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Supplementary material

Soil moisture as an indicator of growing-season herbaceous fuel moisture and curing rate in grassland

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Derivation of equations for the constituent differential method

The constituent differential method is designed to determine the relative proportion of two herbage components in a mixture of both. In our study it was used to estimate the live and dead herbaceous fuel loads of an herbaceous mixture based on estimated live fuel moisture (LFM), measured dead fuel moisture (DFM), measured fuel moisture of the mixed live and dead herbaceous fuels (MFM), and the measured mixed fuel load (m_M). For each patch and sampling date, six samples of approximately 100 g each of pure green and pure dead fuel were taken, aggregated per type, weighed in the field, and subsequently oven dried to determine green fuel moisture (GFM) and DFM. In addition, MFM was determined using 12 quadrat samples along a transect spanning the patch.

As was pointed out by Kidnie et al. (2015), live herbaceous fuel includes both green and senescing fuel. Accordingly, LFM pertains to the fuel moisture of all the live fuel. We only sampled the green component of the live fuel, resulting in measurements of GFM rather than LFM, which remained unknown. As described in the text of our article, we bracketed the true and unknown value of the patch LFM by using three estimated values of LFM (LFM_1, LFM_2, LFM_3) based on our measurements of MFM and GFM. With this background, we can now proceed with the derivation of the equations for the constituent differential method as used in our study.

<u>Variables:</u>

LFM = live fuel moisture (%), assumed representative of the patch, where LFM is LFM_1, LFM_2, or LFM_3 (see text of the article for full explanation)

DFM = dead fuel moisture (%), assumed representative of the patch

MFM = mix fuel moisture (%), assumed representative of the patch, and calculated as the mass-weighted average across quadrat samples

m_M = mix fuel load (g m^{-2}), calculated as the patch average of the mix fuel load in each quadrat

m_L = live fuel load (g m^{-2}), assumed representative of the patch

m_D = dead fuel load (g m^{-2}), assumed representative of the patch

a = fraction of live fuel in mix by dry weight

b = fraction of dead fuel in mix by dry weight

The following two relationships hold:

$$a\ (LFM) + b\ (DFM) = MFM \tag{1}$$

$$a + b = 1 \tag{2}$$

Once a and b are determined, then it also follows that:

$$m_L = a\ (m_M) \tag{3}$$

$$m_D = b\ (m_M) \tag{4}$$

$$m_L + m_D = m_M \tag{5}$$

Inserting (2) into (1), gives

$$a\ (LFM) + (1\text{-}a)\ DFM = MFM \tag{6}$$

from which it follows:

$$a\ (\mathrm{LFM} - \mathrm{DFM}) + \mathrm{DFM} = \mathrm{MFM} \tag{7}$$

$$a = (\mathrm{MFM} - \mathrm{DFM}) / (\mathrm{LFM} - \mathrm{DFM}) \tag{8}$$

$$b = 1 - [(\mathrm{MFM} - \mathrm{DFM}) / (\mathrm{LFM} - \mathrm{DFM})] \tag{9}$$

Inserting (3) into (8), it now follows:

$$m_{\mathrm{L}} = m_{\mathrm{M}}\ [(\mathrm{MFM} - \mathrm{DFM}) / (\mathrm{LFM} - \mathrm{DFM})] \tag{10}$$

which is equation (1) in the main text.

From (5), it then follows:

$$m_{\mathrm{D}} = m_{\mathrm{M}} - m_{\mathrm{L}} \tag{11}$$

which is equation (2) in the main text.