Sharples fuel moisture and fire danger rating indices

Description

The forest fire danger rating index (F) and fuel moisture index (FMI, a sub-index of F) were recently developed by Sharples et al. (2009a, 2009b). They require temperature, relative humidity and windspeed (for F) as input variables.

The purpose of these indices was to assess moisture content and fire danger in eucalypt forests in southern Australia in a very simple way and as effectively as with more sophisticated models (cf.
$FFDI$ and
$FFWI$).

The F index is based on the principle that fire danger is determined by the combined influence of wind speed and fuel moisture content. It increases when wind speed increases and decreases when fuel moisture content increases (cf. equation below Sharples et al. 2009a).

NB: the FMI is dimensionless and therefore is not a direct estimate of fuel moisture content (Sharples et al. 2009b).

Formula

The FMI is obtained as follows:

$$FMI = 10 - 0.25 \cdot (T - H)$$

where T is air temperature and H relative air humidity;

And F as follows:

$$F = \frac{max(U_0, U)}{FMI}$$

where U is wind speed in [km/h] and U_0 = 1 [km/h] (threshold value in order to ensure that that fire danger is always greater than 0, even when there is no wind).

The F and FMI indices are supposed to be calculated on a hourly basis. Thus the meteorological data used for its calculation are the meteorological data at the time of the basic weather observation.

In the case of the F and of the FMI, no particular values or conditions are required when starting the index calculation.

Modifications

The FMI in the F formula reflects short-term changes in fuel moisture contents. In order to take into account long-term moisture effects (or in other words fuel availability), Sharples et al. (2009a) proposed to include a drought factor in the F equation (a function of the
$KBDI_{SI}$ (in millimeters); cf.
$FFDI$). The modified F formula would therefore be as follows:

$$F_d = DF \cdot \frac{max(U_0, U)}{FMI}$$

where DF is the drought factor (cf. $FFDI$) defined as follows (Noble et al. 1980):

$$DF = \frac{0.191 \cdot (KBDI + 104) \cdot (w + 1)^{1.5}}{3.52w + 1^{1.5} + P - 1}$$

where w is the number of days since last rain and P the last precipitation amount (measured over the entire period of rainfall).

NB: if the calculated drought factor is greater than 10, then DF in the F_d formula is equal to 10.

The F_d index is aimed to be calculated on a hourly basis. Thus the meteorological data used for its calculation are the meteorological data at the time of the basic weather observation.

As the F_d includes the $KBDI_{SI}$ in its formulation, the starting conditions of the $KBDI_{SI}$ have to be met, i.e. the soil layer has to be saturated with water, e.g. after a period of abundant rainfall, e.g. 152 or 203 mm in a period of a week. The $KBDI_{SI}$ component takes the starting value of 0.

References

Original publications:
Sharples et al. (2009a)
Sharples et al. (2009b)

Other publication:
Noble et al. (1980)
