Appendix C-A

Potential Evaporation and Potential Transpiration Calculations

Conversions

This section provides some conversion equations, for some units commonly used in the worksheet.

$Langley := 0.0418 \cdot 10^{6} \cdot joule$ $\quad mbar := 10^{2} \cdot Pa$ $\quad kJ := 10^{3} \cdot joule$

Conversions

Constants

This section defines some constants used in the worksheet.

Latent heat of fusion: $\lambda_v := 590 \cdot cal \cdot gm^{-1}$

Heat capacity of water: $c_a := 0.24 \cdot cal \cdot gm^{-1} \cdot K^{-1}$

Universal gas constant: $R := 8.31451 \cdot joule \cdot K^{-1}$

Stefann-Boltzmann constant: $\sigma := 1.17 \cdot 10^{-7} \cdot cal \cdot cm^{-2} \cdot day^{-1} \cdot K^{-4}$

Density of water: $\rho_w := 1 \cdot gm \cdot cm^{-3}$

Constants

UNSAT-H Met constants

Some of these calculations use parameters originally calculated for use in UNSAT-H. This section defines those parameters

$Albedo := 0.2$ $\quad Alt := 1500 \cdot m$ $\quad ZU := 6 \cdot m$ $\quad PMB := 845 \cdot mbar$

UNSAT-H Met constants

Vapor pressure function

Calculate the relationship between vapor pressure and temperature, using the Clausius - Clapeyron equation:

Clausius-Clapeyron equation

$p' := 6.11 \cdot mbar$

$e_s(T) := p' \cdot \exp\left(\frac{17.3 \cdot T}{T + 237.3}\right)$ $\qquad e_s(20) = 2.345 \times 10^3\ Pa$

Define the slope of the vapor pressure function

$s(Temp) := \frac{d}{dTemp} e_s(Temp) \cdot K^{-1}$ $\qquad s(20) = 1.454\ \frac{1}{K}\ mbar$

Define the psychometric constant

$\gamma := \frac{c_a \cdot PMB}{0.622 \cdot \lambda_v}$ $\qquad \gamma = 0.553\ \frac{1}{K}\ mbar$

Vapor pressure function

Read multiple met data files

The meteorological data files were formatted for UNSAT-H input. Each year's data is contained in a separate file. Each 'Met' data file contains 8 columns:

1. Day number of year
2. Daily max temp. (F)
3. Daily min temp. (F)
4. Daily average dewpoint temperature (F)
5. Daily net shortwave irradiance (Langleys per square meter per day)
6. Daily average windspeed (mi/hr)
7. Daily average cloudiness (0 to 10, for fraction covered in tenths)
8. Daily precipitation total (in)

$I_{files} := 54$ $\qquad i_{files} := 1 .. I_{files}$ $\qquad DateYr_{i_{files}} := i_{files} + 1949$

$FileName_{i_{files}} := concat(\text{"D:\Projects\SDA Prelim Landfill Cover Design\UNSAT-H sims\MartianMetData\"}, \text{"Met"}, num2str(1949 + i_{files}), \text{".dat"})$

$$DataSet_{i_{files}} := READPRN(FileName_{i_{files}})$$

$i_{day} := 1..365$ $\quad$ $j := 1..8$

Read multiple met data files

Account for snow in P

This sections adjusts precipitation input to account for snow accumulation and melt:

Access daily precipitation data: $$Praw_{i_{files}} := \left(DataSet_{i_{files}}\right)^{\langle 8 \rangle} \cdot \frac{in}{cm}$$

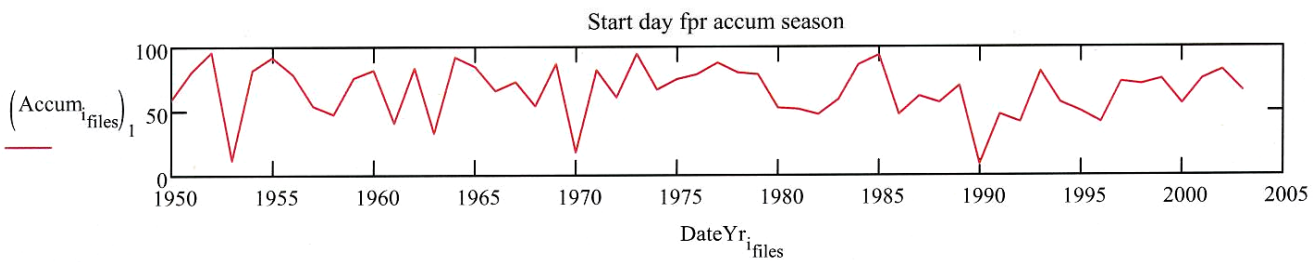
Calculate mean daily temperature (C) from daily min and max temperature (F): $$T_{mean_C_{i_{files}}} := \left[\frac{\left(DataSet_{i_{files}}\right)^{\langle 2 \rangle} + \left(DataSet_{i_{files}}\right)^{\langle 3 \rangle}}{2} - 32\right] \cdot \frac{5}{9}$$

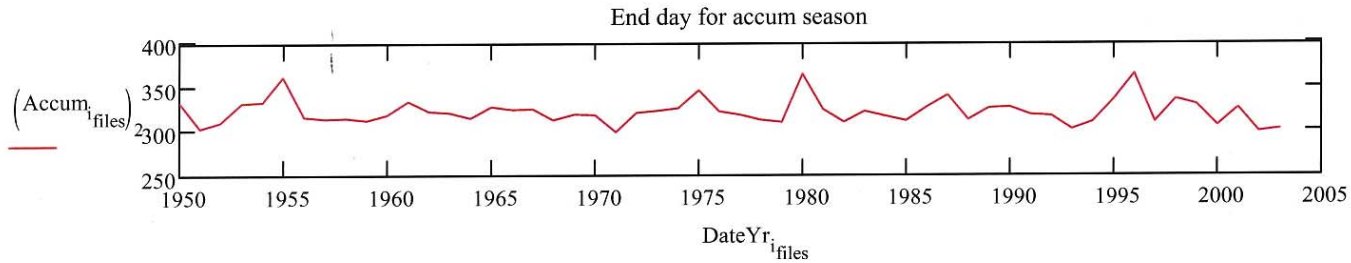
Calculate a smoother temperature function, for the calculation of snow melt season start and end, which depends on many days in a row being warm/cold $$SmoothedT_{mean_C_{i_{files}}} := medsmooth\left[\left(T_{mean_C_{i_{files}}}\right), 13\right]$$

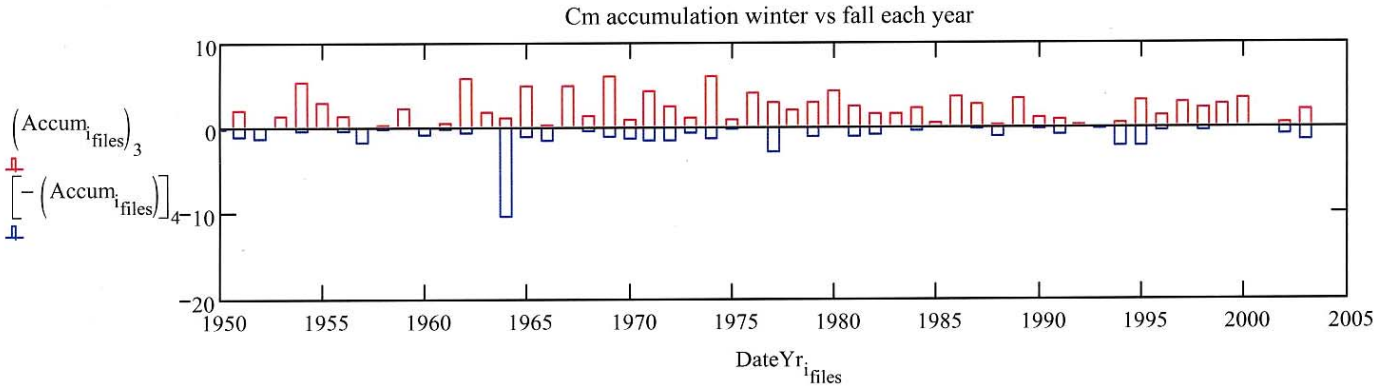
The following function calculates, for each year, the daynumber associated with (1) the end of snow accumulation, (2) the start of snow accumulation, (3) the amount of snow accumulated before spring and (4) in the fall. It uses the smoothed temperature function so anomalously warm or cold days don't start or end the accumulation season at the wrong time. Because infiltration requires that the ground has been warmed to the melting point, the critical temperature above which infiltration can be slightly above freezing.

$T_{crit} := 0$

$$Accum_{i_{files}} := \left| \begin{array}{l} Accum1 \leftarrow 0 \\ Accum2 \leftarrow 0 \\ \text{for } j \in 1..180 \\ \quad \left| \begin{array}{l} Accum1 \leftarrow \left(Praw_{i_{files}}\right)_j + Accum1 \\ End \leftarrow j \\ \text{break if } \left(SmoothedT_{mean_C_{i_{files}}}\right)_j > T_{crit} \end{array} \right. \\ \text{for } j \in 365..180 \\ \quad \left| \begin{array}{l} Accum2 \leftarrow \left(Praw_{i_{files}}\right)_j + Accum2 \\ Start \leftarrow j \\ \text{break if } \left(SmoothedT_{mean_C_{i_{files}}}\right)_j > T_{crit} \end{array} \right. \\ \begin{pmatrix} End \\ Start \\ Accum1 \\ Accum2 \end{pmatrix} \end{array} \right.$$







Use the scrollbar below to scroll through the years of data, and examine the characteristics of each year, and that year's precip and snow accumulation

egFile :=

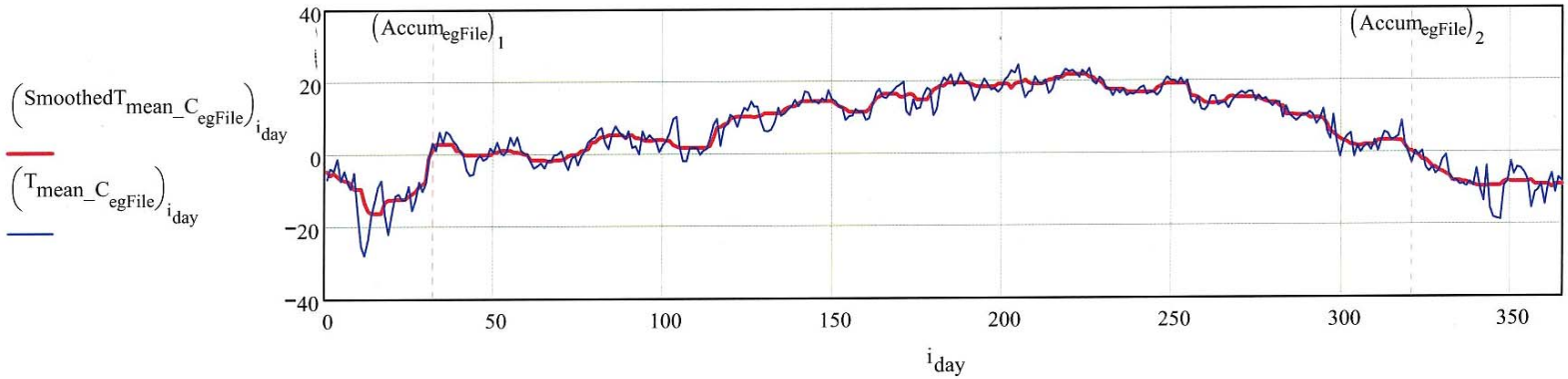
14

egFile = 14

$$Accum_{egFile} = \begin{pmatrix} 32 \\ 321 \\ 1.778 \\ 0 \end{pmatrix}$$

egFileYr := 1949 + egFile

egFileYr = 1963



Modify precipitation file now:

Set precip to zero during accumulation periods

$$\text{Prain}_{i_{files}} := \left| \begin{array}{l} \text{for } i \in 1..365 \\ \quad \left| \begin{array}{l} \text{Ptemp}_i \leftarrow 0 \ \text{ if } \left[i < \left(\text{Accum}_{i_{files}}\right)_1\right] \vee \left[i > \left(\text{Accum}_{i_{files}}\right)_2\right] \\ \text{Ptemp}_i \leftarrow \left(\text{Praw}_{i_{files}}\right)_i \ \text{ otherwise} \end{array} \right. \\ \text{Ptemp} \end{array} \right.$$

Degree day melt calculation: $C_m := 0.274$ (cm per degree C)

$$\text{MeltPotl}_{i_{files}} := \left| \begin{array}{l} \text{for } i \in 1..365 \\ \quad \left| \begin{array}{l} \text{temp}_i \leftarrow 0 \ \text{ if } \left[i < \left(\text{Accum}_{i_{files}}\right)_1\right] \vee \left[i > \left(\text{Accum}_{i_{files}}\right)_2\right] \vee \left[\left(\text{T}_{\text{mean_C}i_{files}}\right)_i < 0\right] \\ \text{temp}_i \leftarrow C_m \cdot \left[\left(\text{T}_{\text{mean_C}i_{files}}\right)_i\right] \ \text{ otherwise} \end{array} \right. \\ \text{temp} \end{array} \right.$$

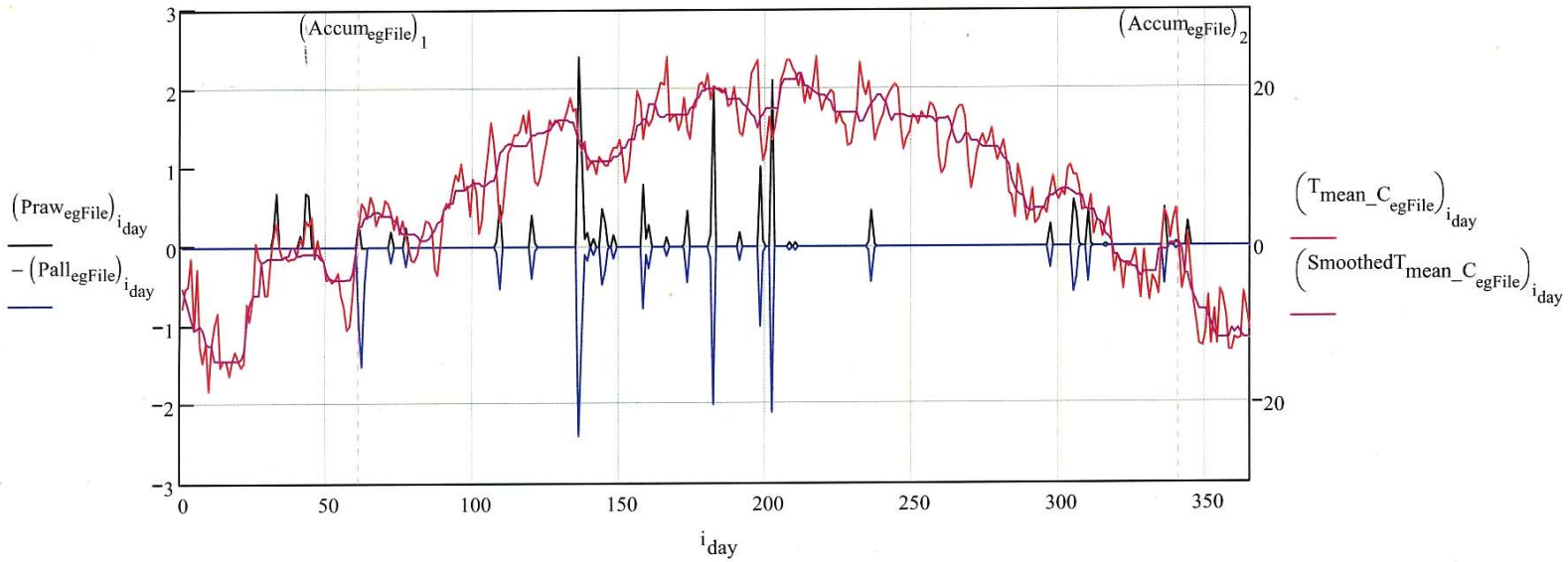
$$
\begin{aligned}
Pall_{i_{files}} := \;& pack_{i_{files}} \leftarrow \left(Accum_{i_{files}}\right)_3 \quad \text{if } i_{files} = 1 \\
& pack_{i_{files}} \leftarrow \left(Accum_{i_{files}-1}\right)_4 + \left(Accum_{i_{files}}\right)_3 \quad \text{otherwise} \\
& snowpack \leftarrow pack_{i_{files}} \\
& \text{for } i \in 1..365 \\
& \quad melt_i \leftarrow \left(MeltPotl_{i_{files}}\right)_i \quad \text{if } \left[snowpack > \left(MeltPotl_{i_{files}}\right)_i\right] \vee \left[i < \left(Accum_{i_{files}}\right)_1\right] \\
& \quad melt_i \leftarrow snowpack \quad \text{otherwise} \\
& \quad snowpack \leftarrow snowpack - melt_i \\
& \quad Ptemp_i \leftarrow \left(Prain_{i_{files}}\right)_i + melt_i \\
& Ptemp
\end{aligned}
$$

Add end of last year and start of this yr's accum to spring precip

$$egFile := \boxed{38}$$

$egFile = 38$

$$Accum_{egFile} = \begin{pmatrix} 61 \\ 341 \\ 2.642 \\ 0.305 \end{pmatrix}$$



Account for snow in P

$FullDataSet_{[(i_{files}-1)\cdot 365+i_{day}],j} := (DataSet_{i_{files}})_{i_{day},j}$

$I := length(FullDataSet^{\langle 1 \rangle})$ $\quad I = 19710$ $\quad i := 1..I$

$DayOfYr := FullDataSet^{\langle 1 \rangle}$

$T_{mean_C} := \left(\frac{FullDataSet^{\langle 2 \rangle} + FullDataSet^{\langle 3 \rangle}}{2} - 32\right)\cdot\frac{5}{9}$ $\quad max(T_{mean_C}) = 28.361$ $\quad min(T_{mean_C}) = -33.056$

$T_{mean_K} := (T_{mean_C} + 273.15)\cdot K$ $\quad max(T_{mean_K}) = 301.511\ K$ $\quad min(T_{mean_K}) = 240.094\ K$

$T_{dewpt_C} := (FullDataSet^{\langle 4 \rangle} - 32)\cdot\frac{5}{9}$ $\quad max(T_{dewpt_C}) = 17$ $\quad min(T_{dewpt_C}) = -33.056$

$SW_{net} := FullDataSet_{i}^{\langle 5 \rangle} \cdot Langley \cdot m^{-2} \cdot day^{-1}$ $\quad max(SW_{net}) = 387.085 \frac{watt}{m^2}$ $\quad min(SW_{net}) = 0 \frac{watt}{m^2}$

$U_{avg} := FullDataSet^{\langle 6 \rangle} \cdot mi \cdot hr^{-1}$ $\quad max(U_{avg}) = 99.913 \frac{m}{sec}$ $\quad min(U_{avg}) = 0 \frac{m}{sec}$

$U_{avg_i} := if\left(U_{avg_i} > 15 \cdot \frac{m}{sec}, 15 \cdot \frac{m}{sec}, U_{avg_i}\right)$ $\quad max(U_{avg}) = 15 \frac{m}{sec}$ $\quad min(U_{avg}) = 0 \frac{m}{sec}$

$Cloud := FullDataSet^{\langle 7 \rangle}$ $\quad max(Cloud) = 10$ $\quad min(Cloud) = 0$

$Praw_full := FullDataSet^{\langle 8 \rangle} \cdot in$ $\quad max(Praw_full) = 0.044\ m$ $\quad min(Praw_full) = 0\ m$

Alternative choice for Precip is the snow-modified precipitation timeseries:

$Pfull_{\left(i_{files}-1\right) \cdot 365 + i_{day}} := \left(Pall_{i_{files}}\right)_{i_{day}} \cdot cm$ $\quad max(Pfull) = 0.042\ m$ $\quad min(Pfull) = 0\ m$

$Precip := Pfull$ $\quad max(Precip) = 0.042\ m$ $\quad min(Precip) = 0\ m$

Replace measured Cloudiness data with calculated data

Cloudiness data is incomplete. Replace it using the method described in the UNSAT-H manual (which is based on Campbell (1985))

Calculate potential daily solar (shortwave) radiation:

$\phi := 43 \cdot deg \qquad sin_\phi := sin(\phi) \qquad cos_\phi := cos(\phi)$

$sin_\delta(day) := 0.3985 \cdot sin(4.869 + 0.0172 \cdot day + 0.03345 \cdot sin(6.224 + 0.0172 \cdot day))$ $\quad sin_\delta(100) = 0.133$

$\delta(day) := asin(sin_\delta(day))$ $\quad \delta(100) = 0.133$

$$h_s(day) := acos(-tan(\phi)\cdot tan(\delta(day)))$$ $h_s(100) = 1.696$

$$Q_{0_{(i_{files}-1)\cdot 365+i_{day}}} := \frac{117.5\cdot 10^6\cdot \frac{joule}{m^2\cdot day}}{\pi}\cdot\left(h_s(i_{day})\cdot sin_\phi\cdot sin_\delta(i_{day}) + cos_\phi\cdot cos(\delta(i_{day}))\cdot sin(h_s(i_{day}))\right)$$ $Q_{0_1} = 132.501\ \frac{kg}{s^3}$

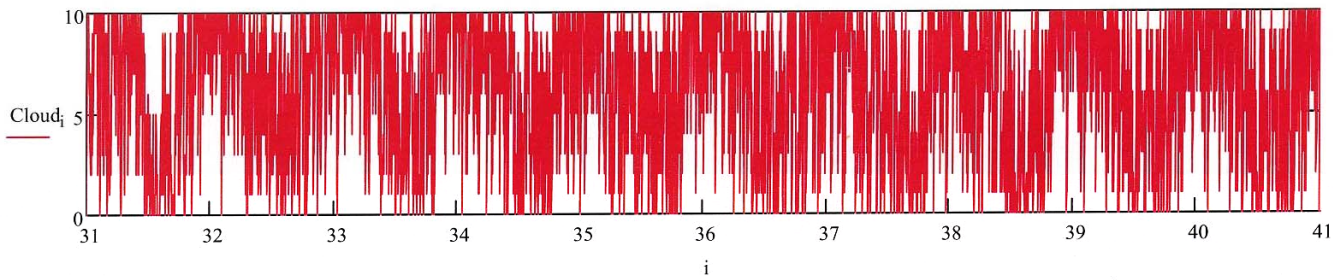
Calculate transmission coefficient:

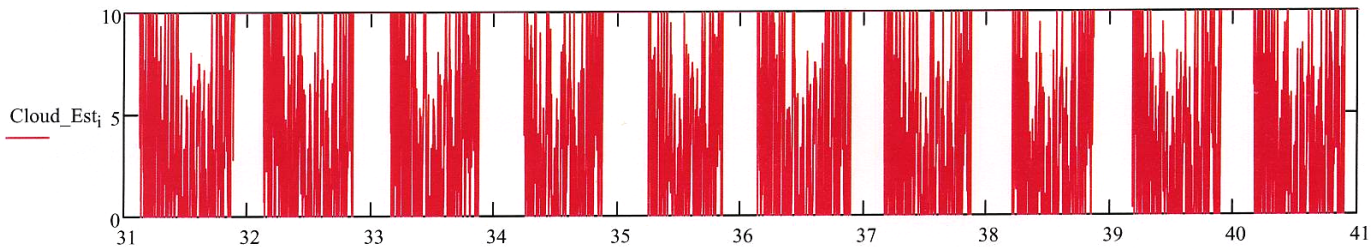
$$T_t := \frac{SW_{net}}{Q_0}$$ $SW_{net_{1000}} = 230.287\ \frac{1}{m^2\cdot s}\ joule$ $Q_{0_{1000}} = 306.416\ \frac{1}{m^2}\ watt$ $T_{t_{1000}} = 0.752$

Estimate cloudiness from transmission coefficient:

$$Cloud_Est_{(i_{files}-1)\cdot 365+i_{day}} := 10\cdot max\left[0, min\left[1, \left[2.33 - 3.33\cdot T_{t_{(i_{files}-1)\cdot 365+i_{day}}}\right]\right]\right]$$ $Cloud_Est_{1000} = 0$

Graphs below compare measured cloudiness data (top) to calculated cloudiness data (bottom)





$$\frac{i}{365}$$

Replace measured Cloudiness data with calculated data

Parameter calcs for Penman eq.

Potential evapotranspiration is calculated using the form of the Penman equation described by Doorenbos and Pruitt (1977) in order to use essentially the same method employed in UNSAT-H Version 3, which therefore allows us to check the calculated PET against the output of Pete Martian's INTEC study using the same data and that model. The UNSAT-H manual describes PET as

When heat flow is not being modeled, the boundary condition for evapotranspiration will be a function of the PET rate. The PET rate can be either input directly as a daily value or calculated as a daily value using the form of the Penman equation reported by Doorenbos and Pruitt (1977)

$$\mathrm{PET} = \frac{sR_{ni}}{s+\gamma} + \frac{\gamma}{s+\gamma} 0.27\left(1+\frac{U}{100}\right)(e_a - e_d) \qquad (4.51)$$

where s = slope of the saturation vapor pressure-temperature curve, mb K^{-1}
R_{ni} = isothermal net radiation, mm d^{-1}
γ = psychrometric constant, mb K^{-1}
U = 24-hr wind run, km d^{-1}
e_a = saturation vapor pressure at the mean air temperature, mb
e_d = actual vapor pressure, mb.

The units used by Doorenbos and Pruitt (1977) were retained for this option.

The equation used here is: $\mathrm{PET} = W \cdot R_{ni} + (1 - W) \cdot \frac{\gamma}{s+\gamma} \cdot fU \cdot \left(\frac{e_{sat} - e_{actual}}{mbar}\right) \cdot \frac{mm}{day}$ with parameters as described below:

$e_{sat} := \overrightarrow{e_s(T_{mean_C})}$ Saturated vapor pressure $\max(e_{sat}) = 3.874 \times 10^3$ Pa $\min(e_{sat}) = 37.159$ Pa

$e_{actual} := \overrightarrow{e_s(T_{dewpt_C})}$	Actual vapor pressure	$\max(e_{actual}) = 1.942 \times 10^3$ Pa	$\min(e_{actual}) = 37.159$ Pa
$s := \overrightarrow{s(T_{mean_C})}$	Slope of vapor pressure function	$\max(s) = 2.253 \frac{1}{K}$ mbar	$\min(s) = 0.037 \frac{1}{K}$ mbar
$nNRatio := 0.1 + 0.9 \frac{Cloud_Est}{10}$	Cloudiness effect	$\max(nNRatio) = 1$	$\min(nNRatio) = 0.1$
$\varepsilon_{effect} := \overrightarrow{\left(0.34 - 0.044 \cdot \sqrt{\frac{e_{actual}}{mbar}}\right)}$		$\max(\varepsilon_{effect}) = 0.313$	$\min(\varepsilon_{effect}) = 0.146$
$LW_{net} := \overrightarrow{\left(\varepsilon_{effect} \cdot nNRatio \cdot \sigma \cdot T_{mean_K}^4\right)}$		$\max(LW_{net}) = 105.232 \frac{watt}{m^2}$	$\min(LW_{net}) = 5.798 \frac{watt}{m^2}$

The calculation in UNSAT-H v3, for comparison only ----------

$NRATIO := \overrightarrow{\left(0.95 - 0.66 \cdot Cloud_Est - 0.0023 \cdot Cloud_Est^2\right)}$	$\max(NRATIO) =$	$\min(NRATIO) =$
$FNN := \overrightarrow{\left(0.1 + 0.9 \cdot \frac{NRATIO}{10}\right)}$	$\max(FNN) =$	$\min(FNN) =$
$LW_{net} := \overrightarrow{\left(\varepsilon_{effect} \cdot FNN \cdot \sigma \cdot T_{mean_K}^4\right)}$	$\max(LW_{net}) = 105.232 \frac{watt}{m^2}$	$\min(LW_{net}) = 5.798 \frac{watt}{m^2}$

$R_{ni} := \overrightarrow{\left[\left[(1 - Albedo) \cdot SW_{net} - LW_{net}\right] \cdot \left(\lambda_v \cdot \rho_w\right)^{-1}\right]}$	$\max(R_{ni}) = 10.514 \frac{mm}{day}$	$\min(R_{ni}) = -2.564 \frac{mm}{day}$

The wind measurement ht correction factor in UNSAT-H v3:

$$UHTCF := \left| \begin{array}{l} ZU \leftarrow ZU \cdot m^{-1} \\ A \leftarrow 0.17 \\ A \leftarrow 0.22 \ \text{ if } ZU < 2.0 \\ UHTCF \leftarrow \left(\frac{2.0}{ZU}\right)^{A} \end{array} \right.$$

$UHTCF = 0.83$

(Note that according to tables in Doorenbos and Pruitt, the height correction should be 0.93. Here we maintain consistency with UNSAT-H)

$$fU := \overrightarrow{\left[0.27 \cdot \left(1 + \frac{UHTCF \cdot \frac{U_{avg}}{km \cdot day^{-1}}}{100}\right)\right]}$$

$max(fU) = 3.173$ $\quad$ $min(fU) = 0.27$

$$W := \overrightarrow{\frac{s}{s + \gamma}} \qquad 1 - W = \overrightarrow{\frac{\gamma}{s + \gamma}}$$

Parameter calcs for Penman eq.

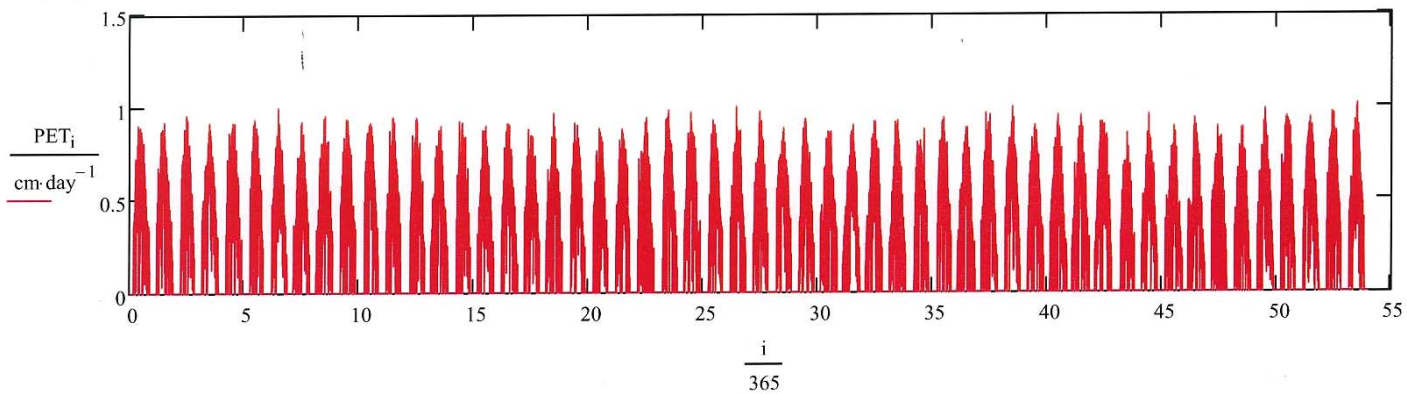
Calc PET from Penman eq

$$PET := \overrightarrow{\left[W \cdot R_{ni} + (1 - W) \cdot \frac{\gamma}{s + \gamma} \cdot fU \cdot \left(\frac{e_{sat} - e_{actual}}{mbar}\right) \cdot \frac{mm}{day}\right]}$$

$PET_i := if(PET_i < 0, 0, PET_i)$

$max(PET) = 10.16 \frac{mm}{day}$ $\quad$ $min(PET) = 0 \frac{mm}{day}$

Turn of ET for days when precipitation exceeds a critical value: $\quad P_Crit := 0.5 \cdot cm \quad PET_i := if(Precip_i > P_Crit, 0, PET_i)$

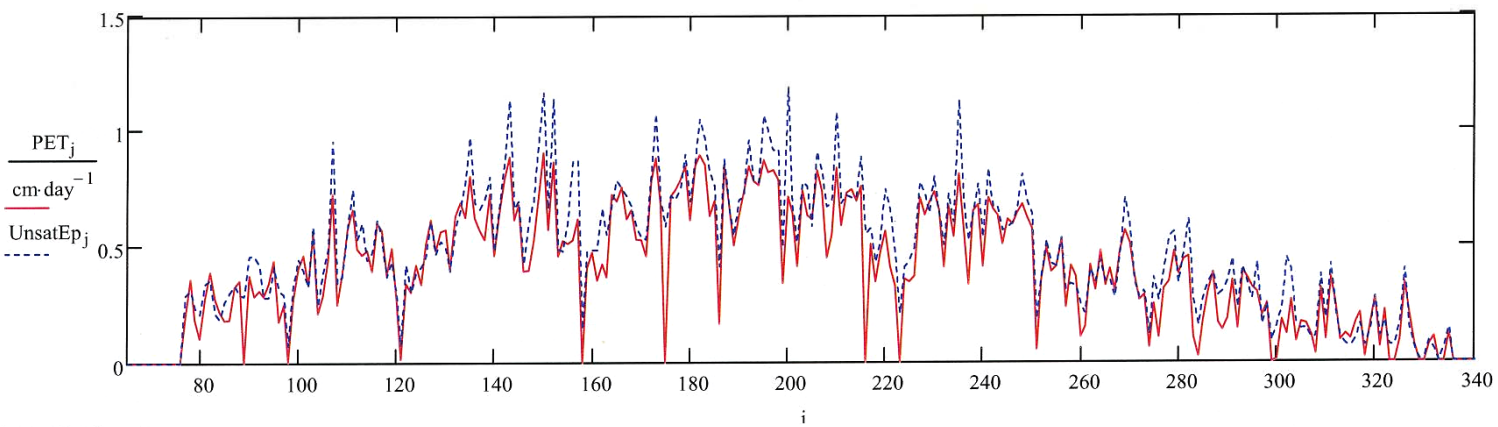


To compare this PET calc to that produced by UNSAT-H V3, we read data from 1950 and plot both on the same graph (for reference, the UNSAT-H V3 CALPET routine code is included at the bottom of this worksheet):

UnsatEp :=

1950 Pevap.xls

$j := 1..365$ $\sum_j (PET_j \cdot day) = 110.766\ cm$ $\sum_j UnsatEp_j = 128.111$



Calc PET from Penman eq

Hydrus requires that PET be partitioned into potential evaporation and potential transpiration. To allow comparisons with UNSAT-H simulations, we partition PET into PE and PT using the second of the two methods described in that model. That section of the UNSAT-H manual is included here, for reference:

UNSAT-H manual on PET > PE, PT

Partition PET to PE and PT

Partition PET into Tp and Ep, according to phenology of cheatgrass, using method described in UNSAT-H V3:

$$Day_{germ} := 79$$

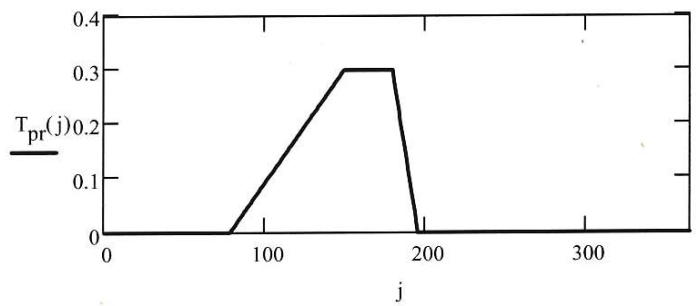
$$Day_{StFull} := 150$$

$$Day_{EndFull} := 180$$

$$Day_{senesce} := 196$$

$$Biomass := 100\% \cdot \left(220 \cdot \frac{gm}{m^2}\right)$$

$$T_{pr}(day) := \left| \begin{array}{l} x \leftarrow mod(day, 365) \\ Biomass_0 \leftarrow Biomass \\ T_{pr_max} \leftarrow \dfrac{Biomass}{Biomass_0} \cdot 0.3 \\ T_{pr} \leftarrow \left| \begin{array}{ll} T_{pr_max} \cdot \dfrac{x - Day_{germ}}{Day_{StFull} - Day_{germ}} & \text{if } (x > Day_{germ}) \wedge (x < Day_{StFull}) \\ T_{pr_max} & \text{if } (x \geq Day_{StFull}) \wedge (x \leq Day_{EndFull}) \\ T_{pr_max} \cdot \left(1 - \dfrac{x - Day_{EndFull}}{Day_{senesce} - Day_{EndFull}}\right) & \text{if } (x > Day_{EndFull}) \wedge (x < Day_{senesce}) \\ 0 & \text{otherwise} \end{array} \right. \\ T_{pr} \end{array} \right.$$



The above function calculates the ratio of transpiration to net radiation, but where net radiation is expressed in terms PET (depth of water per unit time). Because the PET calculated here depends primarily on net radiation, the net radiation term here is effectively the PET value, so here we calculate potential transpiration by multiplying the potential transpiration / net radiation (=PET) ratio by the PET term:

$SimDay_i := i$ $\quad T_{p_i} := \left(T_{pr}(i) \cdot PET_i\right)$

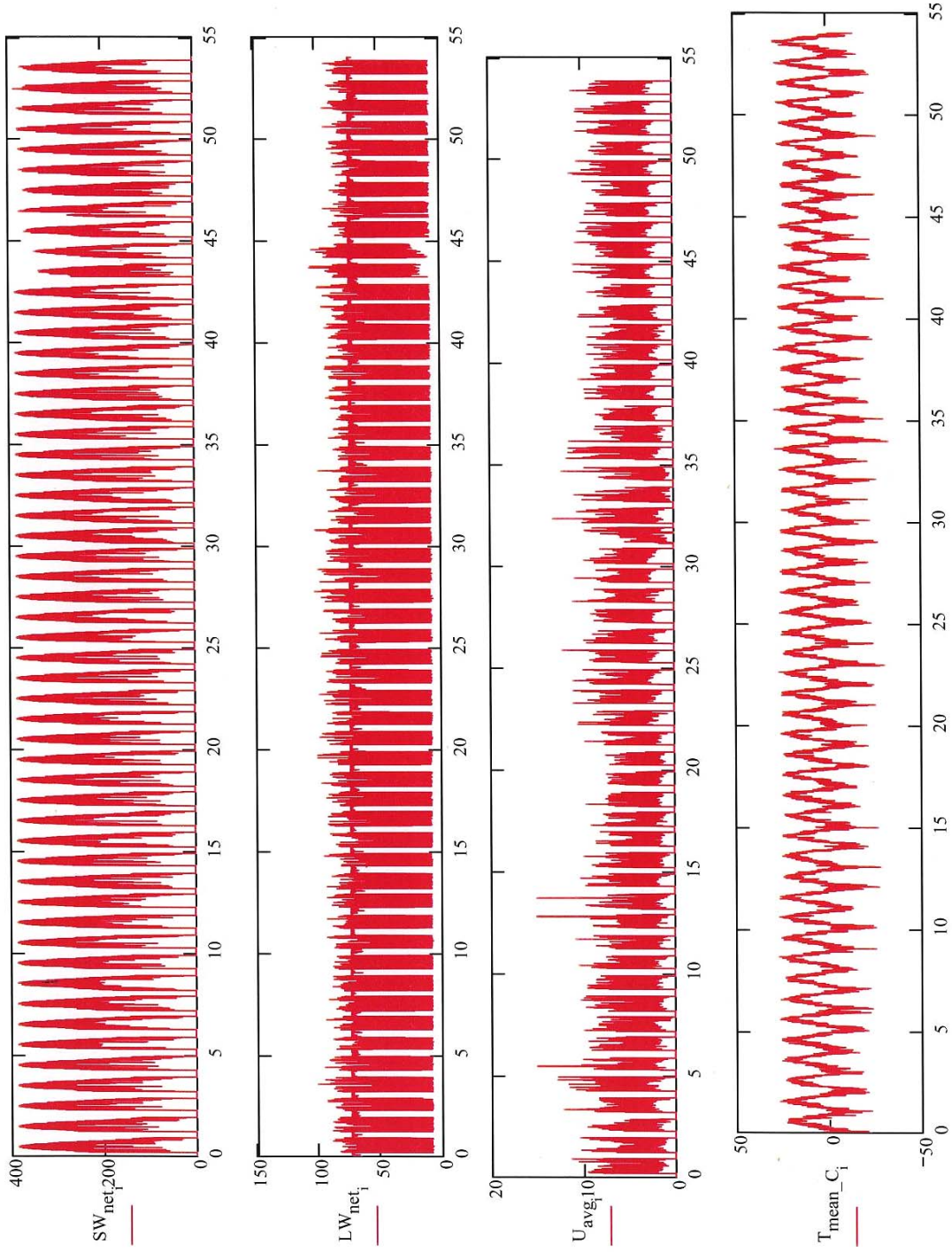
The potential evpaporation must now be reduced by the amount of energy partitioned to potential transpiration: $E_p := \overrightarrow{\left(PET - T_p\right)}$

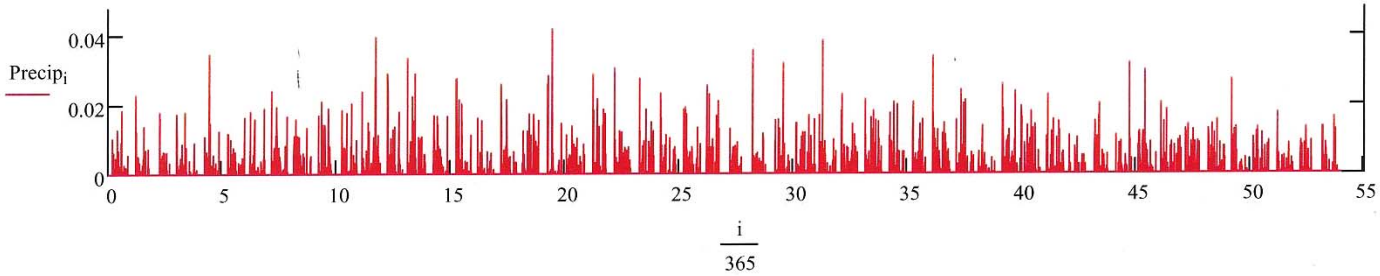
Hydrus also requires a tension value for the greatest tension that the plants can maintain when energy is not limiting. $hCritA_i := 500000$

Partition PET to PE and PT

The following sections plot computed data over various time intervals, for checking calculations.

Full time-series component figs

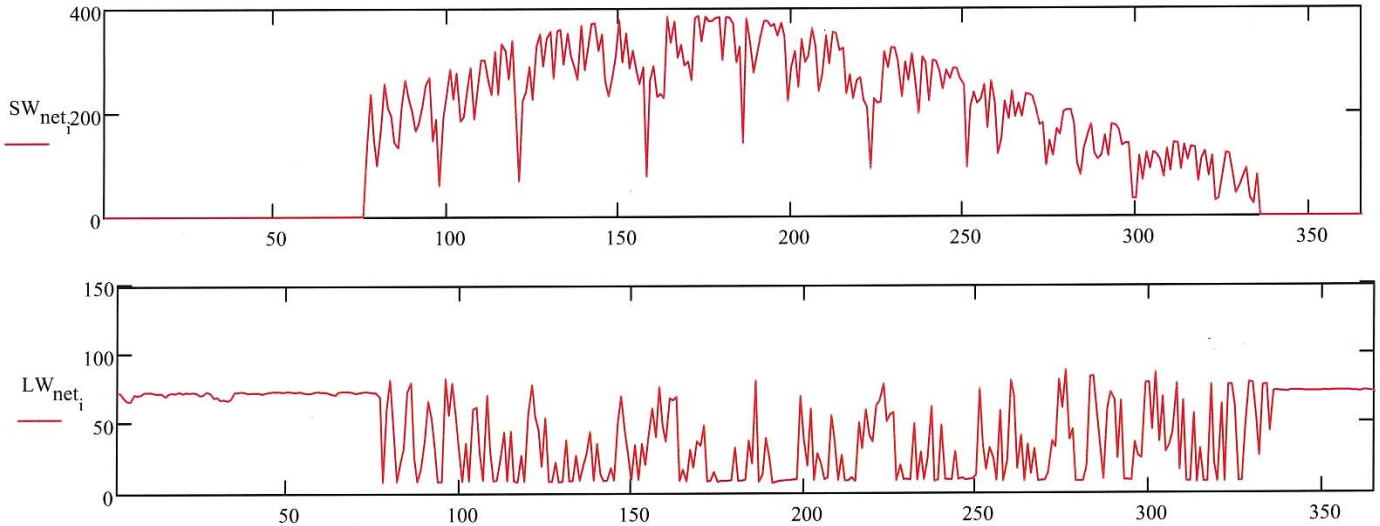

SW_net_i
LW_net_i
U_avg_10_i
T_mean_C_i

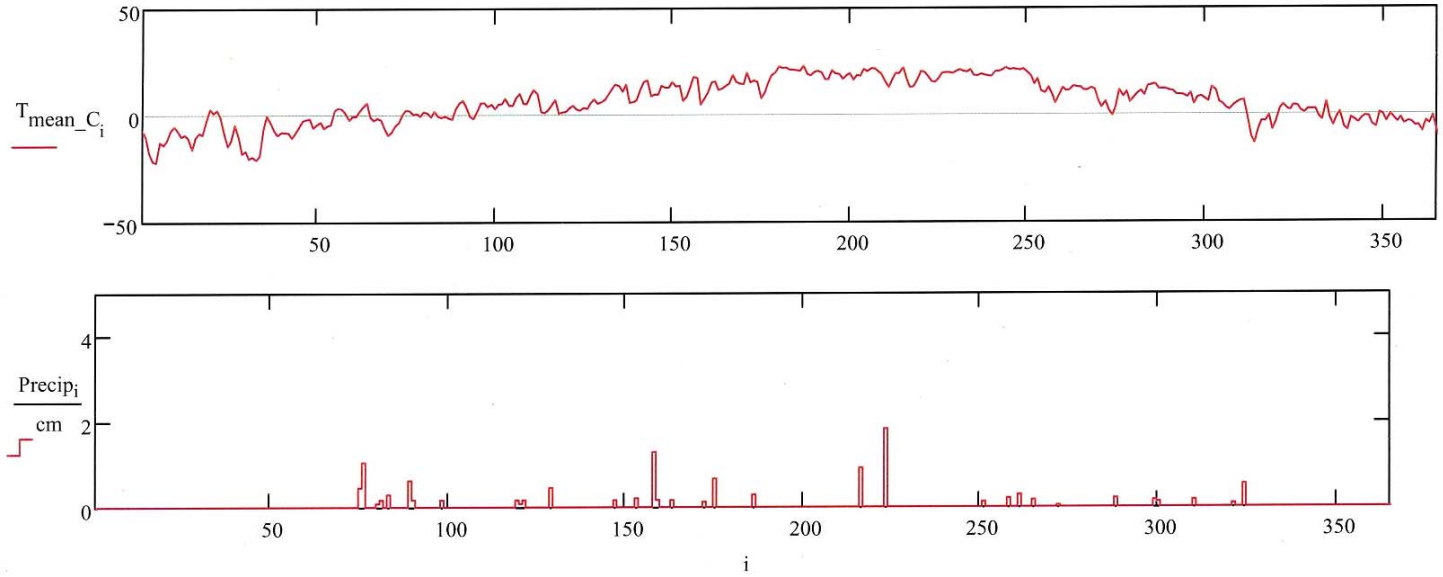


$$\frac{\sum_i \text{Precip}_i}{55} = 20.9$$

Full time-series component figs

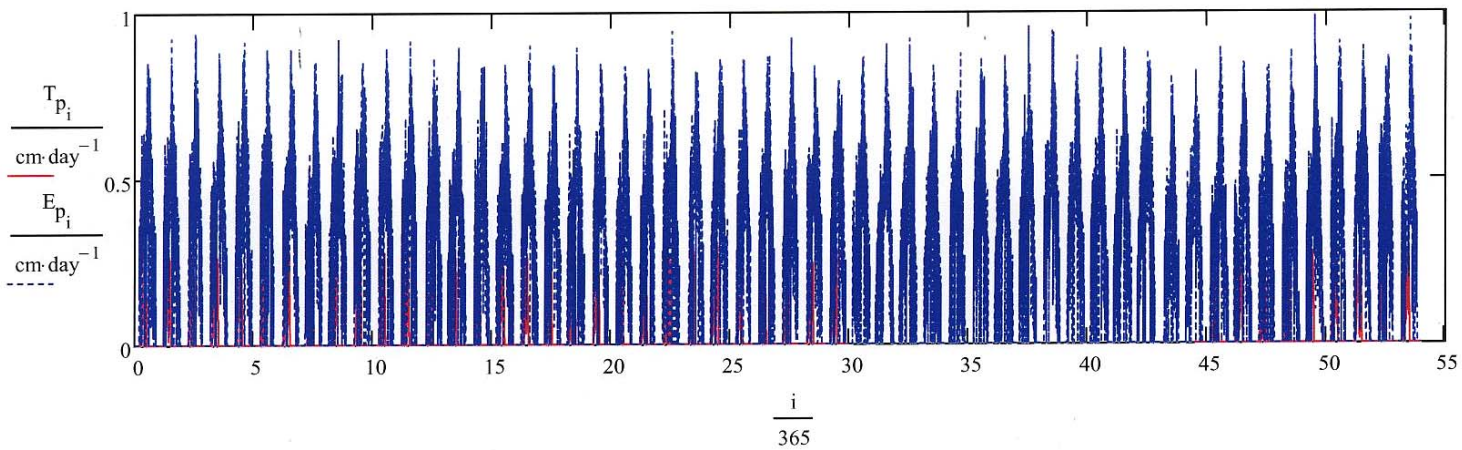
1-yr time-series component figs





1-yr time-series component figs

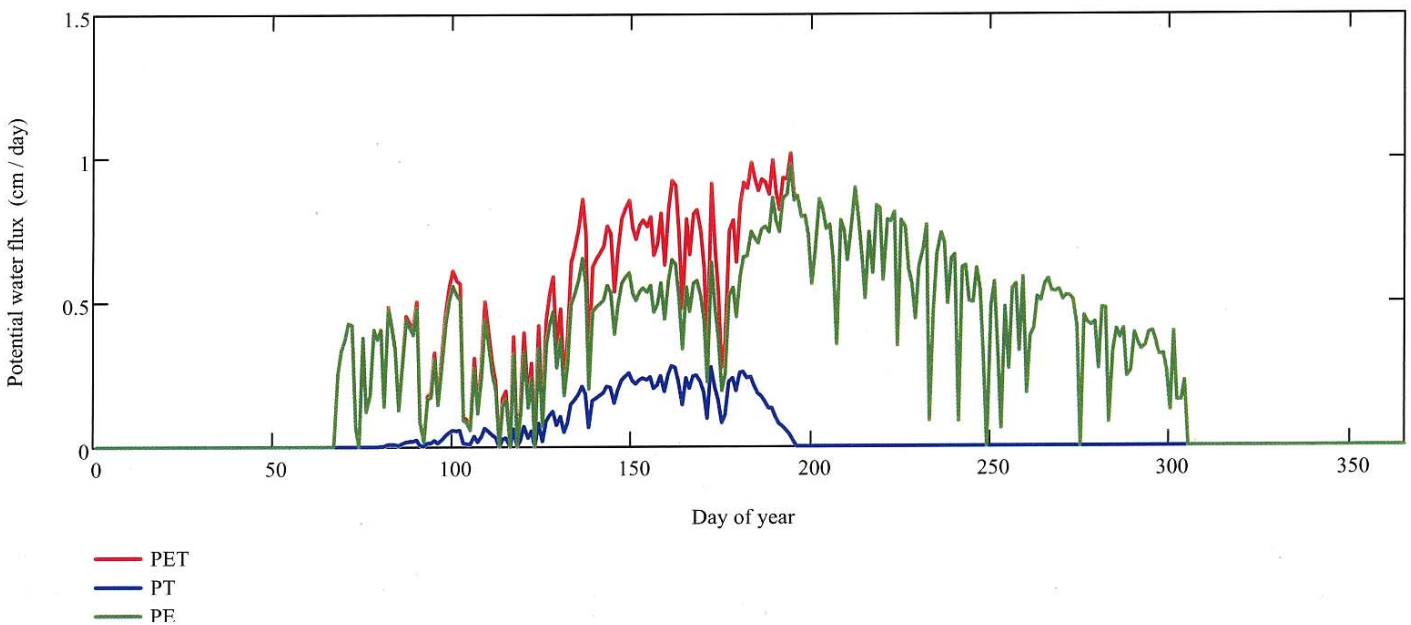
Examine annual precipitation

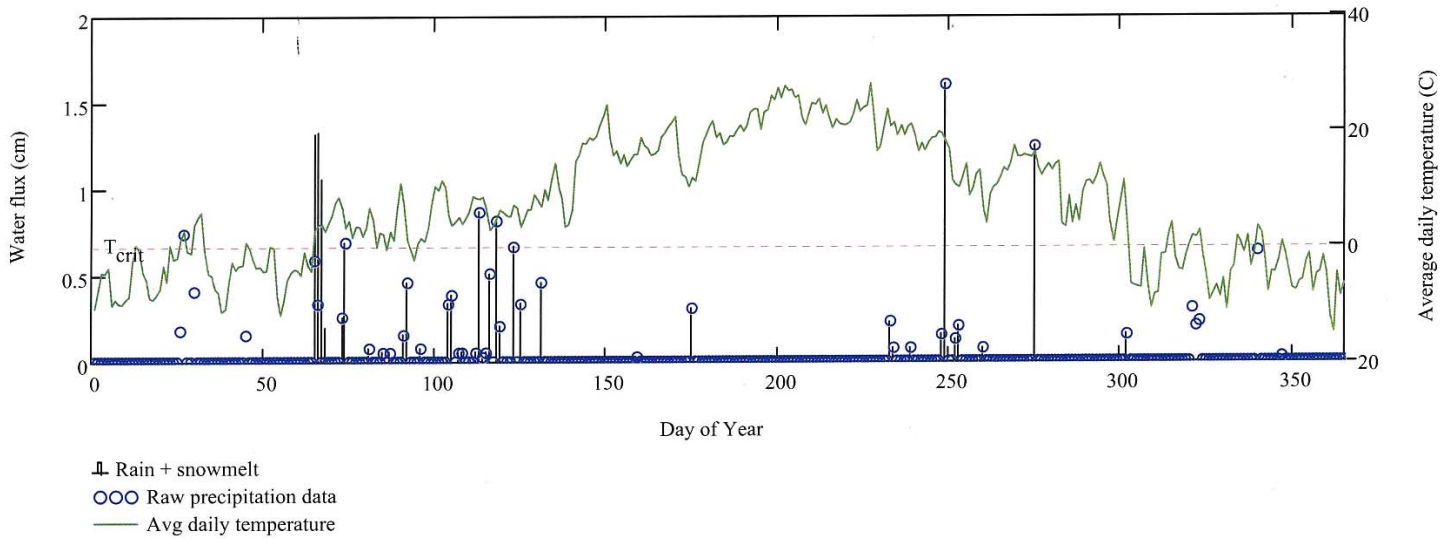


YrNo := 53

YrNo = 53

egFileYr := 1949 + YrNo egFileYr = 2002





$$\text{WRITEPRN("V2-DataForHydrus.prn")} := \text{augment}\left(\text{SimDay}, \frac{\text{Precip}}{\text{cm}}, \frac{E_p}{\text{cm}\cdot\text{day}^{-1}}, \text{hCritA}, \frac{T_p}{\text{cm}\cdot\text{day}^{-1}}\right)$$

UNSAT-H V3 CALPET routine

For reference, the UNSAT-H V3 subroutine that calculates PET from provided met. data is included below:

```
      SUBROUTINE CALPET
!-----------------------------------------------------------------------
!     Called by ETBC
!
!     Calculates PET using Penman formula from FAOPET
!     Note that negative PET values are reported as zero values.
!-----------------------------------------------------------------------
      INCLUDE 'unsath.inc'
      REAL*8 NRATIO
      FUNED(TDEW) = EXP(54.878919-(6790.4985/TDEW)-5.02808*LOG(TDEW))
!
```

```
!     From Doorenbos and Pruitt (1977), the following equation is
!     drived from long time mean PMB for a number of stations in Africa
!     (Climate of Africa, Vol 10, World Survey of Climatology)
!
      IF (PMB .LE. 0.0) PMB = 1013.0-0.1152*ALT+5.44*10.E-6*ALT*ALT
      A = 0.17
      IF (ZU .LE. 2.0) A = 0.22
      UHTCF = (2.0/ZU)**A
      SIGMA = 2.0E-9
      FACTRS = 0.017
      FU24 = 38.6
      I = 0
100   I = I+1
      TMAX = RMDATA(2,I)
      TMIN = RMDATA(3,I)
      TDEW = RMDATA(4,I)
      SR_MEAS = RMDATA(5,I)*FACTRS
      WIND  = RMDATA(6,I)*UHTCF*FU24
      CLOUD = RMDATA(7,I)
      TMAX  = (TMAX-32.0)*5.0/9.0
      TMIN  = (TMIN-32.0)*5.0/9.0
      TMEAN = 273.16+(TMAX+TMIN)/2.0
      TDEW  = 273.16+(TDEW-32.0)*5.0/9.0
      EA = FUNED(TMEAN)
      ED = FUNED(TDEW)
      NRATIO = 0.95-0.066*CLOUD-0.0023*CLOUD**2.0
      GG  = 0.0006595*PMB
      D   = (EA/TMEAN)*(6790.4985/TMEAN-5.02808)
      W   = D/(D+GG)
      FT  = SIGMA*TMEAN**4.0
      FED = 0.34-0.044*SQRT(ED)
      FNN = 0.1+0.9*NRATIO
      RN  = (1.0-ALBEDO)*SR_MEAS-FT*FED*FNN
      FU  = 0.27*(1.0+WIND/100.0)
      PET(I) = (W*RN+(1.0-W)*FU*(EA-ED))/10.0
      IF (PET(I) .LT. 0.0) PET(I) = 0.0
      IF (I .LT. NDAYS) GO TO 100
      RETURN
!-----------------------------------------------------------------------
!     End of subroutine CALPET
!-----------------------------------------------------------------------
```

END