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! _____
! This program computes TOA solar radiation every hour for any
! location on Earth and any day of year
!
! Input:  lat    [the latitude in degrees]
!         j      [the Julian day number or day of year]
! Output: q      [the solar flux per unit surface area in W/m2]
!         qdaily [daily mean value of q]
!         h00    [the hour angle at sunrise or sunset in radians
!               based on discrete time intervals of one hour]
!         h0     [the hour angle at sunrise or sunset in radians]
!               based on analytical form]
!         qinte  [daily mean value of q, from analytical form]
!
! Author: Liang Yang 1/31/2002
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! Modifications:
! 1) output zenith angle
! 2) add several other terms
! Liang Yang 10/12/2005
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! Modifications:
! 1) Converted to Fortran 90
! 2) Calculate different time interval
! Xavier 9/13/2010
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! _____
PROGRAM Hmk1_1
IMPLICIT NONE
INTEGER                ::      i,k
DOUBLE PRECISION      ::      t,qdaily,phi,fe,delta,h,czen,q,h00,h0,qinte
DOUBLE PRECISION,PARAMETER ::      lat = 32.0 ! latitude in degrees
! (negative if in the southern hemisphere)
INTEGER,PARAMETER    ::      j = 256 !day of year
DOUBLE PRECISION, PARAMETER ::      pi = 3.1415926
REAL,PARAMETER       ::      s0 = 1367. !Wm^-2
phi = lat*pi / 180.0
fe = 1 + 0.033*cos(2.*pi*j/365.)
!convert to radians.
!the eccentricity factor
!or the relative distance between Earth and S
un
delta = 0.4093*sin(2*pi*j/365.0 - 1.405) !the solar declination
!in radians
h0 = acos(-tan(phi)*tan(delta))
!the hour angle at sunrise
!or sunset
qinte = (s0*fe/pi)*(h0*sin(phi)*sin(delta)+cos(phi)*cos(delta)*sin(h0))
!daily mean in analytical form
qdaily = 0.0
OPEN (100, FILE='hmk1-1.dat')
WRITE(100,'(A,F6.2,A,I4,A)') ' Latitude: ', lat, ' ;           Day of the Year: ',j, '.'
WRITE(100,*)
WRITE(100,180) 'interval', 'qdiscrete', 'qinte', 'delta'
WRITE(100,180) '(s)', '(W/m2)', '(W/m2)', '(W/m2)'
180 FORMAT(A8,3A14)
DO k=36000,1,-1
!do loop from 0.1 second to 3600 seconds
IF((k<=10 .AND. MOD(K,1)==0) .OR. (k<600 .AND. MOD(K,60)==0) .OR. (k>=600 .AND. MO
D(K,600)==0)) THEN
!Get the integer intervals that make sense
qdaily = 0.0
DO i=k,864000,k
t = (i - k/2.0)/36000. !the hour of day
h = pi*(t-12.)/12. !the hour angle in radians
czen = sin(phi)*sin(delta)+cos(phi)*cos(delta)*cos(h)
q = s0*fe*czen
IF (q.LT.0.) q = 0. !negative means Sun is
!below horizon, set to zero

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      IF (q.GT.0.) h00 = h           !hour angle at sunset
      qdaily = qdaily + q           !get daily cumulative
    END DO
    qdaily = qdaily/(86400./k)
    WRITE(100,280) (k/10.),qdaily,qinte,ABS(qdaily-qinte)
    280 FORMAT(F8.1,3F14.5)
  END IF
END DO
WRITE(*,*) 'Congratulations! Your code executed successfully.'
CLOSE(100)
END PROGRAM Hmk1_1
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