?" (This is Question #4 in the assignment.)



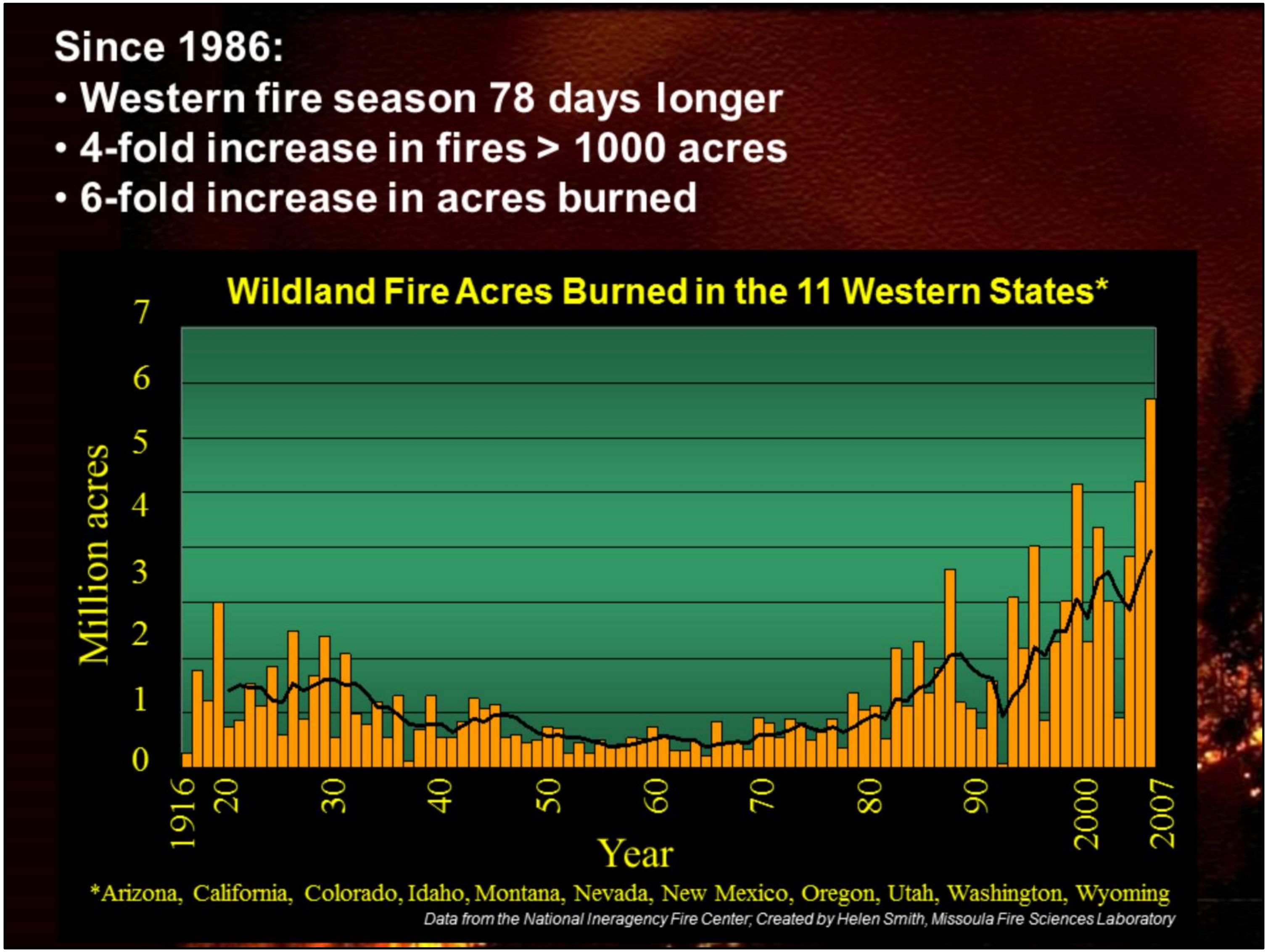
This figure shows the difference in the earth's surface temperatures from January 1999 to December 2008 and "normal" temperatures at the same locations. "Normal" temperatures are defined as the average over the interval January 1940 to December 1980. This graph shows an average increase of 0.48 °C. These widespread temperature increases are considered to be an aspect of global warming.



This graph has two lines. The long red line shows the trend in global average temperatures from 1855 to 2005, a period of 150 years. The short yellow line shows the trend in global average temperatures from 1980 to 2005, a period of 15 years. You may want to use this information in your podcast as you discuss whether global climate change is affecting wildland fires.



This graph shows trends over the last 220 years in the Palmer Drought Severity Index (PDSI). This index uses temperature and precipitation data to estimate dryness. Its scale is not a measurement but instead an “index” that goes from -10 (driest) to +10 (wettest). The PDSI has been reasonably successful at quantifying long-term drought conditions (https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi). Perhaps you will want to use this information in your podcast to talk about possible connections between climate change and wildland fire.



This graph shows how much area burned in 11 states of the American West from 1916 to 2007. You may want to use this information in your podcast as you talk about possible connections between climate change and wildland fire.