Duff moisture code

Description

The Duff moisture code (DMC\)) is one of the three fuel moisture code components of the Canadian forest fire weather index (
FWI) system. The DMC represents the moisture content of loosely compacted, decomposing organic matter weighing about 5 kg/m2 when dry. It assesses fuel consumption in moderate duff layers and medium-size woody material at mid-afternoon. It requires temperature, relative air humidity, precipitation (at noon), and current month (in order to take daylength into account) as input data (Van Wagner 1987).

As the two other fuel moisture codes of the
FWI (cf.
$FFMC$ and
DC), the DMC comprises two phases: one for wetting by rain and one for drying.

Formula

The DMC is calculated as follows (Van Wagner and Pickett 1985):

The previous day's DMC becomes DMC_{t-1}

In case of rain (i.e. if $P > 1.5$), the following procedure for wetting phases has to be chosen:

Effective rainfall P_e [mm] is first calculated:

$$P_e = 0.92 \cdot P - 1.27, \text{ for P} > 1.5$$

Second, the duff moisture content from previous day M_{t-1} is calculated:

$$M_{t-1} = 20 + e^{5.6348 - \frac{DMC_{t-1}}{43.43}}$$

Third, the slope variable in DMC rain effect b is calculated:

$$b = \begin{cases} \frac{100}{0.5 + 0.3 \cdot DMC_{t-1}}, & \text{for } DMC_{t-1} \leqslant 33 \\ 14 - 1.3 \cdot \ln(DMC_{t-1}), & \text{for } 33 < DMC_{t-1} \leqslant 65 \\ 6.2 \cdot \ln(DMC_{t-1}) - 17.2, & \text{for } DMC_{t-1} > 65 \end{cases}$$

Fourth, the duff moisture content after rain M_{r_t} is calulated:

$$M_{r_t} = M_{t-1} + \frac{1000 \cdot P_e}{48.77 + b \cdot P_e}$$

Finally, M_{r_t} is converted to the DMC after rain DMC_{r_t}, which becomes the new DMC_{t-1}:

$$DMC_{r_t} = 244.72 - 43.43 \cdot \ln(M_{r_t} - 20), \text{ if } DMC_{r_t} < 0, \text{then } DMC_{r_t} = 0$$

NB: if $P \leqslant 1.5$, the above rainfall routine must be omitted.

Then, the log drying rate in DMC K has to be calculated:

$$K = 1.894 \cdot (T_{12} + 1.1) \cdot (100 - H_{12}) \cdot L_e \cdot 10^{-6}, \text{ if } T_{12} < -1.1, \text{then } T_{12} = -1.1$$

where the effective day-length L_e for each month is given in the following table.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
L_f	6.5	7.5	9.0	12.8	13.9	13.9	12.4	10.9	9.4	8.0	7.0	6.0

Finally, the DMC can be calculated as follows:

$$DMC_t = \begin{cases} DMC_{t-1} + 100 \cdot K, & \text{for } P \leqslant 1.5 \\ DMC_{r_t} + 100 \cdot K, & \text{for } P > 1.5 \end{cases}$$

The DMC is supposed to be calculated on a daily basis. The meteorological data used for its calculation have to be recorded at noon (for fire danger prediction at about 4 pm).

The DMC calculation starts, in regions normally covered by snow in winter, on the third day after snow has essentially left the area. In regions where snow cover is not a significant feature, the calculation starts on the third successive day with noon temperature greater than 12 °C (Lawson and Armitage 2008). The starting value of the index has to be set to 6.

References

Original publications:
Van Wagner and Pickett (1985)
Van Wagner (1987)

Other publication:
Lawson and Armitage (2008)