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The Meaning of Fire Weather

When you hear "wildfire," what comes to mind? Many people think of the wildfires that have plagued southern California over the past few years. NOAA helps to forecast fire weather so that fire fighters can quickly contain fires and reduce loss of life and property. A wildfire is a fire that burns uncontrollably in a natural setting. Another kind of outdoor fire is called a prescribed fire. Prescribed fires are used to mitigate a potentially devastating wildfire, or to allow new grass and tree seedlings to sprout.

Wildfires can start in many ways: from lightning strikes, sparks from trains, and power lines that are downed by strong winds. Sometimes prescribed fires can flare up a day or two later, with worsening fire weather conditions, and become a wildfire. NOAA plays an important role in supporting land managers, rural fire departments, and farmers/ranchers in conducting prescribed burns and containing wildfires. Rangeland Fire Danger information defines the potential for a grass fire to become out of control. Fire Weather Planning Forecasts give information geared toward the fire community, and is useful for operational decision-making.

Weather conditions have a large impact on both wildfires and prescribed fires. The most critical weather elements are high winds, high temperatures, and low relative humidities. Many National Weather Service offices issue fire weather information either daily or when conditions warrant, including Fire Weather Planning Forecasts, Spot Forecasts, Rangeland Fire Danger, and Red Flag Warnings.

The typical fire season varies across the country, but is generally during each location's climatologically dry season and is dependent on the type of predominant fuel. Trees and large shrubs respond to moisture conditions over a period of weeks or months, while grasses respond to moisture fluctuations over one or two hours. Santa Ana winds can create prime conditions during fall and winter for wildfires in southern California, while the typical fire season in the Rockies is during the summer before the late summer/fall monsoon season begins. Most fires occur between late fall and late spring in the plains when grass is fully cured or dried. However, because these fuels respond to short-term moisture fluctuations, fires can occur at any time. Farther east, the fire seasons vary from mainly springtime to both spring and fall.

Fires impact not only grass and trees, but also homes, businesses, animals, and people. Buildings can be damaged and lives can be lost in a very short time when a fire gets out of control and spreads quickly. Therefore, providing fire weather information is an important component of the daily forecast function within the National Weather Service.

"Only You Can Prevent Wildfires"

Fires have historically occurred both naturally by lightning and by Native Americans who learned to burn their land. In 1944, the Smokey Bear campaign "Only You Can Prevent Forest Fires" was launched, teaching people that all forest fires were hazardous. The consequence was that wild land fires were suppressed, eventually resulting in fires that devastated hundreds of acres of flora and fauna. To offset the impact, prescribed fires increased once again and in 2001 the Smokey Bear campaign was changed to "Only You Can Prevent Wildfires."

Exchange with the Land Down Under

For the past several years, the Australian Bureau of Meteorology has hosted forecasters from the American National Weather Service to assist with fire weather forecasts during the Australian fire season. Like the western United States, Australia has a history of severe fire seasons due to long-term drought. Since Australia is in the Southern Hemisphere, the most intense part of their fire season happens during wintertime in the U.S. It is typically slow for fire weather, which means American experts are available to assist during Australia's busy fire season.

Stringybark. (Photo by Jennifer Zeltwanger)

Australian forests are comprised of mainly eucalyptus trees. Many species can grow to 100 or 200 feet tall making for a very high forest canopy. The Australians have a unique challenge with some of the eucalyptus species. Especially in more mature trees, the bark has a tendency to peel in long strips. These strips of bark, called stringybark, collect on the forest floor and act as extra fuel to burn. Even worse, stringybark can get caught higher up in the canopy, start on fire, and then easily get carried away in the wind to create another fire (called spotting) in a part of the forest that is not yet burning.

As in the U.S., forest fires are greatly affected by the weather. Fire is sensitive to relative humidity and wind. The drier and windier it is, the more intensely a fire can burn and the faster it can move. February 2009 was an extreme example of the devastation that can occur when critical fire weather conditions combine with dry forests. Forecasters at the Bureau of Meteorology knew days in advance that dangerous fire weather conditions would develop. Unfortunately on Saturday, February 7, 2009, several fires started and wrecked havoc in the state of Victoria near Melbourne. Known as Black Saturday, weather conditions were conducive to extreme fire behavior. Temperatures climbed to 110-120 degrees Fahrenheit with relative humidity as low as 6%. Winds blew as strong as 60 mph, downing power lines and starting fires. Other fires are believed to have been arson. Sadly, 173 people lost their lives, and another 414 were injured.

MODIS Aqua satellite imagery showing smoke plume northeast of Melbourne

The purpose of this exciting exchange program is two-fold: to share fire weather knowledge and to help local Australian forecasters with increased staffing. American forecasters work side-by-side with Australian counterparts to create fire weather forecasts and determine days when warnings are warranted. Once a warning is issued, other agencies typically issue a fire ban, and forecasters help spread the word by created a fire ban warning on request. Forecasters also help produce any "spot" forecasts when a fire starts. Spot forecasts have been used in the U.S. for a number of years, and the Australians adopted a similar program. If a fire starts, the fire agency responding to it can directly request a fire weather forecast for that specific location. This gives firefighters onsite the latest weather information so they can be aware of any dangerous fire weather conditions. As in the U.S., firefighter safety is the number one priority.

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Exchange with the Land Down Under (cont.)

Australian forecasters also visit during the U.S. fire season to learn about fire weather in America. They typically attend the Incident Meteorologist (IMET) workshop in Boise, ID in March each year. Many Australian colleagues have also had the opportunity to work the fire weather desk or visit an incident when an IMET is out on a wildfire. By sharing information and working side-by-side, Australian and American fire weather programs both benefit and help to protect lives and property.

This issue's Employee Spotlight features Jennifer Zeltwanger, NWS Central Region Fire Weather and Aviation Program Manager, who spent six weeks in Australia during December and January as part of the exchange program.

New growth in forest that burned during Black Saturday. A year later: December 2009. (Photo by Jennifer Zeltwanger)

Playing with Fire

ESRL ensures better predictions of fire weather and its effects on fire behavior

Springtime in South Carolina is typically mild and moist, encouraging trumpet flowers to bloom—not burn. But in April 2009, emergency managers had to evacuate thousands of people from homes that were in the path of the Myrtle Beach wildfire. The fire, fueled in part by weather, jumped over highways and canals, causing $16 million in property damage.

As the Myrtle Beach fire demonstrated, protecting the public and firefighters requires a better understanding of how weather affects fire and fire affects weather. According to a NOAA Science Advisory Board Report published last year titled "Fire Weather Research: A Burning Agenda for NOAA," fire seasons have become longer and fires more severe. The report calls for better fire data and fire weather information "to serve the American public."

The Global Systems Division (GSD) team of the Earth System Research Laboratory (ESRL) is helping to increase public safety by understanding such unpredictable fire behavior. "You need a model that couples weather physics and fire dynamics," said Sher Schranz, FX-Net Project Manager. "That's what we're working toward."

Schranz has been helping NOAA and the National Weather Service (NWS) develop fire weather prediction tools for nine years. Her team developed the FX-Net workstation, which provides weather data to Incident Meteorologists (IMETs) during wildfires. IMETS use FX-Net to brief fire behavior analysts and fire Incident Commanders onsite.

This summer for the first time, GSD will run an experimental, Western U.S. weather model, the High Resolution Rapid Refresh (HRRR)/Chem/Smoke at 3-km resolution during wildfire season, in support of smoke and fire management operations.

"The HRRR has plume rise, fire emissions dispersion analysis and forecasts that are a big step forward for firefighting operations," Schranz said. "The 3-km winds over complex terrain, combined with the smoke forecast, provide critical situational awareness for the movement of fire fighters and the planning and execution of emergency evacuation." The U.S. Forest Service and NWS FX-Net users across the continental United States will have access to the 3-km HRRR model data.

Schranz anticipates NOAA and its partners will continue to make significant improvements to fire weather prediction. She is collaborating with researchers who model fire behavior at 1-meter resolution. Linking those fire models to weather models will necessitate extremely fine resolution weather models, down to 100 m, which will require resources for dedicated downscaling research and increased access to high performance computers.

Schranz is also seeking to use new technologies such as unmanned aircraft systems (UAS) to collect over-the-fire data essential for model verification. In 2006, a NOAA pilot study showed that a UAS could collect data over a southern California wildfire, but the plane carried only chemical sensors. To understand how well various fire models are behaving, researchers need atmospheric instruments to capture heat flux, relative humidity wind and pressure fields. These fields will also be used by forecasters in real time. "We really need relative humidity observations at night, for example," Schranz said. ""If relative humidity drops at night, fires can suddenly flare, causing a substantial, unpredictable spread."

For more information on FX-Net, visit **http://fx-net.noaa.gov/**.

IMET Workshop: Boise, ID
March 23-25, 2010

Each March, a cadre of National Weather Service Incident Meteorologists (IMETs) gathers in Boise, ID for annual training. The National Weather Service has about 80 certified IMETs and approximately 30 trainees, all volunteer forecasters specifically trained to be called on-site to an incident, most of which are wildfires. The annual training session allows IMETs to share experiences, review case studies, and practice computer skills. The required training, which helps IMETs respond to an incident on scene, includes safety information provided by smokejumpers and fire shelter deployment training. Another critical part of the IMET workshop is the pilot balloon (pibal) practice. Pibals are used on scene to measure wind speed and direction through the lower layers of the atmosphere right at the incident site.

IMET Julia Ruthford giving a weather briefing to fire officials

Pibal practice using a theodolite

Fire shelter deployment practice

EMPLOYEE SPOTLIGHT: *Jennifer Zeltwanger*

What do you do for NOAA?

I'm the National Weather Service Central Region Fire Weather and Aviation Program Manager. We have many forecast offices that provide specific weather information important to firefighters. We try to forecast dangerous weather conditions in advance that impact wildfires, such as low relative humidity, strong winds, thunderstorms, etc.

I also work on the Aviation Program, since we have forecast offices that produce forecasts for the FAA and traffic control centers. I wear two hats, and it's a balancing act. I'm also an IMET.

What's an IMET?

An IMET is an incident meteorologist. There are about 80 fully certified IMETs who are specially trained to stay in a fire camp, do specific weather forecasts at the fire site, and provide continuous service for the team managing the fire. The team uses the forecasts for firefighter safety, to plan what part of the fire to address first, and how to move resources around. It's exciting and rewarding – the IMET is the first up and last to go to bed. You can see the results and what you're doing is making a difference. My busiest summer, I was out just over 30 days in a month and half.

Were you always interested in weather?

Weather was our household TV when I was little. I grew up in Wisconsin, and used to highlight counties and circle town names on maps, so if I heard of thunderstorms, I could tell where they were. I got a B.S. in Atmospheric and Oceanic Science from the University of Wisconsin in Madison. The very first office I interned in was Elko, Nevada, which sees a lot of active fires, and where I was first introduced to fire weather. I got hooked there.

What are your biggest challenges and achievements?

Challenges? Everything! A big challenge is having two programs, since things are different every day, and I have to focus on the top issue of the moment. As for achievements, there's nothing I can take credit for myself. The forecast office is a team effort all the way.

What do you do for fun?

My husband and I have two Boston terriers, so we spend a lot of time spoiling them and taking them for walks. I like to golf, but I'm not very good at it. I'm also a national parks nut; my husband and I have been to 12 so far. My favorites are Yellowstone and the Tetons.

How can people contact you?

They can reach me at **jennifer.zeltwanger@noaa.gov**. I'd love to talk to anyone who needs research or data on fire weather and aviation.

*Email **noaa.centralregion@noaa.gov** and share your ideas on the next employee to feature.*