Using Weather in Forest Management

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The summer of 1933 in northwest Oregon had been exceptionally hot and dry. When in mid-August, hot, dry winds blew in from the east, all the fire crews were ready. But there were not enough of them. Scattered fires that started in the coast range merged into what became known as the Tillamook Burn.

In 1986, the Forest Service is researching procedures to forecast severe fire-weather conditions like those of 1933 far enough in advance to move fire crews and equipment from where little fire activity is expected to areas where conditions point to high fire danger and a shortage of equipment and manpower. The goal is to rapidly deploy fire crews while the fires are small and more readily controlled.

Current Weather Forecasting

Weather forecast support for fire-severity outlooks currently covers a 30-day period. A mix of the 30-day forecasts for precipitation and temperature, a forecast of drought and soil moisture, and an assessment of the potential energy release of fires is currently being used to forecast potential fire severity for the country. Fire management uses these severity forecasts at the national level to make the public aware of potential problems as part of fire-prevention programs and to work with Congress in requesting resources to meet above-normal demands on fire-suppression funds. Nationally and regionally, these 30-day forecasts and forecasts of shorter range (3–5 days) are used to alert underutilized crews and equipment for potential mobilization and deployment to different portions of the country.

Improving Weather Forecasts

There are three steps in improving use of weather forecasts in forest management. First is to improve the science of weather forecasting. Second, weather observations need to be collected at locations from which these data can be effectively extrapolated to predict weather in areas where no data are available. Learning how to design a weather station network that provides required information and is justified by the economies of the use of those data must be considered. The third way is by developing analytical tools to process the weather forecasts. Such analysis transforms a weather forecast into estimates of, among other things, potential fire severity, transport of pollutants or pesticides, and airborne transport of pests. With these analytical tools, managers can translate a weather forecast into a quantitatively useful form for decisionmakers.

Science of Forecasting. The current forecast system has gaps, such as 5 to 10 days in the future, where needed information is not available. Managers need to know that once a decision is made to stage and deploy crews and equipment, they will actually be needed when they arrive at the fire. Likewise, if there are limited crews and equipment to dispatch, managers need to know which fires they should be sent to.

Research on weather forecasting

Fire crews fell trees and line them up in parallel rows to slow the progress of small forest fires.

holds much promise in three areas: (1) Improving the precision of weather forecasts and, as a result, the accuracy of short-range (3–5 days) fire-severity outlooks; (2) developing the capability to forecast fire severity in the medium range (5–10 days); and (3) developing more precise, physically based forecasts in the extended range (10–30 days). Accompanying this basic research are programs to use the forecasts in management decisions. Quantitative assessment of the probabilities of forecast events and confidence in those forecasts will be processed through models of fire ignition and behavior.

How does this research benefit forest management, the forest user, and the consumer? First, improved use of personnel and equipment in controlling forest and brushfires will reduce costs. Second, forest and brushfires will be attacked with adequate resources at an early stage, resulting in better protection of life, property, watersheds, and other forest resources.

Weather Observations. Many weather observations are now made manually and, therefore, are limited to those places where we have personnel. Because forest facilities are staffed along roads, which tend to follow river drainages in mountain areas, and in rural communities and at the occasional fire lookout, manual weather observations and forecasts are based on data limited by human demographics.

To effectively support a weather intelligence and forecast operation for forest management, meteorologists need to observe weather at those locations where its impacts influence decisions and where they can effectively estimate what will take place between weather stations. Research on techniques to incorporate weather data into geographic information systems (i.e., provide weather intelligence where needed, not just where staff are) is being conducted. The engineering developments in automated weather stations that telemeter data through geostationary orbiting satellites made this possible.

As a result of this research, weather station networks can be designed for fire management, air-quality assessment, and a variety of other activities. The number of weather stations and their locations will be objectively determined. An estimated error is determined for any given number of weather stations. As a result, a manager may determine the acceptable error or risk and be assured that the network meets the management accuracy requirements on a cost-effective basis.

These newly designed weather station networks will provide improved intelligence on weather aspects of fire severity and an improved data base on which to make fire-severity forecasts.

Quantitative Analysis Tools. Analysis of weather with high geographic resolution, particularly in the case of winds, is needed to assess the impacts of pollution transported to the Nation's forests. Equally important is the requirement to predict the pattern and amount of pesticides reaching an area being sprayed. The management of air resources to minimize adverse effects of smoke from prescribed fire also requires that high-spatial-resolution analysis of meteorology information be generated.

Research has focused on developing these analytical tools for use in mountainous areas because mountain wind patterns are extremely variable and less understood than wind information over level ground.

Results of this research will be applied in air pollution evaluations, such as transport of oxidants or acidic particulates into forest areas.

Also, with the introduction of gypsy moths into the mountainous West, predictability is needed to pinpoint where airborne transport of the larvae might occur. Use of these analysis tools will suggest likely areas to set out traps for assessment of the infestations and will help to minimize the area requiring pesticides. This latter use has both economic and environmental consequences—pesticides are expensive and not particularly selective and their impact on population of desirable species, such as bees, can be minimized.

These quantitative analysis tools are designed to (1) use observed weather to provide a current assessment, and (2) forecast weather to quantitatively assess the future. Research has focused on mathematically mimicking physical and biological processes so that, as observations of weather and forecasts of weather improve, the tools available to the decisionmakers and policymakers will increase in accuracy.