Usando um *Process Based Crop Model*

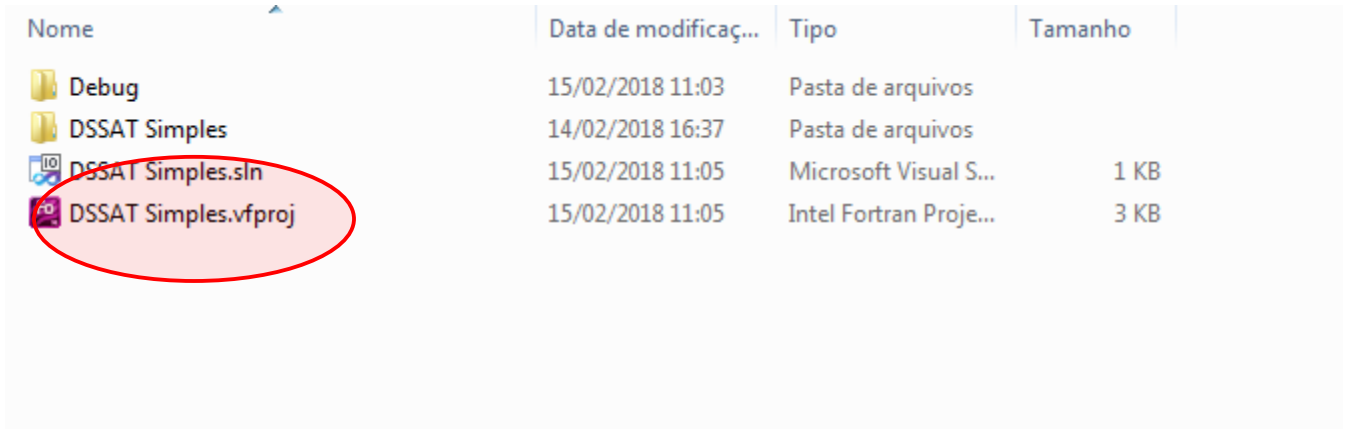
1100222 e LEB5048

Modelagem do crescimento de culturas

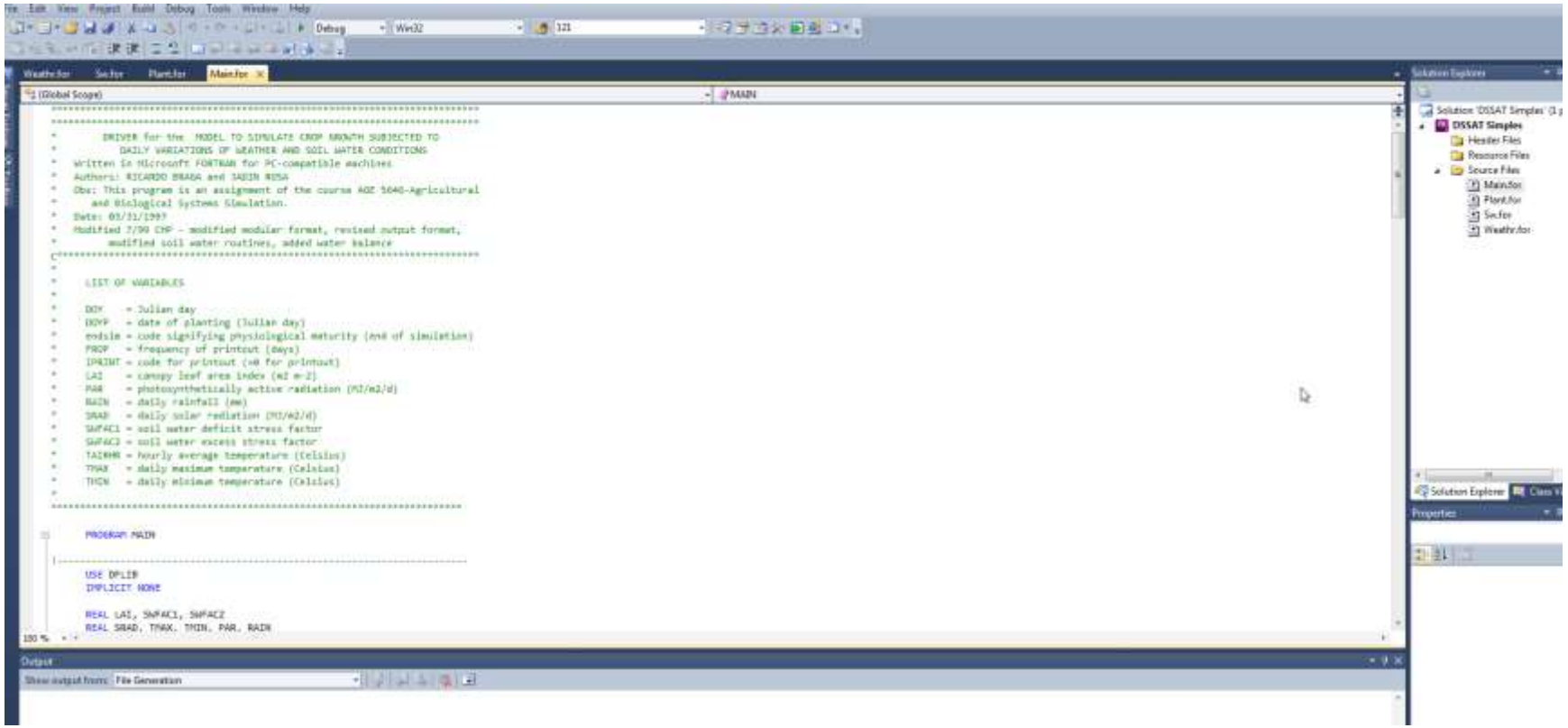
Prof Quirijn de Jong van Lier

Prof Fábio R Marin

Criando o projeto do modelo simples :



O nosso projeto / modelo inicial:



Manual disponível em 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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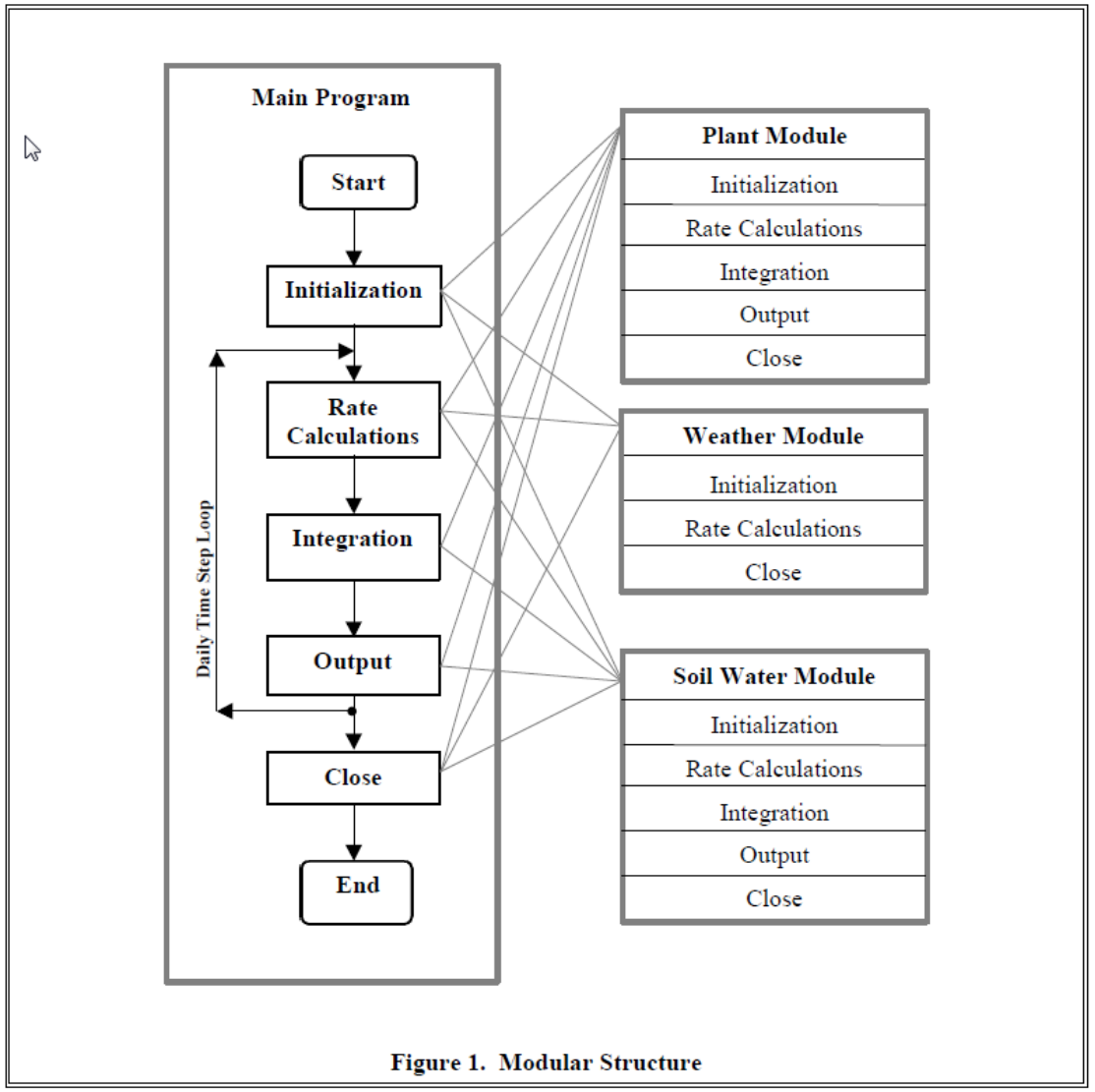
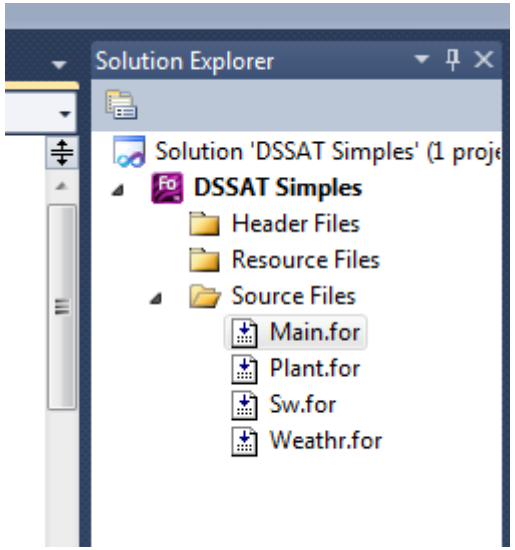


Figure 1. Modular Structure



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

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

      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

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

```
!***********************************************************************
*     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,              !Input
     &    SWFAC1, SWFAC2,                                !Output
     &    'INITIAL    ')                                 !Control

      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

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

```
      SUBROUTINE SW(
     &    DOY, LAI, RAIN, SRAD, TMAX, TMIN,              !Input
     &    SWFAC1, SWFAC2,                                !Output
     &    DYN)                                           !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,ESp,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='TRRIG.INP',STATUS='UNKNOWN')
```

SIMCTRL.INP | Soil.inp

WPp	FCp	STp	DP	DRNp	CN	SWC
(cm3/cm3)	(cm3/cm3)	(cm3/cm3)	(cm)	(frac/d)	-	(mm)
0.06	0.17	0.28	145.000	0.10	55.00	246.5

Table 2 – Input data read for soil water balance module

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
WPp	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 limite
minimum of zero. If the com

USP ESALQ cena

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]/m2-day
RAIN	Daily rainfall	mm
SRAD	Daily solar radiation	MJ/m2
TMAX	Daily maximum temperature	°C
TMIN	Daily minimum temperature	°C