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Climate Systems
National Environmental Science Program
Regional climate change guidance for local action

Developing a simple fire-weather index

Emergency fire services have a lot of information and modelling to help predict and manage fire. But how can they anticipate and respond quickly when the weather conditions change? We've developed the Dry Windy Index.

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Background

Australia introduced a new system for rating fire danger in 2022 that built on many decades of research and understanding of fire behaviour.

The Australian Fire Danger Rating System (AFDRS) calculates, forecasts and reports fire danger using up-to-date information on fuel amount and how much is available to burn, and weather conditions. These variables change over different timescales and areas, impacting the fire danger in a given location. Information about fuel relates to vegetation type (place of fire risk) and slow changes in drying or rainfall often across months or years.

However, the weather-effect (temperature, rainfall, humidity and wind speed) can change quickly in a matter of seconds up to several hours. Fire agencies need a quick and easy way to assess how weather conditions are changing the risk, to complement the AFDRS.

Climate Systems Hub researchers have developed a simple fire-weather index called the Dry Windy Index (DWI), in collaboration with current and former fire researchers from the Victorian Country Fire Authority, CSIRO, New South Wales Rural Fire Service and Western Australian Department of Biodiversity, Conservation and Attractions, to help fire agencies quickly assess the weather contribution to fire danger independently of fuels.

How fire danger is determined

The AFDRS determines fire danger using models that predict fire spread rates and intensity.

As fire behaviour varies depending on vegetation and fuel types, the system incorporates eight different models for eight vegetation types across the country.

Each model accounts for the impact on fire from weather, fuel amount (quantity, distribution and structure of fuel that might readily burn) and fuel fraction (the proportion of fuel that can burn on any given day).

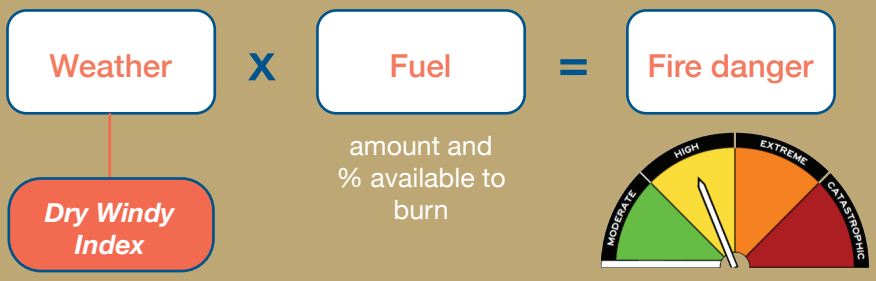

Figure 1: Shows how fire danger is calculated from weather, fuel amount (quantity, distribution and structure of fuel that might readily burn) and fuel fraction (the proportion of fuel that can burn on any given day). The Dry Windy Index (DWI) enables the impact of the weather component on fire danger to be assessed independently of fuels.

How a fire-weather index can help

Fire-behaviour analysts from state and territory fire agencies need a simple and quick-to-calculate assessment of fire weather to determine days when prescribed burning will be favourable, and when bushfires will be difficult to manage. Ideally, this fire-weather index would closely resemble the fire-weather functions incorporated in the highly sophisticated fire danger models of the Australian Fire Danger Rating System (AFDRS).

The challenge is that each of the inputs (weather, fuel amount and percentage of fuel available to burn) vary at different times and locations, for example, the vegetation type varies slowly but the weather-effect can change quickly on timescales of seconds to hours.

Developing a Dry Windy Index

Climate Systems Hub researchers, in collaboration with current and former fire researchers from the Victorian Country Fire Authority, CSIRO, New South Wales Rural Fire Service and Western Australian Department of Biodiversity, Conservation and Attractions, are developing a simple fire-weather index called the Dry Windy Index (DWI).

> ***The Dry Windy Index (DWI) is simple and quick to calculate, and resembles the weather calculations in existing models used by AFDRS.***

To be useful and enable side-by-side comparisons of the weather calculations in the previous models, our agency partners needed the fire-weather index to be both simple and quick to calculate, and to resemble the weather calculations in existing models used in the AFDRS.

The DWI serves this purpose. It is quick and easy to calculate using only 3 variables: temperature, relative humidity and wind speed. Testing so far has focused on the fire spread-rate model used in the AFDRS for dry eucalypt forests, with potential to expand to grasslands, heath and mallee scrub in the future.

Simple fire-weather indices, like the DWI, are also of value when considering how fire risk might change with changes in climate. Fire-behaviour analysts can use the DWI to produce hindcasts and forecasts of fire weather to provide important insights into past changes in fire weather and potential future changes.

Hub researchers in collaboration with fire agencies are now testing the application and value of the DWI.

While the DWI is not a substitute for the highly sophisticated AFDRS, it is helping fire agencies transition by enabling side-by-side comparisons of the new and old fire danger rating systems.

The DWI also allows fire agencies to easily 'see' the weather contribution to fire danger in isolation.

For more information about the Climate Systems Hub, check out our website and subscribe to our Newsletter at:

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