

Usando um *Process Based Crop Model*

1100222 e LEB5048

Modelagem do crescimento de culturas

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Criando o projeto do modelo simples :

Nome	Data de modificaç...	Tipo	Tamanho
Debug	15/02/2018 11:03	Pasta de arquivos	
DSSAT Simples	14/02/2018 16:37	Pasta de arquivos	
DSSAT Simples.sln	15/02/2018 11:05	Microsoft Visual S...	1 KB
DSSAT Simples.vfproj	15/02/2018 11:05	Intel Fortran Proje...	3 KB

O nosso projeto / modelo inicial:

```
*****  
* DRIVER for the MODEL TO SIMULATE CROP GROWTH SUBJECTED TO  
* DAILY VARIATIONS OF WEATHER AND SOIL WATER CONDITIONS  
* Written in Microsoft FORTRAN for PC-compatible machines  
* Authors: RICARDO BRAGA and JADIN RESA  
* Desc: This program is an assignment of the course AGE 3640-Agricultural  
* and Biological Systems Simulation.  
* Date: 01/11/1993  
* Modified 7/09 CNP - modified modular format, revised output format,  
* modified soil water routines, added water balance  
*****  
*  
* LIST OF VARIABLES  
*  
* DOY = Julian day  
* SOVP = date of planting (Julian day)  
* endsim = code signifying physiological maturity (end of simulation)  
* FREQP = frequency of printout (days)  
* IPRINT = code for printout (00 for printout)  
* LAI = canopy leaf area index (m2/m2)  
* PAR = photosynthetically active radiation (MJ/m2/d)  
* RAIN = daily rainfall (mm)  
* SRAD = daily solar radiation (MJ/m2/d)  
* SWPACL = soil water deficit stress factor  
* SWPAC2 = soil water excess stress factor  
* TAMBH = hourly average temperature (Celsius)  
* THMX = daily maximum temperature (Celsius)  
* THMN = daily minimum temperature (Celsius)  
*  
*****  
PROGRAM MAIN  
*****  
USE DPLIB  
IMPLICIT NONE  
  
REAL LAI, SWPACL, SWPAC2  
REAL SRAD, THMX, THMN, PAR, RAIN
```

[Manual disponível em
https://www.researchgate.net/publication/265118060](https://www.researchgate.net/publication/265118060) An Approach for Modular Crop Model Development

An Approach for Modular Crop Model Development

August 3, 1999

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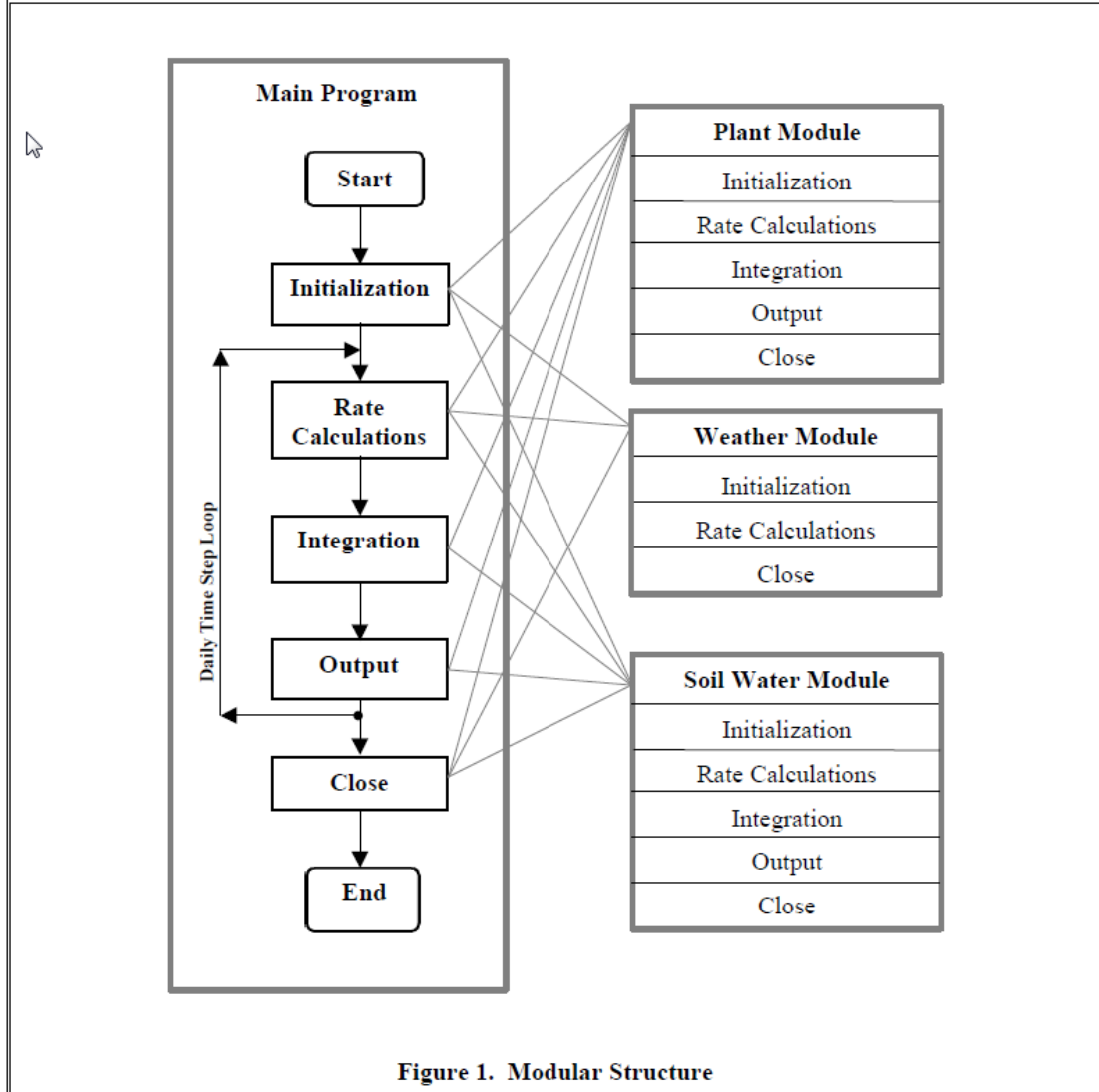
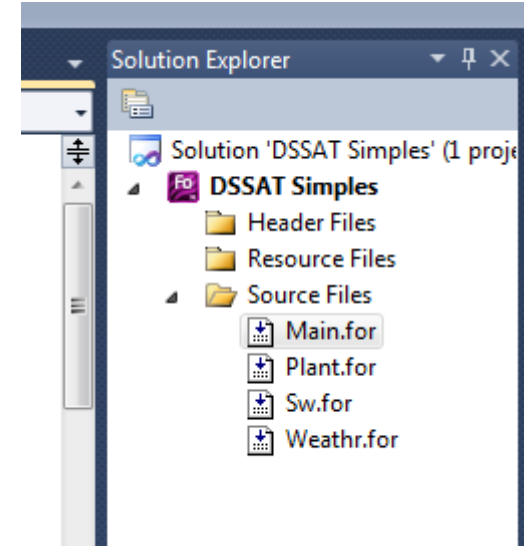


Figure 1. Modular Structure



```
*****  
PROGRAM MAIN  
-----  
USE DFLIB  
IMPLICIT NONE  
  
REAL LAI, SWFAC1, SWFAC2  
REAL SRAD, TMAX, TMIN, PAR, RAIN  
INTEGER DOY,DOYP, endsim  
INTEGER FROP, IPRINT  
  
!*****  
!*****  
!   INITIALIZATION AND INPUT OF DATA  
!*****
```



```

!*****
!*****
!  INITIALIZATION AND INPUT OF DATA
!*****

```

```
CALL OPENF(DOYP, FROP)
```

```
CALL WEATHR(SRAD, TMAX, TMIN, RAIN, PAR, 'INITIAL  ')
```

```
CALL SW(
!Input
!Output
!Control
DOY, LAI, RAIN, SRAD, TMAX, TMIN,
SWFAC1, SWFAC2,
'INITIAL  ')
```

```
CALL PLANT(DOY, endsim, TMAX, TMIN,
!Input
!Output
!Control
PAR, SWFAC1, SWFAC2,
LAI,
'INITIAL  ')
```

```
!-----
!  DAILY TIME LOOP
!-----
```

```
DO 500 DOY = 0,1000
  IF (DOY .NE. 0) THEN
```

```
    CALL WEATHR(SRAD, TMAX, TMIN, RAIN, PAR)
```

```
!*****
```

```

*****
*  SUBROUTINE OPENF(DOYP)
*  This subroutine opens the simulation control file, and reads date of
*  planting (DOYP)
*
*  SIMCTRL.INP => date of planting, frequency of printout
*****

```

```
SUBROUTINE OPENF(DOYP, FROP)
```

```

IMPLICIT NONE
INTEGER DOYP, FROP

OPEN (UNIT=8, FILE='SIMCTRL.INP', STATUS='UNKNOWN')
READ(8,5) DOYP, FROP
IF (FROP .LE. 0) FROP = 1
5 FORMAT(2I6)
CLOSE(8)

```

```

RETURN
END SUBROUTINE OPENF

```

```

*****
*****

```

SIMCTRL.INP	
121	3
DOYP	FROP



```

!*****
!*****
!   INITIALIZATION AND INPUT OF DATA
!*****
CALL OPENF(DOYP, FROP)

CALL WEATHR(SRAD, TMAX, TMIN, RAIN, PAR, 'INITIAL  ')

CALL SW(
DOY, LAI, RAIN, SRAD, TMAX, TMIN,
SWFAC1, SWFAC2,
'INITIAL  ')

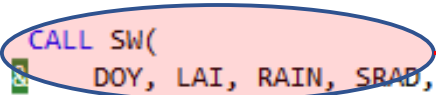
CALL PLANT(DOY, endsim, TMAX, TMIN,
PAR, SWFAC1, SWFAC2,
LAI,
'INITIAL  ')

!-----
!   DAILY TIME LOOP
!-----

DO 500 DOY = 0,1000
  IF (DOY .NE. 0) THEN

    CALL WEATHR(SRAD, TMAX, TMIN, RAIN, PAR, 'RA
!*****

```



```

!Input
!Output
!Control

```

```

SUBROUTINE SW(
DOY, LAI, RAIN, SRAD, TMAX, TMIN,
SWFAC1, SWFAC2,
DYN)
!Input
!Output
!Control

```

```

IMPLICIT NONE
SAVE

INTEGER  DATE, DOY
REAL     SRAD, TMAX, TMIN, RAIN, SWC, INF, IRR, ROF, ESa, EPa, DRNp
REAL     DRN, DP, Wpp, Fcp, STp, WP, FC, ST, ESsp, Epp, ETp, LAI
CHARACTER*10 DYN

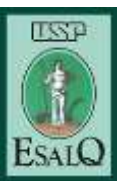
REAL CN, SWFAC1, SWFAC2, POTINF
REAL SWC_INIT, TRAIN, TIRR, TESA, TEPA, TROF, TDRN
REAL TINF, SWC_ADJ

```

```

!*****
!*****
!   INITIALIZATION
!*****
IF (INDEX(DYN, 'INITIAL') .NE. 0) THEN
!*****
OPEN(3, FILE='SOIL.INP', STATUS='UNKNOWN')
OPEN(10, FILE='sw.out', STATUS='REPLACE')
OPEN(11, FILE='TRDTG.TMP', STATUS='UNKNOWN')

```



SIMCTRL.INP	Soil.inp						
0.06	0.17	0.28	145.000	0.10	55.00	246.5	
Wp	FCp	STp	DP	DRNp	CN	SWC	
(cm ³ /cm ³)	(cm ³ /cm ³)	(cm ³ /cm ³)	(cm)	(frac/d)	-	(mm)	

Variable Name	Definition	Units
CN	Runoff curve number	--
DP	Depth of soil profile	cm
DRNp	Daily drainage percentage (fraction of void space)	1/day
FCp	Soil water content at field capacity (fraction of void space)	cm ³ /cm ³
STp	Soil water content saturation (fraction of void space)	cm ³ /cm ³
SWC	Soil water content in the profile (value read from file represents initial soil water content)	mm
Wp	Soil water content at wilting point (fraction of void space)	cm ³ /cm ³

5.3 Integration

The integration portion of the soil water balance module updates the value of the soil water content based on the computed values of infiltration (INF), soil evaporation (ESa), plant transpiration (EPa), and vertical drainage (DRN):

$$SWC = SWC + (INF -$$

The computed value is limited to a minimum of zero. If the com

4.0	Plant growth module (PLANT.FOR)
4.1	Initialization.....
4.2	Rate calculations
4.3	Integration.....
4.4	Output.....
4.5	Close.....
5.0	Soil Water Balance Module (SW.FOR) ..
5.1	Initialization.....
5.2	Rate calculations
5.3	Integration.....
5.4	Output.....
5.5	Close.....



Plant Module - Parameters

Table 1 – Input data read for plant module		
Variable Name	Definition	Units
EMP1	Empirical coefficient for LAI computation, maximum leaf area expansion per leaf	m ² /leaf
EMP2	Empirical coefficient for LAI computation	--
fc	Fraction of total crop growth partitioned to canopy	--
intot	Duration of reproductive stage	degree-days
lai	Leaf area index	m ² / m ²
Lfmax	Maximum number of leaves	--
n	Leaf number	--
nb	Empirical coefficient for LAI computation	--
p1	Dry matter of leaves removed per plant per unit development after maximum number of leaves is reached	g
PD	Plant density	plants/m ²
rm	Maximum rate of leaf appearance	leaf/day
sla	Specific leaf area	m ² /g
tb	Base temperature above which reproductive growth occurs	°C
w	Total plant dry matter weight	g/m ²
wc	Canopy dry matter weight	g/m ²
wr	Root dry matter weight	g/m ²

Weather File

Table 3 – Input data read for weather module		
Variable Name	Definition	Units
DATE	Julian date in YYDDD format	--
PAR	Daily photosynthetically active radiation	mol[photon]/m ² -day
RAIN	Daily rainfall	mm
SRAD	Daily solar radiation	MJ/m ²
TMAX	Daily maximum temperature	°C
TMIN	Daily minimum temperature	°C