

Fire weather index

Description

The Fire weather index (*FWI*) is the final index of the *FWI* system. It consists of the combination of the *ISI* and *BUI* and is a measure of fire intensity in the form of energy output rate per unit length of fire front. Nevertheless, the *FWI* is appropriated for predicting various aspects of fire activity as it combines all influencing factors in one number (Van Wagner 1987).

Formula

The previous version of the *FWI* was measured on scale from 0 to 16 (the D-scale). For different reasons, this D-scale was judged inappropriate and a new scale was developed: the I-scale. As its values were judged too high, the I-scale was substituted by a reduced function (square root) of itself, the B-scale. However, the B-scale still not being optimal, a new scale was finally developed: the S-scale. For further details about the development of the different *FWI* scales, see Van Wagner (1987).

The equations for converting the S-scale into the I-scale when fire intensity is expressed in kilowatts per meter are the following (Van Wagner 1987):

$$\ln S = 1.013 \cdot \{\ln(0.289 \cdot I)\}^{0.647}$$

$$\ln(0.289 \cdot I) = 0.980 \cdot (\ln S)^{1.546}$$

The *FWI* is a measure of fire intensity and thus requires for its computation factors representing rate of spread and fuel consumption. While the *ISI* represents rate of spread, this is not the case for the *BUI*. In order to convert the *BUI* into a measure of weight of fuel consumed, $f(D)$, the following equation is needed (Van Wagner 1987):

$$f(D) = \begin{cases} 0.626 \cdot BUI^{0.809} + 2, & \text{for } BUI \leq 80 \\ \frac{1000}{25 + 108.64 \cdot e^{-0.023 \cdot BUI}}, & \text{for } BUI > 80 \end{cases}$$

where *BUI* is the Buildup index.

Then, the B-scale *FWI* is obtained as follows:

$$B = 0.1 \cdot ISI \cdot f(D)$$

And the S-scale *FWI* as follows:

$$S = \begin{cases} e^{2.72 \cdot (0.434 \cdot \ln B)^{0.647}}, & \text{for } B > 1 \\ B, & \text{for } B \leq 1 \end{cases}$$

Interpretation of the index

While the *FWI* scale is uniform everywhere, this is not the case for the range of fire weather. Therefore, it is required to define fire danger classes (e.g. very low, low, moderate, etc.) within the *FWI* scale fitting regional or local fire weather patterns. A procedure in order to develop a rational class breakdown (and an example) is proposed in [Van Wagner \(1987\)](#): "First, compile a historical sample of the *FWI* over a number of seasons. Second, decide how many Extreme days should be allowed each season on the average, and set the lower limit of the Extreme class. Third, arrange the other classes on a geometric progression in terms of the I-scale, using a constant ratio of I-scale value from class to class. Finally, convert the I-scale values back to the S-scale *FWI*. Alternately, the *FWI* scale may simply be divided to provide some predetermined proportion of days in each class."

References

Original publication:

[Van Wagner \(1987\)](#)

The original document is available at <http://wiki.fire.wsl.ch/tiki-index.php?page=Fire+weather+index>