```
function Func =
Model_st_P2013(t,y,q1,q2,q3,p1,p2,p3,p4,p5,p6,p7,p8,p9,p10,p11,p12,p13,p1
4,p15,p16,p17,p18,p19,p20,p21,p22,p23,p24,p25,p26,p27,p28,p29,p30,p31,p32
,p33,m1,m2,m3,m4,m5,m6,m7,m8,m9,m10,m11,m12,m13,m14,m15,m16,m17,m18,m19,m
20,m21,m22,m23,m24,m25,m26,m27,m28,m29,m30,m31,m32,m33,m34,m35,m36,m37,m3
8,m39,n1,n2,n3,n4,n5,n6,n7,n8,n9,n10,n11,n12,n13,n14,n15,n16,n17,g1,g2,g3
,g4,g5,g6,g7,g8,g9,g10,g11,g12,g13,g14,g15,g16,g17,g18,g19,g20,g21,g22,g2
3,g24,g25,g26,g27,g28,g29,a,b,c,d,e,ff,g,h,j,dusk,dawn,dawn1,dusk1,dawn2,
dusk2,period,Loffset,Lamplitude,A0,st0,f,fM,fG3,KMb,KMisa,KMr,Kbg,KMbg,vc
,vs,KMmex,KMglut,KMhxk,Vmb,Vmisa,Vmdpe1,Vmdpe2,Vmmex,Vmglut,Vmhxk,Vphdat,
ATPs,ADPs,ATPc,ADPc,NADP,NADPH,Pc,PPic,Ptots,KeqPFP,Vmfbpases,Kmfbpase,Ki
F6Pfbpase,Vmagpase,KmagpG1P,KmagpATP,KagpPGA,KmATPsynt,KmHP,KmTHP,KmSP,Ke
qPGI,KeqPGM,KeqAld,KeqIso,KeqPGAGAP,VmTPT,Vmsps,KMF6P,KMUDPG,KiG6P,Vmpgm,
Vmpgi,Vmugpase,UTPc,KeqUGPase,KmUTP,Vmresp,KmTHPc,Vmexp,Vmfbpasec,Kmfbpas
ec,KiF26P,VmPFP,KmF26PK,KmF26PP,K_F26PK,K_F26PP,KiF6P_F26P,KiPGA,Vm_St_si
nk,Ki_cons,Vmcons,VmSuSy,UDP,KeqSuSy,kd_int,ksb1,ksb2,Ksb1,Ksb2,kdb,ksa1,
ksa2,ksa3,kda1,kdai,Ksa1,ksX,kdX,ksGPT,kdGPT,KsGPT,kidiurn,Kdiurn0,ksA,kd
A,ksi,kdi,Ki_si,dusks,dawns,VmGPT2,Vso);


tw=0.05;
L=1;
Lst=1;
L=0.5*((1+tanh((t-period*floor(t/period)-dawn)/tw))-(1+tanh((t-
period*floor(t/period)-dusk)/tw))+(1+tanh((t-period*floor(t/period)-
period)/tw)));
%L=0.5*((1+tanh((t-period*floor(t/period)-dawn1)/0.5))-(1+tanh((t-
period*floor(t/period)-dusk1)/0.5))+(1+tanh((t-period*floor(t/period)-
dawn2)/0.5))-(1+tanh((t-period*floor(t/period)-dusk2)/0.5))+(1+tanh((t-
period*floor(t/period)-period)/0.5)));   % skeleton photoperiod
Lst=L;

Func = zeros(61, 1);
% y(1)  LHY mRNA
% y(2)  P
% y(3)  GI-ZTL
% y(4)  GI-ELF3 cytoplasm
% y(5)  LHY prot
% y(6)  TOC1 mRNA
% y(7)  PRR9 prot
% y(8)  PRR5 (NI) mRNA
% y(9)  PRR5 (NI) prot
% y(10) GI prot cytoplasm
% y(11) TOC1 prot
% y(12) ZTL
% y(13) EC
% y(14) GI mRNA
% y(15) PRR9 mRNA
% y(16) PRR7 mRNA
% y(17) PRR7 prot
% y(18) ELF4 mRNA
% y(19) ELF4 prot
% y(20) LHY prot modif.
% y(21) ABAR mRNA
% y(22) COP1 cytoplasm
% y(23) ELF3 mRNA
% y(24) ELF3 cytoplasm
% y(25) ELF3 nuclear
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```
% y(26) COP1 nuclear night
% y(27) COP1 nuclear day
% y(28) LUX mRNA
% y(29) LUX prot
% y(30) ABAR prot
% y(31) SnRK2 prot
% y(32) X
% y(33) alfa
% y(34) I
% y(35) betta
% y(36) GPT2
% y(37) St_isa_int (integral amount of starch linkage groups released by
ISA in dark)
% y(38) St_bam_int (integral amount of starch degraded by b amylase)
% y(39) F26P
% y(40)-G2 cytosol
% y(41)-G cytosol
% y(42)-sucrose cytosol
% y(43)-THP stroma
% y(44)-HP stroma
% y(45)-Pi stroma
% y(46)-G1P cytosol
% y(47)-G6P cytosol
% y(48)-F6P cytosol
% y(49)-UDPG cytosol
% y(50)-THP cytosol
% y(51)- starch
% y(52)- GN - starch linkage groups
% y(53)- G2 maltose stroma
% y(54)- G3 stroma
% y(55)- G stroma
% y(56)- G5 stroma
% y(57)- HP sink
% y(58)- sucrose sink
% y(59)- D

Gn=p28*y(10)/(p29+m19+p17*y(25));
EGn=(p18*y(4)+p17*y(25)*Gn)/(m10*y(26)+m9*y(27)+p31);
e34=p25*y(19)*y(25)/(p26*y(29)+p21+m10*y(26)+m9*y(27));
ar=A0*y(21)/(y(21)+g29);
ar=0.5*(A0+y(21)+g29-sqrt((A0+y(21)+g29)^2-4*A0*y(21)));

SPs=Ptots-y(43)-y(44)-y(45);
F6Ps=y(44)/(1+KeqPGI+KeqPGI*KeqPGM);
G1Ps=y(44)*KeqPGM/(1+KeqPGM+1/KeqPGI);
G6Ps=y(44)/(1+KeqPGM+1/KeqPGI);
am=2*KeqAld/KeqIso;
bm=1+1/KeqIso+ADPs*NADP*y(45)/(ATPs*NADPH*KeqIso*KeqPGAGAP);
DHAPs=0.5*(sqrt(bm*bm+4*am*y(43))-bm)/am;
FBPs=KeqAld*DHAPs*DHAPs/KeqIso;
PGAs=DHAPs*ADPs*NADP*y(45)/(ATPs*NADPH*KeqIso*KeqPGAGAP);
Vphsyn=Lst*Vphdat;
Vsfbpase=Vmfbpases*FBPs/(FBPs+Kmfbpase*(1+F6Ps/KiF6Pfbpase));
Vagpase=Vmagpase*Lst*G1Ps*ATPs/((G1Ps+KmagpG1P)*(ATPs+KmagpATP*(1+y(45)/(
KagpPGA*PGAs+0.00001)))))/(1+(y(51)/1000)^2);

b1=1+1/KeqIso+ADPc*NADP*Pc/(ATPc*NADPH*KeqIso*KeqPGAGAP);
DHAPc=0.5*(sqrt(b1*b1+4*am*y(50))-b1)/am;
```

```
FBPc=KeqAld*DHAPc*DHAPc/KeqIso;
PGAc=DHAPc*ADPc*NADP*Pc/(ATPc*NADPH*KeqIso*KeqPGAGAP);
Vcfbpase=Vmfbpasec*FBPc/(FBPc+Kmfbpasec*(1+y(48)/KiF6Pfbpase+y(39)/KiF26P
));
Vpfp=VmPFP*(PPic*y(48)-Pc*FBPc/KeqPFP);
VtptDHAP=VmTPT*(DHAPs*Pc-DHAPc*y(45));
VtptPGA=VmTPT*(PGAs*Pc-PGAc*y(45));

Stb=f*y(51);
Stisa=(1-f)*y(51);
Vb=Vmb*(1-Lst);
Kbact=(0.5-atan(10*(y(38)/(f*(y(37)+y(38))+st0)-1))/pi);
Visa=Vmisa*(1-Lst)*Stisa/(Stisa+KMisa)*(0.5-
atan(10*(y(37)/((y(37)+y(38))*(1-f)+st0)-1))/pi);
VbamM=Vb*Kbact*fM*Stb/(fM*Stb+KMb*(1+(y(53)*y(53)+y(53)*y(54))/KMr));
VbamG3=Vb*Kbact*fG3*Stb/(fG3*Stb+KMb*(1+(y(53)*y(53)+y(53)*y(54))/KMr));
VbamG5=Kbg*Vb*y(56)/(y(56)+KMbg*(1+(y(53)*y(53)+y(53)*y(54))/KMr));
VbamMslg=Kbg*Vb*fM*y(52)/(fM*y(52)+KMbg*(1+(y(53)*y(53)+y(53)*y(54))/KMr)
);
VbamG3slg=Kbg*Vb*fG3*y(52)/(fG3*y(52)+KMbg*(1+(y(53)*y(53)+y(53)*y(54))/K
Mr));
Vmex=Vmmex*(y(53)/(y(53)+KMmex)-y(40)/(y(40)+KMmex));
Vglut=Vmglut*(y(55)/(y(55)+KMglut)-y(41)/(y(41)+KMglut));
VdpeG3=Vmdpe1*(y(54)*y(54)/9-0.2*y(56)*y(55));
Vd=Vmdpe2*(0.5*y(40)*Pc-y(46)*y(41));
Vhxk=Vmhxk*y(41)/(y(41)+KMhxk)/(1+y(47)/KiG6P);
Vpgm=Vmpgm*(y(46)/KeqPGM-y(47));
Vpgi=Vmpgi*(y(47)/KeqPGI-y(48));
Vugpase=Vmugpase*(y(46)*UTPc-y(49)*PPic/KeqUGPase)/(UTPc+KmUTP);
Vresp=Vmresp*y(50)/(y(50)+KmTHPc);
Vexp=Vmexp*(y(42)-y(58));

Vst_sink=1*(Vm_St_sink+1*VmGPT2*y(36))*Lst*y(57)/(1+(y(51)/1000)^2);
Vgpt2=VmGPT2*Lst*y(36)*(y(47)*y(45)-Pc*y(44));

Vst_degr=(VbamM+VbamG3+Visa)*y(32);
Vcons=Vmcons*y(57)/(1+(y(34)/Ki_cons)^2);

VSuSy=VmSuSy*(y(58)/2*UDP-y(57)*y(57)/KeqSuSy);
Kdiurn=y(59)*(1-Vso)/Vso/(1+(y(34)/kidiurn)^2)+Kdiurn0;
Vsps=Vmsps*(y(48)/(y(48)+KMF6P))*(y(49)/(y(49)+KMUDPG))*Kdiurn;
Vf26pK=K_F26PK*y(48)/(y(48)+KmF26PK*(1+PGAc/KiPGA))-
K_F26PP*y(39)/(y(39)+KmF26PP*(1+y(48)/KiF6P_F26P))*Kdiurn;

Func(1) = 1*(q1*L*y(2)+n1*g1^a/(g1^a+(y(7)+y(17)+y(9)+y(11))^a))-
y(1)*(m1*L+m2*(1-L));
Func(2) = p7*(1-L)*(1-y(2))-m11*y(2)*L;
Func(3) = p12*L*y(12)*y(10)-p13*y(3)*(1-L)-m21*y(3);
Func(4) = p17*y(24)*y(10)-m10*y(4)*y(22)-p18*y(4)+p31*EGn;
Func(5) = (p2+p1*L)*(y(1))-m3*y(5)-p3*y(5)^c/(y(5)^c+g3^c);
Func(6) = 1*n2/(1+(y(5)/(g5*(1+(y(31)/g25)^j)))^e)*g4/(g4+y(13))-y(6)*m5;
Func(7) = p8*y(15)-(m13+m22*(1-L))*y(7);
Func(8) =
1*g23^g/(g23^g+y(11)^g)*(n10*y(20)^e/(g12^e+y(20)^e)+n11*y(17)^b/(g13^b+y
(17)^b))-m16*y(8);
Func(9) = p10*y(8)-(m17+m24*(1-L))*y(9);
Func(10)= p11*y(14)-m19*y(10)-p12*L*y(12)*y(10)+p13*y(3)*(1-L)-
p17*y(24)*y(10)-p28*y(10)+p29*Gn;
```

```
Func(11)= p4*(y(6)+n16)-m8*y(11)-(m6+m7*(1-L))*y(11)*(p5*y(12)+y(3));
Func(11)= p4*y(6)-m8*y(11)-(m6+m7*(1-L))*y(11)*(p5*y(12)+y(3));
Func(12)= 1*p14-m20*y(12)-p12*L*y(12)*y(10)+p13*y(3)*(1-L);
Func(13)= p26*y(29)*e34-m10*y(13)*y(26)-m9*y(13)*y(27)-
m32*y(13)*(1+p24*L*(EGn+Gn)^d/(g7^d+(EGn+Gn)^d));
Func(14)=
1*g17^g/(g17^g+y(11)^g)*(q2*L*y(2)+g15^e/(g15^e+y(5)^e)*g14/(g14+y(13))*n
12)-y(14)*m18;
Func(15)=
1*g18^g/(g18^g+y(11)^g)*(q3*L*y(2)+g8/(g8+y(13))*(n4+n7*y(5)^e/(y(5)^e+g9
^e)))-m12*y(15);
Func(16)=
1*g22^g/(g22^g+y(11)^g)*(n8*(y(5)+y(20))^e/(g10^e+(y(5)+y(20))^e)+n9*y(7)
^ff/(g11^ff+y(7)^ff))-m14*y(16);
Func(17)= p9*y(16)-y(17)*(m15+m23*(1-L));
Func(18)= 1*n15*g21^g/(g21^g+y(11)^g)*g6^e/(g6^e+y(5)^e)*g20/(g20+y(13))-
y(18)*m34;
Func(19)= p23*y(18)-m35*y(19)-p25*y(25)*y(19)+p21*e34;
Func(20)= p3*y(5)^c/(y(5)^c+g3^c)-m4*y(20);
Func(21)= n17*y(5)^e/(y(5)^e+g28^e)*g24^g/(g24^g+y(11)^g)-m37*y(21);
Func(22)= 1*n5-p6*y(22)-m27*y(22)*(1+p15*L);
Func(23)= 1*n3*g16^e/(g16^e+y(5)^e)-m26*y(23);
Func(24)= p16*y(23)-m9*y(24)*y(22)-p17*y(24)*y(10)-p19*y(24)+p20*y(25);
Func(25)= p19*y(24)-p20*y(25)-m10*y(25)*y(26)-m9*y(25)*y(27)-
p25*y(25)*y(19)+p21*e34-p17*y(25)*Gn;
Func(26)= p6*y(22)-n6*L*y(2)*y(26)-n14*y(26)-m27*y(26)*(1+p15*L);
Func(27)= 1*(n14*y(26)+n6*L*y(2)*y(26))-m31*(1+m33*(1-L))*y(27);
Func(28)= n13*g19^g/(g19^g+y(11)^g)*g6^e/(g6^e+y(5)^e)*g2/(g2+y(13))-
y(28)*m34;
Func(29)= p27*y(28)-m36*y(29)-p26*y(29)*e34;
Func(30)= p33*g27^h/(ar^h+g27^h)-m39*y(30);
Func(31)= p32-m30*y(31)*y(30);
Func(32) = ksX*y(51)*y(33)*(1+1/(1+(y(34)/0.2)^2))*Lst-kdX*y(32)*Lst;
Func(33) = ksa1*Ksa1^2/(y(5)^2+Ksa1^2)+ksa2+ksa3*y(2)*L-y(33)*(kda1+(1-
L)/(1+(y(7)/kdai)^2));
Func(34) = ksi*y(35)*(1-y(57)^3/(y(57)^3+Ki_si^3))-kdi*y(34);
Func(35) = (ksb1*Ksb1^2/(y(11)^2+Ksb1^2)+ksb2*y(5)^2/(y(5)^2+Ksb2^2))-
kdb*y(35)*Lst;
Func(36) = ksGPT*Lst*y(34)^4/(y(34)^4+KsGPT^4)-y(36)*kdGPT;
Func(37) = Visa*y(32)-kd_int*y(37)*Lst;
Func(38) = (VbamM+VbamG3)*y(32)-kd_int*y(38)*Lst;
Func(39)= Vf26pK;
Func(40)= Vmex-2*Vd;
Func(41)= Vglut+Vd-Vhxk;
Func(42)= Vsps-Vexp;
Func(43)= Vphsyn*(3*SPs/(SPs+KmSP)-1.5*y(43)/(y(43)+KmTHP))-2*Vsfbpase-
VtptDHAP*vc/vs-VtptPGA*vc/vs;
Func(44)= Vsfbpase-Vagpase-0.5*Vphsyn*y(44)/(y(44)+KmHP)+Vgpt2*vc/vs;
Func(45)= VtptDHAP*vc/vs+VtptPGA*vc/vs+Vagpase+Vsfbpase-
Vphsyn*y(45)/(y(45)+KmATPsynt)-Vgpt2*vc/vs;
Func(46)= Vd-Vpgm-Vugpase;
Func(47)= Vhxk+Vpgm-Vpgi-Vgpt2;
Func(48)= Vcfbpase-Vpfp+Vpgi-0.5*Vsps;
Func(49)= Vugpase-0.5*Vsps;
Func(50)= VtptDHAP+VtptPGA-2*(Vcfbpase-Vpfp)-Vresp;
Func(51) = Vagpase*Vso+Vst_sink*(1-Vso)-Vst_degr;
Func(52) = Visa*y(32)-VbamMslg-VbamG3slg;
Func(53) = VbamM*y(32)+VbamMslg+0.4*VbamG5-Vmex*vc/vs;
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Func(54) = VbamG3*y(32)+VbamG3slg+0.6*VbamG5-6*VdpeG3;
Func(55) = VdpeG3-Vglut*vc/vs;
Func(56) = 5*VdpeG3-VbamG5;
Func(57) = VSuSy-Vcons-Vst_sink;
Func(58) = Vexp*Vso/(1-Vso)-VSuSy;
Func(59) = ksA*Vcons-kdA*y(59);
Func(60) = 0;
Func(61) = 0;
```