Fire Danger Indices: current limitations and a pathway towards better indices

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FIRE DANGER RATINGS IN AUSTRALIA RELY ON McARTHUR'S FOREST & GRASSLAND INDICES. CURRENT KNOWLEDGE OF LIMITATIONS AND TECHNOLOGICAL ADVANCES ARE NOT REFLECTED.

The National Fire Danger Rating Project team, through the Bushfire CRC, has engaged the Bureau of Meteorology in conjunction with the Centre for Australian Weather and Climate Research to conduct research into new candidate fire danger indices (FDIs).

PROJECT AIM

- To identify potential new candidate Fire Weather Indices (FWIs) for a New Fire Danger Ratings System.
- Categorise the limitations of the current FDI.

RESEARCH REPORT STRUCTURE INCLUDES

- A holistic investigation into fire prediction to determine an improved Fire Danger Rating System
- Discussion on recent fuel and soil moisture research.

CURRENT SYSTEM

- FDIs are produced by the Bureau of Meteorology. Fire Danger Ratings (FDRs) are determined by fire agencies based on FDIs.
- Surface weather inputs: wind, moisture, temperature;
  fuel components: (in forests) soil moisture proxies for the fuel state based on rain, (in grassland) curing or dead to live fuel ratios based on visual observation and remote sensing.

NEW FIRE DANGER INDICES SHOULD:

- Represent the complexity of the problem. Fire is a multi-faceted hazard and it may be necessary to use several indices to accurately represent the risk
- Incorporate missing factors, such as three dimensional structure of the atmosphere, stability, mixing height, wind change, fire influence on weather, pyro-thunderstorm.
- Be future proof: future scientific advances should slot in easily.

KEY RECOMMENDATIONS

1. The indices should be defined in terms of physically meaningful quantities that are relevant to stakeholders. Examples are spread rate and fire-line intensity.

2. These physically meaningful indices should be routinely verified against observations (weather and fire).

3. The definition of the candidate index should be distinct from the means of calculating it.
a. The means of calculation can alter with time, as improved science enables greater accuracy.
b. The means of calculation can depend on the application - quick and cheap methods have their place, as do slow and costly ones where greater spatial and temporal resolution is required and the computational resources and input data are available.

4. The calculated index should feature error bars, to reflect the amount and quality of data that went into the calculation (e.g. was full weather data including stability available, or just surface data) and the method of calculation (complex model, or simple statistical relationship). As more data is included, the more the bars decrease (Figure 1).

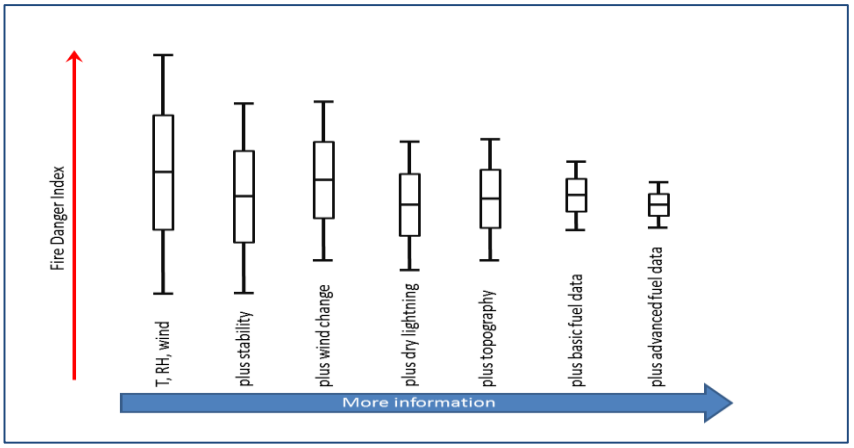

Figure 1: Schematic showing the progressive refinement of a hypothetical fire weather index as more information is used. The box-and-whisker plots represent the estimated mean value (central bar), 25th and 75th percentiles (the box) and the 5th and 95th percentiles (whiskers). Note that the meaning of an index of, say, 50, is the same in each case, but as more information is applied, we become increasingly confident that the actual fire behaviour will be consistent with an index of 50.

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