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Tools to Support Computational Crop Model Analysis and Comparison

ml4ai.github.io/automates

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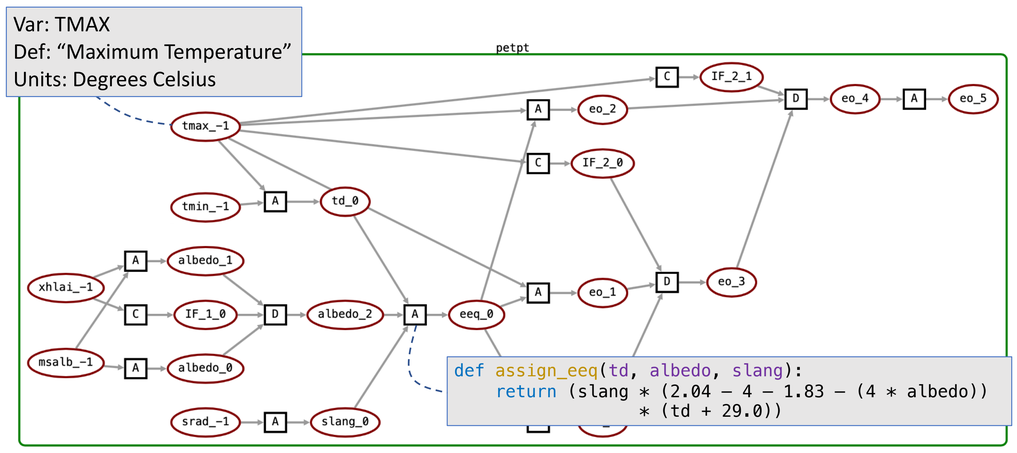
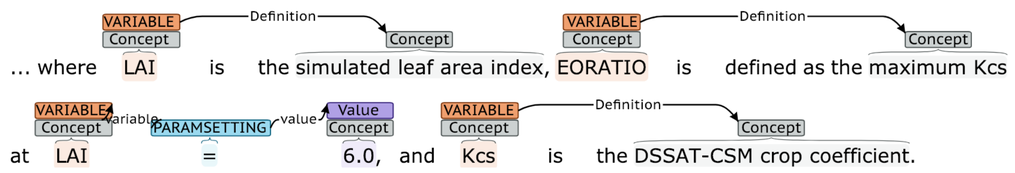
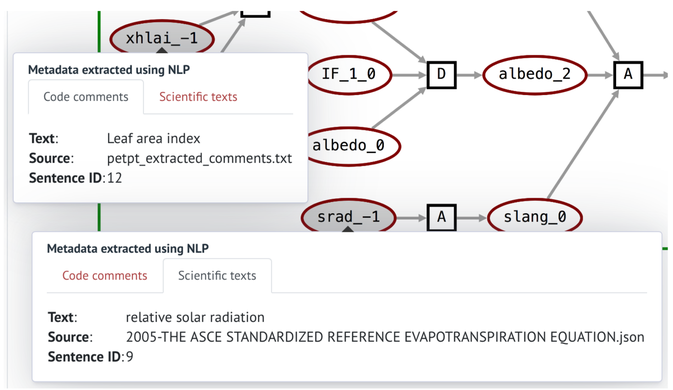
```
C=======================================================================
C  PETPT, Subroutine, J.T. Ritchie
C  Calculates Priestly-Taylor potential evapotranspiration
C-----------------------------------------------------------------------
C  REVISION HISTORY
C  ??/??/19?? JR  Written
C  11/04/1993 NBP Modified
C  10/17/1997 CHP Updated for modular format.
C  09/01/1999 GH  Incorporated into CROPGRO
!  07/24/2006 CHP Use MSALB instead of SALB (includes mulch and soil
!                 water effects on albedo)
!-----------------------------------------------------------------------
!  Called by:   WATBAL
!  Calls:       None
C=======================================================================
      SUBROUTINE PETPT(
     &    MSALB, SRAD, TMAX, TMIN, XHLAI,                 !Input
     &    EO)                                             !Output

!-----------------------------------------------------------------------
      IMPLICIT NONE

!-----------------------------------------------------------------------
!     INPUT VARIABLES:
      REAL MSALB, SRAD, TMAX, TMIN, XHLAI
!-----------------------------------------------------------------------
!     OUTPUT VARIABLES:
      REAL EO
!-----------------------------------------------------------------------
!     LOCAL VARIABLES:
      REAL ALBEDO, EEQ, SLANG, TD

!-----------------------------------------------------------------------
!     Should use TAVG here -- we have it from WEATHER variable!
!     SSJ 9/18/2006
!     TD = TAVG
!     JWJ 2/15/2007 - Can't use TAVG unless coefficients in EEQ
!         equation are recalibrated.  Keep TD calc as it was
!         developed.
      TD = 0.60*TMAX+0.40*TMIN

      IF (XHLAI .LE. 0.0) THEN
        ALBEDO = MSALB
      ELSE
        ALBEDO = 0.23-(0.23-MSALB)*EXP(-0.75*XHLAI)
      ENDIF

      SLANG = SRAD*23.923
      EEQ = SLANG*(2.04E-4-1.83E-4*ALBEDO)*(TD+29.0)
      EO = EEQ*1.1

      IF (TMAX .GT. 35.0) THEN
        EO = EEQ*((TMAX-35.0)*0.05+1.1)
      ELSE IF (TMAX .LT. 5.0) THEN
        EO = EEQ*0.01*EXP(0.18*(TMAX+20.0))
      ENDIF
```



The AutoMATES project is developing technology to automatically extract scientific models from source code, equations, and free text, and provide a unified framework for model analysis and comparison.

Reading Software to Extract Models: In this example, source code for the DSSAT implementation of the Priestley-Taylor potential evapotranspiration (PET) model (**left**) is analyzed and translated into a *dataflow* representation of the model (**above**). Additionally, metadata about the variables is automatically extracted from source code comments and papers using rule-based natural language processing (**below**) and associated with the variables (**right**).

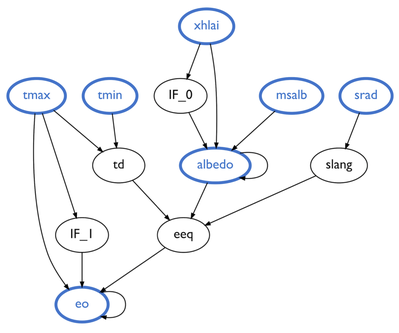




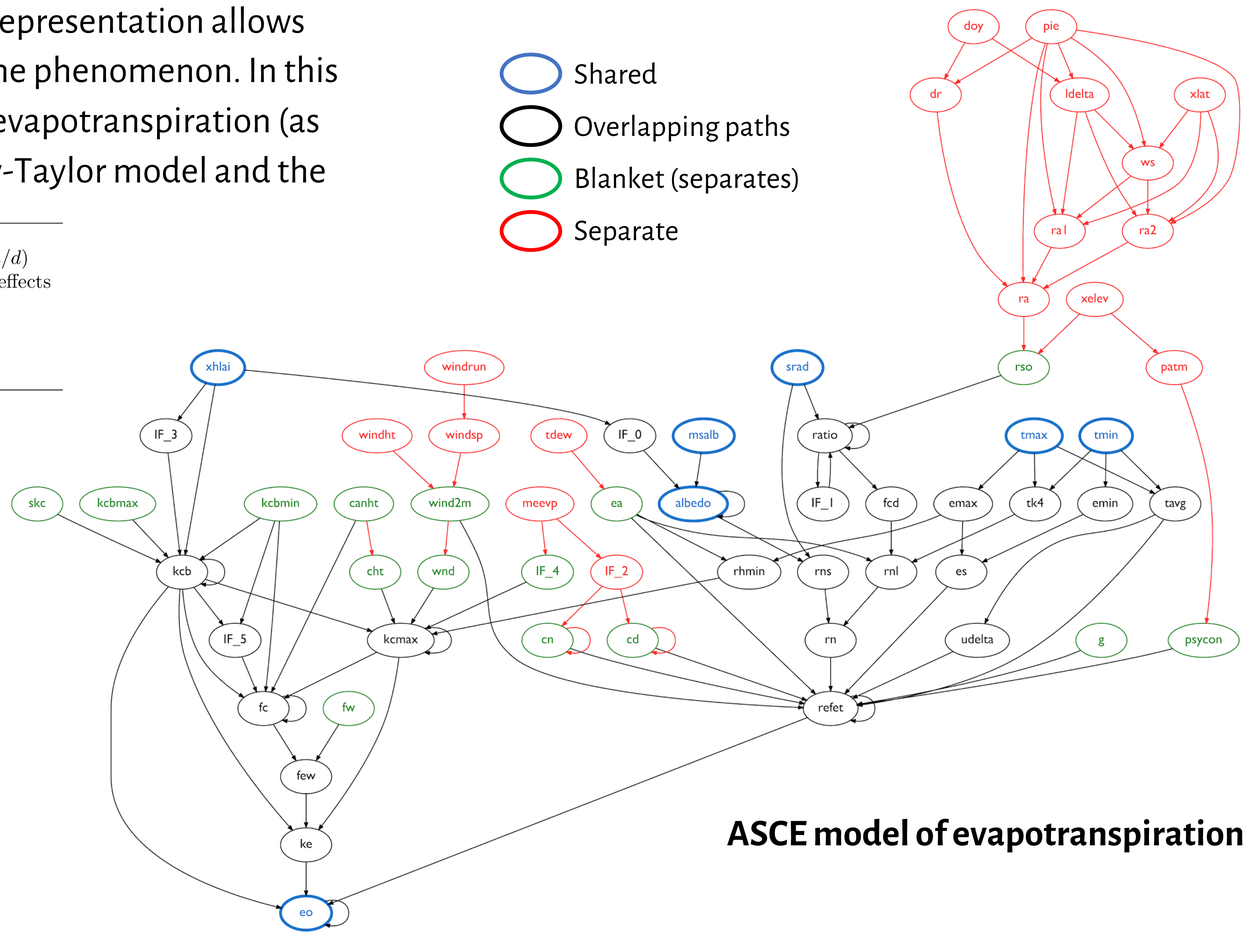
Model Comparison: Extracting models to a common representation allows us to more easily compare different models of the same phenomenon. In this example, the topological structures of two models of evapotranspiration (as implemented in DSSAT) are contrasted – the Priestley-Taylor model and the ASCE model.

Shared variables

`albedo`	Reflectance of soil-crop surface
`eo`	Potential evapotranspiration rate (mm/d)
`msalb`	Soil albedo with mulch and soil water effects
`srad`	Solar radiation ($MJ/m^2 - d$)
`tmax`	Maximum daily temperature ($°C$)
`tmin`	Minimum daily temperature ($°C$)
`xhlai`	Leaf area index (m^2[leaf]/m^2[ground])



Priestley-Taylor model of evapotranspiration



ASCE model of evapotranspiration