1000-hour timelag dead fuel moisture model

Description

The 1000-hour timelag fuel moisture MC_{1000} is the moisture content of the 1000-hour timelag fuels, which consist of dead roundwood 3 to 8 inches in diameter and/or the forest floor more than 4 inches below the surface (Deeming et al. 1977).

The calculation of the 1000-hour timelag fuel moisture model requires latitude (in degrees or radians, cf. below), maximum and minimum daily air temperature [°F] and relative humidity [%] at early to midafternoon time, as well as precipitation duration during the previous 24 hours [hr] as input variables (Bradshaw et al. 1983).

NB: the calculation of the 1000-hour timelag fuel moisture model requires precipitation duration (in hours) as input variable, which is not a standard meteorological variable.

Formula

Similarly to the 100-hour fuel class, the 1000-hour fuel class responds very slowly to changes in environmental conditions. Therefore, an equilibrium moisture content (EMC) representing the average drying-wetting potential of the atmosphere for the preceding 24 hours is used for its calculation (Cohen & Deeming 1985).

The 1000-hour dead fuel moisture model is calculated as follows (Cohen & Deeming 1985):

First, the weighted 24-hour average EMC is calculated (similar to that of the 100-hr timelag moisture model):

$$EMC_{24} = \frac{N_{nfdrs} \cdot EMC_{min} + (24 - N_{nfdrs}) \cdot EMC_{max}}{24}$$

where N_{nfdrs} is the daylight hours (cf. NFDRS formulation), EMC_{max} the 24-hr maximum EMC, and EMC_{min} the 24-hr minimum EMC. The 24-hour average EMC_{max} is obtained by substituting T [Â°F] and H [%] by T_{max} and H_{min} in the standard EMC equation (cf. Equilibrium moisture content), and the 24-hour average EMC_{min} is obtained by substituting T [Â°F] and H [%] by T_{min} and H_{max} in the standard EMC equation.

Then, the weighted 24-hour average moisture condition D [%], which is different from that for the 100-hour timelag moisture model, is calculated as follows (Cohen & Deeming 1985):

$$D = \frac{(24 - P_{dur}) \cdot EMC_{24} + P_{dur} \cdot (2.7 \cdot P_{dur} + 76)}{24}$$

where P_{dur} is the 24-hours precipitation duration (in hours).

Based on D, the seven day running average moisture condition $\bar{D}$ on day i has to be calculated:

$$\bar{D}_t = \sum_{i=0}^{6} \frac{D_{t-i}}{7}$$

Finally, the 1000-hour timelag fuel moisture model MC_{1000} [%] on day i is calculated as follows (Cohen & Deeming 1985):

$$MC_{1000_t} = MC_{1000_{t-1}} + (\bar{D}_t - MC_{1000_{t-1}}) \cdot (1 - 0.82 \cdot e^{-0.168})$$

where $MC_{1000_{t-1}}$ is the MC_{1000} value from the previous day.

The 1000-hour timelag fuel moisture model is aimed to be calculated on a daily basis. The meteorological data used for its calculation have to be recorded at early to mid-afternoon time (1 to 3 pm).

NB1: The model used in the 1978 NFDRS version (cf. Burgan et al. 1977 and Deeming et al. 1977) to calculate the 1000-hour timelag fuel moisture differs from the model presented here (cf. Cohen & Deeming 1985): in the 1978 version, daylength was not considered, and the 24-hour average EMC was a function of the simple averages of the 24-hour temperature and relative humidity extremes.

NB2: In order to stabilize the prediction of the 1000-hour timelag fuel moisture, the calculation of the model should be started at least four weeks before the beginning of the fire season. Usally, the starting value of the 1000-hour timelag fuel moisture is set to 30 [%], but if the four-week rule is adhered to, accurate starting values are not needed (Deeming et al. 1977).

References

Burgan et al. (1977)
Deeming et al. (1977)
Bradshaw et al. (1983)
Cohen & Deeming (1985)
