Differential equations for the calculation of development rates and rates of change of BBCH values for the different growth stages (GS) of CERES Wheat modified.

GS	BBCH	Phase	Development rate	Calculation BBCH
7	00	Fallow		
8	00	Sowing to germination	$\frac{dGS}{dt} = \frac{T_{eff}}{P9}$	$\frac{dBBCH}{dt} = 10\frac{T_{eff}}{P9}$
9	05	Germination to emergence		
1	10	Emergence to terminal Spikelet initiation	$\frac{dGS}{dt} = \frac{T_{eff} \cdot \min(f(V), f(P))}{(400 \cdot Phyll / 95)}$	$\frac{dBBCH}{dt} = \frac{T_{eff}}{Phyll}$
2	30	Terminal spikelet to end of leaf growth and beginning of ear growth	$\frac{dGS}{dt} = \frac{T_{eff}}{fL \cdot Phyll + Ph39}$ fL = inL_MS-2- nL_MS, "*number of leaves still have to appear*" fL fixed at GS=2	$\frac{dBBCH}{dt} = \frac{T_{eff}}{TSumInternode}$ If nL_MS > inL_MS-2 and If BBCH< 37 then BBCH = 37 If BBCH>=37: $\frac{dBBCH}{dt} = 2 \cdot \min\left(\frac{T_{eff}}{Ph39}, (40 - BBCH)\right)$
3	40	End of leaf growth and beginning of ear growth to end of pre-anthesis ear growth	$\frac{dGS}{dt} = \frac{T_{eff}}{2 \cdot Phyll}$	$\frac{dBBCH}{dt} = (4 + 1.7(GS - 3)) \cdot 10 - BBCH$
4	57	End of pre-anthesis ear growth to beginning of grain filling	$\frac{dGS}{dt} = \frac{T_{eff}}{200}$	$\frac{dBBCH}{dt} = (5.7 + 1.4(GS - 4)) \cdot 10 - BBCH$
5	71	Grain filling	$\frac{dGS}{dt} = \frac{T_{eff} - 1}{Tsum_{GF}}$	$\frac{dBBCH}{dt} = (7.1 + 1.9(GS - 5)) \cdot 10 - BBCH$
6	90	End of grain filling to harvest	$\frac{dGS}{dt} = \frac{T_{eff}}{250}$	$\frac{dBBCH}{dt} = (9 + (GS - 6)) \cdot 10 - BBCH$

(T_d = daily average temperature; T_b = T base temperature; Teff = "effective" Temparature; P9 = degree days from sowing to emergence; Phyll = phyllochron;. inL_MS = number of leaf primordia; nL_MS = number of visible main stem leaves; fl = number of initiated but not emerged leaves at GS 2, Ph39 = degree days between BBCH 37 and 39; Plast = plastochron; Tsuminternode = degree days between node appearance, $Tsum_{GF}$ = temperature sum for grain filling).

$$T_{eff} = \max(0, T_d - T_b),\ Tsum_{GF} = \frac{(P5 + 21.5)}{0.05}$$