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Integrating microbial physiology and physio-chemical principles in soils with the MIcrobial-MIneral Carbon Stabilization (MIMICS) model

W. R. Wieder et al.

Correspondence to: W. R. Wieder (wwieder@ucar.edu)

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Carbon fluxes in MIMICS, shown in Figure 1. Six C pools are considered in MIMICS that include: metabolic and structural litter (LIT_m and LIT_s, respectively); copiotrophic and oligotrophic microbial biomass (MIC_r and MIC_K, respectively); and physically and chemically protected soil organic matter (SOM_p and SOM_c, respectively). Fluxes between these pools are grouped into C entering or leaving MIC_r (F_1-F_5) or MIC_K (F_6-F_{10}). Decomposition of LIT and SOM pools follows Michaelis-Menten kinetics (eq. 1), with temperature sensitive maximum reaction velocity (V_{max}; mg C_s (mg MIC)$^{-1}$ h^{-1} and half saturation constant ($K_{m;}$ mg C cm^{-3}) calculated for each substrate and MIC pool (eq. 2 & 3). See Table 1 and Fig. 1 for a description of all parameters used. Fluxes, numbered on Fig. 1, are calculated as:

$$F_1 = MIC_r \times V_{max[r1]} \times LIT_m / (Km_{[r1]} + LIT_m) \quad (S1)$$

$$F_2 = MIC_r \times V_{max[r2]} \times LIT_s / (Km_{[r2]} + LIT_s) \quad (S2)$$

$$F_3 = MIC_r \times V_{max[r3]} \times SOM_p / (Km_{[r3]} + SOM_p) \quad (S3)$$

$$F_4 = MIC_r \times V_{max[r4]} \times SOM_c / (Km_{[r4]} + SOM_c) \quad (S4)$$

$$F_5 = MIC_r \times \tau_{[r]} \quad (S5)$$

$$F_6 = MIC_K \times V_{max[K1]} \times LIT_m / (Km_{[K1]} + LIT_m) \quad (S6)$$

$$F_7 = MIC_K \times V_{max[K2]} \times LIT_s / (Km_{[K2]} + LIT_s) \quad (S7)$$

$$F_8 = MIC_K \times V_{max[K3]} \times SOM_p / (Km_{[K3]} + SOM_p) \quad (S8)$$

$$F_9 = MIC_K \times V_{max[K4]} \times SOM_c / (Km_{[K4]} + SOM_c) \quad (S9)$$

$$F_{10} = MIC_K \times \tau_{[K]} \quad (S10)$$

Thus, changes in C pools can be described using the following equations:

$$\frac{dLITm}{dt} = I_{[LITm]} \times (1- f_{i,\,met}) - F_1 - F_6 \quad (S11)$$

$$\frac{dLITs}{dt} = I_{[LITs]} \times (1- f_{i,\,struc]}) - F_2 - F_7 \quad (S12)$$

$$\frac{dMICr}{dt} = (MGE_{[1]} \times F_1) + (MGE_{[2]} \times F_2) + (MGE_{[3]} \times F_3) + (MGE_{[4]} \times F_4) - F_5 \quad (S13)$$

$$\frac{dMICk}{dt} = (MGE_{[1]} \times F_6) + (MGE_{[2]} \times F_7) + (MGE_{[3]} \times F_8) + (MGE_{[4]} \times F_9) - F_{10} \quad \text{(S14)}$$

$$\frac{dSOMp}{dt} = I_{[LITm]} \times f_{i,\,met} + ((1 - f_{c[r]}) \times F_5) + ((1 - f_{c[K]}) \times F_{10}) - F_3 - F_8 \quad \text{(S15)}$$

$$\frac{dSOMc}{dt} = I_{[LITs]} \times f_{i,\,struc} + (f_{c[r]} \times F_5) + (f_{c[K]} \times F_{10}) - F_4 - F_9 \quad \text{(S16)}$$